

# Wetlands at the National and International Scale

## General Information

### 1. Agricultural conservation: USDA needs to better ensure protection of highly erodible cropland and wetlands: Report to the ranking Democratic member, Committee on Agriculture, Nutrition, and Forestry, U.S. Senate.

United States. General Accounting Office.  
U.S. General Accounting Office, 2003.

*Notes:* Cover title./ "April 2003."/ Chiefly tables./ Includes bibliographical references (p. 106).

<http://www.gao.gov/new.items/d03418.pdf>

*Descriptors:* agricultural conservation---United States/ soil conservation---United States/ wetland conservation---United States

### 2. Agricultural wetlands and waterbirds: A review.

Czech, H. A. and Parsons, K. C.

*Waterbirds* 25(2 [supplement]): 56-65. (2002)

*NAL Call #:* QL671; *ISSN:* 1524-4695.

*Notes:* Managing Wetlands for Waterbirds: Integrated Approaches

*Descriptors:* wetlands/ agricultural ecosystems/ habitat changes/ habitat utilization/ reviews/ aquatic birds/ habitat/ literature reviews/ agriculture/ breeding sites/ foraging behaviour/ rice fields/ Aves/ birds/ management/ ecology/ community studies/ conservation/ wildlife management and recreation

*Abstract:* Waterbird use of agricultural wetlands has increased as natural wetlands continue to decline worldwide. Little information exists on waterbird use of wetland crops such as taro, hasu, and wild rice. Several reports exist on waterbird use of cranberry bog systems. Information exists on waterbird use of rice fields, especially by herons and egrets. Rice fields encompass over 1.5 million km<sup>2</sup> of land and are found on all continents except Antarctica. Rice fields are seasonally flooded for cultivation and to decoy waterfowl, and drawn down for sowing and harvest. A wide variety of waterbirds including wading birds, shorebirds, waterfowl, marshbirds, and seabirds utilize rice fields for foraging and to a lesser extent as breeding sites. In some areas, especially Asia, waterbirds have come to rely upon rice fields as foraging sites. However, few reports exist on waterbird use of rice ecosystems outside of the Mediterranean Region. Species that are commonly found utilizing agricultural wetlands during the breeding season, migration, and as wintering grounds are listed. General trends and threats to waterbirds utilizing agricultural wetlands, including habitat destruction and degradation, contaminant exposure, and prey fluctuations are presented.

© CSA

### 3. Anthropogenic effects on the biodiversity of riparian wetlands of a northern temperate landscape.

Mensing, D. M.; Galatowitsch, S. M.; and Tester, J. R.

*Journal of Environmental Management* 53(4):

349-377. (1998)

*NAL Call #:* HC75.E5J6; *ISSN:* 0301-4797

*Descriptors:* wetlands/ assessment/ land use/ fish/ aquatic invertebrates/ riparian vegetation/ effects/ biodiversity/ landscape/ land resources/ resource conservation/ resource management/ riparian forests/ biological

indicators/ human activity/ forestry practices/ birds/ Amphibia/ Minnesota/ disturbance/ vertebrates/ Chordata/ animals/ west north central states of USA/ north central states of USA/ United States/ North America/ developed countries/ OECD countries/ lake states of USA

*Abstract:* The present study explores the relationships between riparian wetland communities and anthropogenic disturbances, including urban, forestry and cultivated land. Small stream riparian wetlands in central Minnesota, USA, provided an opportunity to detect these relationships because land use within the region is heterogeneous, resulting in disturbance gradients at the scales of stream reach and landscape. The research tested 2 hypotheses: organismal groups (wet meadow vegetation, shrub carr vegetation, aquatic macro-invertebrates, amphibians, fish and birds) respond differently to various types of anthropogenic disturbance; and the observed biological responses are dependent on the spatial scale of the disturbance. It was shown that birds were the best indicators of landscape condition within the near vicinity of small stream riparian wetlands, and fish community composition corresponded to broader landscape land use patterns. It is suggested that the type of anthropogenic disturbance and the spatial scale at which the disturbance occurs will have variable consequences to different organismal groups. If the effectiveness of the proposed indicators is verified, then managers can strategically monitor the biota and accurately interpret the results. The strength and interpretability of bird and fish relationships to land use of riparian wetlands suggest that indicator and criteria development are warranted.

© CAB International/CABI Publishing

### 4. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices.

Smith, R. Daniel. and United States. Army. Corps of Engineers. U.S. Army Engineer Waterways Experiment Station. Wetlands Research Program (U.S.).

Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station; Series: Wetlands Research Program technical report WRP-DE-9. (1995)

*Notes:* Title from title page. "Final report." "October 1995."

Includes bibliographical references.

*NAL Call #:* GB624 .A76 1995

<http://el.erdc.usace.army.mil/elpubs/pdf/wrpde9.pdf>

*Descriptors:* wetlands---United States/ ecosystem management---United States

This citation is from AGRICOLA.

### 5. Assessing wetland functional condition in agricultural landscapes.

Eckles, S. Diane. and United States. Natural Resources Conservation Service.

Vicksburg, MS: U.S. Dept. of Agriculture, Natural Resources Conservation Service; Series: Wetland technical note 1. (2002)

*Notes:* Title from web page. "March 2002." Description based on content viewed May 13, 2003. Includes bibliographical references.

*NAL Call #:* aQH87.3 .A77 2002

<http://www.nrcs.usda.gov/technical/land/pubs/directiv%5F%20files/TN%5FECS%5F190%5F2%5Fa.pdf>

*Descriptors:* wetlands---United States/ environmental impact analysis---United States/ wetland restoration---United States/ wetland ecology---environmental aspects---United States/ wetland agriculture---United States/ ecological assessment---biology---United States/ agricultural landscape management---United States  
This citation is from AGRICOLA.

#### 6. Base cation chemistry of storm runoff in a forested headwater wetland.

Hill, A. R.

*Water Resources Research* 29(8): 2663-2674. (1993)

*NAL Call #:* 292.8 W295; *ISSN:* 0043-1397

*Descriptors:* wetlands/ storm runoff/ headwaters/ geochemistry/ forest hydrology/ cations/ chemical analysis/ stormwater runoff/ catchment area/ stormwater runoff/ catchment area/ storm runoff/ headwaters/ forest hydrology/ chemical processes/ composition of water

© CSA

#### 7. Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles.

Semlitsch, R. D. and Bodie, J. R.

*Conservation Biology* 17(5): 1219-1228. (Oct. 2003)

*NAL Call #:* QH75.A1C5; *ISSN:* 0888-8892

*Descriptors:* wetlands/ riparian environments/ environment management/ buffers/ conservation/ habitat/ feeding/ life cycle/ water resources/ biodiversity/ nature conservation/ agricultural practices/ overwintering/ ecotones/ silviculture/ breeding/ amphibiotic species/ nesting/ aquatic reptiles/ literature reviews/ habitat selection/ Caudata/ Anura/ salamanders/ frogs/ toads/ conservation/ biodiversity/ habitat community studies/ general environmental engineering

*Abstract:* Terrestrial habitats surrounding wetlands are critical to the management of natural resources. Although the protection of water resources from human activities such as agriculture, silviculture, and urban development is obvious, it is also apparent that terrestrial areas surrounding wetlands are core habitats for many semiaquatic species that depend on mesic ecotones to complete their life cycle. For purposes of conservation and management, it is important to define core habitats used by local breeding populations surrounding wetlands. Our objective was to provide an estimate of the biologically relevant size of core habitats surrounding wetlands for amphibians and reptiles. We summarize data from the literature on the use of terrestrial habitats by amphibians and reptiles associated with wetlands (19 frog and 13 salamander species representing 1363 individuals; 5 snake and 28 turtle species representing more than 2245 individuals). Core terrestrial habitat ranged from 159 to 290 m for amphibians and from 127 to 289 m for reptiles from the edge of the aquatic site. Data from these studies also indicated the importance of terrestrial habitats for feeding, overwintering, and nesting, and, thus, the biological interdependence between aquatic and terrestrial habitats that is essential for the persistence of populations. The minimum and maximum values for core habitats, depending on the level of protection needed, can be used to set

biologically meaningful buffers for wetland and riparian habitats. These results indicate that large areas of terrestrial habitat surrounding wetlands are critical for maintaining biodiversity.

© CSA

#### 8. Bottom-up control of carabid beetle communities in early successional wetlands: Mediated by vegetation structure or plant diversity?

Brose, U.

*Oecologia (Berlin)* 135(3): 407-413. (2003)

*NAL Call #:* QL750.O3; *ISSN:* 0029-8549

*Descriptors:* terrestrial ecology: ecology, environmental sciences/ cluster analysis/ linear regression analysis/ mathematical and computer techniques/ pitfall trapping/ applied and field techniques/ agricultural landscapes/ biodiversity/ bottom up control/ early successional woodlands: habitat/ enemy free space/ feeding activity/ hunting efficiency/ morphological traits/ plant height/ predation/ spatial heterogeneity/ species diversity/ species richness/ vegetation structure

*Abstract:* Two hypotheses of bottom-up control that predict that the species richness of Carabidae will depend either on the taxonomic diversity of plants ("taxonomic diversity hypothesis") or on the structural heterogeneity of the vegetation ("structural heterogeneity hypothesis") were tested. Plant species were classified into nine plant structural groups through cluster analysis of morphological traits (e.g. total height) at 30 early successional temporary wetlands in the East-German agricultural landscape. In a linear regression analysis, the heterogeneity of vegetation structures explained 55% of the variation in carabid beetle diversity. According to a partial correlation analysis, plant taxonomic diversity did not have a significant effect, consistent with the "structural heterogeneity hypothesis," and contradicting previous studies which concluded that plant taxonomic diversity would be the most important factor in early successional habitats. An experimental study was used to test hypotheses on the processes underlying this bottom-up control by vegetation structure: the "hunting efficiency hypothesis," the "enemy-free space hypothesis," and the "microhabitat specialization hypothesis." The composition of plant structural groups in 15 vegetation plots (1 m<sup>2</sup>) was manipulated, creating a gradient from dense vegetation to open plots. Subsequent pitfall catches revealed significant differences in the activity-abundances of the carabid species. Large species preferred dense vegetation plots, consistent with the enemy-free space hypothesis that large species are more vulnerable to predation on the open plots and prefer dense vegetation to escape from natural enemies. The results indicate that bottom-up control is not mediated only by plant taxonomic or functional group diversity and that vegetation structures may be more important than previously suggested.

© The Thomson Corporation

#### 9. Capacity of natural wetlands to remove nutrients from wastewater.

Nichols, D. S.

*Journal of the Water Pollution Control Federation* 55(5): 495-505. (1983)

*NAL Call #:* TD419.R47; *ISSN:* 1047-7624

*Abstract:* Interest in removing nitrogen and phosphorus from treated wastewater by applying it to wetlands is rapidly increasing. This may be a simple and energy efficient

means of removing these nutrients from wastewater. However, the capacities and limitations of wetlands to function in this manner have not been well quantified. This paper reviews the major mechanisms by which wetlands remove N and P from wastewater flows, and develops some approximate relations between the nutrient removal efficiency of wetlands and wastewater N and P loading rates. Wetlands retain P by adsorption and precipitation reactions. This capacity declines with continued P addition, and a wetland eventually can become saturated. Nitrogen removal is mainly by denitrification, which seems not to diminish with time. Plant uptake of N and P can be important during the growing season, but most of these nutrients are quickly returned to the system when the vegetation dies and decays. Wetland removal of wastewater nutrients can be effective at low loading rates, but efficiency decreases rapidly as application rates increase. About 1 ha of wetland area seems to be required to remove 50% of the N and P from the wastewater generated by 60 people.  
© 2006 Elsevier B.V. All rights reserved.

**10. Carbon distribution of a well- and poorly-drained black spruce fire chronosequence.**

Wang, C.; Bond-Lamberty, B.; and Gower, S. T. *Global Change Biology* 9(7): 1066-1079. (July 2003)  
NAL Call #: QC981.8.C5G6323; ISSN: 1354-1013  
Descriptors: wetlands/ carbon/ drainage/ methodology/ environmental impact/ forests/ vegetation cover/ plant populations/ biomass/ roots/ ecosystem disturbance/ fire/ biological age/ Picea mariana/ Bryophyta/ Canada, Manitoba/ black spruce/ bryophytes/ hornworts/ mosses/ conifers/ habitat community studies  
Abstract: The objective of this study was to quantify carbon (C) distribution for boreal black spruce (Picea mariana (Mill.) BSP) stands comprising a fire chronosequence in northern Manitoba, Canada. The experimental design included seven well-drained (dry) and seven poorly-drained (wet) stands that burned between 1998 and 1850. Vegetation C pools (above-ground + below-ground) steadily increased from 1.3 to 83.3 t C ha<sup>super(-1)</sup> for the dry chronosequence, and from 0.6 to 37.4 t C ha<sup>super(-1)</sup> for the wet chronosequence. The detritus C pools (woody debris + forest floor) varied from 10.3 to 96.0 t C ha<sup>super(-1)</sup> and from 12.6 to 77.4 t C ha<sup>super(-1)</sup> for the dry and wet chronosequence, respectively. Overstorey biomass, mean annual biomass increment (MAI), woody debris mass, and litterfall were significantly greater ( $\alpha = 0.05$ ) for the dry stands than for the wet stands, but the bryophyte, understorey, and forest floor C pools were significantly less for the dry than for the wet stands. The root mass ratio decreased with stand age until 37 years after fire, was fairly constant thereafter, and was not significantly affected by soil drainage. The C pools of the overstorey and bryophyte tended to increase with stand age. Foliage biomass, litterfall, and MAI (for the dry stands) peaked at 71 years after fire and declined in the oldest stands. The results from this study illustrate that the effects of disturbance and edaphic conditions must be accounted for in boreal forest C inventories and C models. The appropriateness of using chronosequences to examine effects of wildfire on ecosystem C distribution is discussed.  
© CSA

**11. Carrying capacity of wetland habitats used by breeding greater snow geese.**

Masse, H.; Rochefort, L.; and Gauthier, G. *Journal of Wildlife Management* 65(2): 271-281. (Apr. 2001)  
NAL Call #: 410 J827; ISSN: 0022-541X  
Descriptors: wetlands/ carrying capacity/ grazing/ wildlife management/ Canada, Nunavut/ population number/ breeding sites/ herbivores/ food availability/ ecosystem management/ environment management/ Chen caerulescens atlantica/ Canada, Nunavut, Bylot I./ greater snow goose/ management/ population dynamics/ conservation, wildlife management and recreation  
Abstract: Because geese can damage their arctic breeding habitats through overgrazing, there is debate about limiting the rapid growth of the greater snow goose (Chen caerulescens atlantica) population and setting a population goal. To answer these questions, we assessed the nutritional carrying capacity of freshwater wetland habitats for breeding greater snow geese at the Bylot Island colony, Nunavut, Canada. Specifically, we (1) mapped the different types of wetlands on the island; (2) estimated net aboveground primary production of these habitats; (3) compared total food availability with predicted total food requirements of the current population; and (4) validated our predictions of plant biomass consumed by comparing them to the intensity of goose grazing measured. Freshwater wetlands represented 173 plus or minus 6 km<sup>super(2)</sup> or 11% of the total area of the south plain of Bylot Island. Streams and wet polygons were the most important habitats in terms of availability of suitable forage plants for geese. The average net aboveground primary production ranged from 21.0 plus or minus 4.6 along lakes to 46.0 plus or minus 9.8 g/m<sup>super(2)</sup> in polygon channels. We estimated the total food supply available for geese in wetlands at 2,625 plus or minus 461 tons in 1997 but only 1,247 plus or minus 473 tons in 1996, a year of low plant production. We predicted a summer food requirement for goslings at 8.1 plus or minus 0.6 kg/bird, for breeding adults at 7.9 plus or minus 2.3, and for nonbreeding adults at 4.7 plus or minus 1.5, and we predicted the total summer food requirements of the goose population at 1,201 plus or minus 160 tons. The predicted amount of biomass removed (32 plus or minus 7%) agreed well with the actual amount of biomass removed measured in mid-August (39 plus or minus 11%) in 1997, but not in 1996 (67 plus or minus 27% vs 26 plus or minus 17%, respectively), possibly because the goose population was lower that year due to poor breeding success. In 1997, the goose population was at 46 plus or minus 10% of the theoretical short-term carrying capacity (341,000 geese) of the wetlands of Bylot Island. We recommend keeping the goose population below this theoretical carrying capacity.  
© CSA

**12. A case for wetland restoration.**

Hey, Donald L. and Philippi, Nancy S. New York: Wiley; x, 215 p.: ill. (some col.), maps. (1999)  
Notes: "A Wiley-Interscience publication." Includes bibliographical references and index.  
NAL Call #: QH75 .H49 1999; ISBN: 0471176427  
Descriptors: wetland conservation/ restoration ecology/ wetland conservation---United States---case studies  
This citation is from AGRICOLA.

**13. Classification and inventory of wetlands: A global overview.**

Scott, D. A. and Jones, T. A.

*Plant Ecology* 118(1-2): 3-16. (1995)

NAL Call #: QK900.P63; ISSN: 0042-3106

*Descriptors:* conservation/ ecology/ environmental sciences/ freshwater ecology/ ecological change monitoring/ conservation and resource management/ environmental biology/ plants/ limnology

*Abstract:* Classification of wetlands is extremely problematical, definition of the term wetland being a difficult and controversial starting point. Although considerable effort has gone into the development of national and regional wetland classifications, the only attempt at establishing a global system has been under the auspices of the Ramsar Convention on Wetlands of International Importance. In view of the fact that the Ramsar Convention has 70 Contracting Parties world-wide, it is suggested that the Convention's definition and classification system should be adopted generally for international purposes. Much of the world has been covered by preliminary wetland inventories, but there is an urgent need to extend coverage to those areas not yet included. It is essential that all inventory projects give adequate attention to meeting the real information needs of agencies and individuals which have an impact on the conservation and wise use of wetlands. Attention should also be given to providing for wide dissemination and regular updating of information and establishment of procedures for monitoring ecological change at the sites identified.

© The Thomson Corporation

**14. Climate change, agriculture and wetlands in eastern Europe: Vulnerability, adaptation and policy.**

Hartig, Ellen Kracauer; Grozev, Ognyan; and Rosenzweig, Cynthia

*Climatic Change* 36(1-2): 107-121. (1997)

NAL Call #: QC980; ISSN: 0165-0009

*Descriptors:* wetlands/ agronomy: agriculture/ climatology: environmental sciences/ conservation/ freshwater ecology: ecology, environmental sciences/ government and law/ agricultural drainage/ agriculture/ climate change/ climatology/ conservation/ evapotranspiration/ policy/ temperature

*Abstract:* Naturally-occurring wetlands perform such functions as flood control, pollution filtration, nutrient recycling, sediment accretion, groundwater recharge and water supply, erosion control, and plant and wildlife preservation. A large concentration of wetlands is located in Eastern Europe. A significant amount of Eastern European wetlands has been converted to agricultural use in the past, and remaining wetlands are subject to agricultural drainage. Drained wetlands are used as prime agriculture lands for a variety of food crops. Other agricultural uses of wetlands range from growing *Phragmites australis* (common reed) for thatch and livestock feed, to collecting peat for heating and cooking fuel. Altered hydrologic regimes due to global climate change could further exacerbate encroachment of agricultural land use into wetlands. The vulnerability and adaptation studies of the U.S. Country Studies Program are used to analyze where climate change impacts to agriculture may likewise impact wetland areas. Scenarios indicate higher temperatures and greater evapotranspiration altering the hydrologic regime such that freshwater wetlands are potentially vulnerable in Bulgaria,

Czech Republic, and Russia, and that coastal wetlands are at risk in Estonia. Runoff is identified as a key hydrological parameter affecting wetland function. Since wetland losses may increase as a result of climate-change-induced impacts to agriculture, precautionary management options are reviewed, such as establishing buffer areas, promoting sustainable uses of wetlands, and restoration of farmed or mined wetland areas. These options may reduce the extent of negative agricultural impacts on wetlands due to global climate change.

© The Thomson Corporation

**15. Coastal management practices for prevention of future impacts on wetlands.**

Baca, B. J. and Clark, J. R.

In: *Ecology and Management of Wetlands Vol 2:*

*Management, Use and Value of Wetlands/* Hook, D. D.

London: Timber Press, 1988; pp. 28-44

NAL Call #: QH541.5.M3E26

*Descriptors:* land types/ protection/ coastal wetlands

*Abstract:* The world's coastal wetlands are seriously threatened by both man-made and natural factors. These include coastal development and erosion, coastal pollution, natural erosion and sea-level rise. Progress in the developed countries in reducing man-made impacts on wetlands has not reached the developing countries.

© CAB International/CABI Publishing

**16. Coastal salt marsh systems in the U.S.: A review of anthropogenic impacts.**

Kennish, M. J.

*Journal of Coastal Research* 17(3): 731-748. (2001); ISSN: 0749-0208

*Descriptors:* USA/ coasts/ salt marshes/ reviews/ water level fluctuations/ environmental effects/ dredging/ drainage/ tides/ subsidence/ global warming/ ecosystem disturbance/ coastal morphology/ anthropogenic factors/ coastal engineering/ dredge spoil/ harvesting/ flood control/ tidal effects/ hydrology/ deglaciation/ sea level changes/ eustatic changes/ man-induced effects/ climatic changes/ greenhouse effect

*Abstract:* During the past century, human modification of environmental systems has greatly accelerated tidal salt marsh deterioration and shoreline retreat in many coastal regions worldwide. As a result, more than 50% of the original tidal salt marsh habitat in the U.S. has been lost. Numerous human activities have contributed directly or indirectly to wetland loss and alteration at local, regional, and global scales. Human impacts at the local scale include those that directly modify or destroy salt marsh habitat such as dredging, spoil dumping, grid ditching, canal cutting, leveeing, and salt hay farming. Indirect impacts, which can be even more significant, typically are those that interfere with normal tidal flooding of the marsh surface, alter wetlands drainage, and reduce mineral sediment inputs and marsh vertical accretion rates. These impacts usually develop over a greater period of time. At the regional scale, subsidence caused by subsurface withdrawal of groundwater, oil, and gas has submerged and eliminated hundreds of square kilometers of salt marsh habitat in the Chesapeake Bay, San Francisco Bay, and Gulf of Mexico. At the global scale, atmospheric warming due to increased burden of anthropogenic greenhouse gases and tropospheric sulfate aerosols appears to be strongly coupled to glacial melting, thermal expansion of ocean

waters, and eustatic sea-level rise. Changes in coastal water levels ascribable to eustatic sea-level rise pose a long-term threat to the stability and viability of these critically important coastal systems.

© CSA

**17. Conflicting processes in the wetland plant rhizosphere: Metal retention or mobilization?**

Jacob, D. L. and Otte, M. L.

*Water, Air, and Soil Pollution: Focus* 3(1): 91-104. (2003)

NAL Call #: TD172 .W36; ISSN: 1567-7230

*Descriptors:* bioavailability/ metals/ organic matter/ pH/ redox/ rhizosphere/ wetland

*Abstract:* Increasingly wetlands are used for treatment of metal-contaminated water or as a cover over metal-enriched mine tailings. Natural wetlands may also be contaminated with metals from anthropogenic sources. While wetland conditions tend to be favorable for immobilization of metals, wetland plants could influence metal mobility through redox and pH processes in the rhizosphere. Our current knowledge of these processes is reviewed, focusing on the question of whether the advantages of growing wetland plants in metal-contaminated sediments outweigh the disadvantages. Wetland plants alter the redox conditions, pH and organic matter content of sediments and so affect the chemical speciation and mobility of metals. Metals may be mobilized or immobilized, depending on the actual combination of factors, and it is extremely difficult to predict which effects plants will actually have on metal mobility under a given set of conditions. However, while the effects of plants can extend several tens of centimeters into the sediments, there are no reports suggesting large-scale mobilization of metals by wetland plants. © 2003 Kluwer Academic Publishers. © 2006 Elsevier B.V. All rights reserved.

**18. Conservation management of freshwater habitats: Lakes, rivers and wetlands.**

Maitland, Peter S. and Morgan, N. C.

London; New York: Chapman & Hall; Series: Conservation Biology Series 9; 233 p. (1997)

*Notes:* Includes bibliographical references (p. 207-223) and index.

NAL Call #: QH75.M34 1997; ISBN: 0412594102

*Descriptors:* wetland conservation/ fishery conservation/ wildlife conservation/ conservation of natural resources/ freshwater fishes

This citation is from AGRICOLA.

**19. Constructed wetlands for pollution control: Processes, performance, design and operation.**

International Water Association. IWA Specialist Group on Use of Macrophytes in Water Pollution Control.

London: IWA Pub.; Series: Scientific and technical report (International Water Association) no. 8; 156 p. (2000)

*Notes:* Includes bibliographical references (p. 141-149) and index.

NAL Call #: TD756.5 .C76 2000

*Descriptors:* constructed wetlands/ sewage---purification---biological treatment

This citation is from AGRICOLA.

**20. Constructed wetlands for the treatment of organic pollutants.**

Haberl, R.; Langergraber, G.; Grego, S.; Kadlec, R. H.; Cicalini, A.-R.; Dias, S. M.; Novais, J. M.; Aubert, S.; Gerth, A.; Thomas, H.; and Hebner, A.

*Journal of Soils and Sediments* 3(2): 109-124. (2003);

ISSN: 1439-0108

*Descriptors:* constructed wetlands/ groundwater/ organic contaminants/ wastewater/ water treatment

*Abstract:* Background. Constructed wetlands (wetland treatment systems) are wetlands designed to improve water quality. They use the same processes that occur in natural wetlands but have the flexibility of being constructed. As in natural wetlands vegetation, soil and hydrology are the major components. Different soil types and plant species are used in constructed wetlands. Regarding hydrology surface flow and subsurface flow constructed wetlands are the main types. Subsurface flow constructed wetlands are further subdivided into horizontal or vertical flow. Many constructed wetlands deal with domestic wastewater where BOD and COD (Biochemical and Chemical Oxygen Demand respectively) are used as a sum parameter for organic matter. However, also special organic compounds can be removed. Objective. The objectives are to summarise the state-of-the-art on constructed wetlands for treatment of specific organic compounds, to the present the lack of knowledge, and to derive future research needs. Methods. Case studies in combination with a literature review are used to summarise the available knowledge on removal processes for specific organic compounds. Results and Discussion. Case studies are presented for the treatment of wastewaters contaminated with aromatic organic compounds, and sulphonated anthraquinones, olive mill wastewater, landfill leachate, and groundwater contaminated with hydrocarbons, cyanides, chlorinated volatile organics, and explosives. In general the removal efficiency for organic contaminants is high in all presented studies. Conclusion. Constructed wetlands are an effective and low cost way to treat water polluted with organic compounds. There is a lack of knowledge on the detailed removal pathways for most of the contaminants. Removal rates as well as optimal plant species are substance-specific, and also typically not available. If a constructed wetland provides different environmental conditions and uses different plant species the treatment efficiency can be improved. Recommendations and Outlook. There is a great need to lighten the black box 'constructed wetland' to obtain performance data for both microbial activity and the contribution of the plants to the overall removal process. Also genetic modified plants should be considered to enhance the treatment performance of constructed wetlands for specific compounds. © 2006 Elsevier B.V. All rights reserved.

**21. Constructed wetlands for water quality improvement.**

Moshiri, Gerald A.

Boca Raton, Fla.: Lewis Publishers; 632 p. (1993)

*Notes:* Papers presented at the Pensacola conference. Includes bibliographical references and index.

NAL Call #: TD756.5.M67 1993; ISBN: 0873715500

*Descriptors:* constructed wetlands---congresses/ water quality management---congresses/ constructed wetlands---case studies---congresses

This citation is from AGRICOLA.

**22. Created and natural wetlands for controlling nonpoint source pollution.**

Olson, Richard K.; United States. Environmental Protection Agency. Office of Research and Development; and United States. Environmental Protection Agency. Office of Wetlands, Oceans and Watersheds  
 Boca Raton, Fla.: C.K. Smoley; 216 p. (1993)  
*Notes:* "U.S. EPA, Office of Research and Development, and Office of Wetlands, Oceans, and Watersheds."  
 Includes bibliographical references.  
*NAL Call #:* TD223.C73 1993; *ISBN:* 0873719433  
*Descriptors:* water quality management--United States/ water--pollution--United States/ wetland conservation--United States/ constructed wetlands--United States  
 This citation is from AGRICOLA.

**23. Criteria and procedures to maximize the quality and value of wetlands constructed at surface mines.**

Nelson, R. W.  
*International Journal of Ecology and Environmental Sciences* 17(2): 77-90. (1991)  
*NAL Call #:* QH540.I54; *ISSN:* 0377-015X  
*Abstract:* Provides a synthesis of ideas or principles derived from recent experience, both at mine reclamation sites and with projects designed to replace wetland functions and values lost to agricultural and urban development. -from Author  
 © 2006 Elsevier B.V. All rights reserved.

**24. Cumulative effects on wetland landscapes: Links to wetland restoration in the United States and southern Canada.**

Bedford, B. L.  
*Wetlands* 19(4): 775-788. (1999)  
*NAL Call #:* QH75.A1W47; *ISSN:* 0277-5212.  
*Notes:* Conference: Temperate Wetlands Restoration Workshop, Barrie, ON (Canada), 27 Nov-1 Dec 1995  
*Descriptors:* wetlands/ land management/ geohydrology/ biogeochemistry/ land reclamation/ environmental quality/ environmental restoration/ human impact/ regional planning/ hydrology/ biogeochemical cycle/ land use/ restoration/ environment management/ ecosystem management/ USA/ Canada/ land restoration  
*Abstract:* The cumulative effects of human actions on wetland ecosystems motivate current efforts at wetland restoration. They also have created in part the context within which restorations are undertaken. Using modern hydrogeological understanding of wetland-landscape linkages, I argue that restorations should begin with a cumulative impact analysis for the entire region in which the restoration is proposed. The analysis, however, should not focus merely on number of hectares of wetlands lost or degraded. It should be based on the concept of templates for wetland development. These templates are the diversity of settings created in specific landscapes by the complex interactions of hydrogeologic factors and climate. They control key hydrologic variables and hydrologically influenced chemical variables that cause specific wetland types to form and to be maintained through time. They also determine in large part the biogeochemical cycling characteristics specific to different types of wetlands. They thus account for both the biological and functional diversity of wetlands. A cumulative impact assessment for restoration purposes should identify the kinds, numbers, relative abundances, and spatial distribution of wetland

templates in a region - both past and present. These past and present profiles of the wetland landscape can be used to make decisions regarding the type and location of restorations. Matching type and location to the appropriate hydrogeologic setting will maximize the probability of success for individual projects. Regional wetland diversity can be restored if individual restoration decisions about wetland type and location are made in light of the diversity of templates in past and present regional profiles.  
 © CSA

**25. Cumulative impacts to wetlands.**

Johnston, C. A.  
*Wetlands* 14(1): 49-55. (1994)  
*NAL Call #:* QH75.A1W47; *ISSN:* 0277-5212  
*Descriptors:* wetlands/ United States/ environmental impact/ forest industry/ agriculture/ literature reviews/ geographic information systems/ environmental effects/ forestry/ geographic information systems/ cumulative impact analysis/ mechanical and natural changes/ freshwater pollution/ effects on water of human nonwater activities/ environmental degradation  
*Abstract:* "Cumulative impact," the incremental effect of an impact added to other past, present, and reasonably foreseeable future impacts, was reviewed as it pertains to southern forested wetlands. In the U.S., the largest losses of forested wetlands between the 1970s and 1980s occurred in southeastern states that had the most bottomland hardwood to begin with: Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina. These losses were due primarily to forestry and agriculture. Other sources of cumulative impact include decrease in average area of individual wetlands, shift in proportion of wetland types, change in spatial configuration of wetlands, and loss of cumulative wetland function at the landscape scale. For two wetland-related functions, flood flow and loading of suspended solids, watersheds that contained less than 10% wetlands were more sensitive to incremental loss of wetland area than were watersheds with more than 10% wetlands. The relative position of wetlands within a drainage network also influenced their cumulative function. Geographic Information Systems (GIS) are becoming an important tool for evaluating cumulative impacts and their effects.  
 © CSA

**26. Denitrification in freshwater wetlands.**

Groffman, P. M.  
*Current Topics in Wetland Biogeochemistry* 1: 15-35. (1994); *ISSN:* 1076-4674  
*Descriptors:* wetlands/ denitrification/ nitrogen fixing bacteria/ energy transfer/ biogeochemistry/ nitrogen cycle/ water quality/ physiological ecology/ cycling nutrients/ bacteria/ nutrient cycles/ nutrient cycles/ nitrogen fixing bacteria/ physiological ecology/ cycling nutrients/ energy transfer  
*Abstract:* In this paper, I first review the physiology and ecology of denitrifying organisms, focusing on how conditions in wetlands influence denitrification at organismal, ecosystem, landscape, and regional scales. My focus is on the role that denitrification plays in wetland processes more than on denitrification per se. As a result, the physiology discussion is oriented more towards how environmental factors regulate physiology than on the specifics of the physiology itself. The review of physiology

and ecology is followed by a brief review of methods for study of denitrification. The main section of the paper is a synthesis of existing data to determine general principles of where and when denitrification is likely to be important to energy flow, nutrient cycling and water quality maintenance in wetlands. The final section discusses key questions and issues for future research.

© CSA

### 27. Designing constructed wetlands for nitrogen removal.

Hammer, D. A. and Knight, R. L.

*Water Science and Technology* 29(4): 15-27. (1994)  
NAL Call #: TD420.A1P7; ISSN: 0273-1223

*Descriptors:* wastewater treatment/ artificial wetlands/ nitrogen removal/ biochemical oxygen demand/ nitrification/ denitrification/ toxicity/ case studies/ design criteria/ artificial wetlands/ case studies/ design criteria

*Abstract:* Many constructed wetlands adequately treat BOD sub(5), TSS, and bacteria. However, a review of nitrogen (N) data from 52 constructed and natural wetlands in the North American data base confirmed that N removal was variable. Nitrification and denitrification require aerobic and anaerobic conditions. This paper presents case histories of systems that use alternating shallow and deep zones to create both environments. Regression analysis of N removal and N loadings in 18 shallow-deep water systems suggested that NH sub(4) super(+) loading (kg N/ha/day) could be used to predict effluent NH sub(4) super(+) values. Combinations of shallow water-emergent vegetation and deep water-submergent vegetation with low NH sub(4) super(+) (and TKN) loading rates can produce very low levels of discharged NH sub(4) super(+).

© CSA

### 28. Determining ecological equivalence in service-to-service scaling of salt marsh restoration.

Strange, E.; Galgrath, H.; Bickel, S.; Mills, D.; Beltman, D.; and Lipton, J.

*Environmental Management* 29(2): 290-300. (Feb. 2002)  
NAL Call #: HC79.E5E5; ISSN: 0364-152X

*Descriptors:* wetlands/ habitat/ environmental restoration/ salt marshes/ environmental policy/ natural resources/ ecology/ habitats/ rehabilitation/ planning/ environmental effects/ nutrient cycles/ policies/ ecosystem management/ environment management/ restoration/ environmental action/ water quality control/ peclamation/ protective measures and control/ general environmental engineering

*Abstract:* The amount of ecological restoration required to mitigate or compensate for environmental injury or habitat loss is often based on the goal of achieving ecological equivalence. However, few tools are available for estimating the extent of restoration required to achieve habitat services equivalent to those that were lost. This paper describes habitat equivalency analysis (HEA), a habitat-based "service-to-service approach for determining the amount of restoration needed to compensate for natural resource losses, and examines issues in its application in the case of salt marsh restoration. The scientific literature indicates that although structural attributes such as vegetation may recover within a few years, there is often a significant lag in the development of ecological processes such as nutrient cycling that are necessary for a fully functioning salt marsh. Moreover, natural variation can make recovery trajectories difficult to define and predict for

many habitat services. HEA is an excellent tool for scaling restoration actions because it reflects this ecological variability and complexity. At the same time, practitioners must recognize that conclusions about the amount of restoration needed to provide ecological services equivalent to those that are lost will depend critically on the ecological data and assumptions that are used in the HEA calculation.

© CSA

### 29. Developing an invertebrate index of biological integrity for wetlands.

Helgen, Judy; United States. Environmental Protection Agency. Office of Science and Technology; and United States. Environmental Protection Agency. Office of Wetlands, Oceans and Watersheds

In: *Methods for evaluating wetland condition*; Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, 2002.

*Notes:* Original title: Developing an invertebrate index of biological integrity for wetlands (#9); Title from web page. "March 2002." "EPA-822-R-02-019." Description based on content viewed April 10, 2003. "Prepared jointly by U.S. Environmental Protection Agency, Health and Ecological Criteria Division (Office of Science and Technology) and Wetlands Division (Office of Wetlands, Oceans, and Watersheds)" Includes bibliographical references.

NAL Call #: QH541.5.M3 H46 2002

<http://www.epa.gov/waterscience/criteria/wetlands/9Invertebrate.pdf>

*Descriptors:* wetlands---United States/ aquatic invertebrates---environmental aspects---United States

This citation is from AGRICOLA.

### 30. Developing the scientific basis for assessing cumulative effects of wetland loss and degradation on landscape functions: Status, perspectives, and prospects.

Bedford, B. L. and Preston, E. M.

*Environmental Management* 12(5): 751-771. (1988)  
NAL Call #: HC79.E5E5; ISSN: 0364-152X

*Descriptors:* wetlands/ comprehensive planning/ reviews/ environmental effects/ cumulative impacts/ landscape functions/ research priorities/ regulations/ synoptic analysis/ data acquisition/ environmental protection

*Abstract:* The incongruity between the regional and national scales at which wetland losses are occurring, and the project-specific scale at which wetlands are regulated and studied, has become obvious. A synthesis is presented of recent efforts by the Environmental Protection Agency and the Ecosystems Research Center at Cornell University to bring wetland science and regulation into alignment with the reality of the cumulative effects of wetland loss and degradation on entire landscapes and regions. It summarizes the status of our present scientific understanding, discusses means by which to actualize the existing potential for matching the scales of research and regulation with the scales at which effects are observed, and provides guidelines for building a stronger scientific base for landscape-level assessments of cumulative effects. It also provides the outlines for a synoptic and qualitative approach to cumulative effects assessment based on a reexamination of the generic assessment framework. A sound scientific basis for regulation will not come merely from acquiring more information on more

variables. It will come from recognizing that a perceptual shift to larger temporal, spatial, and organizational scales is overdue. The shift in scale will dictate different--not necessarily more--variables to be measured in future wetland research and considered in wetland regulation. (Author 's abstract)

© CSA

**31. Diel flux of dissolved carbohydrate in a salt marsh and a simulated estuarine ecosystem.**

Burney, C. M.; Johnson, K. M.; and Sieburth, J. M.

*Marine Biology* 63(2): 175-187. (1981)

NAL Call #: QH91.A1M35; ISSN: 0025-3162

*Descriptors:* organic compounds/ salt marshes/ diurnal variations/ carbohydrates/ zooplankton/ nutrient cycles/ bacteria/ Narragansett Bay/ habitat community studies/ ecosystems and energetics

*Abstract:* The concentrations of total dissolved carbohydrate (TCHO), monosaccharide (MCHO) and polysaccharide (PCHO) were followed over a total of ten diel cycles in a salt marsh and a 13 m super(3) seawater tank simulating an estuarine ecosystem. Their patterns are compared to those for total dissolved organic carbon (DOC), Sigma CO sub(2), pH, O sub(2), chlorophyll a, phaeopigments and solar radiation. During 5 of the 6 marsh studies, PCHO underwent periods of sustained accumulation starting in the late morning or early afternoon and continuing into the early evening. These periods possibly represent release of recently synthesized PCHO from phototrophs. Similar patterns were not found in the tank although direct associations between TCHO and phaeopigment dynamics suggest that zooplankton excretion was an important source of dissolved carbohydrate. The numbers of planktonic bacteria determined in one tank study increased rapidly during a late morning PCHO pulse and varied inversely with PCHO throughout the afternoon and evening, indicating that they were able to respond rapidly and control natural substrate concentrations on a time scale of a few hours.

© CSA

**32. Ecoclimatological survey of the wetland biota in the tropical wet-and-dry climatic zone.**

Heckman, Charles W.

*Global Ecology and Biogeography Letters* 6(2): 97-114. (1997)

NAL Call #: QH84.G56; ISSN: 0960-7447

*Descriptors:* agronomy: agriculture/ climatology: environmental sciences/ ecology: environmental sciences/ aquatic ecosystem/ biodiversity/ climate/ climatology/ floodplains/ Mato grosso/ pantanal/ phylogeny/ recruitment/ rice field/ seasonal changes/ tropical ecology/ wetland biota

*Abstract:* The distinctness of the conditions in the water bodies of the tropical wet-and-dry climatic zone is demonstrated by a survey of the adaptations employed by the plant and animal species to survive the seasons unfavourable to their activity. The species filling common niches in the water bodies of this zone on different continents are compared. Unmistakable phylogenetic relationships among the species filling common niches in various parts of the world can be recognized. Through comparisons of the activity and distribution of 104 species, the adaptations of the biota to the seasonal changes were found to be generally similar to those of the biota in the temperate zones in that both must produce dormant stages

during the same months each year. The inherent instability of the aquatic ecosystem encourages the development of very fast growing organisms with high rates of recruitment and very unstable but resilient populations. As a consequence of their characteristic population dynamics, the impact of intercontinental introductions of aquatic species inhabiting this zone are found to be more likely to cause severe biotic disturbances than similar introductions of species adapted to other climatic zones.

© The Thomson Corporation

**33. Ecological issues related to wetland preservation, restoration, creation and assessment.**

Whigham, Dennis F

*Science of the Total Environment* 240(1-3): 31-40. (1999)

NAL Call #: RA565.S365; ISSN: 0048-9697

*Descriptors:* ecologically based Hydrogeomorphic approach/ wetland assessment/ wetland creation/ wetland ecosystem function/ wetland-no-net-loss policy/ wetland preservation/ wetland restoration

*Abstract:* A wide range of local, state, federal, and private programs are available to support the national (USA) policy of wetland 'No Net Loss'. Implementation of programs, however, has resulted in the continued loss of natural wetlands on the premise that restored or created wetlands will replace the functions and values lost by destruction of natural wetlands. What are the ecological implications and consequences of these programs from a biodiversity and ecosystem perspective? From a biodiversity perspective, ongoing wetland protection policies may not be working because restored or created wetlands are often very different from natural wetlands. Wetland protection policies may also be inadequate to preserve and restore ecological processes such as nutrient cycling because they mostly focus on individual wetlands and ignore the fact that wetlands are integral parts of landscapes. Wetland mitigation projects, for example, often result in the exchange of one type of wetland for another and result in a loss of wetland functions at the landscape level. The most striking weakness in the current national wetlands policy is the lack of protection for 'dry-end' wetlands that are often the focus of debate for what is and what is not a wetland. From an ecological perspective, dry-end wetlands such as isolated seasonal wetlands and riparian wetlands associated with first order streams may be the most important landscape elements. They often support a high biodiversity and they are impacted by human activities more than other types of wetlands. The failings of current wetland protection and mitigation policies are also due, in part, to the lack of ecologically sound wetland assessment methods for guiding decision making processes. The ecologically based Hydrogeomorphic (HGM) approach to wetland assessment has the potential to be an effective tool in managing biodiversity and wetland ecosystem function in support of the national 'No Net Loss' policy.

© The Thomson Corporation

**34. Ecology of insect communities in nontidal wetlands.**

Batzer, D. P. and Wissinger, S. A.  
*Annual Review of Entomology* 41: 75-100. (1996)  
 NAL Call #: 421 An72; ISSN: 0066-4170 [ARENAA]  
 Descriptors: wetlands/ insects/ community ecology/  
 habitats/ interactions/ colonization/ nature conservation/  
 insect communities/ reviews/ freshwater ecology  
 This citation is from AGRICOLA.

**35. Ecotoxicology and risk assessment for wetlands: Proceedings from the SETAC Pellston Workshop on Ecotoxicology and Risk Assessment for Wetlands.**

Lewis, Michael A.  
 Pensacola, Fla.: SETAC Press, 1999. 375 p. SETAC special publications series.  
 Notes: ISBN: 1880611163. "Publication sponsored by the Society of Environmental Toxicology and Chemistry (SETAC) and the SETAC Foundation for Environmental Education." Includes bibliographical references and index.  
 Venue: Fairmont Hot Springs, Anaconda, Montana.  
 NAL Call #: QH541.5.M3 S48 1995  
 Descriptors: wetland ecology---congresses/ pollution---environmental aspects---congresses/ ecological risk assessment---congresses  
 This citation is from AGRICOLA.

**36. Ecotoxicology and wetland ecosystems: Current understanding and future needs.**

Catallo, W. J.  
*Environmental Toxicology and Chemistry* 12(12): 2209-2224. (1993)  
 NAL Call #: QH545.A1E58; ISSN: 0730-7268  
 Descriptors: wetlands/ contaminants/ ecosystem analysis/ toxins/ ecosystems/ pollutants/ aquatic environment/ environmental policy/ literature reviews/ ecotoxicology/ environmental policy/ literature reviews/ contaminants/ ecosystem analysis/ pollutants/ toxins  
 Abstract: The term wetlands refers to a mosaic of important ecosystems that typically form transition zones between uplands and aquatic environments. These areas provide support functions for natural and living resources and mediate biogeochemical transformations of global significance. It is becoming clear that the introduction of toxic and other contaminants to large wetland areas has contributed to a series of undesirable trends in habitat quality; availability of valuable fish and wildlife; and quality of associated resources, including surface and ground waters. The purpose of this review is to indicate the importance of wetlands to regional and global ecology and discusses research on the effects of contaminants in wetland ecosystems. Areas of needed future research also are suggested.  
 © CSA

**37. The effect of aquatic plant species richness on wetland ecosystem processes.**

Engelhardt, K. A. M. and Ritchie, M. E.  
*Ecology* 83(10): 2911-2924. (2002)  
 NAL Call #: 410 Ec7; ISSN: 0012-9658  
 Descriptors: wetlands/ algal colonization/ competitive ability/ diversity/ ecosystem functioning/ indirect sampling effect/ inverse sampling effect/ nutrient retention/ productivity/ sampling effect/ submersed aquatic macrophytes

Abstract: Rapid environmental changes have fostered debates and motivated research on how to effectively preserve or restore ecosystem processes. One such debate deals with the effects of biodiversity, and the loss thereof, on ecosystem processes. Recent studies demonstrate that resource-use complementarity, now known as the "niche-differentiation effect," and the presence of a competitive species with strong effects on ecosystem processes, now known as the "sampling effect," can explain why productivity and nutrient retention are sometimes enhanced with increasing species richness. In a well-replicated outdoor mesocosm experiment, we tested these and other alternative mechanisms that could explain the effects of submersed aquatic plant (macrophyte) diversity on wetland ecosystem processes. Algal biomass increased and phosphorus loss decreased as species richness increased. This result can best be explained by an indirect sampling effect caused by one of the weakest competitors, which appeared to facilitate algal growth and thereby filtering of particles, and thus phosphorus, from the water column. The dominant competitor also appeared to decrease phosphorus loss through direct effects on phosphorus availability in the soil and water. Thus, the effects by one of the weakest and the most dominant competitors combine to produce a diversity effect on phosphorus loss. Macrophyte biomass was not enhanced, but converged toward the intermediate biomass of the most competitive species. Such an "inverse sampling effect" may be produced when the most competitive species is not the most productive species owing to species-specific feedbacks and adaptations to the wetland environment. In summary, we reject the niche-differentiation effect as the dominant mechanism in our macrophyte communities and expand on the role of sampling effects in explaining the relationship between plant communities and ecosystem processes. In particular, indirect and inverse sampling effects combine to drive the relationship between species richness and wetland ecosystem processes. Thus, we demonstrate that plant diversity may affect wetland ecosystem processes when inferior competitors drive system productivity and nutrient retention. To ensure coexistence of such species with superior competitors, wetland systems may need to be maintained in a nonequilibrium state, such as with hydrologic disturbances, which would maintain both higher diversity and enhance ecosystem functioning.  
 © 2006 Elsevier B.V. All rights reserved.

**38. Effects of macrophyte species richness on wetland ecosystem functioning and services.**

Engelhardt, K. A. M. and Ritchie, M. E.  
*Nature* 411(6838): 687-689. (June 2001)  
 Descriptors: wetlands/ species richness/ mesocosms/ phosphorus/ macrophytes/ ecosystems/ biomass/ human impact/ biological diversity/ nutrient retention/ aquatic plants/ phosphorus cycle/ species diversity/ plants/ ecosystem management/ environment management/ plant populations/ suspended particulate matter/ uptake/ man-induced effects/ phytoplankton/ pollution control/ nutrient cycles/ Phytobenthos/ aquatic macrophytes/ algae/ Potamogeton crispus/ Potamogeton pectinatus/ sago pondweed/ biodiversity/ nutrient retention/ human population-biosphere interactions/ physiology, biochemistry, biophysics/ protective measures and control/ water resources and supplies

**Abstract:** Wetlands provide many important ecosystem services to human society, which may depend on how plant diversity influences biomass production and nutrient retention. Vascular aquatic plant diversity may not necessarily enhance wetland ecosystem functioning, however, because competition among these plant species can be strong, often resulting in the local dominance of a single species. Here we have manipulated the species richness of rooted, submerged aquatic plant (macrophyte) communities in experimental wetland mesocosms. We found higher algal and total plant (algal plus macrophyte) biomass, as well as lower loss of total phosphorus, in mesocosms with a greater richness of macrophyte species. Greater plant biomass resulted from a sampling effect; that is, the increased chance in species mixtures that algal production would be facilitated by the presence of a less competitive species--in this case, crisped pondweed. Lower losses of total phosphorus resulted from the greater chance in species mixtures of a high algal biomass and the presence of sago pondweed, which physically filter particulate phosphorus from the water. These indirect and direct effects of macrophyte species richness on algal production, total plant biomass and phosphorus loss suggest that management practices that maintain macrophyte diversity may enhance the functioning and associated services of wetland ecosystems.  
© CSA

**39. Effects of open marsh water management on selected tidal marsh resources: A review.**

Wolfe, R. J.  
*Journal of the American Mosquito Control Association* 12(4): 701-712. (1996)  
NAL Call #: QL536.J686; ISSN: 8756-971X  
**Descriptors:** pest control/ marshes/ water management/ reviews/ literature reviews/ aquatic insects/ literature review/ ecological effects/ resources management/ Culicidae/ Diptera/ Diptera/ literature reviews/ aquatic insects/ literature review/ mosquito control/ ecological effects/ resources management/ reviews/ pest control/ Culicidae

**Abstract:** Open Marsh Water Management (OMWM) is a method of salt-marsh mosquito control that advocates source reduction and biological control through selective pond creation and ditching in mosquito breeding areas. This method has been used as an alternative to chemical insecticides in coastal wetlands for 30 years. This paper reviews the effects of OMWM on hydrology, topography, vegetation, mosquitoes, invertebrates, fishes, birds, mammals, and water quality. Other source reduction techniques and the economics of OMWM are also discussed.  
© CSA

**40. The end of a tradition: 1000 years of embankment and reclamation of wetlands in the Netherlands.**

Wolff, W. J.  
*Ambio* 21(4): 287-291. (1992)  
NAL Call #: QH540.A52; ISSN: 0044-7447  
**Descriptors:** wetlands/ land reclamation/ historical account/ marshes/ salt marshes/ environment management/ agriculture/ embankments/ Netherlands/ embankments/ reclamation/ conservation, wildlife management and recreation/ conservation and environmental protection/ environmental action

**Abstract:** Embankment and subsequent reclamation of coastal salt marshes in The Netherlands started about 1000 years ago. Thousands of km super(2) of salt marshes have been reclaimed since that time. In about the same period, reclamation of inland peat moors and swamp forests by improving drainage started, again resulting in the reclamation of thousands of km super(2) mainly in the center of the present-day Netherlands. A few centuries later, another technology was applied to pump dry lakes to gain new agricultural land at the former lake bottom. The embankment and reclamation of wetlands culminated in the 20th century Zuiderzee and Delta projects. However, since the 1960s opposition to the loss of wetlands gradually mounted and finally resulted in changing the nature of some major projects under way and the abandonment of several other projects.  
© CSA

**41. EPW: A procedure for the functional assessment of planned wetlands.**

Bartoldus, C. C.  
*Water, Air, and Soil Pollution* 77(3-4): 533-541. (1994)  
NAL Call #: TD172.W36; ISSN: 0049-6979  
**Abstract:** The practice of compensating wetland losses through wetland construction, restoration, or enhancement has become more commonplace; however, an appropriate method for assessing replacement of wetland function has been lacking. The Evaluation for Planned Wetlands (EPW) was developed to meet this need. It is a rapid assessment procedure which documents and highlights differences between a wetland assessment area and planned wetland based on their capacity to provide six functions: shoreline bank erosion control, sediment stabilization, water quality, wildlife, fish (tidal, non-tidal stream/river, and non-tidal pond/lake), and uniqueness/heritage. The differences between wetlands are expressed in terms of individual elements, Functional Capacity Indices, and Functional Capacity Units. The results provide information on individual design elements and measures of functional capacity which are a necessity under current regulatory programs that require tangible goals and a method for calculating planned wetland size. EPW includes functional assessment models, a procedure for using these models during the planning/mitigation process, and guidelines for functional design.  
© 2006 Elsevier B.V. All rights reserved.

**42. Evaluating cumulative effects of disturbance on the hydrologic function of bogs, fens, and mires.**

Siegel, D. I.  
*Environmental Management* 12(5): 621-626. (1988)  
NAL Call #: HC79.E5E5; ISSN: 0364-152X  
**Abstract:** Any evaluation of cumulative impacts will have to (1) consider the complicated and little understood interactions among wetland hydrology, water chemistry, and biota, and (2) place the effect of individual wetland impacts within the context of the cumulative impacts contributed to the watershed from other geomorphic areas and land uses. It is difficult to evaluate the potential cumulative impacts on wetland hydrology because geologic settings of wetlands are often complex and the methods used to measure wetland streamflow, groundwater flow, and evapotranspiration are inexact. This article reviews current understanding of the hydrologic function of bogs, fens, and mires at different scales and in different

physiographic settings and presents hypotheses on potential cumulative impacts on the hydrologic function that might occur with multiple disturbances. -from Author  
© 2006 Elsevier B.V. All rights reserved.

**43. Evaluating cumulative effects on wetland functions: A conceptual overview and generic framework.**

Preston, E. M. and Bedford, B. L.  
*Environmental Management* 12(5): 565-583. (1988)

NAL Call #: HC79.E5E5; ISSN: 0364-152X

*Descriptors:* wetlands/ management planning/ environmental effects/ research priorities/ landscape functions/ flood-control storage/ water quality/ sediments/ hydrological regime

*Abstract:* Issues that must be confronted in developing a sound scientific basis for investigating cumulative effects on freshwater wetlands are outlined. The foundation is laid for a research program to develop methods to quantify cumulative effects of wetland loss or degradation on the functioning of interacting systems of wetlands: (1) the concept of cumulative effects is defined in terms that permit scientific investigation of effects; (2) the scientific component of cumulative impact analysis is distinguished from other aspects of the assessment process; (3) critical scientific issues in assessing cumulative effects on wetlands are defined; and (4) a hypothetical and generic structure is set up for measuring cumulative effects on the functioning of wetlands as landscape systems. A generic framework is provided for evaluating cumulative effects on three basic wetland landscape functions: flood storage, water quality, and life support. The contribution of a particular wetland to landscape function within watersheds or regions will be determined by its intrinsic characteristics, e.g., size, morphometry, type, percent organic matter in the sediments, and hydrologic regime, and by extrinsic factors, i.e., the wetland's context in the landscape mosaic. The time scales of recovery for processes controlling particular wetland functions determine temporal boundaries. Landscape-level measures are proposed for each function. (Author's abstract)

© CSA

**44. Factors affecting the performance of stormwater treatment wetlands.**

Carleton, J. N.; Grizzard, T. J.; Godrej, A. N.; and Post, H. E.

*Water Research* 35(6): 1552-1562. (2001)

NAL Call #: TD420.W3; ISSN: 0043-1354

*Descriptors:* ammonia: pollutant/ nitrate: pollutant/ phosphorus: pollutant/ hydraulic loading rate/ pollutant input/ pollutant removal/ stormwater runoff/ stormwater treatment wetlands/ wastewater treatment

*Abstract:* Data from 35 studies on 49 wetland systems used to treat stormwater runoff or runoff-impacted surface waters were examined and compared in order to identify any obvious trends that may aid future stormwater treatment wetland design efforts. Despite the intermittent nature of hydrologic and pollutant inputs from stormwater runoff, our analysis demonstrates that steady-state first-order plug-flow models commonly used to analyze wastewater treatment wetlands can be adapted for use with stormwater wetlands. Long-term pollutant removals are analyzed as functions of long-term mean hydraulic loading rate and nominal detention time. First-order removal rate constants for total phosphorus, ammonia, and nitrate

generated in this fashion are demonstrated to be similar to values reported in the literature for wastewater treatment wetlands. Constituent removals are also demonstrated via regression analyses to be functions of the ratio of wetland area to watershed area. Resulting equations between these variables can be used as preliminary design tools in the absence of more site-specific details, with the understanding that they should be employed cautiously.  
© The Thomson Corporation

**45. Fire in North American wetland ecosystems and fire-wildlife relations: An annotated bibliography.**

Kirby, R. E.; Lewis, S. J.; and Sexson, T. N.  
Washington, DC: U.S. Fish and Wildlife Service, 1988.  
146 p. Biological Report .

NAL Call #: QH540.U562 no.88(1)

*Abstract:* Provides an annotated bibliography of 319 citations that provide specific research data, summaries of existing knowledge, or site-specific management advice for North America. To this bibliography is appended a supplemental bibliography of all articles cited in the US Fish & Wildlife Service publication series, Wildlife Review, years 1935 through the September 1987 issue (Number 206) that discussed any aspect of wildlife management and ecology related to fire management, fire behaviour, or fire effects in North America. The 942 citations in the supplemental bibliography are intended to provide a ready reference to the fire-wildlife literature that can be used to evaluate past, current or proposed use of fire in wildlife habitat management. -from Authors

© 2006 Elsevier B.V. All rights reserved.

**46. Flood pulsing in wetlands: Restoring the natural hydrological balance.**

Middleton, Beth

New York: Wiley; 308 p. (2002)

NAL Call #: QH541.5.V3 F46 2002; ISBN: 0471418072

*Descriptors:* floodplain ecology---North America/ wetland restoration---North America

This citation is from AGRICOLA.

**47. Foreign plant stock: Concerns for wetland mitigation.**

Padgett, D. J. and Crow, G. E.

*Restoration & Management Notes* 12(2): 168-171. (1994)

NAL Call #: QH76.R47; ISSN: 0733-0707

*Descriptors:* wetlands/ introduced species/ horticulture/ genetic variance/ aquatic plants/ transplantation/ hybridization/ ecosystem disturbance/ genomes/ artificial wetlands/ planning/ flora/ USA, New Hampshire/ constructed wetlands/ genetics/ horticulture/ genetic variance

*Abstract:* While analyzing the floristic composition and plant species richness of created wetland ecosystems of southeastern New Hampshire, we made several observations on the methodology of vegetation composition planning, and how particular plant species are selected and become incorporated into mitigation projects. The outcome of this investigation along with a review of the subsequent literature, has evoked questions concerning the revegetation strategies, vegetation sources, and resultant floristic compositions of created wetland ecosystems.

© CSA

**48. Forested wetlands in freshwater and salt-water environments.**

Lugo, A. E.; Brown, S.; and Brinson, M. M.  
*Limnology and Oceanography* 33(4): 894-909. (1988)  
NAL Call #: GC1 .L5; ISSN: 0024-3590  
*Descriptors:* wetlands/ lakes/ seawater/ reviews/ limnology/  
forest hydrology/ forests/ forest watersheds/ ecosystems/  
productivity  
*Abstract:* A review of data from over 50 freshwater and  
about 50 salt-water sites revealed that freshwater and salt-  
water forested wetlands exhibit parallel responses to  
hydrologic factors. Greater ecosystem complexity and  
productivity are associated with higher hydrologic energy  
and more fertile conditions. However, structural complexity  
is greater in freshwater forested wetlands than in salt-water  
wetlands. Net primary productivity, litter fall, and export of  
organic matter are higher in salt-water forested wetlands.  
These differences raise questions about the efficiency with  
which nutrients are used in forested wetlands. Available  
data suggest that nutrient-use efficiency by litter fall and  
litter turnover are higher in tidal salt-water wetlands than in  
freshwater wetlands. (Author's abstract)  
© CSA

**49. Freshwater wetlands, urban stormwater, and nonpoint pollution control: A literature review and annotated bibliography.**

Stockdale, E. C.  
Olympia, Wash.: Washington Department of Ecology,  
1991. 273 p.  
NAL Call #: Z6004.S94S76 1991  
*Descriptors:* wetlands/ bibliographies/ literature review/  
nonpoint pollution sources/ storm runoff/ storm water  
management/ urban runoff/ wastewater treatment/ water  
pollution control/ wastewater disposal/  
water pollution effects  
*Abstract:* It is well established that wetlands under certain  
circumstances improve water quality. There is a limited  
body of literature on the long-term effects of using  
freshwater wetlands for stormwater storage and nonpoint  
pollution control. A much larger body of literature pertains to  
the use of wetlands for sewage effluent treatment. Some  
work has been done utilizing natural as well as artificial  
wetlands for flood control and/or water quality  
management, but their direct application to this region is  
limited. Some researchers believe the characteristics of  
wastewater and urban runoff are similar enough that some  
findings in the wastewater literature may be applied to  
stormwater systems. These findings can be confirmed by  
careful studies in the Northwest to help fill the gaps in  
present knowledge. The literature strongly indicates that  
caution should be taken when natural wetlands are  
modified for use in stormwater management. Short-term  
water quality benefits are often realized, but long-term  
ecological impacts to the wetland system itself are likely  
and poorly understood. Constructed wetlands can be  
valuable tools for managing the effects of stormwater  
impacts on natural systems, particularly if they are built as  
part of basin-wide stormwater plans. The literature review  
summarizes wetland water quality improvement principles,  
case studies, and areas of greatest uncertainty regarding  
the use of wetlands for urban stormwater management. A

comprehensive glossary is provided for use as a reference  
with definitions to terms contained in the review and  
bibliography, as well as the general literature. (Author's  
abstract)  
© CSA

**50. From wastelands to wetlands.**

Patrick, W. H.  
*Journal of Environmental Quality* 23(5): 892-896. (1994)  
NAL Call #: QH540.J6; ISSN: 0047-2425.  
*Notes:* Conference: Symposium on Wetland Processes and  
Water Quality, Minneapolis, MN (USA), 3-4 Nov 1992  
*Descriptors:* wetlands/ water quality/ flood control/ land  
use/ agriculture/ environmental protection/ water quality  
acts/ federal regulations/ ecosystem disturbance/ waste  
disposal sites/ historical account/ environmental legislation/  
North America/ Clean Water Act/ water quality acts/ effects  
on water of human nonwater activities/ environmental  
action/ conservation, wildlife management and recreation/  
environmental degradation  
*Abstract:* When the Europeans first came to North  
America, they discovered vast expanses of fertile land in  
forests and prairies that would support the production of  
agricultural crops. Along with the upland fertile soils that  
lent themselves to clearing and farming, these settlers also  
encountered large areas of water-dominated lands that we  
now call wetlands. To the early settlers these wetland areas  
were for the most part wastelands and were generally  
considered to be unpleasant and unhealthy environments.  
We have learned in recent decades that the extensive  
wetland areas of this country have many beneficial uses.  
Improvement in water quality, flood control, storm  
abatement, protection of unique species of plants and  
animals, and food chain support are some of the important  
functions that wetlands perform. Before and during the  
same time that the value of natural wetlands was slowly  
being recognized, extensive drainage and conversion of  
wetlands to other uses were taking place, resulting in  
conversion of approximately half of the country's wetlands  
to nonwetland uses. Most drainage of wetlands, both past  
and present, is for agricultural use. There is now  
considerable interest country-wide in slowing this wetland  
conversion. Conversion of wetlands to agricultural, urban,  
and industrial uses is now regulated under Section 404 of  
the Federal Clean Water Act. The present level of  
regulation is not without problems, especially in regions  
with extensive areas of wetlands where there might be  
insufficient upland area for development, and in regions  
where the few areas that have wetland characteristics do  
not qualify for 404 protection.  
© CSA

**51. Functional assessment of a reference wetland set as a tool for science, management and restoration.**

Findlay, S. E. G.; Kiviat, E.; Nieder, W. C.; and Blair, E. A.  
*Aquatic Sciences* 64(2): 107-117. (2002); ISSN: 1015-1621  
*Descriptors:* wetlands/ tidal marshes/ education/  
environmental protection/ hydrology/ geomorphology/  
analysis/ variability/ restoration/ inland water environment/  
USA, New York, Hudson R./ habitat community studies/  
protective measures and control/ general environmental  
engineering

*Abstract:* Wetlands are increasingly becoming the target of efforts to restore or mitigate past and current loss of area and other impacts on their function. Tidal wetlands serve an array of functions deemed beneficial (ecosystem services) but there are relatively few efforts to provide verified indicators of these functions or assess variability in function among wetlands. We assessed twelve functions ranging from wave energy dissipation to fish species richness in tidal freshwater wetlands on the Hudson River. These functions were assessed along with potential "indicators" of function at fifteen marshes selected to span hydrogeomorphic classes as well as expected level of function. Functions varied dramatically among wetland sites, with scores summed across functions ranging from 16% to 70% of the maximum possible. Some of the functions were positively associated such that improvement in one would probably be accompanied by improvements in others. Some functions (e.g., surface water exchange and breeding bird habitat) were negatively correlated indicating that one site cannot maximize all potential functions. A verified reference data set allows more objective selection of targets and sites for restoration as well as establishing realistic goals for what might be achieved. The validated indicators of function are valuable tools for extrapolating from a few intensively studied sites to the larger, unsampled, population of wetland sites in a region.  
© CSA

#### 52. Genetic issues for the restoration of seagrass populations.

Williams, S. L. and California Sea Grant.  
In: Restoration Genetics Workshop. (Held 4 Dec 1997-5 Dec 1997 at St. Petersburg, FL (USA).); pp. 53-60; 1997.  
*Notes:* Conference: Workshop on the Restoration Genetics of Wetland Plants

*Descriptors:* wetlands/ sea grass/ genetic diversity/ bioturbation/ ecosystem disturbance/ habitat improvement (biological)/ restoration/ nature conservation/ environment management/ coastal zone management/ genetics and evolution/ protective measures and control

*Abstract:* This paper explores the relationships between genetic variation and seagrass restoration. The author discusses some topics restorationists must address such as temporal scale, evolutionary potential, bioturbation, and habitat fragmentation.  
© CSA

#### 53. Geochemical processes and nutrient uptake by plants in hydric soils.

McKee, W. H. and McKevlin, M. R.  
*Environmental Toxicology and Chemistry* 12(12): 2197-2207. (Dec. 1993)

*NAL Call #:* QH545.A1E58; *ISSN:* 0730-7268

*Notes:* Annual Review Issue: Wetland Ecotoxicology and Chemistry. Includes references.

*Descriptors:* wetland soils/ flooding/ biological production/ plant water relations/ plant nutrition/ metabolism/ mineral nutrition/ nutrient uptake/ soil physical properties/ reduction  
This citation is from AGRICOLA.

#### 54. Geographically isolated wetlands: A preliminary assessment of their characteristics and status in selected areas of the United States.

Tiner, Ralph W. and U.S. Fish and Wildlife Service.  
Region 5.

Hadley, Mass.: U.S. Fish and Wildlife Service, Northeast Region. (2002)

*Notes:* Title from web page. "June 2002." Description based on content viewed July 3, 2003. Includes bibliographical references.

*NAL Call #:* QH87.3 .G64 2002

<http://wetlands.fws.gov/Pubs%5FRports/isolated/report.htm>

*Descriptors:* wetlands---United States/ wetland ecology---United States

This citation is from AGRICOLA.

#### 55. Grazing management for riparian wetland areas.

Leonard, S. G.; National Applied Resource Sciences Center (U.S.); and United States. Forest Service.  
Denver, CO: U.S. Dept. of the Interior, Bureau of Land Management, National Applied Resource Sciences Center; Series: Riparian area management. Technical reference (United States. Bureau of Land Management) 1737-14; 63 p. (1997)

*Notes:* "U.S. Department of Agriculture, Forest Service"--Cover. Shipping list no.: 98-0126-P. "BLM/RS/ST-97/002+1737"--P. [2] of cover. Includes bibliographical references (p. 57-63). SUDOCs: I 53.35:1737-14.

*NAL Call #:* SF85.3.G75 1997

*Descriptors:* range management---United States/ grazing---environmental aspects---United States/ riparian ecology---United States/ wetland conservation---United States  
This citation is from AGRICOLA.

#### 56. Groundwater-surface water interactions in headwater forested wetlands of the Canadian Shield.

Devito, K. J.; Hill, A. R.; and Roulet, N.  
*Journal of Hydrology (Amsterdam)* 181(1-4): 127-147. (1996)

*NAL Call #:* 292.8 J82; *ISSN:* 0022-1694

*Descriptors:* wetlands/ surface-groundwater relations/ forest hydrology/ swamps/ headwaters/ runoff/ catchment areas/ hydrological regime/ hydrology/ catchment area/ vegetation cover/ stormwater runoff/ ground water/ catchment area/ vegetation cover/ stormwater runoff/ ground water/ surface-groundwater relations/ forest hydrology/ headwaters/ catchment areas/ hydrological regime/ dynamics of lakes and rivers

*Abstract:* Groundwater and surface water interaction in two conifer swamps located in headwater catchments with contrasting till depth, typical of the southern Canadian Shield, were studied from June 1990 to August 1992. Both swamps had little influence on the regulation or attenuation of seasonal runoff response in the catchment. The two valley bottom swamps were connected to local aquifers but the upland-wetland connection was continuous in the catchment with deeper till and ephemeral in the catchment with thin till-rock ridges. Groundwater movement through the wetlands was restricted mainly to the surface peat layer in both wetlands, because a large portion of inputs from shallow soil layers and stream inflows enter near the peat surface. However, differences in upland-wetland connections resulted in contrasting hydrologic regimes in the two swamps. During seasons with larger inputs, both

swamps were hydrologically connected to uplands and had a similar hydrology characterized by a high water table, rapid storm response, and predominance of saturated overland flow. In summer, upland inputs were absent in the catchment with thin till-rock ridges, resulting in cessation of baseflow and a lower water table that varied in response to variations in rainfall. Continuous upland inputs throughout the summer in the catchment with deeper tills (1-3 m) sustained baseflow and kept the water table near the peat surface. This study demonstrates the control of morphology and shallow subsurface geology on the hydrology of valley bottom swamps influenced by local aquifers.

© CSA

**57. How 'green' are aquaculture, constructed wetlands and conventional wastewater treatment systems?**

Brix, H.

*Water Science and Technology* 40(3): 45-50. (1999)

NAL Call #: TD420.A1P7; ISSN: 0273-1223.

Notes: Conference: 6. International Conference on Wetland Systems for Water Pollution Control, Aguas de Sao Pedro, SP (Brazil), 27 Sep-2 Oct 1998; Issue editor: Cooper, P.

Descriptors: aquaculture development/ environmental impact/ environment management/ eutrophication/ pollution control/ energy/ aquaculture/ wastewater treatment/ artificial wetlands/ water quality/ nutrients/ biomass/ tropical regions/ productivity/ comparison studies/ technology/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ mechanical and natural changes/ wastewater treatment processes

Abstract: The term 'green' is nowadays widely used (and misused) in connection with many types of technologies. If a technology is 'green' it usually means that the technology requires less non-renewable energy sources than other alternatives. However, other parameters need to be considered as well, such as sustainability, recycling potential, treatment capacity and potential, conservation of ecosystems, etc. In this paper the energy requirements and nutrient recycling potential of constructed wetlands and wastewater aquaculture facilities are compared with that of conventional wastewater treatment technologies. The energy requirements of constructed wetlands are very low, but if significant reuse of nutrients is included (aquaculture), the energy requirements increase significantly and usually beyond the energy equivalent of the biomass produced. This is especially true in cold temperate climates where the aquaculture systems need to be housed in heated greenhouses and artificial light must be provided to secure operation throughout the year. In countries where fresh water itself is a limiting resource and where the economic capability may limit the use of artificial fertilisers, the reuse potential of wastewater may be more important. The potential for sustainable cropping of the plant biomass is excellent in tropical wetlands as the plants have a high productivity and a continuous growing season. In order to evaluate in more detail the 'greenness' of the different wastewater treatment technologies, the life-cycle approach might be applied. However, because constructed wetlands, besides the water quality improvement function, perform a multitude of other functions such as biodiversity, habitat, climatic, hydrological and public use functions, methodologies need to be developed to evaluate these functions and to weigh them in relation to the water quality issues.

© CSA

**58. Hydrological modelling and the sustainable development of the Hadejia-Nguru Wetlands, Nigeria.**

Thompson, J. R. and Hollis, G. E.

*Hydrological Sciences Journal* 40(1): 97-116. (1995)

NAL Call #: 292.9 As7; ISSN: 0262-6667

Descriptors: productivity/ irrigation/ groundwater recharge/ flooding/ hydrologic budget/ model studies/ water storage/ water use/ hydrology/ water resources/ water management/ biological production/ water budget/ resource development/ ground water/ Nigeria, Hadejia-Nguru Wetlands/ sustainable development/ biological production/ water budget/ resource development/ ground water/ productivity/ groundwater recharge/ hydrologic budget/ model studies/ water storage/ general papers on resources/ conservation, wildlife management and recreation

Abstract: The Hadejia-Nguru Wetlands produce agricultural, fishing and fuelwood benefits of upto 1277 Naira/ha (N1 = US\$22, October 1994), over five times the productivity of formal irrigation schemes. The wetlands play a vital role in aquifer recharge. The key is the annual wet season flooding of over 2000 km super(2) in the 1960s and around 1500 km super(2) in the 1970s. A water balance model, utilizing monthly hydrological and meteorological data simulates flood extent and groundwater storage within the wetlands. The model was operated between 1964 and 1987 and was calibrated using observed flood extents ranging from 50 to 3265 km super(2). Subsequently elements were added for dams and irrigation schemes. Results indicate that full implementation of all the schemes constructed or planned would cause flooding to be less than 375 km super(2) for 60% of the time and groundwater storage to fall by over 5500 10 super(6) m super(3). It is possible to define an operating regime for the basin's hydraulic structures which could provide artificial floods and enable a distribution of water between formal irrigation, small scale irrigators, the wetlands and downstream users. This regime would provide assured flooding, of around 1000 km super(2) each year and a reduced loss of groundwater storage. Such a sustainable development scheme could offset decades of piecemeal development.

© CSA

**59. Hydrology of natural wetlands and wet nature reserves.**

Van Der Molen, W. H.

*Agricultural Water Management* 14(1-4): 357-364. (1988)

NAL Call #: S494.5.W3A3; ISSN: 0378-3774

Descriptors: wetlands/ hydrology/ ecosystems/ ecological effects/ reviews/ salt marshes/ swamps/ marshes/ hydrologic systems/ bogs

Abstract: This review considers wetlands as they occur in nature, first discussing common properties, and then distinguishing different varieties. Wetlands discussed lack extensive open water spaces or large areas of bare sands and mudflats, and are mostly vegetated. The water logged wetland environment severely limits the number of plant species. Other factors, like high salinity, abundant or very poor supply of plant nutrients, may further reduce the possibilities. Often the vegetation is dominated by only a few but highly typical species. The following main types of wetlands are considered: swamp forests; reedlands and wet grasslands; highmoor bogs; and salt marshes. The general features of wetlands, and their botanical and zoological aspects have been extensively studied. The knowledge about the hydrology of wetlands, however, is

scanty. More studies have been made on the hydrology of nature reserves. Interest in wetland hydrology is obviously rising as such areas become scarcer. Our present knowledge of the hydrology of wetlands is insufficient as a base to make the right decisions on how to preserve threatened wetlands. (Author 's abstract)

© CSA

**60. Identifying vulnerable wetland systems: Modelling the impact of sea-level rise on large-scale wetland response.**

McFadden, L.; Spencer, T.; and Nicholls, R. J.

In: Solutions to Coastal Disasters 2005 - Proceedings of the Conference.; pp. 453-465; 2005.

*Descriptors:* coastal forest/ ecological sensitivity/ tidal flats, saltmarsh/ wetland loss/ wetland transition

*Abstract:* A broad-scale Wetland Change Model has been developed to identify the vulnerability of coastal wetlands at the large-scale. The model provides a dynamic and integrated assessment of regional to global patterns of wetland loss, and a means of estimating the transitions between different vegetated wetland types and open water under a range of scenarios of sea-level rise and changes in accommodation space from human intervention. This paper discusses key concepts raised in the process of quantifying the vulnerability of coastal wetlands to forcing from sea-level rise.

© 2006 Elsevier B.V. All rights reserved.

**61. The impact of a riparian wetland on streamwater quality in a recently afforested upland catchment.**

Emmett, B. A.; Hudson, J. A.; Coward, P. A.; and Reynolds, B.

*Journal of Hydrology (Amsterdam)* 162(3-4): 337-353. (1994)

*NAL Call #:* 292.8 J82; *ISSN:* 0022-1694

*Descriptors:* wetlands/ water quality/ streams/ geochemistry/ stream pollution/ sinks/ nutrients/ water treatment/ agricultural runoff/ aquaculture effluents/ nutrients (mineral)/ aquaculture effluents/ nutrients (mineral)/ streams/ stream pollution/ sinks/ nutrients/ sources and fate of pollution/ mechanical and natural changes/ freshwater pollution

*Abstract:* The influence of a small remnant wetland on streamwater chemistry at the outflow of an afforested catchment has been investigated. The wetland reduced the volume weighted mean concentrations of a number of solutes. Stream solute loadings were calculated from chemical and flow data from two flumes situated above and below the wetland at the catchment outlet. The flow contribution from the wetland itself was estimated on an areal basis and combined with sampled chemistry to estimate solute fluxes. Streamwater dissolved nitrogen loading equivalent to an input of 55 kg N/ha/year, was reduced by 38% after flowing through the wetland. Reductions in streamwater loadings were also observed for phosphate (94%), total dissolved-P (42%), total monomeric aluminium (39%), total filtrable aluminium (21%), iron (54%), DOC (34%) and silica (21%). All other retention rates were within the original streamwater loading estimate errors. Retention of nitrogen was lower than expected, perhaps due to exhaustion of the wetland's immobilisation capacity by the large nitrogen loading in the streamwater entering the wetland from the surrounding land in combination with atmospheric loadings. Retention of

nitrogen and other solutes was also reduced due to a prolonged period of low rainfall during the summer of 1989 which resulted in high concentration events of various elements from the wetland relative to concentrations at the wetland inflow.

© CSA

**62. The impact of federal programs on wetlands: A report to Congress.**

United States. Dept. of the Interior

Washington, D.C.: U.S. Dept. of the Interior, 1988.

*Notes:* v. 1. The Lower Mississippi Alluvial Plain and the Prairie Pothole Region -- v. 2. The Everglades, coastal Louisiana, Galveston Bay, Puerto Rico, California's Central Valley, western riparian areas, southeastern and western Alaska, the Delmarva Peninsula, North Carolina, northeastern New Jersey, Michigan, and Nebraska.

*NAL Call #:* QH76.I48 1988

<http://www.doi.gov/oepec/wetlands2/index.html>

*Descriptors:* wetland conservation---government policy---United States/ wetlands---government policy---United States/ reclamation of land---government policy---United States

This citation is from AGRICOLA.

**63. Impact of urbanization on coastal wetland structure and function.**

Lee, S. Y.; Dunn, R. J. K.; Young, R. A.; Connolly, R. M.; Dale, P. E. R.; Dehayr, R.; Lemckert, C. J.; Mckinnon, S.; Powell, B.; and Teasdale, P. R.

*Austral Ecology* 31(2): 149-163. (2006)

*NAL Call #:* QH540 .A8; *ISSN:* 1442-9985

*Abstract:* Urbanization is a major cause of loss of coastal wetlands. Urbanization also exerts significant influences on the structure and function of coastal wetlands, mainly through modifying the hydrological and sedimentation regimes, and the dynamics of nutrients and chemical pollutants. Natural coastal wetlands are characterized by a hydrological regime comprising concentrated flow to estuarine and coastal areas during flood events, and diffused discharge into groundwater and waterways during the non-flood periods. Urbanization, through increasing the amount of impervious areas in the catchment, results in a replacement of this regime by concentrating rain run-off. Quality of run-off is also modified in urban areas, as loadings of sediment, nutrients and pollutants are increased in urban areas. While the effects of such modifications on the biota and the physical environment have been relatively well studied, there is to date little information on their impact at the ecosystem level. Methodological issues, such as a lack of sufficient replication at the whole-habitat level, the lack of suitable indices of urbanization and tools for assessing hydrological connectivity, have to be overcome to allow the effects of urbanization to be assessed at the ecosystem level. A functional model is presented to demonstrate the impact of urbanization on coastal wetland structure and function.

This citation is from AGRICOLA.

**64. Impacts of sediment burial on mangroves.**

Ellison, J. C.

*Marine Pollution Bulletin* 37(8-12): 420-426. (1998)

*NAL Call #:* GC1000.M3; *ISSN:* 0025-326X

*Descriptors:* wetlands/ roots/ tolerance/ sedimentation/ burying/ mangrove swamps/ ecosystem disturbance/

restoration/ environment management/ nature conservation/ ecosystem management/ rehabilitation/ elevation/ accretion/ literature review/ mortality/ trees/ environmental restoration/ habitat/ respiration/ forests/ sediments/ mangroves

**Abstract:** Aerial roots are a common adaptation of mangrove trees to their saline wetland habitat, allowing root respiration in the anaerobic substrate. While mangroves flourish on sedimentary shorelines, it is shown here that excess input of sediment to mangroves can cause death of trees owing to root smothering. Descriptions of 26 cases were found in the literature or described here, where mangroves have been adversely affected by sediment burial of roots. The impacts ranged from reduced vigour to death, depending on the amount and type of sedimentation, and the species involved. There are insufficient data to establish specific tolerances. For rehabilitation, where the disturbance was a past event, the elevation change must be assessed in selection of species for replanting, and field trials are required in areas where rapid accretion is an ongoing problem.

© CSA

**65. The importance of wetlands in water resource management: A literature review.**

Brady, Anne.; Riding, Tim.; and New South Wales. Dept. of Land and Water Conservation.

Sydney, Australia: Sydney Dept. of Land & Water Conservation; 48 p.: ill. (1996)

**Notes:** "March 1996"--T.p. verso. Includes bibliographical references (p. 30-37).

**NAL Call #:** QH541.5.M3B73 1996; **ISBN:** 0731023544

**Descriptors:** wetland conservation---Australia---New South Wales/ wetlands---Australia---New South Wales---management

This citation is from AGRICOLA.

**66. An integrated model of soil, hydrology, and vegetation for carbon dynamics in wetland ecosystems.**

Zhang, Yu; Li, Changsheng; Trettin, Carl C.; Li, Harbin; and Sun, Ge

*Global Biogeochemical Cycles* 16(4): 1-17. (2002)

**NAL Call #:** QH344.G562; **ISSN:** 0886-6236

<http://www.srs.fs.usda.gov/pubs/20282>

**Descriptors:** wetland/ model/ carboncycles/ methane emissions/ hydrology

**Abstract:** Wetland ecosystems are an important component in global carbon (C) cycles and may exert a large influence on global climate change. Predictions of C dynamics require us to consider interactions among many critical factors of soil, hydrology, and vegetation. However, few such integrated C models exist for wetland ecosystems. In this paper, we report a simulation model, Wetland-DNDC, for C dynamics and methane (CH<sub>4</sub>) emissions in wetland ecosystems. The general structure of Wetland-DNDC was adopted from PnET-N-DNDC, a process-oriented biogeochemical model that simulates C and N dynamics in upland forest ecosystems. Several new functions and algorithms were developed for Wetland-DNDC to capture the unique features of wetland ecosystems, such as water table dynamics, growth of mosses and herbaceous plants, and soil biogeochemical processes under anaerobic conditions. The model has been validated against various observations from three

wetland sites in Northern America. The validation results are in agreement with the measurements of water table dynamics, soil temperature, CH<sub>4</sub> fluxes, net ecosystem productivity (NEP), and annual C budgets. Sensitivity analysis indicates that the most critical input factors for C dynamics in the wetland ecosystems are air temperature, water outflow parameters, initial soil C content, and plant photosynthesis capacity. NEP and CH<sub>4</sub> emissions are sensitive to most of the tested input variables. By integrating the primary drivers of climate, hydrology, soil and vegetation, the Wetland-DNDC model is capable of predicting C biogeochemical cycles in wetland ecosystems. This citation is from Treeseearch.

**67. Intensive wetland agriculture in Mesoamerica: Space, time, and form.**

Sluyter, A.

*Annals of the Association of American Geographers* 84(4): 557-584. (1994)

**NAL Call #:** 500 As73; **ISSN:** 0004-5608

**Descriptors:** wetlands/ agriculture/ maps/ irrigation practices/ ecological effects/ population density/ irrigation/ land use/ historical account/ anthropogenic factors/ ecosystem disturbance/ environmental impact/ mesoamerica/ archeology/ historical account/ anthropogenic factors/ ecosystem disturbance/ environmental impact/ irrigation practices/ ecological effects/ conservation in agricultural use/ habitat community studies/ mechanical and natural changes

**Abstract:** Geographers have led the effort to better understand Prehispanic, intensive wetland agriculture ("raised fields") in Mesoamerica. An overview of that literature provides the database for a subsequent spatial-temporal analysis and a resource for primary research. The analysis employs maps to identify changing relationships among distribution, hectareage, and morphometry in order to address wetland agriculture's role in the emergence of sedentism, urbanism, statism, and corollary environmental change; its interrelationships with other agroecosystems and ecological parameters; and its productivity and sustainability. The result is a modest benchmark in the research process which identifies significant variables, putative patterns, and several testable hypotheses, namely 1) that wherever social processes elicited dense population nucleations and hydrology was appropriate, farmers built wetland fields; 2) that the emergence of intensive wetland agriculture was ecologically interrelated with terracing, canal irrigation, and extensive agroecosystems; 3) that morphometric variation among wetland fields reflected contextual variables of hydrology, population density, taxation, and centralization of decision making; and 4) that intensive wetland agriculture in Mesoamerica was a productive and sustainable agroecosystem.

© CSA

**68. Interior wetlands of the United States: A review of wetland status, general ecology, biodiversity, and management.**

Giudice, John H.; Ratti, John T.; United States. Army. Corps of Engineers; U.S. Army Engineer Waterways Experiment Station; and Wetlands Research Program (U.S.)

Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station; Series: Wetlands Research Program technical report WRP-SM-9; 156 p. (1995)

*Notes:* "November 1995." Includes bibliographical references (p. 100-132).

*NAL Call #:* QH76.G58 1995

*Descriptors:* biological diversity conservation---United States/ ecosystem management---United States/ wetlands---United States

This citation is from AGRICOLA.

#### 69. Invasiveness in wetland plants in temperate North America.

Galatowitsch, S. M.; Anderson, N. O.; and Ascher, P. D. *Wetlands* 19(4): 733-755. (1999)

*NAL Call #:* QH75.A1W47; *ISSN:* 0277-5212

*Descriptors:* wetlands/ exotic species/ vegetation/ literature review/ hydrology/ salinity/ introduced species/ vegetation patterns/ growth/ herbivores/ hybridization/ ecosystem disturbance/ plant populations/ salinity effects/ temperate zones/ *Phragmites australis*/ *Typha glauca*/ *Lythrum salicaria*/ *Myriophyllum spicatum*/ *Phalaris arundinacea*/ North America/ invasive taxa

*Abstract:* The spread of invasive taxa, including *Lythrum salicaria*, *Typha X glauca*, *Myriophyllum spicatum*, *Phalaris arundinacea*, and *Phragmites australis*, has dramatically changed the vegetation of many wetlands of North America. Three theories have been advanced to explain the nature of plant invasiveness. Aggressive growth during geographic expansion could result because 1) growth is more favorable under new environmental conditions than those of resident locales (environmental constraints hypothesis); 2) herbivores may be absent in the new locale, resulting in selection of genotypes with improved competitive ability and reduced allocation to herbivore defenses (evolution of increased competitive ability hypothesis); and 3) interspecific hybridization occurred between a new taxon and one existing in an area, resulting in novel phenotypes with selective advantages in disturbed sites or phenotypes that can grow under conditions not favorable for either parent (introgression/hybrid speciation hypothesis). A review of published literature found few studies that compare the growth and dynamics of invasive populations in their new range versus those in historic ranges. However, there is evidence that hydrologic alterations could facilitate invasions by *Typha X glauca* and *Phalaris arundinacea* and that increased salinity promoted spread of *Typha angustifolia* (parental taxon) and *Phragmites australis*. The potential for reduced herbivory causing aggressive growth is greatest for *Lythrum salicaria*. Introgressive hybridization is potentially a cause of invasiveness for all five species but has been established only for *Typha X glauca* and *Lythrum salicaria*.

© CSA

#### 70. Land-use characterization for nutrient and sediment risk assessment.

Valk, Arnoud van der; United States. Environmental Protection Agency. Health and Ecological Criteria Division.; United States. Environmental Protection Agency. Wetlands Division.; and United States. Environmental Protection Agency. Office of Water.

In: *Methods for evaluating wetland condition*; Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, 2003.

*Notes:* Original title: Land use characterization for nutrient and sediment risk assessment #17; Title from web page. "March 2002." Prepared jointly by: the U.S. Environmental

Protection Agency, Health and Ecological Criteria Division (Office of Science and Technology) and Wetland Division (Office of Wetlands, Oceans, and Watersheds). "EPA-822-R-02-025." Description based on content viewed Feb. 28, 2003. Includes bibliographical references.

*NAL Call #:* QH76.5.N8 V47 2002

<http://www.epa.gov/waterscience/criteria/wetlands/17LandUse.pdf>

*Descriptors:* wetland ecology---evaluation/ land use surveys---United States/ wetland management---United States/ water quality management---United States  
This citation is from AGRICOLA.

#### 71. Lessons learned from five decades of wetland restoration and creation in North America.

Lewis, R. R.; Kusler, J. A.; and Erwin, K. L.

In: *Proceedings of the Conference on Challenges and Opportunities in the Marine Environment*.

Washington D.C.: 1994; pp. 233-240.

*Notes:* Conference: MTS 94. Challenges and Opportunities in the Marine Environment, Washington, DC (USA), 7-9 Sep 1994

*Descriptors:* wetlands/ environmental protection/ ecosystem disturbance/ historical account/ ecosystem management/ hydrology/ site selection/ ecosystems/ monitoring/ environmental restoration/ siting criteria/ USA/ wetland restoration

*Abstract:* Practical experience and the available science base on restoration and creation are limited for most wetland types and vary regionally. Most wetland restoration and creation projects do not have specific, measurable goals, complicating efforts to evaluate "success". Monitoring of wetland restoration and creation projects has been lacking and needs more emphasis. Despite thousands of instances in which wetlands have been intentionally or unintentionally restored or created in the United States, in the last 50 years there has been very little short term monitoring and even less long term monitoring of sites. Monitoring of sites of comparisons with naturally occurring wetlands over time would provide a variety of information including rates of revegetation, repopulation by animal species, and redevelopment of soil profiles, patterns of succession, and evidence of persistence.

© CSA

#### 72. Linking actions to outcomes in wetland management: An overview of U.S. state wetland management.

La Peyre, M. K.; Reams, M. A.; and Mendelsohn, I. A. *Wetlands* 21(1): 66-74. (2001)

*NAL Call #:* QH75.A1W47; *ISSN:* 0277-5212

*Descriptors:* wetlands/ government policy/ surveys/ environment management/ planning/ ecology/ ecosystem management/ regional planning/ Mapping/ nature conservation/ environmental protection/ policies/ management/ United States/ government policies/ resource management/ land management/ environmental quality/ resources management/ state jurisdiction/ assessments/ resource conservation/ environmental law, regulations & policy/ conservation, wildlife management and recreation/ management/ environmental action/ evaluation process

*Abstract:* Despite a national focus on saving wetland systems in the U.S., evaluations of wetland resources and management outcomes have been limited. A fifty-state

survey of wetland managers was conducted in order to collect information on (1) wetland resources, (2) management actions taken, and (3) management impact on the resources (wetlands). An overview of the general status of state knowledge of the quantity and quality of their wetland resources is presented. Results indicate that most states have a rough estimate of the resources and most have wetland conservation plans and intend to develop better databases of wetland resources. However, few states track management actions relevant to wetlands and fewer have any idea of the success or impact of past management actions. The ability to assess program effectiveness is key to implementing adaptive management frameworks. A number of lessons learned suggest a basic framework for future wetland management that includes state planning, better quantification (mapping) of wetlands, development of methods to measure wetland quality, and tracking of wetland management actions and outcomes. This framework could also be used as an outline for the development of a more adaptive approach to wetland management.

© CSA

**73. Mercury sequestration in forests and peatlands: A review.**

Grigal, D. F.

*Journal of Environmental Quality* 32(2): 393-405. (2003)  
NAL Call #: QH540.J6; ISSN: 0047-2425

*Abstract:* Nearly all Hg in vegetation is derived directly from the atmosphere. Mass of Hg in forest vegetation (roughly 0.1 mg m<sup>-2</sup>) is about an order of magnitude smaller than that in the forest floor (1 mg m<sup>-2</sup>) and two orders of magnitude smaller than that in the mineral soil (10 mg m<sup>-2</sup>). Mass of Hg in peat (20 mg m<sup>-2</sup>) is greater than the sum of that in mineral soil and the forest floor; wetlands usually sequester more Hg than associated uplands. The strong relationship of Hg to organic matter, associated with binding by reduced S groups, is fundamental to understanding Hg distribution and behavior in terrestrial systems. The stoichiometry of the Hg-C relationship varies; Hg-S relationships, though less variable, are not constant. Because of the Hg-organic matter link, landscape conditions that lead to differential soil organic matter accumulation are likely to lead to differential Hg accumulation. The ratio of methylmercury (MeHg) to total Hg is generally low in both vegetation (near 1.5%) and soil (<1%), but areas of poorly drained soils and wetlands are sites of MeHg production. The annual emission of anthropic Hg from the 48 contiguous states of the USA (144 Mg) is two orders of magnitude less than the pool of Hg in forests of those states (30 300 Mg). Peatlands, less than 2% of total land area, sequester more than 20 times annual emissions (2930 Mg). If global climate change affects C storage it will indirectly affect Hg storage, having a major effect on the balance between emissions and sequestration and on the global Hg cycle.

© 2006 Elsevier B.V. All rights reserved.

**74. Metal accumulation within salt marsh environments: A review.**

Williams, T. P.; Bubb, J. M.; and Lester, J. N.

*Marine Pollution Bulletin* 28(5): 277-290. (1994)

NAL Call #: GC1000.M3; ISSN: 0025-326X

*Descriptors:* salt marshes/ heavy metals/ literature reviews/ sea grass/ pollution indicators/ indicator species/

biogeochemical cycle/ erosion/ pollution effects/ physicochemical properties/ chemical speciation/ accumulation/ biogeochemistry/ bioaccumulation/ literature review/ water pollution effects/ *Zostera marina*/ British Isles/ accumulation/ literature reviews

*Abstract:* A comprehensive assessment of the chemical and physical factors affecting metal accumulation and cycling within salt marshes is presented. The effects that changes in physico-chemical properties (redox potential, salinity, pH, etc.) have upon metal mobility, speciation and consequent biological availability are described together with the implications for salt marsh habitat loss. Salt marshes act as very efficient sinks for metal contaminants although metal concentrations in halophytes do not generally reflect environmental contamination levels. Marine angiosperms, particularly *Zostera marina*, do however, reflect external metal concentrations and can therefore be used as biomonitors. Evidence suggests that the concentration of heavy metals in the sediments of most estuaries is not sufficiently high to cause ill effects to salt marsh plants although further investigations are necessary to assess potential threats of pollutants upon the health of these intertidal ecosystems.

© CSA

**75. Methane production and methane consumption: A review of processes underlying wetland methane fluxes.**

Segers, R.

*Biogeochemistry* 41(1): 23-51. (1998)

NAL Call #: QH345 .B564; ISSN: 0168-2563

*Descriptors:* wetlands/ methane/ fluctuations/ atmosphere/ atmospheric gases/ atmospheric chemistry/ peat/ oxidation/ methanogenesis/ greenhouse effect/ climatic changes/ soils/ anoxic conditions/ biogeochemical cycle/ soil microorganisms/ greenhouse gases/ microorganisms

*Abstract:* Potential rates of both methane production and methane consumption vary over three orders of magnitude and their distribution is skew. These rates are weakly correlated with ecosystem type, incubation temperature, in situ aeration, latitude, depth and distance to oxic/anoxic interface. Anaerobic carbon mineralisation is a major control of methane production. The large range in anaerobic CH<sub>4</sub>:CO<sub>2</sub> production rates indicate that a large part of the anaerobically mineralised carbon is used for reduction of electron acceptors, and, hence, is not available for methanogenesis. Consequently, cycling of electron acceptors needs to be studied to understand methane production. Methane and oxygen half saturation constants for methane oxidation vary about one order of magnitude. Potential methane oxidation seems to be correlated with methanotrophic biomass. Therefore, variation in potential methane oxidation could be related to site characteristics with a model of methanotrophic biomass.

© CSA

**76. Modeling habitat change in salt marshes after tidal restoration.**

Boumans, R. M.; Burdick, D. M.; and Dionne, M.

*Restoration Ecology* 10(3): 543-555. (Sept. 2002)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

*Descriptors:* hydrology/ salt marshes/ human impact/ tides/ topography/ coastal zone management/ restoration/ man-induced effects/ plant populations/ vegetation cover/ tidal

effects/ tidal currents/ USA, New England/ reclamation/ conservation, wildlife management and recreation/ ecosystems and energetics

**Abstract:** Salt marshes continue to degrade in the United States due to indirect human impacts arising from tidal restrictions. Roads or berms with inadequate provision for tidal flow hinder ecosystem functions and interfere with self-maintenance of habitat, because interactions among vegetation, soil, and hydrology within tidally restricted marshes prevent them from responding to sea level rise. Prediction of the tidal range that is expected after restoration relative to the current geomorphology is crucial for successful restoration of salt marsh habitat. Both insufficient (due to restriction) and excessive (due to subsidence and sea level rise) tidal flooding can lead to loss of salt marshes. We developed and applied the Marsh Response to Hydrological Modifications model as a predictive tool to forecast the success of management scenarios for restoring full tides to previously restricted areas. We present an overview of a computer simulation tool that evaluates potential culvert installations with output of expected tidal ranges, water discharges, and flood potentials. For three New England tidal marshes we show species distributions of plants for tidally restricted and nonrestricted areas. Elevation ranges of species are used for short-term (<5 years) predictions of changes to salt marsh habitat after tidal restoration. In addition, elevation changes of the marsh substrate measured at these sites are extrapolated to predict long-term (>5 years) changes in marsh geomorphology under restored tidal regimes. The resultant tidal regime should be designed to provide habitat requirements for salt marsh plants. At sites with substantial elevation losses a balance must be struck that stimulates elevation increases by improving sediment fluxes into marshes while establishing flooding regimes appropriate to sustain the desired plants.

© CSA

**77. Modelling biodiversity and land use: Urban growth, agriculture and nature in a wetland area.**

Eppink, F. V.; van den Bergh, J.; and Rietveld, P.

*Ecological Economics* 51(3-4): 201-216. (2004)

NAL Call #: QH540.E26; ISSN: 0921-8009

**Descriptors:** wetlands/ integrated modelling/ species richness/ land cover/ bid rent models/ land use/ anthropogenic impacts/ dynamic simulation models/ conservation/ ecology/ mathematical models/ equations/ forestry/ agriculture

**Abstract:** Wherever human land use is located near sensitive natural areas, such as wetlands, it has significant impacts on biodiversity in those areas. Both species richness and species composition are affected. As biodiversity is lost, conservation efforts increase and act as a constraint on land use options. Given these links, land use is a central factor in an ecological-economic analysis of biodiversity. This paper presents a general, dynamic simulation model of the interaction between wetland biodiversity and land use. Results for a set of scenarios suggest that urban growth is unsustainable and that there may be a conflict between conservation of distinct aspects of biodiversity.

© NISC

**78. Modification of peak flood discharges by wetland environments: A review.**

Tobin, G. A.

*Geographical Perspectives* 57: 6-18. (1986);

ISSN: 0199-994X

**Abstract:** The traditional view equating wetland environments with wasteland has gradually given way to one which recognizes several valuable functional roles of such areas. This review paper focuses on just one of these roles, the ability of wetlands to mitigate peak flood flows, and questions the basic assumption that all wetlands a priori act as sponges temporarily, storing water during times of excess and releasing it during times of drought. Both theoretical arguments and empirical evidence are examined and it is concluded that more attention should be given to controlled research studies which develop more sophisticated hydrological models of wetlands. -Author © 2006 Elsevier B.V. All rights reserved.

**79. Multiple limiting gradients in peatlands: A call for a new paradigm.**

Bridgham, S. D.; Pastor, J.; Janssens, J. A.; Chapin, C.; and Malterer, T. J.

*Wetlands* 16(1): 45-65. (1996)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

**Descriptors:** wetlands/ peat/ classification systems/ gradients/ biogeochemistry/ hydrology/ community composition/ nutrients (mineral)/ hydrogen ion concentration/ acidic soils/ plant populations

**Abstract:** Peatlands often have readily apparent gradients of plant species distributions, biogeochemistry, and hydrology across several spatial scales. Many inferences have been drawn about the colinearity of these gradients, and these assumptions have become ingrained in the terminology that describes and classifies peatlands. We review the literature and present some of our own data that show that many of these inferences are either wrong or correct only under a limited set of ecological conditions. We examine historical classification schemes of peatlands and, in this context, gradients of alkalinity, pH, nutrient availability for plant growth, nutrient mineralization, hydrology, and decomposition. We further suggest a strictly defined set of terms to describe separate gradients of hydrology, alkalinity, and nutrients that limit plant growth in peatlands. Specially, we make the following suggestions concerning terminology. (1) The suffix O-trophicO should only be used when referring to nutrients that directly limit plant growth at natural availabilities (e.g., eutrophic and oligotrophic). (2) Terms such as circumneutral, moderately acid, and very acidic (or alternatively strong, intermediate, and weak) should be used to describe the pH of peatlands. (3) Ombrogenous and geogenous (or limnogenous, topogenous, and soligenous) should be used to describe the hydrology of peatlands. (4) The terms bog and fen should be defined broadly based on water/soil chemistry and dominant plant species without accompanying assumptions regarding hydrology, topography, ontogeny, nutrient availability, or the presence or absence of nondominant indicator plant species. Better yet, the generic term peatland be used when possible to avoid confusion about conditions that may or may not be present at a particular site.

© CSA

**80. N:P balance in wetland forests: Productivity across a biogeochemical continuum.**

Lockaby, B. G. and Conner, W. H.

*Botanical Review* 65(2): 171-185. (1999)

NAL Call #: 450 B6527; ISSN: 0006-8101

*Descriptors:* nitrogen: nutrient/ phosphorus: nutrient/ net primary productivity/ nitrogen:phosphorus balance: biogeochemical continuum, productivity/ nutrient transformation/ wetland forest

*Abstract:* The nature of and driving forces behind variation among wetland forests in terms of biogeochemistry and vegetation production are not well understood. We suggest that insight into biogeochemical and productivity differences may be gained by examining the degree to which nitrogen and phosphorus are balanced within wetland vegetation. On the basis of examinations of data related to N:P balance and nutrient use efficiencies, vegetation productivity in both depressional and riverine forests appears to be primarily N limited. In contrast to some current theories of wetland biogeochemistry, these data suggest that when P deficiency occurs at all, it represents a secondary productivity constraint in comparison to N. Similarly, a biogeochemical continuum is suggested for wetland forests based on the relationship between N:P ratios in senesced foliage vs. annual litterfall mass. We theorize that the position of a particular wetland forest on this continuum reflects the integration of its geomorphic position and biogeochemical history. In addition, the position of a particular system on the continuum may have predictive value with regard to net primary productivity and nutrient transformation capabilities.

© The Thomson Corporation

**81. National water summary of wetland resources.**

Fretwell, J. D.; Williams, John S.; Redman, Phillip J.; and Geological Survey (U.S.).

Washington, D.C.: U.S. G.P.O; Series: U.S. Geological Survey water-supply paper 2425; 431 p. (1996)

NAL Call #: 407 G29W no.2425; ISBN: 0607856963

*Descriptors:* wetlands---United States/ water resources development---United States/ wetland conservation---United States

This citation is from AGRICOLA.

**82. Natural and constructed wetlands in Canada: An overview.**

Kennedy, Gavin and Mayer, Tatiana

*Water Quality Research Journal of Canada* 37(2): 295-325. (2002); ISSN: 1201-3080

*Descriptors:* bioprocess engineering/ freshwater ecology: ecology, environmental sciences/ wildlife management: conservation/ wetland research needs/ identification/ Canadian economy/ anthropogenic activities/ climate change/ constructed wetlands: cold weather performance, cost effective, design adaptation, environmentally friendly wastewater treatment method, non point source pollution treatment, wildlife effects/ consumptive activities: derived value/ freshwater wetland research/ hydrogeochemistry/ hydrology/ intrinsic water quality amelioration wetland function/ natural wetlands: sustainability/ non consumptive activities: derived value/ wetland degradation/ wetland loss/ wetland treatment technology

*Abstract:* A review of freshwater wetland research in Canada was conducted to highlight the importance of these ecosystems and to identify wetland research needs. Both

natural and constructed wetland systems are discussed. Natural wetlands are an important part of the Canadian landscape. They provide the habitat for a broad variety of flora and fauna and contribute significantly to the Canadian economy. It is estimated that the total value derived from consumptive and non-consumptive activities exceeds dollar sign10 billion annually. The past decades have witnessed the continued loss and degradation of wetlands in Canada. In spite of recent protection, Canadian wetlands remain threatened by anthropogenic activities. This review shows that more research on fate and transport of pollutants from urban and agricultural sources in wetland systems is needed to better protect the health and to assure the sustainability of wetlands in Canada. Furthermore, improved knowledge of hydrology and hydrogeochemistry of wetlands will assure more effective management of these ecosystems. Lastly, better understanding of the effect of climate change on wetlands will result in better protection of these important ecosystems. Constructed wetlands are man-made wetlands used to treat non-point source pollution. The wetland treatment technology capitalizes on the intrinsic water quality amelioration function of wetlands and is emerging as a cost-effective, environmentally friendly method of treating a variety of wastewaters. The use of wetland technology in Canada is, however, less common than in the U.S.A. A number of research needs has to be addressed before the wetland treatment technology can gain widespread acceptance in Canada. This includes research pertaining to cold weather performance, including more monitoring, research on design adaptation and investigation of the effects of constructed wetlands on wildlife.

© The Thomson Corporation

**83. The need to define hydrologic equivalence at the landscape scale for freshwater wetland mitigation.**

Bedford, B. L.

*Ecological Applications* 6(1): 57-68. (1996)

NAL Call #: QH540.E23; ISSN: 1051-0761

*Descriptors:* wetlands/ environmental restoration/ biological diversity/ hydrology/ ecosystem management/ environment management/ reclamation/ plant populations/ geohydrology/ decision making/ reclamation/ plant populations/ geohydrology/ decision making/ environmental restoration/ biological diversity/ ecosystem management/ environment management

*Abstract:* Attempts to replace wetlands or define hydrologic equivalence for wetland mitigation must be based on an understanding of the complexity of wetland hydrology and of the relationship of individual wetlands to the landscape. Because mitigation has the potential to re-configure the kinds and spatial distribution of wetland ecosystems over large geographic areas, I advocate a landscape approach to defining hydrologic equivalence. This approach does not depend on specification of hydroperiod or other hydrologic variables for individual wetlands. It relies instead on knowledge of landscape properties that control wetland hydrology and water chemistry. In this paper I develop the conceptual framework for defining hydrologic equivalence for wetland mitigation viewed as a de facto landscape management policy with the potential to reduce the diversity of wetland types within regions. I review modern hydrogeological understanding of where wetlands form in the landscape and identify key hydrologic variables responsible for the formation of specific wetland types. I

also review existing evaluations of mitigation projects in several states. On the basis of these reviews, I argue that, in setting regulatory criteria for judging hydrologic equivalence, the scale must be enlarged from the individual wetland project to include the broader landscape. Only this broader view can provide the context within which decision-makers can evaluate the potential cumulative effects of individual mitigation decisions on broad-scale patterns of wetland diversity. The landscape approach to defining hydrologic equivalence that I advocate is based on the concept of templates for wetland development. These templates are the diversity of settings created in specific landscapes by the complex interactions of hydrogeologic factors and climate. These interactions, in turn, control key hydrologic variables and hydrologically influenced chemical variables that cause specific wetland types to form.

Hydrologic equivalence then can be defined at the scale of landscape in terms of the kinds, numbers, relative abundances, and spatial distribution of wetland templates. The approach can be implemented through the identification of landscape goals and profiles based on knowledge of these templates. The profiles would catalog and map the diversity of wetland templates and the diversity of existing wetland types within a given landscape, focusing the attention of decision-makers on broad-scale patterns of loss in wetland types and providing a context within which individual mitigation projects could be evaluated. Landscape goals for maintaining a diversity of wetland templates are suggested.

© CSA

#### 84. Nutrient enrichment and decomposition in wetland ecosystems: Models, analyses and effects.

Rybczyk, J. M.; Garson, G.; and Day, J. W.

*Current Topics in Wetland Biogeochemistry* 2: 52-72. (1996); ISSN: 1076-4674

*Descriptors:* wetlands/ litter/ ecosystems/ mineralization/ decomposition/ nutrients/ cycling nutrients/ model studies/ enrichment/ literature review/ degradation/ biodegradation/ leAves/ biogeochemistry/ nutrient cycles/ nutrients (mineral)/ literature reviews/ decomposers/ nutrient cycles/ nutrients (mineral)/ literature reviews/ decomposers/ nutrient enrichment/ decomposition/ nutrients/ cycling nutrients/ model studies/ enrichment/ literature review/ degradation/ leaves

*Abstract:* Decomposition refers to the breakdown of organic matter to carbon dioxide, water and inorganic mineral components (mineralization) (Dickinson and Pugh 1974). Inorganic components can also be re-incorporated into the litter matrix during decomposition (immobilization). Generally, nutrient availability limits the rate of biological decomposition of plant organic matter because of the disparity between the high demand for nitrogen and phosphorus by decomposer organisms that use plant litter carbon as an energy source and the relatively low concentrations of nutrients found in the leaf litter (Swift et al. 1979, Neely and Davis 1985, Enriquez et al. 1993). Nutrient amendments to wetland ecosystems can potentially increase the rates of decomposition by either improving initial litter nutrient quality, via fertilization of the growing plant (Coulson and Butterfield 1978, Valiela et al. 1985, Lukumbuzya et al. 1994), or by increasing externally, the nutrients available to decomposer communities (Howarth and Fisher 1976, Haines and Hanson 1979, Fairchild et al. 1984). Nutrient amendments can also affect

the mineralization and immobilization of nutrients within the decomposing litter matrix by altering the distribution and amounts of nutrients associated with the labile and refractory litter components, and by increasing the external pool of nutrients that can be re-incorporated into the decomposing litter matrix (Kaushik and Hynes 1971, Howarth and Fisher 1976, Andersen 1978, Coulson and Butterfield 1978, Elwood et al. 1981, Marinucci et al. 1983, DeBusk and Dierberg 1984, Fairchild et al. 1984, Neely and Davis 1985, Valiela et al. 1985, Hohmann and Neely 1993). We reviewed 24 studies that examined the effects of nutrient amendments, most commonly nitrogen and phosphorus, on the rates of wetland plant litter decomposition in either, wetland ecosystems, laboratory wetland mesocosms, streams or vegetated littoral zones of lakes.

© CSA

#### 85. Nutrient limitation and botanical diversity in wetlands: Can fertilization raise species richness?

Gusewell, Sabine; Bailey, Kathleen M.; Roem, Wilma J.; and Bedford, Barbara L.

*Oikos* 109(1): 71-80. (Apr. 2005)

*NAL Call #:* 410 O14; *ISSN:* 0030-1299

*Descriptors:* wetlands/ species richness/ nutrients/ biomass/ pH effects/ soil chemistry/ grasslands/ fertilization/ nature conservation/ species diversity/ aquatic plants/ nitrogen/ phosphorus/ limiting factors/ rare species/ Switzerland/ USA/ Denmark/ Netherlands/ productivity

*Abstract:* The 'resource balance hypothesis' proposes that the species richness of grassland vegetation is potentially highest when the N:P ratio of plant tissues is 10-15 (co-limitation), so that species richness could be raised by fertilization with N or P at sites with lower or higher N:P ratios, respectively. Here we use data from field surveys in Swiss, Dutch and American fens or wet grasslands to analyze what changes in N:P ratios might produce noticeable changes in species richness. Plant species numbers, aboveground biomass, tissue N and P concentrations and soil pH were recorded in plots of 0.06-4 m super(2). In each data set, plots with intermediate tissue N:P ratios (6-20) were on average most species-rich, but N:P ratios explained only 5-37% of the variation in species richness. Moreover, these effects were partially confounded with those of vegetation biomass and/or soil pH. The unique effects of N:P ratios (excluding those shared with biomass and pH) explained 11-17% of variation in species richness. The relationship between species richness and N:P ratios was asymmetric: plots with high N:P ratios were more species-poor than those with low N:P ratios. This was paralleled by a smaller species pool size at high N:P ratios (estimated from species numbers in multiple records), suggesting that fewer species are adapted to P-limited conditions than to N-limited conditions. According to these data, species richness in wetlands may possibly be raised by P-fertilization when the initial N:P ratio of the vegetation is well above 20, but this option is not recommended for nature conservation as it might promote common species at the expense of rare ones.

© CSA

**86. Nutrient removal from wastewater by wetlands.**

Nichols, D. S.

In: Proceedings 6th International Peat Congress. (Held 17 Aug 1980-23 Aug 1980 at Duluth, Minn.)

Eveleth, Minn.: Fisher Company; pp. 638-642; 1981.

NAL Call #: S598.I53 1980

*Descriptors:* wetlands/ wastewater management/ nitrogen removal/ phosphorus removal/ nutrient removal/ literature review/ wastewater/ water quality/ water quality control/ wastewater disposal/ wastewater discharge/ wastewater lagoons/ wastewater treatment/ phosphorus/ nitrogen/ denitrification/ ammonium/ nitrates

*Abstract:* The literature on the capacity of wetlands for removing nitrogen (N) and phosphorus (P) from wastewater was reviewed and assessed. Retention of inflowing P under natural conditions appears to be limited to the relatively small amount of P that is accumulated as peat is formed from partially-decayed vegetation. Some P is absorbed by the soil when above-natural levels are added to a wetland. Wastewater P is most efficiently removed at low loading rates, and efficiency decreases rapidly as loading rates increase. Further, P removal declines with time; hence, short-term studies can give misleadingly high estimates of ultimate P removal capacity. Removal of N in excess of the natural accumulation rate in the peat is apparently by denitrification. As with P, N removal efficiency decreases rapidly as wastewater N loading rates are increased. The denitrification rate may be limited by the nitrification rate of ammonium-N, nitrate-N, or by oxygen diffusion. From the sparse literature data available, it is estimated that 1 ha of wetland would be needed to remove 75% of the P and N generated by 15 and 20 people, respectively, or to remove 54% of the P and N generated by 50 people. Hence, wetland application is feasible only where wetlands are abundant and population densities are low. Large populations cannot be served by this means. (Zielinski-MAXIMA)

© CSA

**87. An overview of constructed wetlands as alternatives to conventional waste treatment systems.**

Hamilton, H.; Nix, P. G.; and Sobolewski, A.

*Water Pollution Research Journal of Canada* 28(3): 529-548. (1993)

NAL Call #: TD420.A1W34; ISSN: 0197-9140.

*Notes:* Conference: BIOQUAL '92 Meet., Vancouver, BC (Canada), 9-11 Jun 1992; Editors: Hall, E. R.

*Descriptors:* wetlands/ construction/ wastewater treatment/ hydrocarbons/ organic compounds/ biodegradation/ bacteria/ biofilms/ non patents/ microbial degradation/ environmental applications/ impact/ sewage & wastewater treatment/ wastewater treatment processes

*Abstract:* Constructed wetlands are an attractive alternative to conventional wastewater treatment under certain conditions. This review presents background information on wetland treatment and wetland design, and outlines the potential for wetlands to treat water contaminated with organic compounds including hydrocarbons. The major mechanisms that reduce contaminant concentrations in wetlands are sedimentation, filtration, chemical precipitation, microbial interaction and plant uptake. The presence of bacteria in "Biofilms" on the enormous plant and detrital surface area in wetlands is fundamental to their ability to degrade complex organic contaminants. There are few examples in the literature of wetlands being used to

control organic chemical pollution. However, the very high level of biochemical activity in the water column and upper sediment layer in wetlands, combined with a high degree of ecological resilience, suggests that wetlands can be an attractive low cost, low energy, low maintenance alternative to conventional treatment methods.

© CSA

**88. An overview of major wetland functions and values.**

Sather, J. H.; Smith, R. D.; and Western Energy and Land Use Team

Washington, D.C.: U.S. Fish and Wildlife Service;

FWS/OBS-84/18, 1984.. iv + 68 p.

*Notes:* Microfiche item number: 611-R-1; Other number: SFA 29 (4)

*Descriptors:* wetlands/ management/ research/ ecology/ freshwater environment/ food chains/ nutrients/ trophic interactions/ habitats/ fishery/ aquatic birds/ sociological aspects/ economics/ hydrology/ water quality/ ecology and conservation/ aquaculture, aquariology and water use

© NISC

**89. Overview of the hydrologic concerns related to wetlands in the United States.**

Carter, V.

*Canadian Journal of Botany* 64(2): 364-374. (1986)

NAL Call #: 470 C16C; ISSN: 0008-4026

*Descriptors:* wetlands/ hydrologic aspects/ vegetation/ ecosystems/ surface-groundwater relationships/ hydrologic budget/ floods/ recharge/ base flow/ estuarine environment/ water quality

*Abstract:* Regional, geologic, topographic, and climatic differences create a tremendous diversity in wetland types and wetland vegetation in the United States. Wetland hydrology, a primary driving force influencing wetland ecology, development, and persistence, is as yet poorly understood. The interaction between groundwater and surface water and the discharge-recharge relationships in wetlands affect water quality and nutrient budgets as well as vegetative composition. Hydrologic considerations necessary for an improved understanding of wetland ecology include detailed water budgets, water chemistry, water regime, and boundary conditions. Wetland values are often based on perceived wetland functions. These hydrologic functions include (1) flood storage and flood-peak desynchronization, (2) recharge and discharge, (3) base flow and estuarine water balance, and (4) water-quality regulation. Expanded research and basic data collection focussed on wetland hydrology and its relation to wetland ecology are needed to identify and quantify the hydrologic functions of wetlands. (Lantz-PTT)

© CSA

**90. Overview: Surface flow constructed wetlands.**

Kadlec, R. H.

*Water Science and Technology* 32(3): 1-12. (1995)

NAL Call #: TD420.A1P7; ISSN: 0273-1223

*Descriptors:* wetlands/ design/ macrophytes/ marshes/ nutrients/ performance/ processes/ wastewater treatment

*Abstract:* Several hundreds of marshes have now been built primarily for the purposes of water quality improvement. This paper reviews statistics on the types and numbers and character of these low-tech water treatment wetlands. The operational processes are

discussed, including sedimentation, plant uptake, sorption, nutrient cycling, and chemical and microbial conversion. Performance has been good for reduction of suspended solids, biological oxygen demand, phosphorus, nitrogen, metals and some anthropogenic chemicals. Design procedures are evaluated, showing that the overly simplistic techniques used in the infancy of the technology may now be replaced by rational procedures based on the large and rapidly growing information base for constructed surface flow treatment wetlands. Ancillary wildlife and human use is an important part of this type of wetland, and should be acknowledged in design. Capital costs are low, but the principal financial advantage is the extremely low base cost of operation. Several hundreds of marshes have now been built primarily for the purposes of water quality improvement. This paper reviews statistics on the types and numbers and character of these low-tech water treatment wetlands. The operational processes are discussed, including sedimentation, plant uptake, sorption, nutrient cycling, and chemical and microbial conversion. Performance has been good for reduction of suspended solids, biological oxygen demand, phosphorus, nitrogen, metals and some anthropogenic chemicals. Design procedures are evaluated, showing that the overly simplistic techniques used in the infancy of the technology may now be replaced by rational procedures based on the large and rapidly growing information base for constructed surface flow treatment wetlands. Ancillary wildlife and human use is an important part of this type of wetland, and should be acknowledged in design. Capital costs are low, but the principal financial advantage is the extremely low base cost of operation.

© 2006 Elsevier B.V. All rights reserved.

#### 91. Parasitism and ecology of wetlands: A review.

Thomas, F.; Cezilly, F.; De Meeues, T.; Crivelli, A.; and Renaud, F.

*Estuaries* 20(3): 646-654. (1997)

NAL Call #: GC96.E79; ISSN: 0160-8347

*Descriptors:* wetlands/ ecosystems/ ecology/ coastal waters/ parasites/ reviews/ predation/ conservation/ literature reviews/ estuaries/ nature conservation/ species interactions: parasites and diseases/ ecology/ community studies

*Abstract:* Recent advances in ecology have suggested that parasites, through the spectrum of their effects, could act as key species in ecosystems. Wetlands are productive ecosystems within which parasitism is diversified. There already exists evidence for direct and indirect effects of parasites on their host species. The influence of parasites on the population ecology of hosts includes survival, castration, sexual selection, predation, and spatial distribution. Parasites can also affect the evolution of host biological diversity (i.e., genetic structure and interspecific competition) and trophic interactions between prey and predators. The key role parasites might play in the ecology of coastal waters and wetlands should be considered in conservation programs applied to such ecosystems.

© CSA

#### 92. Perspectives on setting success criteria for wetland restoration.

Kentula, M. E.

*Ecological Engineering* 15(3-4): 199-209. (July 2000)

NAL Call #: TD1.E26; ISSN: 0925-8574

*Descriptors:* wetlands/ environmental restoration/ compliance/ environment management/ natural resources/ environmental protection/ conservation/ environmental policy/ performance evaluation/ planning/ restoration/ hydrology/ biota/ ecology/ terminology/ ecosystem management/ biodiversity/ structure-function relationships/ ecological evaluation/ soil fauna/ models/ compliance success/ functional success/ landscape success/ reclamation/ environmental action/ techniques of planning/ protective measures and control/ land/ general environmental engineering

*Abstract:* The task of determining the success of wetland restoration has long been challenging and sometimes contentious because success is an imprecise term that means different things in different situations and to different people. Compliance success is determined by evaluating compliance with the terms of an agreement, e.g. a contract or permit, whereas functional success is determined by evaluating whether the ecological functions of the system have been restored. Compliance and functional success have historically focused on the individual project (the site being restored); we are only beginning to consider another important factor, the success of restoration at the landscape scale. Landscape success is a measure of how restoration (or management, in general) has contributed to the ecological integrity of the region or landscape and to achievement of goals such as the maintenance of biodiversity. The utility of all definitions of success is ultimately constrained by the current status of the science of restoration ecology and by our ability to use that information to make sound management decisions and to establish measurable success criteria. Measurements of vegetation are most commonly used in evaluations of restoration projects, with less frequent analysis of soils, fauna, and hydrologic characteristics. Although particular characteristics of projects, such as vegetative cover and production, can resemble those in similar naturally occurring wetlands, overall functional equivalency has not been demonstrated. However, ongoing research is providing information on what can and cannot be accomplished, valuable insights on how to correct mistakes, and new approaches to defining success. The challenge is how to recognize and deal with the uncertainty, given that projects are ecologically young and that our knowledge of the process of restoration is evolving. One way to deal with the uncertainty is to use scientific principles of hypothesis testing and model building in an adaptive management framework. In this way, options can be systematically evaluated and needs for corrective actions identified when a project is not progressing toward goals. By taking such an approach we can improve our ability to reliably restore wetlands while contributing to our understanding of the basic structure and function of ecosystems.

© CSA

#### 93. Phosphorus retention in streams and wetlands: A review.

Reddy, K. R.; Kadlec, R. H.; Flaig, E.; and Gale, P. M.

*Critical Reviews in Environmental Science and Technology* 29(1): 83-146. (1999)

NAL Call #: QH545.A1C7; ISSN: 1064-3389

*Descriptors:* wetlands/ phosphorus/ nutrients/ retention/ streams/ reviews/ kinetics/ biogeochemical cycle/ rivers/ nutrient cycles/ residence time/ biogeochemistry/ sources

and fate of pollution/ ecosystems and energetics/  
composition of water/ behavior and fate characteristics/  
freshwater pollution/ chemical processes

**Abstract:** Wetlands and streams buffer the interactions among uplands and adjacent aquatic systems. Phosphorus (P) is often the key nutrient found to be limiting in both estuarine and freshwater ecosystems. As such, the ability of wetlands and streams to retain P is key to determining downstream water quality. This article reviews the processes and factors regulating P retention in streams and wetlands and evaluates selected methodologies used to estimate P retention in these systems. Phosphorus retention mechanisms reviewed include uptake and release by vegetation, periphyton and microorganisms; sorption and exchange reactions with soils and sediments; chemical precipitation in the water column; and sedimentation and entrainment. These mechanisms exemplify the combined biological, physical, and chemical nature of P retention in wetlands and streams. Methodologies used to estimate P retention include empirical input-output analysis and mass balances, and process kinetics applied at various scales, including micro- and mesocosms to full-scale systems. Although complex numerical models are available to estimate P retention and transport, a simple understanding of P retention at the process level is important, but the overall picture provided by mass balance and kinetic evaluations are often more useful in estimating long-term P retention.

© CSA

**94. Physiological-ecological impacts of flooding on riparian forest ecosystems.**

Kozlowski, T. T.

*Wetlands* 22(3): 550-561. (Sept. 2002)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

**Descriptors:** wetland forests/ ecosystems/ riparian vegetation/ water resources management/ ecological effects/ water deficit/ flooding/ trees/ plant physiology/ plant growth/ mortality/ forests/ riparian environments/ ecophysiology/ riparian zone/ man-induced effects/ environmental impact/ flood control/ river engineering/ river basin management/ ecological impact of water development/ temperate forests/ habitat community studies/ soil pollution: monitoring, control and remediation

**Abstract:** Riparian forest ecosystems are important for their high productivity of biomass, their biodiversity, and ecological services including control of floods and erosion, removal of nutrients from agricultural runoff, alleviation of pollution effects, and as habitats for birds and mammals. Intermittent cycles of flooding by meandering streams followed by soil drainage are essential for regeneration, optimal growth, preservation of biodiversity, and sustainability of these valuable ecosystems. The straightening of river channels and disruption of intermittent river flow by dams lead to decreases in downstream forest productivity and ecological services, reflecting arrested forest regeneration, suppression of tree growth, and early tree mortality. These responses result from inadequate seed supplies and poor seedbeds, as well as deficiencies of ground water and mineral nutrients. Water deficits in downstream forest trees induce dysfunctions in photosynthesis and mineral nutrition, which lead to growth inhibition and plant mortality. Very few bottomland forest species can withstand extended soil inundation. Hence, prolonged upstream flooding by interruption of river flow is

followed by massive losses of biomass as a result of poor seed germination, arrested plant growth, and accelerated mortality of trees. The adverse impacts of flooding on upstream forests are associated with physiological dysfunctions induced by soil anaerobiosis.

© CSA

**95. Phytoremediation in wetland ecosystems: Progress, problems, and potential.**

Williams, J. B.

*Critical Reviews in Plant Sciences* 21(6): 607-635. (2002)  
NAL Call #: QK1.C83; ISSN: 0735-2689 [CRPSD3].

**Notes:** Special issue: Phytoremediation II/ edited by B.V. Conger. Includes references.

**Descriptors:** wetlands/ bioremediation/ seasonal variation/ plant succession/ site factors/ heavy metals/ litter plant/ waste disposal/ rhizosphere/ indicator species/ temporal variation/ toxicity/ organic compounds/ herbicides/ pesticides/ explosives/ soil pollution/ evapotranspiration/ petroleum/ petroleum hydrocarbons/ plant communities/ monitoring/ literature reviews

This citation is from AGRICOLA.

**96. Phytosociology and succession on earthquake-uplifted coastal wetlands, Copper River Delta, Alaska.**

Thilenius, J. F. Pacific Northwest Research Station, USDA Forest Service, 1995. 58 p. General Technical Reports .

NAL Call #: aSD11.A46 no.346

<http://www.fs.fed.us/pnw/pubs/gtr346.pdf>

**Descriptors:** wetlands/ deltas/ earthquakes/ marshes/ plant communities/ plant succession/ salinity/ shrubs/ tides/ woody plants/ Carex/ plants

**Abstract:** The delta formed by the Copper River stretches more than 75 kilometres along the south-central coastline of Alaska, USA. It is the terminus of the outwash deposits from a large part of the most heavily glaciated region of North America, and all major rivers that flow into the delta carry extremely high levels of suspended sediments. Coastal wetlands extend inland for as much as 20 kilometres. In 1964, an earthquake of Richter Scale 8.4 to 8.6 raised the entire delta from 1.8 to 3.4 metres above the previous mean sea level. Subtidal areas became intertidal, and intertidal areas supertidal. Marshland advanced seaward as much as 1.5 kilometres in the intertidal zone. Vegetation on many, but not all, newly supertidal levees began to change from herb to shrub. A change in frequency and duration of tidal inundation and water salinity has been thought to be the most obvious cause of this succession, but explanation is lacking. Fresh water dominates the estuarine circulation as a result of a bar-built estuary and the extremely high input of fresh water from glacier runoff and precipitation. Tides merely raise fresh water onto the wetlands. Halophytes are rare even at the seaward edge of vegetation. The characteristic species of the present intertidal marshes, *Carex lyngbyei*, is also the characteristic of inland fresh water marshes. Initial postearthquake invasion of woody plants was confined to natural levees. More recently, shrubs have begun to move seaward into new intertidal marshland and into supertidal interlevee basins. Current plant communities on new marshland (tidal) are *Carex* C-T (low marsh); *Carex* C-T (high marsh); *Carex*/Potentilla C-T (low levee); and *Myrica*/*Carex*-*Potentilla* C-T (high levee). On old marshland (nontidal) the current plant communities are *Alnus*/*Myrica*-*Salix*/*Carex* C-T (foreshore levee); *Myrica*/*Carex*-*Calamagrostis* (foreshore

levee); *Carex/Equisetum-Lathyrus* C-T (interior levee); *Carex/Lathyrus* C-T (moderately hydric interlevee basin); and *Carex-Cicuta*/C-T (hydric interlevee basin). Vegetation analogous to that developing on supertidal levees and basins is present on older wetland habitats further inland. Likely, the same plant successions would have occurred without an uplift. The uplift appears to have altered locations and rates, but not the nature, of wetland plant succession on the Copper River Delta.

© CAB International/CABI Publishing

#### 97. Picoplankton dynamics in a hypertrophic semiarid wetland.

Ortega-Mayagoitia, E.; Rodrigo, M. A.; Rojo, C.; and Alvarez-Cobelas, M.

*Wetlands* 22(3): 575-587. (Sept. 2002)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

*Descriptors:* wetlands/ ecology/ plankton/ bacterial/ cyanophyta/ population dynamics/ spatial distribution/ temporal distribution/ experimental data/ nutrients/ grazing/ semiarid environments/ abundance/ nanoplankton/ phytoplankton/ zooplankton/ trophic structure/ water budget/ algae/ bacteria/ Spain/ bacteria/ algae/ productivity  
*Abstract:* This study was carried out on a neglected component of wetlands: the picoplankton community. We analyzed the picoplanktonic community patterns and their related environmental factors in a hypertrophic semi-arid wetland located in Central Spain (Las Tablas de Daimiel National Park, TDNP). We determined the bacterial and autotrophic picoplankton (APP) abundance over a three-year period (1996: the end of a long drought period and 1997-1998: after flooding) in five sites of the wetland. The overall range of bacterial abundance was  $0.2 \times 10^6$  to  $10 \times 10^6$  cells/ml. The annual mean abundance increased in the wettest 1997. APP was composed mainly by coccoid phycocyanin-containing cyanobacteria, with the greatest abundance up to  $25 \times 10^5$  cells/ml. The annual mean also increased considerably in wetter 1997-98. Despite the large APP biomass in some sites, its percentage of total phytoplankton biomass was low (the annual average did not exceed 1.5%). We observed spatial heterogeneity in the picoplankton fraction depending on the fluctuating hydrology: bacteria tends to spatial homogeneity after flooding while APP showed only similarity among the output sites. Among the considered predictive variables (temperature, phosphorus, nitrogen, zooplankton, phytoplankton) of the picoplanktonic dynamics, temperature was the most closely correlated to picoplankton, especially to bacterial abundance. Further, in two factorial, coupled-hierarchical laboratory experiments (constant temperature), we searched for control mechanisms of picoplankton. We tested (a) the trophic cascade hypothesis by analyzing the effect of presence/absence of mosquitofish (experiment 1) or directly modifying the zooplanktonic community (experiment 2) and (b) the bottom-up regulation by altering the nutrient conditions (presence/absence of sediment in experiment 1; reducing the nutrient content in experiment 2). Bacterioplankton failed to show any behavior related to trophic cascade direct effects, while nutrients increased its abundance. APP was affected positively by nutrients and negatively by zooplankton grazing.

© CSA

#### 98. Plant-mediated controls on nutrient cycling in temperate fens and bogs.

Aerts, R.; Verhoeven, J. T. A.; and Whigham, D. F.

*Ecology* 80(7): 2170-2181. (1999)

NAL Call #: 410 Ec7; ISSN: 0012-9658

*Descriptors:* bogs/ climate control of nutrient cycling/ decomposition/ evergreen/ fens/ leaf life-span/ litter chemistry effects on decomposition/ mineralization/ nutrient cycling/ nutrient resorption/ nutrient-use efficiency/ sphagnum/ temperate

*Abstract:* This paper reports on patterns in plant-mediated processes that determine the rate of nutrient cycling in temperate fens and bogs. We linked leaf-level nutrient dynamics with leaf-litter decomposition and explored how the observed patterns were reflected in nutrient cycling at the ecosystem level. Comparisons were made among growth forms (evergreen and deciduous shrubs and trees, graminoids and Sphagnum mosses) and between mire types (fens and bogs). A literature review showed that the predominant growth form was more important as a determinant of leaf-level nutrient-use efficiency (NUE) than mire type (fen vs. bog). Evergreens had the highest N and P use efficiency. The growth form differences in NUE were mainly determined by differences in N and P concentrations in mature leaves and not by differences in resorption efficiency from senescing leaves. Sphagnum leaves had lower N and P concentrations than the other growth forms, but because of a lack of data on nutrient resorption efficiency the NUE of these mosses could not be calculated. Nitrogen use efficiency did not differ among fen and bog species, whereas bog species had a higher P use efficiency than fen species. However, a complete evaluation of mire-type or growth-form effects on NUE is only possible when data become available about nutrient resorption from senescing Sphagnum leaves. As leaf-level NUE is negatively correlated with leaf-litter nutrient concentrations, there is a direct link between NUE and litter decomposition rate. Rates of litter decomposition of Sphagnum mosses are lower than in the other growth forms, but there is still much speculation about possible reasons. The role of litter chemistry of Sphagnum mosses (including decay inhibitors and decay-resistant compounds) in decomposition especially warrants further study. The strongly deviating nutritional ecology of Sphagnum mosses clearly distinguishes fens and bogs from other ecosystems. Moreover, N and P concentrations in mature leaves from vascular plant species from fens and bogs are in almost all cases lower and leaf-level N use efficiency is higher than in species from other ecosystems, irrespective of the growth form considered. Both literature data and data from a comparative study on soil nutrient cycling in temperate fens and bogs in the United States (Maryland), The Netherlands, and Poland showed that nutrient mineralization did not differ clearly between fens and bogs. The comparative study further showed that cellulose decomposition in bogs was lower than in fens and that nutrient mineralization was higher in forested than in herbaceous mires. The occurrence of dominant growth forms was clearly related to soil nutrient-cycling processes, and observed patterns were in agreement with patterns in the components of NUE as found in the literature study. We conclude that a protocol with standardized procedures for measuring various nutrient-cycling process rates that is used by scientists in

various wetland types and geographical regions is a useful tool for unravelling large-scale patterns in soil nutrient-cycling processes in wetlands and for linking plant-mediated nutrient dynamics with ecosystem nutrient-cycling processes.

© 2006 Elsevier B.V. All rights reserved.

**99. Pollution filtration by plants in wetland-littoral zones.**

Mickle, A. M.

*Proceedings of the Academy of Natural Sciences Philadelphia* 144: 282-290. (1993)

NAL Call #: 500 P53; ISSN: 0097-3157 [PANPA5].

Notes: Literature review. Includes references.

Descriptors: wetlands/ aquatic plants/ bog plants/ filtration/ purification/ waste water/ waste water treatment/ coastal areas/ literature reviews

This citation is from AGRICOLA.

**100. Pre-European settlement conditions and human disturbance of a coniferous swamp in southern Ontario.**

Bunting, M. J.; Morgan, C. R.; Van Bakel, M.; and Warner, B. G.

*Canadian Journal of Botany* 76(10): 1770-1779. (Oct. 1998)

NAL Call #: 470 C16C; ISSN: 0008-4026

Descriptors: wetlands/ plant communities/ succession/ paleoecology/ human impact/ swamps/ palaeoecology/ man-induced effects/ land use/ ecological succession/ pollen/ human settlements/ forests/ rare species/ community composition/ community structure/ terrestrial ecosystems/ *Picea mariana*/ Plantae/ sphagnum/ Canada, Ontario/ black spruce/ mechanical and natural changes/ human population-biosphere interactions

Abstract: A vegetation survey at Oil Well Bog, southern Ontario, suggested that the central *Picea mariana* - Sphagnum (black spruce swamp) community represented the most mature point in the wetland succession. Pollen analysis of short sediment cores from beneath three major communities in the wetland (black spruce swamp, white pine swamp, and low shrub swamp) showed that the black spruce community only became established in the last 100 years. From around 2000 BP, the wetland was dominated by low shrubs with a tall shrub element. Upland forest composition around the wetland changed around 500 BP, with a decrease in percentages of *Fagus* and an increase in Pinaceae. At the same time trees colonized parts of the wetland. When the upland forest was cleared by European settlers (ca. AD 1830-1845), low shrub communities reestablished, suggesting that initially the wetland surface became wetter. Over time, the present-day mosaic of swamp types began to develop. The pollen analyses showed that the black spruce swamp is present as a result of changes in the wetland hydrology induced by human activity, and the fragmentary low shrub vegetation community (which contains locally rare plant species) represents a relic of the pre-European settlement wetland community.

© CSA

**101. Processes of wetland loss in India.**

Foote, A. Lee; Pandey, Sanjeeva; and Krogman, Naomi T.

*Environmental Conservation* 23(1): 45-54. (1996)

NAL Call #: QH540.E55; ISSN: 0376-8929

Descriptors: agronomy: agriculture/ conservation/ forestry/

freshwater ecology: ecology, environmental sciences/ accumulative water demand/ agricultural conversion/ altered upper watershed/ biodiversity/ conservation/ defoliation/ deforestation/ ground water depletion/ hydrologic alteration/ inundation/ oriental region/ resource management/ water quality degradation/ wetland consolidation/ wetland loss

© The Thomson Corporation

**102. Progress in wetland restoration ecology.**

Zedler, J. B.

*Trends in Ecology & Evolution* 15(10): 402-407. (Oct. 2000)

NAL Call #: QH540.T74; ISSN: 0169-5347

Descriptors: wetlands/ environmental restoration/ research programs/ restoration/ environmental factors/ ecology/ reclamation/ protective measures and control

Abstract: It takes more than water to restore a wetland. Now, scientists are documenting how landscape setting, habitat type, hydrological regime, soil properties, topography, nutrient supplies, disturbance regimes, invasive species, seed banks and declining biodiversity can constrain the restoration process. Although many outcomes can be explained post hoc, we have little ability to predict the path that sites will follow when restored in alternative ways, and no insurance that specific targets will be met. To become predictive, bolder approaches are now being developed, which rely more on field experimentation at multiple spatial and temporal scales, and in many restoration contexts.

© CSA

**103. Regional diversity of temporary wetland carabid beetle communities: A matter of landscape features or cultivation intensity?**

Brose, Ulrich

*Agriculture Ecosystems and Environment* 98(1-3): 163-167. (2003)

NAL Call #: S601.A34; ISSN: 0167-8809

Descriptors: agriculture/ biodiversity/ ecology: environmental sciences/ cultivation intensity/ habitat heterogeneity/ landscape ecology/ landscape features/ landscape structure/ macro ecology/ regional diversity/ species richness/ temporary wetland community

Abstract: The challenge of finding applicable indicators for sustainable agriculture requires evaluations at regional scales to lead to policy-relevant results. In this study, the regional diversity of temporary wetland carabid beetles was analysed for six landscapes of 10 km<sup>2</sup> each. The relative importance of landscape features and cultivation intensity for the regional diversity was compared. Total species richness was correlated with the mean soil-indices that were used as indicators of cultivation intensity. This is consistent with studies on local scales, which emphasise the importance of cultivation intensity for arthropod communities. The diversity of wetland and habitat-specific species correlated with the temporary wetlands mean duration of flooding and the density of temporary wetlands, but apart from this, there was no impact of landscape features on diversity. These results do not corroborate concepts of using indices of landscape structure as biodiversity indicators, but the importance of cultivation intensity cannot be too strongly emphasised.

© The Thomson Corporation

**104. Restoration of aquatic ecosystems: Science, technology, and public policy.**

Committee on Restoration of Aquatic Ecosystems: Science, Technology and Public Policy and National Research Council

Washington, DC: National Academy Press; 576 pp. (1992)

NAL Call #: QH541.5.W3N38 1992; ISBN: 0309092884

<http://fermat.nap.edu/catalog/1807.html>

*Descriptors:* wetlands/ environmental restoration/ aquatic ecosystems/ rivers/ lakes/ environmental management/ aquatic environment/ USA/ books/ environmental management/ aquatic environments/ environmental restoration/ aquatic ecosystems/ books/ conservation, wildlife management and recreation/ environmental action/ basic approaches, concepts, and theory/ reclamation  
*Abstract:* This volume examines the prospects for repairing the damage society has done to the USA's aquatic resources: lakes, rivers and streams, and wetlands. Restoration of Aquatic Ecosystems outlines a national strategy for aquatic restoration, with practical recommendations covering both the desired scope and scale of projects and needed government action. It features case studies of aquatic restoration activities throughout the country. With a wealth of data and commentary, the book examines key concepts and techniques used in restoration; common factors in successful restoration efforts; threats to the health of the nation's aquatic ecosystems; approaches to evaluation before, during, and after a restoration project; and the emerging specialties of restoration and landscape ecology--and how they will contribute to better integration of restoration efforts. Individual chapters provide an overview; a selective history of aquatic ecosystem management; planning and evaluating ecosystem restoration; lakes; rivers and streams; wetlands; integrated ecosystem restoration; and a national restoration strategy. An appendix discusses restoration case studies.

© CSA

**105. Restoration of temperate wetlands.**

Wheeler, Bryan D.

Chichester; New York: Wiley; xiv, 562 p.: ill. (1995)

*Notes:* Papers from a symposium held at the University of Sheffield, England in Sept. 1993. Includes bibliographical references and index.

NAL Call #: QH541.5.M3R47 1995; ISBN: 0471951056

*Descriptors:* wetland ecology---congresses/ restoration ecology---congresses/ wetland conservation---congresses  
This citation is from AGRICOLA.

**106. Restored wetlands as management tools for wetland-dependent birds.**

Dick, Thomas M.

*Pennsylvania Birds* 7(1): 4-6. (1993); ISSN: 0898-8501

*Descriptors:* wetlands/ birds/ communities/ ecosystems/ habitat management/ management/ restoration/ wildlife  
© NISC

**107. Review and assessment of methane emissions from wetlands.**

Bartlett, K. B. and Harriss, R. C.

*Chemosphere* 26(1-4): 261-320. (1993)

NAL Call #: TD172.C54; ISSN: 0045-6535

*Abstract:* The number of emission measurements of methane (CH<sub>4</sub>) to the atmosphere has increased greatly in recent years, as recognition of its atmospheric chemical

and radiative importance becomes widespread. In this report, we review progress on estimating and understanding both the magnitude of, and controls on, emissions of CH<sub>4</sub> from natural wetlands. We also calculate global wetland CH<sub>4</sub> emissions using this extensive flux data base and the wetland areas compiled and published by Matthews and Fung (1987). Tropical regions (20° N-30° S) were calculated to release 66 TgCH<sub>4</sub>/yr, 60% of the total wetland emission of 109 Tg/yr. Flux data from tropical wetlands, reported only within the last four years, are currently restricted in geographic coverage. Additional data from other regions will be required to confirm these calculated large emissions. Although emissions from subtropical and temperate wetlands (45° N-20° N and 30° S-50° S) were relatively low at 5 Tg/yr, the process-oriented focus of most of the research in this region suggests that work at these latitudes may serve as models to examine controls and possible uncertainties in estimating fluxes. These types of efforts are frequently not possible in more remote, globally significant wetlands. Northern wetlands (north of 45° N) were calculated to release a total of 38 TgCH<sub>4</sub>/yr (34% of total flux); 34 Tg/yr from wet soils and 4 Tg/yr from relatively dry tundra. These latitudes have been the focus of recent intensive research. Significant differences between the relatively large flux data bases accumulated in the two primary measurement areas, northern Minnesota and the Hudson Bay Lowlands of Canada, indicate that extrapolation from one wetland region to another may be subject to considerable error. Global emissions were also compared to fluxes calculated using the wetland areas published by Aselmann and Crutzen (1989) in an effort to assess uncertainties due to wetland area estimates. Further refinement of wetland CH<sub>4</sub> emissions awaits flux measurements from large areas currently lacking data, particularly in the tropics and the Siberian Lowlands, more realistic assessments of seasonal active periods, and accurate, up-to-date habitat classification and measurement.

© 2006 Elsevier B.V. All rights reserved.

**108. A review on habitats, plant traits and vegetation of ephemeral wetlands: A global perspective.**

Deil, Ulrich

*Phytocoenologia* 35(2-3): 533-705. (2005)

NAL Call #: QK911.P52; ISSN: 0340-269X

*Descriptors:* terrestrial ecology/ environmental sciences/ systematics and taxonomy/ plant traits/ ephemeral wetlands  
*Abstract:* Based upon a world-wide literature review and a database, which refers to 250 publications and documents about 8500 phytosociological relevés, the following questions are discussed: What are the common ecological parameters for temporary wetlands and which environmental conditions offer a niche for dwarf ephemerals? Which taxa have evolved and speciated within ephemeral wetland habitats? How do the relations between relief features, local hydrology and climatic conditions change in different parts of the world? Which global patterns in flora and vegetation do occur? The review is restricted to ephemeral freshwater ecosystems with the following two properties: Above-ground plant cover is seasonal, and the habitats are water-saturated or submerged only part of the year. For a better understanding of large-scale patterns, the results of studies about small-scale zonation, variability in time (phenology and year-to-year dynamics), ecophysiology and life strategies are briefly

reported. Finally, conservation aspects and trends of floristic globalization are considered.1. Seasonal pools: They occur in semi-arid and subhumid climates at both sides of the Tropic of Cancer. The catchment areas are local or the ponds are purely rainwater systems.2. Amphibic shorelines of permanent ponds, lakes and rivers: They concentrate in perhumid extratropical temperate zones and in orotropical climates. Along allochthonous rivers with extended catchments and with seasonal flood pulse, large temporary flood-plains also occur in semi-arid regions.3. Ephemeral flush habitats: In the perhumid tropics and in the subhumid subtropics, ephemeral wetlands are linked to runoff-habitats like the slopes of inselbergs and rock outcrops and to interflow habitats along intermittent streams. The distribution of some keystone taxa reflects the present climatic differentiation of the globe and to some extent also historical events (palaeogeography, speciation processes). *Myosurus* for example is linked to extratropical regions, *Lilaeopsis* to the New World and the Southern Hemisphere, *Limnophila* and *Rhamphicarpa* to the Palaeotropical region. Vicariance patterns are a common phenomenon. Examples can be seen in *Isoetes*, *Marsilea*, *Ophioglossum*, *Juncus* (sections *Tenageia*, *Ozophyllum* and *Caespitosi*), *Limosella*, *Crassula* (section *Helophyllum*), *Bacopa*, *Hydrocotyle*, *Eriocaulon* and *Xyris*. These genera speciated within this environment and evolved habitat equivalent species. The reduced size and the spatial isolation of the habitat reduce gene flow and favour allopatric speciation. The variability in time and small-scale ecological gradients stimulate sympatric speciation by temporal separation of the populations. Niche-equivalent taxa replace each other in different parts of the world. The niche of dwarf ephemeroïd annuals is occupied by *Centrolepidaceae* in the Australian region, by *Restionaceae* in the Capensis, by *Eriocaulaceae* in the Australian region and East Asia, by *Juncaceae* in the holarctic kingdom, by *Orcuttieae* in the Californian phytogeographical sector, and by *Cyperaceae*, *Crassulaceae*, *Gentianaceae*, *Elatinaceae* and *Apiaceae* in all floristic kingdoms. Other predominant life forms are herbaceous perennials with the isoetid syndrome, geophytic ferns (*Ophioglossum*, *Marsilea*), carnivorous plants from the families *Lentibulariaceae* and *Droseraceae*, and polkilohydric vascular plants with the xyroid syndrome. The latter occur in the Tropics, with *Xyridaceae* (pantropical), *Velloziaceae* (neotropical region), *Afrotrilepis*, *Craterostigma*, *Lindernia*, *Chamaegigas* (palaeotropical region), *Trilepis* (neotropical region) and *Borya* (Australian region).

© The Thomson Corporation

**109. Riparian wetlands and water quality.**

Gilliam, J. W.

*Journal of Environmental Quality* 23(5): 896-900. (1994)

NAL Call #: QH540.J6; ISSN: 0047-2425

*Descriptors:* nitrate/ phosphorus/ plant (Plantae unspecified)/ Plantae (Plantae unspecified)/ plants/ drainage/ farming/ nitrate/ nonpoint source pollution/ phosphorus/ urban activity/ wet soils

*Abstract:* Because of wet soils adjacent to the strains, riparian buffers are frequently present between farming and urban activities on the uplands and small streams. These riparian areas have been shown to be very valuable for the removal of nonpoint-source pollution from drainage water. Several researchers have measured gt 90% reductions in sediment and nitrate concentrations in water flowing

through the riparian areas. The riparian buffers are less effective for P removal but may retain 50% of the surface-water P entering them. I consider riparian buffers to be the most important factor influencing nonpoint-source pollutants entering surface water in many areas of the USA and the most important wetlands for surface water quality protection.

© The Thomson Corporation

**110. The role of wetlands in the hydrological cycle.**

Bullock, A. and Acreman, M.

*Hydrology and Earth System Sciences* 7(3):

358-389. (2003)

NAL Call #: GB651 .H937; ISSN: 1027-5606

*Descriptors:* wetlands/ hydrology/ stream flow rate/ water management/ floods/ ground water/ policies/ flood control/ hydrologic cycle/ wetlands hydrology/ water balance/ groundwater recharge/ flood plains/ river flow variations/ streamflow analysis/ low flow/ river flow/ hydrologic models/ aquifers/ water supply/ surface-groundwater relations/ base flow

*Abstract:* It is widely accepted that wetlands have a significant influence on the hydrological cycle. Wetlands have therefore become important elements in water management policy at national, regional and international level. There are many examples where wetlands reduce floods, recharge groundwater or augment low flows. Less recognised are the many examples where wetlands increase floods, act as a barrier to recharge, or reduce low flows. This paper presents a database of 439 published statements on the water quantity functions of wetlands from 169 studies worldwide. This establishes a benchmark of the aggregated knowledge of wetland influences upon downstream river flows and groundwater aquifers. Emphasis is placed on hydrological functions relating to gross water balance, groundwater recharge, base flow and low flows, flood response and river flow variability. The functional statements are structured according to wetland hydrological type and the manner in which functional conclusions have been drawn. A synthesis of functional statements establishes the balance of scientific evidence for particular hydrological measures. The evidence reveals strong concurrence for some hydrological measures for certain wetland types. For other hydrological measures, there is diversity of functions for apparently similar wetlands. The balance of scientific evidence that emerges gives only limited support to the generalised model of flood control, recharge promotion and flow maintenance by wetlands portrayed throughout the 1990s as one component of the basis for wetland policy formulation. That support is confined largely to floodplain wetlands, while many other wetland types perform alternate functions - partly or fully. This paper provides the first step towards a more scientifically defensible functional assessment system.

© CSA

**111. Saline wetlands related to groundwater flows from low permeability Tertiary formations in the Somontano area of Huesca, Spain.**

Sanchez Navarro, J. A.; Coloma Lopez, P.; and Perez Garcia, A.

*Hydrological Processes* 15(4): 633-642. (Mar. 2001)

NAL Call #: GB651.H93; ISSN: 0885-6087

*Descriptors:* wetlands/ surface-groundwater relations/

groundwater movement/ permeability/ model studies/ alkalinity/ soil chemistry/ salinity/ ground water/ saline water/ rivers/ tertiary/ irrigation/ soils/ saline intrusion/ Spain, Aragon, Huesca/ dynamics of lakes and rivers  
**Abstract:** Presence of groundwater flow in the 'Somontano de Huesca' Area, derived from low-permeability detrital Tertiary rocks, is considered. A groundwater flow model is constructed for these Tertiary rocks. This model explains both water flow through them and the chemical characteristics of the water. Groundwater flow has clear surface manifestations: it causes wetlands (which are called 'paules' in the area) with sodic waters, it produces saline, sodic or alkaline soils, and it produces modifies the chemical composition of rivers in Somontano. Irrigation has increased the volume of filtered water, especially in the interfluvial areas, causing the extension of the wetlands in the valley thalwegs, and also the greater movement of salts has increased the problems of saline and/or sodic soils in the area.

© CSA

**112. Salt marsh tidal channel morphometry: Applications for wetland creation and restoration.**

Zeff, M. L.

*Restoration Ecology* 7(2): 205-211. (June 1999)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

**Descriptors:** wetlands/ salt marshes/ tides/ drainage/ hydrology/ channels/ geomorphology/ environmental restoration/ coastal environments/ restoration/ meandering/ tidal inlets/ fluvial morphology/ morphometry/ USA, New Jersey/ reclamation/ protective measures and control/ habitat community studies/ topography and morphology  
**Abstract:** The morphometry of tidal channels in a back-barrier salt marsh in New Jersey was investigated.

Characteristics of the tidal channel drainage network plan form (order, bifurcation ratio, length, sinuosity) and cross section channel form (width:depth ratio, hydraulic geometry) are compared with data from other studies. Drainage patterns follow Horton's Law of Stream Numbers and Law of Stream Lengths. Mitigation sites should be designed in accordance with these laws. The degree to which site-specific substrate, vegetation, and flow conditions constrain or facilitate the development of sinuous, meandering channel reaches should be estimated to provide information for the design of tidal channel geometries and dimensions that will accommodate predicted discharges. Drainage networks in created and restored wetlands should reflect the spatial distribution of width and depth properties (width:depth ratios, cross-sectional areas, longitudinal slopes, hydraulic geometry) found in similar natural systems. Reproducing these characteristics will lessen the practice of oversizing channels. Hydraulic geometry relationships can facilitate the sizing of channels at Atlantic coast salt marsh mitigation sites. Recommendations are given to promote the development of drainage networks that function like the coastal back-barrier Avalon/Stone Harbor marsh in New Jersey.

© CSA

**113. Salt marshes: Biological controls of food webs in a diminishing environment.**

Valiela, Ivan; Rutecki, Deborah; and Fox, Sophia

*Journal of Experimental Marine Biology and Ecology* 300 (1-2): 131-159. (2004)

NAL Call #: QH91.A1J6; ISSN: 0022-0981

**Descriptors:** literature review/ role of biological controls in coastal salt marsh food webs/ diet/ bottom up and top down controls in food webs/ ecology/ food webs/ predators/ top down controls in food webs/ coastal salt marshes/ salt marsh/ coastal saltmarsh ecosystem/ role of bottom up and top down controls/ wetland habitat decline relations/ review

**Abstract:** This essay reviews two important topics in coastal ecology: the work on the relative role of bottom-up and top-down controls in natural communities and the loss of wetlands worldwide. In salt marshes and other coastal wetlands, bottom-up and top-down mechanisms of control on natural communities are pervasive. Bottom-up effects through nutrient supply may propagate to upper trophic levels via better food quality, or indirectly by altering water and sediment quality. Top-down control by consumers alters lower trophic levels through consumption of primary producers, and indirectly by trophic cascades in which higher predators feed on grazers. The combined forcing of bottom-up and top-down controls govern assemblages of species in natural communities, mediated by physical and biogeochemical factors. Although there is much information about biological controls of coastal food webs, more information is needed. Even more important is that large losses of wetland are occurring along coastlines worldwide due to a variety of economic and social activities including filling, wetland reclamation, and sediment interception. Such losses are of concern because these wetlands provide important functions, including export of energy-rich material to deeper waters, nursery and stock habitats, shoreline stabilization, and intercept land-derived nutrients and contaminants. These important functions justify conservation and restoration efforts; barring such efforts, we will find it increasingly difficult to find coastal wetlands where we can continue to gain further understanding of ecology and biogeochemistry and lack the aesthetic pleasure these wetlands provide to so many of us.

© The Thomson Corporation

**114. Salt marshes: Present functioning and future change.**

Boorman, L. A.

*Mangroves and Salt Marshes* 3(4): 227-241. (1999);

ISSN: 1386-3509

**Descriptors:** salt marshes/ coastal zone management/ habitats/ nutrients/ organic matter/ climatic changes/ environmental protection/ nature conservation/ sea level changes/ environmental impact/ pollution monitoring/ pollutant persistence/ ecosystem disturbance

**Abstract:** Salt marshes are no longer viewed as intertidal wastelands of little value to anyone. They are now widely recognised as playing a major role in coastal defence, in wildlife conservation on the coast and as a key source of organic material and nutrients vitally important for a wide range of marine communities. This appreciation of the importance of salt marshes has been brought even more sharply into focus because of the threats posed by predicted rise in sea level as a result of global climatic change. Three decades ago the possibilities of exchanges of organic matter between salt marshes and the sea were

already being recognised in certain areas but it is only in the past five years or so that this process has been studied in a wide range of different areas. Detailed studies have been made into the way that salt marsh fluxes change with the development of increasingly mature and, therefore, increasingly complex salt marsh communities. As well as being sources and sinks of mineral nutrients and organic matter, salt marshes can also function as a sink for pollutants that would otherwise be damaging to the environment. Salt marshes also act as a sink for sediment within coastal ecosystems. Through their various functions they can be seen to be acting as dynamic living filters for various ecologically important materials. With increasing threats to the survival of salt marshes as a result of man's activities in the coastal zone being augmented by the threats from predicted sea level rise, a new approach to salt marsh conservation has come to the fore and that is the actual creation of new salt marshes. For this process to be fully effective we have to make full use of our increased understanding of salt marsh structure and function. Following a review of the current state of the art in the field of salt marsh research, an assessment is made of specific future research needs. Despite the greatly increased effort which has been directed to salt marsh research over the past few years we still have to recognise that resources are limited and, therefore, critical evaluations of the various options regarding the direction of our future efforts need to be made.

© CSA

#### 115. Saltmarshes in a time of change.

Adam, P.

*Environmental Conservation* 29(1): 39-61. (2002)

NAL Call #: QH540.E55; ISSN: 0376-8929

*Descriptors:* salt marshes/ sea level/ sedimentation/ human impact/ environment management/ environmental quality/ exotic species/ resources management/ ecological effects/ water resources planning/ environmental policy/ tides/ aquatic habitats/ human factors/ sustainable development/ intertidal environment/ ecosystem management/ climatic changes/ greenhouse effect/ sea level changes/ tidal range/ erosion control/ man-induced effects/ world oceans

*Abstract:* Saltmarshes are a major, widely distributed, intertidal habitat. They are dynamic systems, responding to changing environmental conditions. For centuries, saltmarshes have been subject to modification or destruction because of human activity. In this review, the range of factors influencing the survival of saltmarshes is discussed. Of critical importance are changes in relative sea level and in tidal range. Relative sea level is affected by changes in absolute sea level, changes in land level and the capacity of saltmarshes to accumulate and retain sediment. Many saltmarshes are starved of sediment because of catchment modification and coastal engineering, or exposed to erosive forces, which may be of natural origin or reflect human interference. The geographical distribution of individual saltmarsh species reflects climate, so that global climatic change will be reflected by changes in distribution and abundance of species, although the rate of change in communities dominated by perennial plants is difficult to predict. Humans have the ability to create impacts on saltmarshes at a range of scales from individual sites to globally. Pressures on the environment created by the continued increase in the human population, particularly in developing tropical

countries, and the likely consequences of the enhanced greenhouse effect on both temperature and sea level give rise to particular concerns. Given the concentration of population growth and development in the coastal zone, and the potential sensitivity of saltmarsh to change in sea level, it is timely to review the present state of saltmarshes and to assess the likelihood of changes in the near (25 years) future. By 2025, global sea level rise and warming will have impacts on saltmarshes. However, the most extensive changes are likely to be the direct result of human actions at local or regional scales. Despite increasing recognition of the ecological value of saltmarsh, major projects involving loss of saltmarshes but deemed to be in the public interest will be approved. Pressures are likely to be particularly severe in the tropics, where very little is known about saltmarshes. At the local scale the cumulative impacts of activities, which individually have minor effects, may be considerable. Managers of saltmarshes will be faced with difficult choices including questions as to whether traditional uses should be retained, whether invasive alien species or native species increasing in abundance should be controlled, whether planned retreat is an appropriate response to rising relative sea level or whether measures can be taken to reduce erosion. Decisions will need to take into account social and economic as well as ecological concerns.

© CSA

#### 116. Shift in wetland plant composition and biomass following low-level episodes in the St. Lawrence River: Looking into the future.

Hudon, Christiane

*Canadian Journal of Fisheries and Aquatic Sciences* 61(4): 603-617. (2004)

NAL Call #: 442.9 C16J; ISSN: 0706-652X

*Descriptors:* freshwater ecology: ecology, environmental sciences/ terrestrial ecology: ecology, environmental sciences/ agricultural landscape/ climate change/ emergent waterlogged mudflats/ faunal habitats/ human intervention/ industrialized landscape/ low level episodes/ natural hydrologic variability/ shoreline alteration/ urbanized landscape/ water level fluctuations: future effects, past effects/ wetland plant biomass shifts/ wetland plant composition shifts

*Abstract:* The effects of a 1-m drop in average water levels in 1999 on species composition and biomass were documented for a St. Lawrence River wetland and compared with a similar episode in 1931. These observations highlight the manifold effects of past and future water level fluctuations on St. Lawrence River wetlands and faunal habitats, resulting from natural hydrologic variability, climate change, and (or) human intervention. In 1931 and 1999, waters were 2-3 degreeC warmer than the previous 10-year average. Low water levels markedly altered wetland vegetation: various Graminea (including *Phalaris arundinacea* and *Phragmites australis*) and facultative annual species invaded previously marshy areas. Submerged species previously found in shallow waters were replaced on dry ground by annual terrestrial plants; *Alisma gramineum* colonized emergent waterlogged mudflats. The low water levels of 1999 induced a spatially discontinuous plant biomass that was richer in terrestrial material than in previous years (1993-1994). In comparison with the 1930s, recent surveys indicate a decline of assemblages dominated by *Equisetum*

spp. and *Najas flexilis* and a rise of those dominated by *Lythrum salicaria*, *Potamogeton* spp., and filamentous algae. These shifts reveal the additional effects of nutrient enrichment, alien species, and shoreline alteration accompanying a change from a mostly agricultural to a mostly urbanized and industrialized landscape.

© The Thomson Corporation

**117. A simple wetland habitat classification for boreal forest waterfowl.**

Rempel, R. S.; Abraham, K. F.; Gadawski, T. R.; Gabor, S.; and Ross, R. K.

*Journal of Wildlife Management* 61(3): 746-757. (July 1997)  
NAL Call #: 410 J827; ISSN: 0022-541X

*Descriptors:* wetlands/ classification systems/ nature conservation/ aquatic birds/ habitats/ forests/ waterfowl/ surveys/ classification/ marshes/ habitat/ community structure/ Aves/ Canada, Ontario, Cochrane, Great Clay Belt/ habitat/ birds/ conservation, wildlife management and recreation/ network design/ birds

*Abstract:* We propose a wetland habitat classification for boreal forest waterfowl that builds on existing classification systems, and apply the habitat classification to wetlands surveyed for 14 species of waterfowl breeding pairs and broods in the boreal Claybelt of Ontario. The habitat classification is based on simple and easily observable structural characteristics measured from black-and-white aerial photography collected for forest resource inventories. Habitat associations were examined using chi super(2) analysis for individual waterfowl species, and canonical correspondence analysis for overall community structure. Habitat use deviated significantly from that expected by random association for both pairs and broods, and canonical ordination of habitat/community structure was significant for both breeding pairs and broods. Beaver-pond marshes, lacustrine marshes located at river mouths, and open-water fens with <25% vegetative cover were used at rates much higher than expected, and deserve attention for conservation in the boreal forest. Based on expected distribution of wetland habitat types, we estimate 96.9 pairs x 100 km super(-2) and 96.1 broods x 100 km super(-2) to occur on average throughout the Claybelt.

© CSA

**118. Simulation of subsurface flow constructed wetlands: Results and further research needs.**

Langergraber, G.

*Water Science and Technology* 48(5): 157-166. (2003)  
NAL Call #: TD420.A1P7; ISSN: 0273-1223

*Descriptors:* freshwater ecology/ models and simulations: computational biology/ pollution assessment control and management/ waste management: sanitation/ nitrogen/ wastewater chemistry/ phosphorus/ CW2D reactive transport model/ subsurface flow constructed wetlands: design optimization, research needs, simulation/ wetland systems: water pollution control

*Abstract:* Simulation of constructed wetlands has two main tasks: to obtain a better understanding of the processes in constructed wetlands, and to check and optimise existing design criteria. This paper shows simulation results for two indoor pilot-scale constructed wetlands for wastewater and surface water treatment respectively. The results presented and discussed are mainly focussed on the hydraulic behaviour of the constructed wetland systems. In addition results of reactive transport simulations with CW2D are

shown. The multi-component reactive transport model CW2D (Constructed Wetlands 2 Dimensional) was developed to model transport and reactions of the main constituents of wastewater (organic matter, nitrogen, and phosphorus) in subsurface flow constructed wetlands. For the pilot-scale constructed wetlands a calibration of the flow model was possible and therefore the results of the reactive transport simulations with CW2D fit the measured data well. The further research needs regarding the simulation of subsurface flow constructed wetlands are discussed.

© The Thomson Corporation

**119. Status and trends of wetlands in the conterminous United States 1986 to 1997.**

Dahl, Thomas E. and U.S. Fish and Wildlife Service  
Washington, D.C.: U.S. Dept. of the Interior, Fish and Wildlife Service; 82 p. (2000)

*Notes:* "December 2000"--P. 4 of cover. Includes bibliographical references (p. 70-72).

NAL Call #: QH541.5.M3 D33 2000

*Descriptors:* wetlands---United States/ wetland conservation---United States

This citation is from AGRICOLA.

**120. Status and trends of wetlands in the conterminous United States 1998 to 2004.**

Dahl, Thomas E.

Washington, D.C.: U.S. Dept. of the Interior, U.S. Fish and Wildlife Service, 2005. 112 p.

NAL Call #: QH541.5.M3 D33 2005

[http://wetlandsfws.er.usgs.gov/status\\_trends/national\\_reports/trends\\_2005\\_report.pdf](http://wetlandsfws.er.usgs.gov/status_trends/national_reports/trends_2005_report.pdf)

*Descriptors:* wetlands--United States/ wetland conservation--United States

**121. The status of forested wetlands and waterbird conservation in North and Central America.**

Erwin, R. Michael

*Conservation Biology Series* 6: 61-109. (1996);

ISSN: 1363-3090

*Descriptors:* Aves/ conservation measures/ waterbirds/ forested wetland status relations/ semiaquatic habitat/ forest and woodland/ Nearctic Region/ neotropical region/ Central America/ forested wetland status/ waterbird conservation significance

© The Thomson Corporation

**122. Status of knowledge, ongoing research, and research needs in Amazonian wetlands.**

Junk, W. J. and Piedade, M. T.

*Wetlands Ecology and Management* 12(6): 597-609. (Jan. 2005)

NAL Call #: QH541.5.M3 W472; ISSN: 0923-4861

*Descriptors:* wetlands/ basins/ economics/ rivers/ structure-function relationships/ classification/ soil/ flood plains/ agriculture/ inland fisheries/ natural resources/ potential resources/ hydroelectric power/ research programmes/ education establishments/ deforestation/ ranching/ biodiversity/ institutions/ economic development/ construction/ channels/ structure/ ecology/ fisheries/ exploitation/ degradation/ priorities/ training/ research priorities/ cattle/ navigation/ surveys/ technology transfer/ artificial wetlands/ exploration/ South America/ South America, Amazonia, Amazon R./ Brazil, Amazonia/

management/ general papers on resources/ other aquatic communities/ control of water on the surface  
*Abstract:* Exploitation and exploration of the Amazon basin by Europeans started in the 17th century, but only since about 1970 has the Brazilian government given priority to the connection of the Amazon basin to the industrialized southern part of the country. This new policy required scientific research on the natural resources of the area. Wetlands cover about 20% of the Amazon basin. Inland fishery, fertile floodplain soils, and hydroelectric energy offer a large potential for economic development. Research concentrates on major wetlands and water bodies near the large cities. The Amazon River floodplain belongs to the best studied tropical river floodplains in the world. However, studies in other areas suffer from lack of wetland inventory and classification. Accelerated economic development is not adequately accompanied by wetland research. Insufficient knowledge about distribution, size, structure and function of many wetlands leads to increasing degradation and loss of biodiversity, for instance, by the construction of hydroelectric power plants, large scale deforestation for cattle ranching and agro-industrial projects, mining activities, the construction of navigation channels (hidrovias), etc. The low number of scientists working in the area and lack of funding require close cooperation in problem-oriented multidisciplinary projects (scientific clustering) to optimize scientific outcome. Intensive, long-term cooperation and scientific exchange with institutions from southern Brazil and from abroad is recommended to improve the scientific infrastructure in Amazonian institutions, to accelerate the transfer of new scientific methods and technology, and to intensify the training program for local human resources.  
 © CSA

**123. Surface flow constructed wetlands: Overview.**

Kadlec, R. H.  
*Water Science and Technology* 32(3): 1-12. (1995)  
*NAL Call #:* TD420.A1P7; *ISSN:* 0273-1223.  
*Notes:* Proceedings for the 4th International Conference on Wetland Systems for Water Pollution Control Held in Guangzhou, China, 6-10 November 1994  
*Descriptors:* flow/ costs/ operation/ performance/ design/ waste water/ biological treatment/ artificial wetlands/ land types/ wastes/ waste water treatment/ wetland systems for water pollution control/ human wastes and refuse/ waste handling and treatment equipment  
*Abstract:* Statistics on the types and character of low-tech waste water treatment wetlands are reviewed. The operational processes are discussed, including sedimentation, plant uptake, sorption, nutrient cycling, and chemical and microbial conversion. Performance was good for reduction of suspended solids, biological oxygen demand, phosphorus, nitrogen, metals and some anthropogenic chemicals. Design procedures were evaluated, showing that the overly simplistic techniques used in the infancy of the technology may now be replaced by rational procedures based on the large and rapidly growing information base for constructed surface flow treatment wetlands. Ancillary wildlife and human use is an important part of this type of wetland, and should be acknowledged in design. Capital costs were low, but the principal financial advantage was the extremely low base cost of operation.

© CAB International/CABI Publishing

**124. Synthesis of soil-plant correspondence data from twelve wetland studies throughout the United States.**

Segelquist, C. A.; Slauson, W. L.; Scott, M. L.; and Auble, G. T.  
 Washington D.C.: U.S. Fish and Wildlife Service, 1990.  
 32 p. Biological Report.  
*NAL Call #:* QH540.U562 no.90(19)  
*Descriptors:* wetlands/ soils/ vegetation/ identification for classification/ census-survey methods/ cover/ North America/ United States/ South Dakota/ Florida/ Nebraska/ New Mexico/ Nevada/ California/ North Carolina/ Alaska/ Mississippi/ Rhode Island/ Massachusetts  
*Abstract:* Objectives were to evaluate the relation between hydric and nonhydric soils and hydrophytic and nonhydrophytic vegetation for selected wetlands and to test the weight average and index average procedures of Wentworth and Johnson (1986)  
 © NISC

**125. Temperate freshwater wetlands: Types, status, and threats.**

Brinson, M. M. and Malvarez, A. I.  
*Environmental Conservation* 29(2): 115-133. (2002)  
*NAL Call #:* QH540.E55; *ISSN:* 0376-8929  
*Descriptors:* wetlands/ land use/ environmental protection/ environmental quality/ eutrophication/ water quality/ drainage/ resources management/ ecosystem analysis/ temperate environments/ environmental degradation/ marshes/ ecosystem disturbance/ man-induced effects/ freshwater pollution/ degradation/ habitat/ pollution effects/ species diversity/ biodiversity/ freshwater organisms/ temperate zones/ North America/ South America/ Europe/ Mediterranean Region/ Russia/ China, People's Rep./ Japan/ Australia/ New Zealand  
*Abstract:* This review examines the status of temperate-zone freshwater wetlands and makes projections of how changes over the 2025 time horizon might affect their biodiversity. The six geographic regions addressed are temperate areas of North America, South America, northern Europe, northern Mediterranean, temperate Russia, Mongolia, north-east China, Korea and Japan, and southern Australia and New Zealand. Information from the recent technical literature, general accounts in books, and some first-hand experience provided the basis for describing major wetland types, their status and major threats. Loss of biodiversity is a consequence both of a reduction in area and deterioration in condition. The information base for either change is highly variable geographically. Many countries lack accurate inventories, and for those with inventories, classifications differ, thus making comparisons difficult. Factors responsible for losses and degradation include diversions and damming of river flows, disconnecting floodplain wetlands from flood flows, eutrophication, contamination, grazing, harvests of plants and animals, global warming, invasions of exotics, and the practices of filling, dyking and draining. In humid regions, drainage of depressions and flats has eliminated large areas of wetlands. In arid regions, irrigated agriculture directly competes with wetlands for water. Eutrophication is widespread, which, together with effects of invasive species, reduces biotic complexity. In northern Europe and the northern Mediterranean, losses have been ongoing for hundreds of years, while losses in North America accelerated during the 1950s through to the 1970s. In contrast, areas such as China appear to be on the cusp of

expanding drainage projects and building impoundments that will eliminate and degrade freshwater wetlands. Generalizations and trends gleaned from this paper should be considered only as a starting point for developing world-scale data sets. One trend is that the more industrialized countries are likely to conserve their already impacted, remaining wetlands, while nations with less industrialization are now experiencing accelerated losses, and may continue to do so for the next several decades. Another observation is that countries with both protection and restoration programmes do not necessarily enjoy a net increase in area and improvement in condition. Consequently, both reductions in the rates of wetland loss and increases in the rates of restoration are needed in tandem to achieve overall improvements in wetland area and condition.

© CSA

**126. Temporary forest pools: Can we see the water for the trees?**

Williams, D. D.

*Wetlands Ecology and Management* 13(3): 213-233. (2005)

NAL Call #: QH541.5.M3 W472; ISSN: 0923-4861

*Descriptors:* community succession/ forests/ freshwater invertebrates/ hydroperiod/ riparian vegetation/ temporary ponds/ wetland management

*Abstract:* Temporary waters, in general, are fascinating habitats in which to study the properties of species adapted to living in highly variable environments. Species display a remarkable array of strategies for dealing with the periodic loss of their primary medium that sets them apart from the inhabitants of permanent water bodies. Survival of individuals typically depends on exceptional physiological tolerance or effective migrational abilities, and communities have their own, distinctive hallmarks. This paper will broadly overview the biology of temporary ponds, but will emphasize those in temperate forests. In particular, links will be sought between aquatic community properties, the nature of the riparian vegetation, and forestry practices. Quite apart from their inherent biological interest, temporary waters are now in the limelight both from a conservation perspective, as these habitats come more into conflict with human activities, and a health-control perspective, as breeding habitats for vectors of arboviruses. Traditionally, many temporary waters, be they pools, streams or wetlands, have been considered to be 'wasted' areas of land, potentially convertible to agriculture/silviculture once drained. In reality, they are natural features of the global landscape representing distinct and unique habitats for many species - some that are found nowhere else, others that reach their maximum abundance there. To be effective, conservation measures must preserve the full, hydroseral range of wetland types. © Springer 2005.

© 2006 Elsevier B.V. All rights reserved.

**127. Threats to waterbirds and wetlands: Implications for conservation, inventory and research.**

O'Connell, Mark

*Wildfowl* 51: 1-15. (2000)

NAL Call #: SK351.W575; ISSN: 0954-6324

*Descriptors:* waterbirds (Aves)/ animals/ birds/ chordates/ nonhuman vertebrates/ vertebrates/ biodiversity/ conservation implications/ demographic changes/ economic changes/ human activity/ social changes/ wetlands: habitat

*Abstract:* The world has undergone major social, economic

and demographic changes in the last two centuries. Predictions suggest that during the next 100 years, even greater changes will occur and this will put increasing pressure on wetlands and their biodiversity. This paper examines the changes that have occurred, and the nature of threats facing waterbirds and wetlands as a result of human activities. The need for specific areas of research is identified, particularly in relation to detecting and measuring change and the need to provide solution-oriented research to underpin conservation action.

© The Thomson Corporation

**128. Trace and toxic metals in wetlands: A review.**

Gambrell, R. P.

*Journal of Environmental Quality* 23(5): 883-891. (Sept. 1994-Oct. 1994)

NAL Call #: QH540.J6; ISSN: 0047-2425 [JEVQAA].

*Notes:* Paper presented at the symposium, "Wetland Processes and Water Quality," November 3-4, 1992, Minneapolis, MN. Includes references.

*Descriptors:* wetland soils/ upland soils/ heavy metals/ leaching/ immobilization/ soil pH/ redox reactions/ bioavailability/ plants

*Abstract:* The mobility and plant availability of many trace and toxic metals in wetland soils is often substantially different from upland soils. Oxidation-reduction (redox) and associated pH changes that occur in soils as a result of flooding or drainage can affect the retention and release of metals by clay minerals, organic matter, iron oxides, and, for coastal wetlands, sulfides. Except where a Hooded soil or sediment becomes strongly acid upon drainage and oxidation, as sometimes occurs, the processes immobilizing metals tend to be complimentary such that large-scale metal releases from contaminated soils and sediments do not occur with changing redox conditions. Metals tend to be retained more strongly in wetland soils compared with upland soils.

This citation is from AGRICOLA.

**129. Tracking wetland restoration: Do mitigation sites follow desired trajectories?**

Zedler, J. B. and Callaway, J. C.

*Restoration Ecology* 7(1): 69-73. (Mar. 1999)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

*Descriptors:* wetlands/ environmental restoration/ environment management/ USA, California/ USA, California, San Diego Bay/ rehabilitation/ ecosystems/ damage/ monitoring/ wildlife habitats/ model studies/ alternative planning/ nature conservation/ environmental assessment/ USA, California, San Diego/ trajectories/ Sweetwater Marsh National Wildlife Refuge/ reclamation/ water quality control/ conservation, wildlife management and recreation/ general environmental engineering

*Abstract:* Hypothetical models in the scientific literature suggest that ecosystem restoration and creation sites follow a smooth path of development (called a trajectory), rapidly matching natural reference sites (the target). Multi-million-dollar mitigation agreements have been based on the expectation that damages to habitat will be compensated within 5-10 years, and monitoring periods have been set accordingly. Our San Diego Bay study site, the Sweetwater Marsh National Wildlife Refuge, has one of the longest and most detailed records of habitat development at a mitigation site: data on soil organic matter, soil nitrogen, plant growth, and plant canopies for up to 10 years from a 12-year-old

site. High interannual variation and lack of directional changes indicate little chance that targets will be reached in the near future. Other papers perpetuate the trajectory model, despite data that corroborate our findings. After reviewing "trajectory models" and presenting our comprehensive data for the first time, we suggest alternative management and mitigation policies.  
© CSA

**130. The U.S. Fish and Wildlife Service's National Wetlands Inventory project.**

Wilén, B. O. and Bates, M. K.

*Vegetatio* 118(1-2): 153-169. (1995)

NAL Call #: 450 V52; ISSN: 0042-3106.

Notes: Conference: 4th International Wetlands Conference, Symposium on Classification and Inventory of the World's Wetlands, Columbus, OH (USA), 13-18 Sep 1992

Descriptors: wetlands/ inventories/ classification/ data banks/ mapping/ USA/ US Fish and Wildlife Service/ data banks/ miscellaneous topics/ general papers on resources

Abstract: In 1974, the US Fish and Wildlife Service directed its Office of Biological Services to design and conduct an inventory of the Nation's wetlands. The mandate was to develop and disseminate a technically sound, comprehensive data base concerning the characteristics and extent of the Nation's wetlands. The purpose of this data base is to foster wise use of the Nation's wetlands and to expedite decisions that may affect this important resource. To accomplish this, state-of-the-art principles and methodologies pertaining to all aspects of wetland inventory were assimilated and developed by the newly formed project. By 1979, when the National Wetlands Inventory (NWI) Project became operational, it was clear that two very different kinds of information were needed. First, detailed wetland maps were needed for site-specific decisions. Second, national statistics developed through statistical sampling on the current status and trends of wetlands were needed in order to provide information to support the development or alteration of Federal programs and policies. The NWI has produced wetland maps (scale = 1:24 000) for 74% of the conterminous United States. It has also produced wetland maps (scale = 1:63 360) for 24% of Alaska. Nearly 9000 of these wetland maps, representing 16.7% of the continental United States, have been computerized (digitized). In addition to maps, the NWI has produced other valuable wetland products. These include a statistically-based report on the status and trends of wetlands that details gains and losses in United States wetlands that have occurred from the mid-1970's to the mid-1980's. Other wetland products include a list of wetland (hydric) soils, a national list of wetland plant species, wetland reports for certain individual States such as New Jersey and Florida, and a wetland values data base.  
© CSA

**131. Urbanization impacts on the structure and function of forested wetlands.**

Faulkner, Stephen

*Urban Ecosystems* 7(2): 89-106. (2004)

NAL Call #: QH541.5.C6 U73; ISSN: 1083-8155

Descriptors: biochemistry and molecular biophysics/ soil science/ terrestrial ecology: ecology, environmental sciences/ forested wetland: function, structure/ nutrient cycling/ soil saturation/ urbanization/ watershed hydrology

Abstract: The exponential increase in population has

fueled a significant demographic shift: 60% of the Earth's population will live in urban areas by 2030. While this population growth is significant in its magnitude, the ecological footprint of natural resource consumption and use required to sustain urban populations is even greater. The land use and cover changes accompanying urbanization (increasing human habitation coupled with resource consumption and extensive landscape modification) impacts natural ecosystems at multiple spatial scales. Because they generally occupy lower landscape positions and are linked to other ecosystems through hydrologic connections, the cascading effects of habitat alteration on watershed hydrology and nutrient cycling are particularly detrimental to wetland ecosystems. I reviewed literature relevant to these effects of urbanization on the structure and function of forested wetlands. Hydrologic changes caused by habitat fragmentation generally reduce species richness and abundance of plants, macroinvertebrates, amphibians, and birds with greater numbers of invasives and exotics. Reduction in soil saturation and lowered water tables result in greater nitrogen mineralization and nitrification in urban wetlands with higher probability of NO<sub>3</sub>- export from the watershed. Depressional forested wetlands in urban areas can function as important sinks for sediments, nutrients, and metals. As urban ecosystems become the predominant human condition, there is a critical need for data specific to urban forested wetlands in order to better understand the role of these ecosystems on the landscape.

© The Thomson Corporation

**132. Use of constructed wetlands in water pollution control: Historical development, present status, and future perspectives.**

Brix, H.

*Water Science and Technology* 30(8 pt 8): 209-223. (1994)

NAL Call #: TD420.A1P7; ISSN: 0273-1223

Descriptors: biochemical oxygen demand/ free water surface flow systems/ nitrogen/ phosphorus/ reaction rate constants/ subsurface flow systems/ suspended solids

Abstract: During the last two decades the multiple functions and values of wetlands have been recognized not only by the scientists and managers working with wetlands, but also by the public. The ability of wetlands to transform and store organic matter has been exploited in constructed wetlands. This paper summarizes the state-of-the-art of the uses of constructed wetlands in water pollution control by reviewing the basics of the technology, the historical development, and the performance expectations with focus on the use of free water surface and subsurface flow constructed wetlands for municipal wastewater treatment. Performance data from a total of 104 subsurface flow systems and 70 free water surface flow systems are reviewed. The present state of knowledge is sufficient to apply constructed wetlands as a tool for improving water quality. The potential applications range from secondary treatment of municipal and various types of industrial wastewaters to polishing of tertiary treated waters and diffuse pollution. In many situations constructed wetlands is the only appropriate technology available. The treatment capacity of subsurface flow systems can be improved by selecting vertical flow systems with intermittent loading, by proper media selection, and by recycling of the wastewater.

Further research is needed to help define and optimize engineering design criteria and the long-term performance capabilities and operational problems.

© 2006 Elsevier B.V. All rights reserved.

**133. Use of restored small wetlands by breeding waterfowl in Prince Edward Island, Canada.**

Stevens, C. E.; Gabor, T. S.; and Diamond, A. W.

*Restoration Ecology* 11(1): 3-12. (2003)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

*Descriptors:* wetlands/ environmental restoration/ breeding/ restoration/ environment management/ aquatic birds/ abundance/ plant populations/ environmental factors/ nature conservation/ *Anas crecca carolinensis*/ *Anas rubripes*/ *Typha*/ Canada, Prince Edward Island/ green-winged teal/ American black duck/ ring-necked ducks/ gadwell

*Abstract:* Since 1990 under the Eastern Habitat Joint Venture over 100 small wetlands have been restored in Prince Edward Island, Canada. Wetlands were restored by means of dredging accumulated sediment from erosion to emulate pre-disturbance conditions (i.e., open water and extended hydroperiod). In 1998 and 1999 we compared waterfowl pair and brood use on 22 restored and 24 reference wetlands. More pairs and broods of Ring-necked Ducks, Gadwall, Green-winged Teal, and American Black Ducks used restored versus reference wetlands. In restored wetlands waterfowl pair density and species richness were positively correlated with wetland/cattail area, percent cattail cover, and close proximity to freshwater rivers. In addition, a waterfowl reproductive index was positively correlated with percent cattail cover. Green-winged Teal pair occurrence in restored wetlands was positively correlated with greater amounts of open water and water depths. American Black Duck pairs occurred on most (86%) restored wetlands. Restored small wetlands likely served as stopover points for American Black Duck broods during overland or stream movements, whereas they likely served as a final brood-rearing destination for Green-winged Teal broods. We suggest that wetland restoration is a good management tool for increasing populations of Green-winged Teal and American Black Ducks in Prince Edward Island.

© CSA

**134. Using algae to assess environmental conditions in wetlands.**

Stevenson, R. Jan; McCormick, Paul V.; Frydenborg, Russ; United States. Environmental Protection Agency. Office of Water; United States. Environmental Protection Agency. Office Science and Technology; and United States.

Environmental Protection Agency. Office of Wetlands, Oceans and Watersheds

In: *Methods for evaluating wetland condition*; Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, 2002.

*Notes:* Original title: Using algae to assess environmental conditions in wetlands (#11); Title from web page. "March 2002." "Prepared jointly by U.S. Environmental Protection Agency, Health and Ecological Criteria Division (Office of Science and Technology) and Wetlands Division (Office of Wetlands, Oceans, and Watersheds)" "EPA-822-R-02-021." Description based on content viewed April 14, 2003.

Includes bibliographical references.

NAL Call #: QH541.15.15 S74 2002

<http://www.epa.gov/waterscience/criteria/wetlands/11Algae.pdf>

*Descriptors:* indicators---biology---United States/ environmental indicators---United States---mathematical models/ algae---United States/ wetland conservation---United States

This citation is from AGRICOLA.

**135. Using amphibians in bioassessment of wetlands.**

Sparling, Donald W.; United States. Environmental Protection Agency. Office of Water.; United States. Environmental Protection Agency. Health and Ecological Criteria Division.; and United States. Environmental Protection Agency. Wetlands Division.

In: *Methods for evaluating wetland condition*; Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, 2002.

*Notes:* Using amphibians in bioassessment of wetlands. (#12). Title from web page. "March 2002." "Prepared jointly by the U.S. Environmental Protection Agency, Health and Ecological Criteria Division (Office of Science and Technology) and Wetlands Division (Office of Wetlands, Oceans, and Watersheds)" "EPA-822-R-02-022."

Description based on content viewed March 31, 2003.

Includes bibliographical references.

NAL Call #: QH541.15.15 M472 2002

<http://www.epa.gov/waterscience/criteria/wetlands/12Amphibians.pdf>

*Descriptors:* wetlands management---United States/ indicators---biology---United States/ environmental indicators---United States/ monitoring, biological---United States/ amphibians---United States

This citation is from AGRICOLA.

**136. Using vegetation to assess environmental conditions in wetlands.**

Fennessy, Slobhan; United States. Environmental Protection Agency. Health and Ecological Criteria Division; United States. Environmental Protection Agency. Wetlands Division; and United States. Environmental Protection Agency. Office of Water

In: *Methods for evaluating wetland condition*; Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, 2002.

*Notes:* Original title: Using vegetation to assess environmental conditions in wetlands (#10); Title from web page. "March 2002." Major contributors: Slobhan Fennessy and others. "Prepared jointly by the U.S. Environmental Protection Agency, Health and Ecological Criteria Division (Office of Science and Technology) and Wetlands Division (Office of Wetlands, Oceans, and Watersheds)" "EPA-822-R-02-020." Description based on content viewed March 31, 2003. Includes bibliographical references.

NAL Call #: QH541.15.15 M473 2002

<http://www.epa.gov/waterscience/criteria/wetlands/10Vegetation.pdf>

*Descriptors:* plant indicators---United States/ indicators---biology---United States/ wetland management---United States/ environmental monitoring---United States

This citation is from AGRICOLA.

**137. Vegetation-based indicators of wetland nutrient enrichment.**

Craft, C.; United States. Environmental Protection Agency. Health and Ecological Criteria Division; United States. Environmental Protection Agency. Wetlands Division; and United States. Environmental Protection Agency.

Office of Water

In: Methods for evaluating wetland condition; Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, 2003.

*Notes:* Title from web page. "March 2002." Prepared jointly by: the U.S. Environmental Protection Agency, Health and Ecological Criteria Division (Office of Science and Technology) and Wetland Division (Office of Wetlands, Oceans, and Watersheds). "EPA-822-R-02-024." Includes bibliographical references.

NAL Call #: QH76.5.N8 V47 2002

<http://www.epa.gov/waterscience/criteria/wetlands/16Indicators.pdf>

*Descriptors:* wetlands/ ecology/ land use/ nutrient enrichment/ nutrient enrichment/ vegetation/ environmental management

**138. Wetland and water bird diversity in desert area of the Western China.**

Liu, Nai-Fa; Huang, Zu-Hao; and Wen, Long-Ying

*Wetland Science* 2(4): 259-266. (Dec. 2004)

NAL Call #: QH87.3 .S47; ISSN: 1672-5948

*Descriptors:* wetlands/ deserts/ habitat selection/ rare species/ species diversity/ ponds/ migratory species/ irrigation/ salt lakes/ ecosystem management/ conservation/ environmental protection/ water use/ Podiceps grisegena/ Aves/ Ciconia ciconia/ China, People's Rep., Qingzang Plateau/ red-necked grebe/ birds/ white stork/ habitat community studies

*Abstract:* The western part of China includes the Mongolia-Xinjiang and Qingzang Plateaus where the climate is either arid or semi-arid with low precipitation levels. Here, wetlands only exist in the depressions, overflowing zones of piedmont groundwater, and lake depressions. The area of wetlands in desert area is 96 180 km<sup>2</sup>, accounting for about 3.6% of the total land area of the Western China. In accordance with the formation, there are four types of wetlands in the desert area of the Western China, (1) wetland formed by gathering water in the basins due to the subsidence of the earth's crust, (2) glacier lake, (3) wetland formed by springs, (4) wetland formed by water withdrawn from irrigated farmland. The special natural conditions and geographical location of these wetlands have resulted in abundant species of waterfowl and play a special role the worldwide waterfowl protection. According to preliminary investigation and statistics, there are 142 species of waterfowls in above wetland as defined in "Wetland Convention", 54.8% of the total number of waterfowls in China. There are many rare and endangered species in these wetlands. These include 8 species of national first-grade protected birds, such as *Ciconia ciconia*, and 18 species of national second-grade protected birds, such as *Podiceps grisegena*. Waterbirds are protected by international convention and agreement. There are 12 species listed in "Convention on International Trade in Endangered Species of Wild Fauna and Flora" (CITES). A total of 83 species among 142 species birds are listed in the "Agreement to Protect Migratory Birds and their Habitats in China and Japan". Wetlands in the desert area of the Western China play an important role in migration,

breeding and overwinter of waterfowl. However, wetlands have been destroyed to different extents. The wetland in the desert area is ultimately developed into salt pond or desert. Important factors leading to desertification of wetlands are climate to transform into dry, irrational use of water resources and reclaiming land from marshes, resulted in considerable loss of waterfowl diversity. Therefore, for the purpose of waterfowl conservation, the wetland in the desert should be strongly conserved.

© CSA

**139. Wetland creation and restoration: Description and summary of the literature.**

Schneller-McDonald, K.; Ischinger, L. S.; and Auble, G. T.; 90(3), 1990. 198 p. Biological Report - US Fish & Wildlife Service.

NAL Call #: QH540.U562 no.90(3)

*Abstract:* Provides a hard copy of the bibliographic information contained in the US Wetland Creation/Restoration data base. -from Authors  
© 2006 Elsevier B.V. All rights reserved.

**140. Wetland ecosystem studies from a hydrological perspective.**

Labough, J. W.

*Water Resources Bulletin* 22(1): 1-10. (1986)

NAL Call #: 292.9 Am34; ISSN: 0043-1370

*Descriptors:* wetlands/ hydrologic budget/ groundwater/ review articles/ chemical budget/ input-output relationship/ biogeochemical processes/ ecosystem research/ hydrology/ ecosystems

*Abstract:* Selected studies from the literature were reviewed to determine the extent of knowledge about the relationship between hydrology and wetland ecosystem studies. Wetland studies of chemical input-output relationship have been the most dependent on hydrologic data of all wetland investigations; yet, very few of these studies have attempted to measure all components of a wetland's water balance. Usually, unmeasured components were calculated as the difference between measured inputs and outputs. Ground water was frequently overlooked. Chemical input-output investigations primarily were concerned with determining the amount of input retained in the wetlands. Few studies also included direct measurement of biogeochemical processes within wetlands of elements that were part of simultaneous input-output investigations. The importance of uncertainties in hydrologic budgets that are due to uncertainties in hydrologic budgets has been addressed in very few wetland investigations. Although many studies have emphasized the importance of hydrology to wetland ecosystem research, few studies have documented this, so that hydrology remains one of the least understood components of wetlands ecosystems. (Author's abstract)

© CSA

**141. Wetland indicators: A guide to wetland identification, delineation, classification, and mapping.**

Tiner, Ralph W.

Boca Raton, Fla.: Lewis Publishers; 392 p. (1999)

NAL Call #: GB624.T564-1999; ISBN: 0873718925

Descriptors: wetlands---United States/ wetland ecology---

United States/ plant indicators---United States

This citation is from AGRICOLA.

**142. Wetland management and conservation of rare species.**

Doust, Lesley Lovett and Doust, Jon Lovett

*Canadian Journal of Botany* 73(7): 1019-1028. (1995)

NAL Call #: 470 C16C; ISSN: 0008-4026

Descriptors: Plantae (Plantae unspecified)/ plants/ ethics/ genetics/ habitat protection/ habitat quality/ legislation

*Abstract:* The value of wetland is now widely recognized; some legislation requires 'no net loss' of wetlands, although economic incentives still exist for wetland conversion. Rare plants may be protected by law; however, wetlands are rarely managed specifically to conserve rare species. Furthermore, it is not always clear how the environment should be manipulated to increase the abundance of such species, since necessary autecological details are rarely available. Species conservation involves demographic and genetic elements, as well as ethical decisions about the merits of transplanting or importing genes through controlled pollinations. Rare species may serve as indicators of habitat quality, although this will depend on the reasons behind the species' rarity. There is a need for multiple-use management plans that incorporate species- and habitat-conservation goals and that implement overall strategies to maintain or enhance the total quantity and quality of wetlands.

© The Thomson Corporation

**143. Wetland management for shorebirds and other species: Experiences on the Canadian prairies.**

Dickson, H. Loney and McKeating, Gerald

*Transactions of the North American Wildlife and Natural Resources Conference* 58: 370-377. (1993)

NAL Call #: 412.9 N814; ISSN: 0078-1355

Descriptors: Aves/ habitat management/ semiaquatic habitat/ wetlands management/ multispecies approach/ Canada/ Alberta/ Manitoba/ Saskatchewan/ multispecies approach to wetland management/ overview

© The Thomson Corporation

**144. Wetland mercury research: A review with case studies.**

Rood, B. E.

*Current Topics in Wetland Biogeochemistry* 2: 73-108.

(1996); ISSN: 1076-4674

Descriptors: wetlands/ mercury/ case studies/ contamination/ literature review/ biogeochemistry/ literature reviews/ biogeochemical cycle/ pollution effects/ USA, Florida, Everglades/ case reports/ literature reviews/ biogeochemical cycle/ pollution effects/ case studies/ contamination/ literature review

*Abstract:* Interestingly, there is a paucity of information regarding the role that wetlands play in the regional and global cycles of mercury (Zillioux et al., 1993). Eugene Odum has said that "a healthy wetland is an indicator of a healthy watershed" (Oglethorpe Power Corporation, 1990). As such, there is a compelling need to: 1) evaluate the

status of mercury contamination in a variety of wetland types, both impacted and unimpacted by regional anthropogenic activities, 2) examine chemical and biological transformations of mercury under the unique ambient conditions associated with wetlands, and 3) reconstruct trends of mercury accumulation in wetlands preserved in the sediment record. The goals of this literature review are to provide wetland scientists with an overview of current issues and observations regarding research of environmental mercury contamination, to identify the critical need for mercury researchers to incorporate detailed wetland studies into current research, and to overview current studies of mercury in wetlands including a case study of mercury paleoecological research in the Florida Everglades.

© CSA

**145. Wetland nutrient removal: A review of the evidence.**

Fisher, J. and Acreman, M. C.

*Hydrology and Earth System Sciences* 8(4):

673-685. (2004)

NAL Call #: GB651 .H937; ISSN: 1027-5606

Descriptors: pollution load/ artificial wetlands/ nutrients/ water quality control/ marshes/ sampling/ nitrogen/ hydrologic models/ ecosystems/ swamps/ high flow/ nutrient removal/ eutrophication/ water quality control/ water treatment/ water and wastewater treatment

*Abstract:* Data from 57 wetlands from around the world have been collated to investigate whether wetlands affect the nutrient loading of waters draining through them: the majority of wetlands reduced nutrient loading and there was little difference in the proportion of wetlands that reduced N to those that reduced P loading. However, some wetlands increased nutrient loadings by increasing the loading of soluble N and P species thus potentially driving aquatic eutrophication. Studies conducted over a period of a year or more, or that involved frequent sampling during high flow events, were more likely to indicate that the wetland increased nutrient loadings. Swamps and marshes differed from riparian zones in their nutrient function characteristics by being slightly more effective at nutrient reduction than riparian zones. The attributes that enable wetlands to be effective in reducing N and P loadings need consideration when constructing or managing wetlands to reduce nutrient loadings. Their wise use will be an important strategy for meeting the Water Framework Directive requirements for many water bodies.

© CSA

**146. Wetland plants: More than just a pretty face?**

Nuttall, C. A.

*Land Contamination & Reclamation* 11(2): 173-180. (2003);

ISSN: 0967-0513

Descriptors: aesthetic value/ aluminium/ aquatic plants/ artificial wetlands/ habitats/ iron/ manganese/ microbial activities/ organic matter/ polluted water/ reviews/ water quality/ Eriophorum/ Phragmites australis/ plants/ Typha latifolia/ Vallisneria americana/ Eriophorum angustifolium/ water treatment/ Cyperaceae/ Cyperales/ monocotyledons/ angiosperms/ Spermatophyta/ plants/ Eriophorum/ Phragmites/ Poaceae/ Typha/ Typhaceae/ Typhales/ Vallisneria/ Hydrocharitaceae/ Hydrocharitales

**Abstract:** Plants are an integral part of wetlands constructed to treat contaminated waters, including those emanating from abandoned mines and their associated spoil heaps. It has become generally accepted that, although plants provide an aesthetic covering to wetlands, they do not play an important role in the remediative processes that occur within the wetland system. Rather the geochemical and microbiological processes that convert soluble metals into immobile forms are by far the most important constituents of the wetlands. We have provided a detailed review of the current knowledge of plant growth within wetlands and the possible roles that they perform in the treatment of mine waters. It is evident from the literature that plants add significantly to the performance of wetland systems through a variety of means. These include the addition of organic matter (maintaining the carbon source for microorganisms), stabilization of sediment surfaces, maintenance of flow patterns, and surfaces for microbial activity. In addition, recent research has shown that in systems receiving low concentrations of metals, as occurs in 'polishing wetlands', plants may actually constitute an important sink for metals. In this situation the majority of metals (iron, manganese and aluminium) are precipitated around root surfaces as plaque deposits, which has important implications for the cycling of metals within these systems. The concentrations of metals in root plaque extracts in field-grown wetland plant species (viz., *Eriophorum angustifolium*, *Phragmites australis*, *Typha latifolia* and *Vallisneria americana*) are given. Finally, plants may also provide a vital resource for other wildlife and as such can encourage the inhabitation of treatment wetlands by invertebrates, birds and mammals. Thus plants as part of treatment wetlands are certainly more than just a pretty face.

© CAB International/CABI Publishing

**147. Wetland rice soils as sources and sinks of methane: A review and prospects for research.** Kumaraswamy, S.; Rath, A. K.; Ramakrishnan, B.; and Sethunathan, N.

*Biology and Fertility of Soils* 31(6): 449-461. (2000)  
NAL Call #: QH84.8.B46; ISSN: 0178-2762

**Descriptors:** flooded rice/ rice soils/ paddy soils/ soil bacteria/ anaerobes/ methane production/ methane/ oxidation/ emission/ *oryza sativa*/ roots/ pollution control/ fertilizers/ pesticides/ nitrification inhibitors/ community ecology/ biological activity in soil/ literature reviews/ methanotrophy

This citation is from AGRICOLA.

**148. Wetlands.**

Mitsch, William J. and Gosselink, James G.  
New York: John Wiley (3rd); xiii, 920 p.: ill., maps; 26 cm. (2000)

NAL Call #: QH104 .M57 2000; ISBN: 047129232X

**Descriptors:** wetland ecology---United States/ wetlands---United States/ wetland management---United States

This citation is from AGRICOLA.

**149. Wetlands: An overview in relation to conservation strategy.**

Wanganeo, A. and Wanganeo, R.

*Nature, Environment and Pollution Technology* 3(3): 307-316. (2004); ISSN: 0972-6268

**Descriptors:** wetlands/ conservation/ municipal wastes/ fodder/ foods/ niches/ wastewater pollution/ municipal wastewater/ sluices/ literature reviews/ habitat improvement/ environmental protection/ classification/ wastewater treatment/ water pollution/ wastes/ vulnerability/ biodiversity/ techniques of planning/ water Resources and supplies/ habitat community studies/ conservation, wildlife management and recreation/ water and wastewater treatment

**Abstract:** In spite of the global attention currently focused on the wetlands there is no recognizable conservation strategy or any law governing their management. These highly productive ecological niches supporting rich biodiversity have been perceived as future resources of food and fodder. Their quality of ameliorating pollution has made them more vulnerable as these systems are also treated as places for tertiary treatment of municipal wastewater besides other wastes. Since no logical segregation of these systems has been done as such, a lot of confusion has been created as to what is their main function and how these systems should be categorized. Present paper categorizes wetlands into three categories viz., Douse, Sluice and Plashy types for their better utilization, management and conservation.

© CSA

**150. Wetlands and water quality: A regional review of recent research in the United States on the role of freshwater and saltwater wetlands as sources, sinks, and transformers of nitrogen, phosphorus, and various heavy metals.**

Nixon, S. W. and Lee, V.

Vicksburg, Miss. Army Corps of Engineers, Waterways Experiment Station, 1986. 229 p. Technical Report.

**Descriptors:** wetlands/ water quality/ limnology/ estuaries/ saline water/ sinks/ nitrogen/ phosphorus/ heavy metals/ literature review/ nutrients

**Abstract:** This report is the first in a series of four literature reviews on wetland functions and values. Each review covers one of the following four broad wetlands functions and values: (1) water quality, (2) fish and wildlife habitat, (3) socioeconomics, and (4) hydraulics. The four reports, along with other information, were used to develop a multiyear wetlands functions and values research study plan implemented by the US Army Engineer Waterways Experiment Station. This report examines the literature on water quality functions of wetlands. Study results indicated considerable diversity in the quantity and quality of wetlands water quality literature between and within each geographic region of the coterminous United States and Alaska. In general, wetlands water quality has been studied most intensely in the estuarine marshes of the Gulf and North Atlantic coasts. Water quality in freshwater wetlands has not received attention commensurate with the wide distribution of these wetland types. Most previous wetlands water quality research has been fragmented into site-specific or function-specific studies. Very few mass balance studies have been conducted. Two complementary approaches to addressing wetlands water quality research data gaps are recommended. The first approach is to

develop mass balances or budgets of carbon, nutrients, heavy metals, and other possible pollutants. The mass balance studies should be determined at carefully selected field sites over several annual cycles. The second approach would focus on the design, construction, and use of experimental wetland microcosms. The microcosms would permit assessment of the fates and effects of various materials under highly controlled conditions. (Lantz-PTT) © CSA

**151. Wetlands classification.**

Detenbeck, Naomi Elizabeth.; United States. Environmental Protection Agency. Office of Science and Technology; and United States. Environmental Protection Agency. Office of Wetlands, Oceans and Watersheds.

In: *Methods for evaluating wetland condition*; Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, 2002.

*Notes:* Original title: *Wetlands classification (#7)*; Title from web page. "March 2002." "EPA-822-R-02-017." "Prepared jointly by the U.S. Environmental Protection Agency, Health and Ecological Criteria Division (Office of Science and Technology) and Wetlands Division Office." Description based on content viewed April 10, 2003. Includes bibliographical references.

NAL Call #: QH541.5.M3 D47 2002

<http://www.epa.gov/waterscience/criteria/wetlands/7Classification.pdf>

*Descriptors:* wetlands---United States/ wetlands---United States---classification

This citation is from AGRICOLA.

**152. Wetlands: History, current status, and future.**

Hook, D. D.

*Environmental Toxicology and Chemistry* 12(12): 2157-2166. (Dec. 1993)

NAL Call #: QH545.A1E58; ISSN: 0730-7268 [ETOCDK].

*Notes:* Annual Review Issue: *Wetland Ecotoxicology and Chemistry*. Includes references.

*Descriptors:* wetlands/ bogs/ fens/ moorland/ history/ uses/ environmental protection/ projections/ literature reviews

This citation is from AGRICOLA.

**153. Wetlands losses in the United States, 1780's to 1980's.**

Dahl, Thomas E.

Washington, D.C.: U.S. Dept. of the Interior, Fish and Wildlife Service, 1990. 13 p.

NAL Call #: QH76.D33 1990

<http://www.npwrc.usgs.gov/resource/wetlands/wetloss/wetloss.htm>

*Descriptors:* wetland conservation---United States/ wetlands---United States

This citation is from AGRICOLA.

**154. Wetlands of Central America.**

Ellison, Aaron M.

*Wetlands Ecology and Management* 12(1): 3-55. (2004)

NAL Call #: QH541.5.M3 W472; ISSN: 0923-4861

*Descriptors:* conservation/ estuarine ecology: ecology, environmental sciences/ freshwater ecology: ecology, environmental sciences/ marine ecology: ecology, environmental sciences/ Ramsar Convention on Wetlands of International Importance/ biological diversity support/ cultural framework/ development pressures/ ecological

research/ essential ecosystem services/ estuarine wetlands/ forest land conversion/ integrated planning/ intensive deforestation/ lacustrine wetlands/ marine wetlands/ palustrine wetlands/ population pressures/ primary productivity/ riverine wetlands/ social framework/ water quality maintenance/ wetland inventory/ wetland losses/ wetland management/ wetland refugia/ wetlands ecology

*Abstract:* The wetlands of seven Central American countries - Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama - are reviewed. The region's wetlands are classified into five systems: marine, estuarine, riverine, lacustrine, and palustrine. At a minimum, wetlands cover approximately 40,000 km<sup>2</sup> (approximately 8%) of the land area of Central America. These wetlands support high levels of biological diversity, especially of invertebrates, amphibians, and migratory birds. Because of intensive deforestation and conversion of forest lands to agriculture, many species of birds and mammals that formerly were abundant in upland forests now are restricted to wetland refugia. Annual primary productivity of some Central American wetlands equals or exceeds that of tropical rainforests, and wetlands also provide essential ecosystem services such as maintaining water quality. Population and development pressures formerly restricted to upland areas are expanding rapidly into wetlands, resulting in losses of wetlands at rates comparable to losses of rainforests. Since 1990, all seven Central American countries have become signatories to the Ramsar convention on wetlands of international importance, but integrated planning for management and conservation of wetlands in the region only began in 2002. A specific set of recommendations for wetland inventory, ecological research, and management is provided that would be feasible and effective within the social and cultural framework of the Central American countries.

© The Thomson Corporation

**155. Wetlands of the United States: Current status and recent trends.**

Tiner, R. W.

Washington D.C.: U.S. Government Printing Office, 1984.

NAL Call #: QH76.W48

*Descriptors:* wetlands/ marshes/ salt marshes/ conservation/ coastal zone management/ nature conservation/ USA

*Abstract:* This report identifies the current status of U.S. wetlands and major areas where wetlands are in greatest jeopardy from the national standpoint. It also presents existing regional and national information of wetland trends. The report is divided into six chapters: (1) Introduction, (2) What is a Wetland?, (3) Major Wetland Types of the United States, (4) Why are Wetlands Important?, (5) Current status and Trends of U.S. Wetlands, and (6) The Future of America's Wetlands. Wetlands include the variety of marshes, swamps and bogs that occur throughout the country. They range from red maple swamps and black spruce bogs in the northern states to salt marshes along the coasts to bottomland hardwood forests in the southern states to prairie potholes in the Midwest to playa lakes and riparian wetlands in the western states to the wet tundra of Alaska. The future of the Nation's wetlands depends on the actions of public agencies, private industry, and private groups and individuals. Recent population and agricultural trends point to increased pressure for converting wetlands

to other use, especially cropland. Increased wetland protection efforts by all levels of government and by private parties are needed to halt or slow wetland losses and to enhance the quality of the remaining wetlands.  
© CSA

**156. Wetlands of the world: Inventory, ecology and management.**

Whigham, Dennis F.; Dykyjova, Dagmar; and Hejny, Slavomil  
Dordrecht: Kluwer Academic; Series: Handbook of vegetation science 15/2; 768 p. (1993)  
*Notes:* Covers: Africa, Australia, Canada, Greenland, Mediterranean, Mexico, Papua New Guinea, South Asia, tropical South America, United States.  
*NAL Call #:* QK911 .A1H3 v. 15/2; *ISBN:* 0792316851  
*Descriptors:* wetlands/ inventory/ wetland management/ wetland ecology

**157. Wildlife responses to wetland restoration and creation: An annotated bibliography.**

Rewa, C.  
In: A comprehensive review of Farm Bill contributions wildlife conservation, 1985-2000/ Heard, L. P.; Hohman, W. L.; Halloum, D. J.; and Wildlife Habitat Management Institute (U.S.); Series: Technical Report USDA/NRCS/WHMI.  
Madison, MS: USDA, NRCS, Wildlife Habitat Management Institute, 2000; pp. 135-150  
*NAL Call #:* aS604.6 .C66 2000  
*Descriptors:* wetlands/ constructed wetlands/ water quality/ wildlife habitats

## Effects of Agricultural Conservation Practices on Wetlands

**158. Agricultural activities affecting the functions and values of Ramsar wetland sites of Greece.**

Gerakis, A. and Kalburtji, K.  
*Agriculture, Ecosystems & Environment* 70(2-3): 119-128. (Oct. 1998)  
*NAL Call #:* S601.A34; *ISSN:* 0167-8809  
*Descriptors:* wetlands/ Greece/ agricultural practices/ environmental effects/ nutrients/ hydrology/ groundwater/ sedimentation/ flood control/ irrigation/ ecosystem management/ agriculture/ sustainable development/ nature conservation/ environment management/ federal policies/ agricultural runoff/ environmental impact/ sediment pollution/ eutrophication/ effects on water of human nonwater activities/ management/ environmental action/ mechanical and natural changes  
*Abstract:* Agricultural activities in the agroecosystems neighbouring wetland ecosystems are considered a major threat to the latter in all Mediterranean countries. This threat was investigated in thirteen internationally important wetland sites (Ramsar sites) of Greece. The effects of ten activities commonly practised in the surrounding agroecosystems on four wetland functions and four wetland values were evaluated. The functions were: nutrient removal/transformation, sediment/toxicant retention, flood flow alteration, and ground water discharge. The values were: biodiversity, fishing, hunting, and recreation. It was found that the Adamus' Wetland Evaluation Technique is useful even in the little studied Ramsar sites of Greece. Irrigation is the most decisive activity negatively influencing all functions and values, followed by cropland expansion and overgrazing. Coastal lagoons are the least affected by agricultural activities. It is concluded that in Greece the sustainability of wetland ecosystems depends to a significant degree on the sustainability of agroecosystems. The reverse is also true because wetlands provide irrigation water, crop pollinators, some frost protection, and predators of crop pests. The two ecosystem types are functionally closely linked. Therefore, a national policy for the sustainable development of the soil, water, and genetic resources of Greece must integratively consider both these ecosystems types.  
© CSA

**159. Agricultural impacts on Mediterranean wetlands: The effect of pesticides on survival and hatching rates in copepods.**

Parra, G.; Jimenez-Melero, R.; and Guerrero, F.  
*Annales de Limnologie* 41(3): 161-167. (2005)  
*NAL Call #:* QH98.A1A5; *ISSN:* 0003-4088  
*Descriptors:* wetlands/ agriculture/ pesticides/ copper compounds/ water quality/ mortality/ herbicides/ trees/ aquatic organisms/ toxicology/ reproduction/ pollution tolerance/ Copepoda/ Arctodiaptomus salinus/ Olea europaea/ western Mediterranean/ copepods  
*Abstract:* Wetlands are one of the most altered natural systems due to the creation and development of agricultural landscapes. Some of agriculture's impacts are in relation to water quality decreases, due to the use of potentially toxic herbicides or pesticides, and they are responsible of ecological alterations. This study shows the negative effect that two pesticides generate in a population of the copepod *Arctodiaptomus salinus* in an aquatic ecosystem that is surrounded by intensive olive tree cultivation. Adult females and egg sacs of that calanoid copepod were exposed to different concentrations of copper sulphate and the pesticide dimethoate, to examine their tolerance response. The adult lethal concentration obtained was lower than the regular dose of pesticide used in olive agriculture. These results also reflect the negative effect over *A. salinus* secondary production as a consequence of the increase in females and nauplii mortality and by the hatching rate reduction.  
© CSA

**160. Agricultural inputs of mecoprop to a salt marsh system: Its fate and distribution within the sediment profile.**

Fletcher, C. A.; Bubb, J. M.; and Lester, J. N.  
*Marine Pollution Bulletin* 30(12): 803-811. (1995)  
*NAL Call #:* GC1000.M3; *ISSN:* 0025-326X  
*Descriptors:* salt marshes/ sediment pollution/ agricultural runoff/ agricultural pollution/ herbicides/ pollution effects/ coast defences/ drainage water/ nonpoint pollution sources/ fate of pollutants/ agricultural chemicals/ British Isles, England, Essex/ mecoprop/ nonpoint pollution sources/ fate

of pollutants/ agricultural chemicals/ coast defences/ drainage water/ sediment pollution/ agricultural pollution/ pollution effects

*Abstract:* The mass of mecoprop discharged in agricultural drainage waters directly onto a salt marsh has been determined and the subsequent fate and distribution of mecoprop within the vegetated and mud flat sediments investigated. The results show the leaching of high mecoprop concentrations from the agricultural soils following heavy rain, with peak concentrations in drainage waters preceding peak water discharges. A direct increase in mecoprop concentration within salt marsh sediments was also identified and, consequently, a preliminary evaluation of the potential threat of the mecoprop loadings to the indigenous biota of the dynamic salt marsh system was made.

© CSA

**161. Agriculture and wildlife: Ecological implications of subsurface irrigation drainage.**

Lemly, A. Dennis

*Journal of Arid Environments* 28(2): 85-94. (1994)

NAL Call #: QH541.5.D4J6; ISSN: 0140-1963

*Descriptors:* farming and agriculture/ subsurface irrigation drainage impact on wetland fauna/ semiaquatic habitat/ subsurface agricultural irrigation drainage impact on fauna/ chemical pollution/ subsurface agricultural irrigation drainage impact on wetlands/ USA/ West/ subsurface agricultural irrigation drainage impact on wetland fauna/ review

© The Thomson Corporation

**162. Aquaculture impacts on the water quality and plankton community in a mangrove ecosystem in Brazil.**

Neumann Leitao, S.; Feitosa, F. A. N.; Moura, M. C. O.; Flores Montes, M. J.; Muniz, K.; Silva Cunha, M. G. G.; and Paranagua, M. N.

*Advances in Ecological Sciences* 18: 161-171. (2003)

NAL Call #: QH540.167; ISSN: 1369-8273

*Descriptors:* animals and man/ disturbance by man/ commercial activities/ ecology/ habitat/ brackish habitat/ marine zones/ Atlantic Ocean/ South Atlantic/ comprehensive zoology: farming and agriculture/ aquaculture/ plankton community structure effect/ community structure/ plankton/ mangrove swamp/ south west Atlantic/ Brazil/ Pernambuco/ Goias/ plankton community structure/ effect of aquaculture/ mangrove

© The Thomson Corporation

**163. Artificial drainage of peatlands: Hydrological and hydrochemical process and wetland restoration.**

Holden, J.; Chapman, P. J.; and Labadz, J. C.

*Progress in Physical Geography* 28(1): 95-123. (2004);

ISSN: 0309-1333

*Descriptors:* drainage/ peat/ catchment areas/ geography/ hydrologic budget/ forestry/ floods/ attitudes/ ecosystems/ artificial wetlands/ risk

*Abstract:* Peatlands have been subject to artificial drainage for centuries. This drainage has been in response to agricultural demand, forestry, horticultural and energy properties of peat and alleviation of flood risk. However, there are several environmental problems associated with drainage of peatlands. This paper describes the nature of these problems and examines the evidence for changes in

hydrological and hydrochemical processes associated with these changes. Traditional black-box water balance approaches demonstrate little about wetland dynamics and therefore the science of catchment response to peat drainage is poorly understood. It is crucial that a more process-based approach be adopted within peatland ecosystems. The environmental problems associated with peat drainage have led, in part, to a recent reversal in attitudes to peatlands and we have seen a move towards wetland restoration. However, a detailed understanding of hydrological, hydrochemical and ecological process-interactions will be fundamental if we are to adequately restore degraded peatlands, preserve those that are still intact and understand the impacts of such management actions at the catchment scale.

© CSA

**164. Bacteria as bioindicators in wetlands: Bioassessment in the Bonneville Basin Of Utah, USA.**

Merkley, M.; Rader, R. B.; McArthur, J. V.; and Eggett, D.

*Wetlands* 24(3): 600-607. (Sept. 2004)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

*Descriptors:* wetlands/ marshes/ basins/ biodegradation/ genetic analysis/ indicator species/ grazing/ surface area/ comparative studies/ analytical techniques/ genetics/ bioassays/ degradation/ man-induced effects/ anthropogenic factors/ genetic diversity/ species diversity/ bacteria/ biodiversity/ organic compounds/ substrates/ ecosystems/ bioindicators/ USA, Utah, Bonneville Basin/ microorganisms/ ecological techniques and apparatus/ mechanical and natural changes/ identification of pollutants/ water pollution: monitoring, control & remediation/ habitat community studies

*Abstract:* Bacteria should be excellent indicators of the early signs of degradation caused by human intervention because they have the highest surface area to volume ratio of all organisms. We determined the utility of a simple procedure that measures aerobic bacterial metabolic diversity (BILOG EcoPlates) as a reliable tool for assessing the effects of cattle grazing on spring ecosystems of the Bonneville Basin, Utah, USA. Marshes disturbed by cattle could be distinguished from protected marshes using EcoPlate analyses. The diversity of organic compounds used by bacteria was greater in grazed versus ungrazed marshes. A separate genetic analysis (DGGE) provided corroborating evidence. Greater metabolic diversity (EcoPlates) corresponded to greater bacterial assemblage diversity in grazed versus protected marshes. Greater plant diversity at grazed sites might account for the greater diversity of organic substrates used by bacteria in grazed sites. However, the results were not conclusive. In some marshes, a greater diversity of organic substrate use occurred where there was greater plant diversity, whereas in other marshes the diversity of organic substrates used by bacteria was lower where plant diversity was greatest. Regardless of the mechanism, aerobic bacterial metabolic diversity (EcoPlates) is a potentially valuable tool for assessing the early signs of degradation in wetland ecosystems.

© CSA

**165. Bioassays with a floating aquatic plant (Lemna minor) for effects of sprayed and dissolved glyphosate.**

Lockhart, W. L.; Billeck, B. N.; and Baron, C. L.

*Hydrobiologia* 188/89: 353-359. (1989)

NAL Call #: 410 H992; ISSN: 0018-8158

**Descriptors:** agricultural runoff/ aquatic plants/ bioassay/ duckweed/ glyphosate/ herbicides/ toxicity/ water pollution effects/ agricultural chemicals/ Canada/ prairie wetlands  
**Abstract:** Macrophytes in forested areas and in prairie wetlands furnish critical habitat for aquatic communities and for several species of birds and mammals. North American agriculture relies heavily on herbicides and these compounds are detected routinely in surface waters of Western Canada. Common duckweed has been used previously in efforts to detect effects of herbicides and other chemicals. Duckweed clones were developed from local collections and grown axenically. The plants were exposed to glyphosate herbicide either by dissolving formulated Roundup (Monsanto Canada Inc.) in the culture media or by spraying of the cultures in a laboratory spray chamber. Plant growth was monitored by counting the fronds present on several occasions over a 2-week period. Plant growth, as measured by increased numbers of fronds or increased wet or dry weights was relatively insensitive to glyphosate dissolved in the culture medium. However, the plants were killed by application of glyphosate as a spray. (Author's abstract)

© CSA

**166. Bird communities of prairie uplands and wetlands in relation to farming practices in Saskatchewan.**

Shutler, D.; Mullie, A.; and Clark, R. G.

*Conservation Biology* 14(5): 1441-1451. (Oct. 2000)

NAL Call #: QH75.A1C5; ISSN: 0888-8892

**Descriptors:** wetlands/ agricultural practices/ community composition/ prairies/ conservation/ agriculture/ chemical control/ man-induced effects/ ecological distribution/ habitat selection/ aquatic birds/ Aves/ Canada, Saskatchewan/ birds/ agricultural practices/ conservation/ behaviour  
**Abstract:** Modern farm practices can vary in their emphasis on tillage versus chemicals to control weeds, and researchers know little about which emphasis has greater ecological benefits. We compared avifaunas of uplands and wetlands in four treatments: conventional farms, conservation farms (contrasting those that minimized frequency of tillage [minimum tillage] with those that eliminated chemical inputs [organic]), and restored or natural (wild) sites in Saskatchewan, Canada. Of 37 different upland bird species encountered during surveys, one made greater use of farms, four made greater use of wild sites, and the remaining species showed no preference. When all upland species were combined, higher relative abundance occurred on wild than on farm sites, and on minimum tillage than on conventional farms. Wild upland sites also had more species than did conventional farms. Of 79 different species encountered during surveys of wetlands and their margins, most had similar encounter probabilities among treatments, although seven were more common on either organic farms or wild sites. Higher relative abundances were documented in wetland habitat of wild sites and organic farms than of minimum tillage or conventional farms. Wetlands of wild sites had more species than did minimum tillage or conventional farms. Overall, in terms of both avifaunal density and diversity, small treatment effects could be

ascribed to differences between conventional and conservation farms, whereas larger effects were due to differences between farms and wild sites. Wetlands were heavily used by birds in all treatments, suggesting high conservation priority regardless of context.

© CSA

**167. Carbon and N mineralization as affected by soil cultivation and crop residue in a calcareous wetland ecosystem in Central Iran.**

Raiesi, F.

*Agriculture, Ecosystems & Environment* 112(1): 13-20. (Jan. 2006)

NAL Call #: S601 .A34; ISSN: 0167-8809

**Descriptors:** mineralization/ soil microorganisms/ tillage/ carbon nitrogen ratio/ wetland soils/ ecosystems/ carbon/ nitrogen/ calcareous soils/ soil analysis/ soil nutrient balance/ Iran

**Abstract:** Mineralization of soil organic matter plays a key role in supplying nutrient elements essential to plant growth. Soil cultivation and crop residue affect C mineralization and nutrient availability in wetland ecosystems. This study evaluated the combined impacts of soil cultivation and crop residue on C and N mineralization in a calcareous wetland soil (Luvic Calcisol) in Central Iran. Soil samples were collected from 0 to 15 cm depth in cultivated and uncultivated plots and analyzed for selected soil attributes. Wheat (*Triticum aestivum* L.) and alfalfa (*Medicago sativa* L.) residues were collected and analyzed for the chemical composition. Nitrogen and C mineralization rates were studied using laboratory incubations for 60 days. Results show that in this calcareous wetland soil, cultivation decreased soil total organic carbon and total N contents, while total organic carbon/total N ratio, bulk density, pH, and extractable P and available K levels remain unaffected. Cultivation resulted in a significant increase in soil C and N mineralization. Wheat residue had a significantly lower quality than alfalfa residue, and therefore decomposed more slowly. Results also indicate that plant residue has a significant impact on decomposition rate and nutrient cycling. Soil cultivation and residue quality had a significant influence on C and N cycling and nutrient contents. The combined effects of soil cultivation and crop residue play a significant role in changing the nutrient balance and availability in calcareous wetland soils with conventional agricultural practices. In summary, significant differences occurred in soil attributes and residue decomposition affecting C and nutrient dynamics, and therefore crop productivity.

This citation is from AGRICOLA.

**168. Changes in some physical and chemical characteristics of peat following reseeded and grazing.**

Williams, B. L.; Boggie, R.; Cooper, J.; and Mitchell, J. W.

*Irish Journal of Agricultural Research* 24(2/3): 229-236. (1985)

NAL Call #: 10.5 IR45; ISSN: 0578-7483

**Descriptors:** peat soils/ peatlands/ physicochemical properties/ shrinkage/ soil compaction/ soil profiles/ bogs/ islands/ grazing/ Ireland

This citation is from AGRICOLA.

**169. Changes in water and physical properties of peaty-bog soils induced by drainage and agricultural use.**

Baranovskii, A. Z.

*Eurasian Soil Science* 31(4): 418-421. (1998)

NAL Call #: S590.P612; ISSN: 1064-2293

*Descriptors:* physical properties/ peat bogs/ soil water/ drainage/ agriculture/ cultivated lands/ moisture content

*Abstract:* Twenty-four years of soil cultivation resulted in the following wastes of organic matter: 104 t/ha for permanent herbs; 159 t/ha for cereal crops; 168 t/ha for intertilled crops; 131 t/ha for crop rotation; and 110 t/ha for virgin lands. The depth of the peat deposit was reduced by 16.8, 29.5, 31.7, 29.1, and 17.9 cm, respectively. Wastes of soil organic matter were reduced together with the depth of peat under the herbs and increased under the crops. The outstripping effect of drainage and cultivation affected peat water and physical properties. The ash content and compaction of peat were raised significantly, while its water-holding capacity decreased.

© CSA

**170. Community attributes of Atlantic white cedar (*Chamaecyparis thyoides*) swamps in disturbed and undisturbed pinelands watersheds.**

Laidig, Kim J. and Zampella, Robert A.

*Wetlands* 19(1): 35-49. (1999)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

*Descriptors:* biodiversity/ biogeography: population studies/ conservation/ freshwater ecology: ecology, environmental sciences/ agricultural development/ biological invasion/ overbank flooding/ phytogeography/ pineland watershed disturbance/ plant community attributes/ plant species composition/ residential development/ seedbed conditions/ seedling density/ species richness/ surface water conditions: nutrient concentration, ph, specific conductance/ understory composition/ wetlands habitat/ Atlantic white cedar swamp

*Abstract:* We assessed the effect of regional watershed conditions on plant community attributes, seedbed and seedling density, and environmental conditions in New Jersey Pinelands Atlantic white cedar (*Chamaecyparis thyoides*) swamps under three disturbance regimes (high, moderate, and low). High regional watershed disturbance, defined by the percentage basin cover of combined residential and agricultural development, was associated with elevated pH, specific conductance, and nutrient concentrations in surface waters adjacent to our study sites. High disturbance sites generally had lower understory species richness and differed from other sites in overall understory species composition. High canopy red maple (*Acer rubrum*) cover and high canopy closure were also associated with swamps in high disturbance basins. Because other environmental variables did not differ significantly between disturbance types and red maple is a common associate of cedar throughout the Pinelands, differences in species richness and composition may be related to canopy conditions rather than the effects of watershed disturbance. Regional differences in biogeography may also be a factor. We found no exotic species in our study sites. Only one species considered uncharacteristic of the Pinelands was associated with high disturbance basin sites. Unlike previous, similar studies in the Pinelands, the high disturbance sites did not support a unique group of plants. Although Sphagnum cover (typically associated with optimal cedar seedbed conditions) was

lowest in disturbed basin sites, there were no significant differences in overall seedbed conditions and cedar seedling density. Cedar swamps located a distance from upgradient watershed disturbances and not affected by overbank flooding seem to be buffered from the impacts of these regional disturbances.

© The Thomson Corporation

**171. Conservation of Mediterranean temporary ponds under agricultural intensification: An evaluation using amphibians.**

Beja, P. and Alcazar, R.

*Biological Conservation* 114(3): 317-326. (2003)

NAL Call #: S900.B5; ISSN: 0006-3207

*Descriptors:* abundance/ crayfish/ exotic species/ fish/ habitat modeling/ hydroperiod/ irrigation/ reservoirs/ species richness/ tadpoles/ Amphibia/ forestry/ agriculture/ conservation/ intercontinental region/ Mediterranean Region/ *Triturus marmoratus*/ insertae/ sedis/ *Triturus boscai*/ *Pelobatidae*/ *Elodytes punctatus*

*Abstract:* This study examined responses of amphibians breeding in Mediterranean temporary ponds to a gradient of agricultural intensification, aiming to identify land uses and management prescriptions favouring the conservation of these habitats in farmed landscapes. Larval amphibian assemblages and habitat attributes were sampled at 57 ponds, 10 of which had been converted into permanent irrigation reservoirs. Species richness increased with area and hydroperiod in temporary ponds, with the addition of rare species to ponds with long hydroperiods resulting in a tendency for the less widespread species (e.g. *Triturus marmoratus* and *T. boscai*) to occur in the most species-rich ponds, while species-poor ponds consisted predominantly of widespread species only (nested pattern). However, one species (*Pelodytes punctatus*) was largely restricted to the most ephemeral ponds, whereas permanent irrigation reservoirs were species-poor and lacked most species occurring in temporary waters. The strongest negative correlates of amphibian abundances were the intensification of agricultural land uses, the transformation of ponds into permanent reservoirs and the introduction of exotic predators (fish and crayfish) from the irrigation channels. The results suggest that conservation of temporary pond amphibian assemblages in Mediterranean farmland requires networks of ponds with diverse hydroperiods, where the natural hydrologic regimes, less intensive land uses and isolation from irrigation waters should be preserved.

© NISC

**172. Degradation of persistent herbicides in riparian wetlands.**

Stoeckel, D. M.; Mudd, E. C.; and Entry, J. A.

In: Phytoremediation of soil and water contaminants/ Kruger, E. L.; Anderson, T. A.; and Coats, J. R.; Series: ACS symposium series 664.

Washington, DC: American Chemical Society, 1997; pp. 114-132.

*Notes:* Conference: 212. National Meeting of the American Chemical Society, Orlando, FL (USA), 25-29 Aug 1996

NAL Call #: QD1.A45 no.664

*Descriptors:* wetlands/ herbicides/ riparian environments/ atrazine/ trifluralin/ agrochemicals/ phytoremediation/ biodegradation/ agricultural chemicals/ riparian land/ agricultural practices/ trifluralin/ fluometuron/ agricultural

chemicals/ riparian land/ agricultural practices/ riparian environments/ agrochemicals/ phytoremediation  
**Abstract:** Modern agricultural practices make extensive use of herbicides to increase crop yields. Persistent herbicides (recalcitrant to degradation) are often preferentially used for season-long protection. The persistence of these herbicides makes them environmentally hazardous if they leach or are carried by surface runoff and erosion to pollute surface- or ground-waters. Three heavily used persistent herbicides are presented for illustration: atrazine (a triazine), fluometuron (a substituted urea), and trifluralin (a dinitroaniline). Vegetated border strips between agricultural fields and adjoining streams are sometimes cleared and protected from flooding to increase the amount of cultivable land. These areas, left in their natural state as seasonally-flooded riparian wetlands, contain micro-environments conducive to immobilization and degradation of persistent herbicides. While natural riparian wetlands should not be used to treat point-source herbicide pollutants, the literature indicates that maintenance of riparian wetlands can help to slow migration of and to enhance degradation of herbicides from non-point sources.

© CSA

**173. Destruction of wetlands and waterbird populations by dams and irrigation on the Murrumbidgee River in arid Australia.**

Kingsford, R. T. and Thomas, R. F.

*Environmental Management* 34(3): 383-396. (2004)

NAL Call #: HC79.E5E5; ISSN: 0364-152X

**Descriptors:** channels/ dams/ floodplain development/ floodplain vegetation communities/ hydroelectricity/ irrigation/ levee banks/ river diversions/ water resource development: ecological consequences/ wetlands destruction

**Abstract:** The Lowbidgee floodplain is the Murrumbidgee River's major wetland in southeastern Australia. From more than 300,000 ha in the early 1900s, at least 76.5% was destroyed (58%) or degraded (18%) by dams (26 major storages), subsequent diversions and floodplain development. Diversions of about 2,144,000 ML year<sup>-1</sup> from the Murrumbidgee River come from a natural median flow of about 3,380,000 ML year<sup>-1</sup> providing water for Australia's capital, hydroelectricity, and 273,000 ha of irrigation. Diversions have reduced the amount of water reaching the Lowbidgee floodplain by at least 60%, from 1888 to 1998. About 97,000 ha of Lowbidgee wetland was destroyed by development of the floodplain for an irrigation area (1975-1998), including building of 394 km of channels and 2,145 km of levee banks. Over 19 years (1983-2001), waterbird numbers estimated during annual aerial surveys collapsed by 90%, from an average of 139,939 (1983-1986) to 14,170 (1998-2001). Similar declines occurred across all functional groups: piscivores (82%), herbivores (87%), ducks and small grebe species (90%), large wading birds (91%), and small wading birds (95%), indicating a similar decline in the aquatic biota that formed their food base. Numbers of species also declined significantly by 21%. The Lowbidgee floodplain is an example of the ecological consequences of water resource development. Yanga Nature Reserve, within the Lowbidgee floodplain, conserved for its floodplain vegetation communities, will

lose these communities because of insufficient water. Until conservation policies adequately protect river flows to important wetland areas, examples such as the Lowbidgee will continue to occur around the world.

© The Thomson Corporation

**174. Diatoms as indicators of wetland salinity in the Upper South East of South Australia.**

Taffs, K. H.

*Holocene* 11(3): 281-290. (2001); ISSN: 0959-6836

**Descriptors:** wetlands/ agricultural inputs/ diatoms/ European settlement/ human impact/ palaeoecology/ salinity/ South Australia/ Australia, Upper South East

**Abstract:** Wetland degradation in the Upper South East of South Australia is an urgent management concern. Scant recent environmental data is available for the region and long-term monitoring data is lacking. Usually a palaeoecological analysis is able to reveal environmental change in the medium- to long-term past. However, the region is not conducive to palaeoecological investigation due to a fluctuating upper groundwater aquifer and alkaline soils which have destroyed most microfossils. It was found that the diatom assemblage was preserved in the wetlands of the region for the period of European settlement.

Analysis of the diatom assemblage enabled production of an inferred salinity curve. In combination with a small amount of historical information that was available, the salinity trend for the wetlands, for the period of European agricultural activities, was identified. It was found that, while groundwater salinity has been increasing, the wetland areas have experienced a freshening of surface water. This is due to an increase of throughflow of surface water, a result of constructed drainage systems flushing salts from the wetlands. Despite the freshening of wetlands they continue to degrade due to the changed hydrology, an impact of the drainage structures.

© 2006 Elsevier B.V. All rights reserved.

**175. Diffuse geographic distribution of herbicides in northern prairie wetlands.**

Donald, D. B.; Gurprasad, N. P.; Quinnett-Abbott, L.; and Cash, K.

*Environmental Toxicology and Chemistry* 20(2): 273-279. (2001)

NAL Call #: QH545.A1E58; ISSN: 0730-7268

**Descriptors:** wetlands/ herbicides/ pollution surveys/ agricultural pollution/ evapotranspiration/ pollution effects/ path of pollutants/ prairies/ agriculture/ distribution/ water analysis/ volatility/ rainfall/ distribution (mathematical)/ volatile materials/ precipitation (atmospheric)/ geography/ pesticides/ water pollution/ USA/ Canada, Saskatchewan

**Abstract:** The concentrations of herbicides in water from wetlands on landscapes where herbicides are not used should be less than on farms with moderate (conventional farms) and intense (minimum-till farms) herbicide use. In general, this hypothesis was not supported for wetlands situated in the Boreal Plains Ecozone of central Saskatchewan, Canada. The overall detection frequency of 10 commonly used herbicides was not significantly different among wildlife habitat with no pesticide use (44.4%), farms with no pesticide use (51.6%), conventional farms (54.9%), and minimum-till farms (56.5%, chi super(2) = 5.64, p =

0.13). The herbicides (4-chloro-2-methylphenoxy) acetic acid (MCPA), 2,4-dichlorophenoxyacetic acid (2,4-D), bromoxynil, dicamba, mecoprop, and diclorprop accounted for 87% of all detections. In general, detection frequencies and concentrations of individual herbicides were similar on all land-use types. For example, the mean concentration of 2,4-D in water on the four land types ranged from 0.12 plus or minus 0.104 to 0.26 plus or minus 0.465  $\mu\text{g/L}$ , and MCPA ranged from 0.08 plus or minus 0.078 to 0.19 plus or minus 0.166  $\mu\text{g/L}$ . However, in the year of application, mean concentrations of MCPA and bromoxynil, but not 2,4-D, were significantly higher by about twofold in wetlands situated in fields where these herbicides were applied compared with all other wetlands. We propose that many agricultural pesticides are rapidly lost to the atmosphere at the time of application by processes such as volatilization from soil and plant evapotranspiration. Then, the herbicides used throughout the region may be directly absorbed to the surface of wetlands from the atmosphere, or they become entrained in local convective clouds, and are redistributed by rainfall in a relatively homogenous mixture over the agricultural landscape. The low levels of individual herbicides we found in most of the wetland waters would not cause chronic effects to aquatic biota.

© CSA

**176. Direct and indirect exogenous contamination by pesticides of rice-farming soils in a Mediterranean wetland.**

Gamon, M.; Saez, E.; Gil, J.; and Boluda, R.  
*Archives of Environmental Contamination and Toxicology* 44(2): 141-151. (2003)

NAL Call #: TD172.A7; ISSN: 0090-4341

*Descriptors:* wetlands/ rice fields/ pesticides/ soil contamination/ surface water/ pollution detection/ rice/ water pollution/ soils/ sediment pollution/ agricultural runoff/ temporal variations/ spatial variations/ Spain, Valencia, Albufera Natural Park/ organophosphorous

*Abstract:* It is known that the sources of soil contamination can be endogenous or exogenous and that exogenous contamination may be direct or indirect. In this work, an environmental pesticide fate study was conducted in soil profiles collected from 23 rice field sites in an important Mediterranean wetland (Albufera Natural Park, Valencia, Spain) from April 1996 to November 1997. Temporal and spatial distribution of 44 pesticide residues in an alluvial Mediterranean soil (gleyic-calcaric Fluvisol, Fluvaquent) were monitored. During this period, the levels of pesticide residues in different soil horizons (Ap1 0-12 cm, Ap2 12-30 cm, ApCg 30-50 cm, C1gr 50-76 cm, and C2r 76-100 cm) were investigated. In addition, information was collected on agricultural pesticide application practices and soil characteristics. Distribution throughout the soil profile showed that pesticide concentrations were always higher in the topsoil (Ap1 horizon), in the autumn season, and in the border with citrus-vegetable orchard soils (calcaric Fluvisol, Xerofluent). Chlorpyrifos (organophosphorus), endosulfan (organochlorine), and pyridaphenthion (organophosphorus) insecticides were, respectively, the most detected of all the pesticides investigated. These results were associated with processes, such as nonleaching, transport by movement into surface waters, retention, volatilization, and chemical and biological degradation in the topsoil, as well as with direct and indirect exogenous contamination sources.

© CSA

**177. Drainage effects in marsh soils: I. Effects on water table and drainflow.**

Ibrahim, S. M.

In: Drainage and water table control: Proceedings of Sixth International Drainage Symposium. (Held 13 Dec 1992-15 Dec 1992 at Nashville, Tennessee.)

St. Joseph, Michigan: American Society of Agricultural Engineers; pp. 169-176; 1992.

*Descriptors:* soil water regimes/ groundwater level/ drainage/ spacing/ wetland soils/ depth/ soil water movement/ flow to drains

*Abstract:* Drainage effects in marsh soils caused by ditches and pipes were studied in long term field experiments (1982/90) in the Elbe river coastal region of Northern Germany. Three fields were selected to demonstrate the effects of drainage on the groundwater table and drainflow comparing ditch drainage and pipe drainage with 7 m, 14 m or 28 m drain spacing and 0.9 m, 1.0 m or 1.2 m drain depths. The results show that without pipe subdrainage the groundwater table remains near the soil surface during heavy rainfall periods. Under favourable hydraulic and topographic conditions, pipe drainage with a moderate drain intensity with open main outfalls (ditches) is recommended. The results also show that with closer drain spacing greater drainflow and a deeper groundwater table result. The calculated drain spacing of 14 m is not necessary. With a drain depth of 1.0 m, an optimum drain spacing of 13-20 m was determined. If the outlet ditch is deep enough and no outside water influence exists, a 28 m drain spacing is proposed for this site. Instead of grassland and traditional ditch drainage, arable use with subsurface drainage has become possible.

© CAB International/CABI Publishing

**178. Ecology and management of moorland pools: Balancing acidification and eutrophication.**

van Dam, H. and Buskens, R. F. M.

*Hydrobiologia* 265(1-3)(1993)

NAL Call #: 410 H992; ISSN: 0018-8158.

*Notes:* Conference: Symp. on Netherlands-Wetlands, Arnhem (Netherlands), Dec 1993

*Descriptors:* acidification/ eutrophication/ ecosystem management/ hydrology/ community composition/ agricultural pollution/ pollution effects/ acid rain/ Netherlands/ moorland pools/ agricultural pollution/ ecosystem management/ ecosystems and energetics/ conservation, wildlife management and recreation/ management/ freshwater pollution

*Abstract:* Moorland pools originally are shallow, often hydrologically isolated, soft-water bodies, with a low productivity. Some thousands of moorland pools originated from the late Pleistocene onwards in the heathland landscape in The Netherlands and adjacent areas, where soils have a poor buffering capacity. As the pools are largely fed by atmospheric precipitation, they are very vulnerable to changes in the environment, e.g. eutrophication and acidification. Acidification by acid atmospheric deposition and eutrophication by agricultural acidification are the main threats to the moorland pool ecosystems and affect the species composition of assemblages of aquatic macrophytes, desmids, diatoms, macrofauna, fishes and amphibians, as has been shown by comparison of old and recent records on their distribution and paleolimnological methods. Afforestation exacerbates acidification and also reduces wind dynamics. Particularly

the decrease of isoetids and desmids by both processes indicate the biological impoverishment of the pools. Reductions of (potential) acid atmospheric deposition to less than 40 mmol m<sup>-2</sup>/yr and of ammonia to less than 30 mmol m<sup>-2</sup>/yr are necessary for recovery of the moorland pools. Methods for the addition of buffering material to a number of moorland pools, to counteract acidification until these deposition rates have lowered sufficiently, are given, as well as other methods for restoring the biological quality of moorland pools.  
© CSA

**179. Effect of agricultural and residential development on aquatic macrophytes in the New Jersey Pine Barrens.**

Morgan, M. D. and Philipp, K. R.  
*Biological Conservation* 35(2): 143-158. (Mar. 1986)  
NAL Call #: S900.B5; ISSN: 0006-3207  
*Descriptors:* wetlands/ regional development/ agricultural development/ residential development/ aquatic plants/ macrophytes/ New Jersey pine barrens/ water pollution effects/ agriculture/ water pollution/ water pollution sources/ species diversity/ hydrogen ion concentration/ nitrates/ effects of pollution/ effects on water of human nonwater activities

*Abstract:* The impact of residential and agricultural development as the cause of water pollution on aquatic macrophyte communities in the New Jersey Pine Barrens was examined by comparison with unpolluted communities. The only major physical and chemical differences between stream types were greatly elevated pH values and NO<sub>3</sub><sup>-</sup> concentrations at the polluted sites. A total of 59 aquatic macrophyte species were identified during the study. Only a few more species (41) occurred at the polluted sites (38). Twentytwo species were confined to polluted sites, and 19 to unpolluted sites. Classification of all species as either typical or non-typical Pine Barrens species revealed that the primary effect of pollution was the replacement of a distinctive Pine Barrens flora (e.g., *Carex walteriana*, *Eleocharis olivacea*, *E. tuberculosa*, *Eriocaulon compressum*, and *Utricularia fibrosa*) with one containing many marginal or non-indigenous species common to wetlands throughout the Eastern US (e.g., *Callitriche heterophylla*, *Galium tinctorium*, and *Polygonum punctatum*). (Doria-PTT)  
© CSA

**180. The effect of cattle and sheep grazing on salt-marsh vegetation at Skallingen, Denmark.**

Jensen, A.  
*Vegetatio* 60(1): 37-48. (1985)  
NAL Call #: 450 V52; ISSN: 0042-3106  
*Descriptors:* cattle/ sheep/ vegetation/ flora/ plant communities/ plant ecology/ grazing/ salt marshes/ Denmark  
This citation is from AGRICOLA.

**181. Effect of farming practices on wetlands of Kish District, Kenya.**

Mironga, J. M.  
*Applied Ecology and Environmental Research* 3(2): 81-91. (2005)  
NAL Call #: QH540.A67; ISSN: 1785-0037  
*Descriptors:* water quality/ farming practice

*Abstract:* Effect of farming practices on wetlands in Kisii District was determined through assessment of farmers' environmental awareness. Effective conservation of wetlands in the district cannot depend on prohibitions but should be based on users' knowledge and attitudes of wetlands. The present study examined farmers' knowledge of the environmental effect of agricultural expansion to wetlands; absence of knowledge of characteristics of farming activities and the attitudes of farmers with respect to planning mechanisms that might be used to support wetland protection in the area. The majority of farmers ignored the effect of agriculture on wetlands. Those who occupied wetland areas practiced intensive agriculture and were ignorant of the effect of this on water quality, soil and landscape. The government should implement training programmes for all wetland users in Kisii District to make them more environmentally aware of the impacts of farming practices on wetlands. This is meant to make them become more environmentally aware of the effects of farming practices on these ecosystems and eventually change their behavior. There is a need to build a conservation ethic among wetland users by educating them to sustainably utilize wetland resources and training them to practise sustainable agriculture.  
© The Thomson Corporation

**182. Effect of forest management practices on southern forested wetland productivity.**

Conner, W. H.  
*Wetlands* 14(1): 27-40. (1994)  
NAL Call #: QH75.A1W47; ISSN: 0277-5212  
*Descriptors:* wetlands/ forest industry/ biological production/ hydrology/ flooding/ resource management/ water levels/ environmental effects/ logging/ forest management/ water level/ drainage/ USA, Southeast/ USA/ forest management/ water level/ drainage/ forest industry/ biological production/ resource management/ water levels  
*Abstract:* In the interest of increasing productivity of forested wetlands for timber production and/or wildlife value, management schemes that deal mainly with water-level control have been developed. The three forest types in the southeastern U.S. most commonly affected are cypress/tupelo forests, bottomland hardwood forests, and wet pine sites (including pocosins). In forested wetlands, hydrology is the most important factor influencing productivity. In bottomland and cypress/tupelo forests, water-level control can have mixed results. Alterations in natural hydrologic patterns leading to increased flooding or drainage can cause decreased growth rates or even death of the forest. Bottomland hardwoods respond favorably in the short term to water-level management, but the long-term response is currently under study. In wet pine sites, timber volume can be increased significantly by water-level management, but the impact upon other ecological functions is less understood. It is difficult to adequately describe productivity relations in wetland forests because of the great diversity in habitat types and the lack of data on how structure and function might be affected by forestry operations. There is a definite need for more long-term, regional studies involving multidisciplinary efforts.  
© CSA

**183. Effect of winter cutting on the passerine breeding assemblage in French Mediterranean reedbeds.**

Poulin, Brigitte and Lefebvre, Gaetan

*Biodiversity and Conservation* 11(9): 1567-1581. (2002)

NAL Call #: QH75.A1 B562; ISSN: 0960-3115

*Descriptors:* passeriformes/ Emberizidae/ Panuridae/ Sylviidae/ Acrocephalus arundinaceus/ Acrocephalus melanopogon/ Acrocephalus scirpaceus/ Emberiza schoeniclus/ Panurus biarmicus/ arthropod distribution/ biomass/ breeding assemblage/ commercial enterprises/ communities/ conservation/ density/ disturbances/ ecosystems/ Eurasia/ Europe/ food supply/ France/ habitat management/ habitat use/ land zones/ management/ management practices/ nutrition/ palaeartic region/ population ecology/ population studies/ reed bed cutting/ reed bed habitat/ reedbeds/ south/ status/ terrestrial ecology/ vegetation structure/ water regime/ wildlife/ wildlife-human relationships/ winter cutting/ wetland vegetation/ food/ brood/ eggs

*Abstract:* Common reed is increasingly harvested from the Mediterranean region to provide thatching material to north European countries. The impact of these management practices on the fauna is poorly known. The aim of this study was to quantify the effect of reed cutting in the Mediterranean region through a comparative analysis of water regime, vegetation structure, arthropod distribution and passerine assemblage at cut and uncut reedbeds in southern France. Cut reedbeds were characterised by a lower salinity, higher water level in spring, and higher reed biomass than uncut reedbeds. Arthropod distribution differed consistently between cut and uncut sites, leading to a higher index of food available to passerines in cut reedbeds. Cut reedbeds had a similar bird species richness but a lower bird abundance, due to the significant decrease in Moustached Warblers and Bearded Tits at cut sites. The mild Mediterranean winter favoured early growth of reed in spring, making harvested reedbeds suitable for breeding of long-distance migrants such as the Great Reed Warbler and Reed Warbler. However, for the resident species that breed earlier in the season, cut reedbeds presumably lack sufficient vegetation cover to provide adequate nesting and feeding sites. Although biennial cutting (double wale) is considered as a good compromise between conservation and commercial interests in the UK, the juxtaposition of annually cut and never cut reed patches appears as the only sustainable alternative for the Mediterranean region. We further hypothesise that an optimal mosaic design of cut/uncut reed patches could provide as high a conservation value as unmanaged reedbeds.

© NISC

**184. Effectiveness of constructed overland flow areas in decreasing diffuse pollution from forest drainages.**

Liljaniemi, Petri; Vuori, Kari-Matti; Tossavainen, Tarmo; Kotanen, Juho; Haapanen, Merja; Lepistö, Ahti; and Kenttämies, Kaarle

*Environmental Management* 32(5): 602-613. (Nov. 2003)

NAL Call #: HC79.E5E5; ISSN: 0364-152X

*Descriptors:* wetlands/ drainage/ peatlands/ metals/ forests/ nutrients/ water quality/ pollution effects/ seasonal variations/ chemical oxygen demand/ sulfur dioxide/ environment management/ phosphorus/ finland/ freshwater pollution/ water pollution: monitoring, control & remediation

*Abstract:* Forestry is the largest scale human impact affecting catchments in Finland and a prominent source of

diffuse pollution in many water courses. Among the forestry activities, draining of wetlands had the most pronounced impacts on sediment, nutrient, and metal loading in the past. At present, renovation of old ditches and fertilization of peatlands constitute the major risk of forestry-induced diffuse pollution. Contemporary forestry aims at decreasing this risk with various riparian buffer strip designs. Among such designs, creation of overland flow areas by plugging the outlet ditches is increasingly used. Our objectives were to evaluate the potential of constructed overland flow areas to function as riparian buffers and estimate the quality and quantity of diffuse pollution from old versus recent forest drainages. We studied retention and release of pollutants from 20 constructed, 2- to 10-m-wide overland flow areas receiving drainage water from forested peatlands. Drainage waters were sampled above and below the plugged ditches three times per year from 1998 to 1999. Chemical oxygen demand and nutrient and metal loads and concentrations varied strongly between seasons, years, and drainage areas. Areas subjected to recent ditch renovations and fertilizations had clearly elevated seasonal loads and concentrations of total phosphorus (TP), PO<sub>4</sub>-P, Fe, and Al in comparison to old treatment areas. Especially TP loads were high above the national average values measured for forestry-induced diffuse pollution. In general, water quality above and below the buffer strips did not differ significantly. Our results indicate that plugged outlet ditches and associated narrow overland flow areas do not function as proper buffers in peatland areas. We suggest that wider buffers with extensive overland flow areas are needed in order to control diffuse pollution from forested and drained peatlands.

© CSA

**185. The effects of adjacent land use on wetland amphibian species richness and community.**

Houlahan, J. E. and Findlay, C. S.

*Canadian Journal of Fisheries and Aquatic Sciences* 60(9): 1078-1094. (2003)

NAL Call #: 442.9 C16J; ISSN: 0706-652X

*Descriptors:* wetlands/ aquatic animals/ forests/ habitats/ land use/ marshes/ nature conservation/ nitrogen/ plant communities/ polluted water/ population density/ roads/ roots/ species richness/ vegetation types/ water pollution/ water quality/ animal communities

*Abstract:* Habitat destruction and fragmentation have been identified as possible causes of large-scale amphibian declines. Here, we examine the effects of adjacent land use and water quality on wetland amphibian species richness, abundance, and community composition in 74 Ontario wetlands. Species richness was positively correlated with wetland area, forest cover, and the amount of wetlands on adjacent lands and negatively correlated with road density and nitrogen levels. The land-use effects peak at 2000-3000 m. Amphibian abundance was positively correlated with forest cover, distance to wetlands >20 ha, and amount of marsh habitat and negatively correlated with road density. The effects of adjacent land use were strongest at around 200 m. Land-use and water quality effects varied widely across species, although most species are positively correlated with forest cover and amount of wetlands on adjacent lands and negatively correlated with road density and water quality. These results suggest that the effects of adjacent land use on amphibian communities can extend over comparatively large distances. As such, effective

wetland conservation will not be achieved merely through the creation of narrow buffer zones between wetlands and intensive land uses, but rather will require maintaining a heterogeneous regional landscape containing relatively large areas of natural forest and wetlands.

© CAB International/CABI Publishing

**186. Effects of agricultural change on abundance, fitness components and distribution of two arctic-nesting goose populations.**

Fox, A. D.; Madsen, J.; Boyd, H.; Kuijken, E.; Norriss, D. W.; Tombre, I. M.; and Stroud, D. A.

*Global Change Biology* 11(6): 881-893. (2005)

NAL Call #: QC981.8.C5G6323; ISSN: 1354-1013

*Descriptors:* wetlands/ Anser/ population ecology/ population growth/ habitat preferences/ agricultural land/ winter/ seasonal migration/ zoogeography/ grain crops/ foraging/ fields/ spring/ Scandinavia/ Western European region/ Greenland/ Irish Republic/ Great Britain/ Iceland  
This citation is from AGRICOLA.

**187. The effects of agricultural irrigation on wetland ecosystems in developing countries: A literature review.**

Galbraith, Hector; Amerasinghe, Priyane; and Huber-Lee, Annette

Colombo, Sri Lanka: International Water Management Institute, 2005. CA Discussion Paper.

<http://www.iwmi.cgiar.org/assessment/files%5Fnew/publications/Discussion%20Paper/CADiscussionPaper1.pdf>

*Descriptors:* wetlands/ irrigation/ developing countries/ environmental impact/ literature reviews

**188. Effects of agriculture development on vole dynamics and conservation of Montagu's harrier in western French wetlands.**

Butet, A. and Leroux, A. B. A.

*Biological Conservation* 100(3): 289-295. (2001)

NAL Call #: S900.B5; ISSN: 0006-3207

*Descriptors:* change of agriculture/ harrier's breeding success/ raptor conservation/ specialist raptors/ vole cyclic pattern/ agricultural development/ population decline/ prey availability/ raptor/ reproductive success/ rodent/ France/ Circus pygargus/ Microtus arvalis

*Abstract:* Nesting populations of Montagu's harrier (*Circus pygargus*) are declining in most parts of Europe; in France, western marshes remain the most important nesting sites in terms of breeding pairs. In this open field landscape dominated by grasslands, the common vole (*Microtus arvalis*) displays regular population outbreaks and constitutes a favourite prey of this raptor. Twelve years of field data indicate significant variations in nesting population size and young harriers produced, which correlate with yearly differences in vole densities. Up to 10 years ago, these marshes were traditionally used as extensive pastures but recent agricultural changes have resulted in almost 50% of the pastures being converted to drained agricultural production, as already observed in many localities of this region next to our study area. Our data, together with previous data collected from 1968 in this region, demonstrate that agricultural changes have resulted in a decrease of frequency and intensity of vole population peaks. A summer density of 100 voles/ha appears as a threshold value to support a good breeding success of harriers. These modifications of the vole fluctuation pattern

suggest that nesting populations of Montagu's harrier from western French marshes could be endangered in future under these current trends in agricultural changes.

© 2006 Elsevier B.V. All rights reserved.

**189. The effects of cattle grazing on tall-herb fen vegetation and molluscs.**

Ausden, M.; Hall, M.; Pearson, P.; and Strudwick, T.

*Biological Conservation* 122(2): 317-326. (2005)

NAL Call #: S900.B5; ISSN: 0006-3207

*Descriptors:* wetlands/ habitat/ interspecific interactions/ species richness/ vegetation/ molluscs/ forestry/ agriculture/ Poaceae/ Phragmites australis/ Glyceria maxima/ Vertigo moulinsiana/ Cyperaceae/ Carex riparia

*Abstract:* The effects of light year-round cattle grazing on tall-herb fen vegetation and wetland molluscs were compared to the effects of non-intervention over a period of four years using grazing exclosures. The distribution of cattle within the area of fen was investigated by plotting the position of the herd at 3-4 day intervals throughout the year. Cattle distributed themselves randomly throughout the fen in spring, autumn and winter, but showed a more aggregated distribution in summer. Grazing reduced the biomass of *Phragmites australis* and increased stem densities of *Glyceria maxima*, resulting in a shift of dominance from *Phragmites* to *Glyceria*. Plant species-richness was also significantly higher in areas open to grazing. Grazing decreased total densities of molluscs and substantially reduced densities of the rare snail *Vertigo moulinsiana*. *V. moulinsiana* was particularly associated with areas of fen that had a high water table and high biomass of ungrazed *Carex riparia*. However, because of the patchy nature of the grazing, *V. moulinsiana* survived at reasonably high densities in patches of ungrazed vegetation within the grazing unit.

© NISC

**190. Effects of climate change and land use on duck abundance in Canadian prairie-parklands.**

Bethke, Raymond W. and Nudds, Thomas D.

*Ecological Applications* 5(3): 588-600. (1995)

NAL Call #: QH540.E23; ISSN: 1051-0761

*Descriptors:* climatology: environmental sciences/ mathematical biology: computational biology/ models and simulations: computational biology/ systematics and taxonomy/ wildlife management: conservation/ agriculture/ drought/ habitat/ mathematical model/ precipitation/ survey  
*Abstract:* Recent declines in the number of breeding ducks in the Canadian prairie-parklands have been hypothesized to be due to loss of habitat to agriculture. However, prairie-parkland also has experienced wetland loss to drought as well as to agriculture. If habitat restoration is to be implemented and monitored successfully, it is important to separate the effects of anthropogenic changes to the landscape on duck populations from those caused by changes in climate. We used data from annual air-ground surveys and from precipitation records to develop relationships between indices of abundance of each of 10 species of ducks and indices of wetland conditions during 1955-1974. We used these relationships to predict annual abundance of each species during 1975-1989. We compared predicted and observed abundances over the period 1975-1989 to distinguish declines in duck abundance greater than those accounted for by drought alone and to determine the magnitude and location of real

"deficits" in duck abundance. Average annual deficits within Canadian prairie-parkland over the period 1975-1989 were estimated at 1.2 times 10<sup>6</sup> birds for both Mallard (*Anas platyrhynchos*) and Northern Pintail (*A. acuta*), 480 000 for Blue-winged Teal (*A. discors*), 190 000 for American Wigeon (*A. americana*), 175 000 for Northern Shoveler (*A. clypeata*), 50 000 for Gadwall (*A. strepera*), 10 000 for Green-winged Teal (*A. crecca*), 40 000 for Canvasback (*Aythya valisineria*), 25 000 for Lesser Scaup (*A. affinis*), and 5000 for Redhead (*A. americana*). Overall, the effect of agricultural expansion in the east on prime waterfowl habitat since 1951 appears to have been negligible. There, as much as 90% had been already lost prior to 1951. In the west, however, where prime waterfowl habitat was still relatively abundant in 1951, agricultural development has encroached substantially. The relationship between the lost area of the best breeding habitats and the size of population deficits for Mallards and Northern Pintails in the entire Canadian prairie-parkland region was significant for both species (P = 0.0027 and P = 0.0001, respectively). Consequently, habitat restoration programs located where the highest quality waterfowl habitat and the lowest quality agricultural lands overlap most should have the greatest potential to affect recovery of breeding duck populations in the Canadian prairie-parklands.

© The Thomson Corporation

**191. Effects of cropping practices on the use of rice fields by waterbirds in the Camargue, France.**

Tourenq, Christophe; Sadoul, Nicolas; Beck, Nicolas; Meslard, Francois; Martin, Jean-Louis; and Martin J. *Agriculture, Ecosystems and Environment* 95(2/3): 543-549. (2003)

NAL Call #: S601.A34; ISSN: 0167-8809

*Descriptors:* Anseriformes/ Charadriiformes/ Ciconiiformes/ rice fields/ waterbirds/ agricultural practices/ waterfowl/ waders gulls and auks/ herons and allies/ agriculture/ wetland/ habitat management/ abundance/ dispersion/ abundance/ France

*Abstract:* The abundance of waterbirds was compared in 46 rice fields in relation with the age of the field and the planting practices in spring. Of the 29 species censused, Charadriiformes represented some 73%, Ciconiiformes 6%, and Anseriformes less than 15.5% of the total number of individuals, flamingos and moorhens being also observed. Insectivorous species were the main component of the waterbird community. Bird numbers decreased with increasing field age and were lower in dry-sown than in wet-sown fields. The present results suggest that intensive and/or repetitive soil management and pesticide use may decrease the food resources available to waterbirds.

(Copyright 2003 Elsevier)

© NISC

**192. Effects of drainage, tilling and PK-fertilization on bulk density, total N, P, K, Ca and Fe and net N-mineralization in two peatland forestry sites in Newfoundland, Canada.**

Wells, E. D. and Williams, B. L.

*Forest Ecology and Management* 84(1-3): 97-108. (1996)

NAL Call #: SD1.F73; ISSN: 0378-1127

*Descriptors:* bog/ bulk density/ calcium/ drainage/ fen/ field method/ forestry/ iron/ net nitrogen mineralization/ nitrogen/ peatland forestry/ phosphorus/ phosphorus potassium fertilization/ potassium/ soil science/ tilling

*Abstract:* Bulk density, total contents of N, P, K, Ca and Fe and field- and laboratory-incubated mineral-N were determined for a bog and fen site 3 years after drainage treatments (3 m and 15 m ditch spacings), tilling treatments (untilled, tilled) and fertilization treatments (unfertilized, PK-fertilized), as well as for adjacent untreated (undisturbed) areas of the bog and fen. Tilling of the surface or fertilization did not significantly affect total nutrient contents in either bog or fen, although nutrient contents were generally higher in fertilization or drainage treatments that included tilling. As a result of decreased ditch spacing (from 15 m to 3 m), bulk density was significantly increased in the bog site (from 44.9 to 63.5 mg cm<sup>-3</sup>) and decreased (nonsignificant) in the fen site (from 105 to 89 mg cm<sup>-3</sup>). Total P and K were increased where PK was applied as fertilizer. In bog peats, bulk density (mg cm<sup>-3</sup>), total N concentrations (mg g<sup>-1</sup>) and total contents (kg ha<sup>-1</sup>) of N, P, K, Ca and Fe were significantly higher in the 3 m ditch spacing than in the 15 m ditch spacing. Thus, increases in total nutrient contents in bog peats can be attributed mainly to increased bulk density as a result of drainage treatment. In contrast, bulk densities and most nutrient contents of fen peats were not significantly affected by treatments.

However, total N concentrations and total N contents were significantly reduced by more intensive ditching (3 m ditch spacing). Contents of mineral-N in fresh peat and field-incubated and laboratory anaerobically incubated (30 degree C) peat consisted entirely of NH<sub>4</sub>-N. Laboratory incubations over a 20-week period demonstrated a high potential for release of NH<sub>4</sub>-N in peat from treated sites of bog and fen. During four 28-day field incubation periods, production of mineral-N varied from 0.1 to 1.2 kg ha<sup>-1</sup> (net mineralization) to -0.1 to -0.3 kg ha<sup>-1</sup> (net immobilization) for bog peat. Similarly, on the fen site production ranged from 0.1 to 2.7 kg ha<sup>-1</sup> (net mineralization) and -0.1 to -1.7 kg ha<sup>-1</sup> (net immobilization). In the unfertilized and PK-fertilized treatments of the fen, as well as the PK-fertilized treatment of the bog, net immobilization predominated during the first incubation period, followed by net mineralization during the next three incubation periods. In the unfertilized treatment of the bog, net mineralization predominated early in the growing season, followed by net immobilization thereafter.

© The Thomson Corporation

**193. Effects of herbicides on two submersed aquatic macrophytes, *Potamogeton pectinatus* L. and *Myriophyllum sibiricum* komarov, in a prairie wetland.**

Forsyth, D. J.; Martin, P. A.; and Shaw, G. G.

*Environmental Pollution* 95(2): 259-268. (1997)

NAL Call #: QH545.A1E52; ISSN: 0269-7491

*Descriptors:* wetlands/ macrophytes/ aquatic plants/ *Potamogeton pectinatus*/ clopyralid/ picloram/ 2,4-dichlorophenoxyacetic acid/ Canada, Saskatchewan/ herbicides/ growth/ toxicity testing/ submerged plants/ plant growth/ plant physiology/ water pollution effects/ toxicity tests/ indicator species/ *Myriophyllum sibiricum*

*Abstract:* Clopyralid, picloram, 2,4-D and a mixture of 2,4-D plus picloram (Tordon registered 202C) were added to the water of 1 m square enclosures in a prairie wetland in Saskatchewan, Canada to produce concentrations of 0.01 and 0.1 mg active ingredient litre super(-1). Effects on the submersed macrophytes, *Potamogeton pectinatus* and *Myriophyllum sibiricum*, were monitored by taking repeated measurements of plant weight, flower and tuber production

and inspecting for injuries at 30 and 60 days after application. Clopyralid did not inhibit weight gain (growth) in either species, but stimulated growth and flowering by *M. sibiricum* at 0.01 mg litre super(-1) and tuber production by *P. pectinatus* at both rates. The low rate of 2,4-D stimulated flowering by *M. sibiricum* and tuber production by *P. pectinatus*, whereas the high rate inhibited growth of *M. sibiricum* and injured both species. Picloram did not affect growth of either species, but injured *M. sibiricum* at both concentrations and inhibited flowering at 0.1 mg litre super(-1). Tordon registered 202C at 0.1 mg litre super(-1) caused reduced growth and flowering in *M. sibiricum* and injured both species; 0.01 mg litre super(-1) also injured *M. sibiricum*. Mortality resulted only from Tordon registered 202C and 2,4-D. Field data are lacking to assess the extent to which submerged macrophytes in prairie ponds are exposed to harmful concentrations of herbicide from aerial spraying, drift from ground application, runoff or wind erosion of soil.

© CSA

**194. Effects of nitrogen fertiliser and pesticide management on floodwater ecology in a wetland ricefield: 3. Dynamics of benthic molluscs.**

Simpson, Ian C.; Roger, Pierre A.; Oficial, Roberto; and Grant, Ian F.

*Biology and Fertility of Soils* 18(3): 219-227. (1994)

NAL Call #: QH84.8.B46; ISSN: 0178-2762

*Descriptors:* animals and man/ disturbance by man/ commercial activities/ ecology/ population dynamics/ habitat/ man made habitat/ abiotic factors/ chemical factors/ land and freshwater zones/ Oriental region/ Mollusca: farming and agriculture/ biomass/ population density/ management influences/ cultivated land habitat/ wetland rice field/ agricultural practices effect on benthon/ fertilizers and pesticides/ wetland rice field management effect on benthon dynamics/ Philippines/ benthon dynamics in wetland rice field/ agricultural management influence/ Mollusca/ invertebrates/ molluscs

© The Thomson Corporation

**195. Effects of pesticides on soil and water microflora and mesofauna in wetland ricefields: A summary of current knowledge and extrapolation to temperate environments.**

Roger, P. A.; Simpson, I.; Oficial, R.; Ardales, S.; and Jimenez, R.

*Australian Journal of Experimental Agriculture* 34(7): 1057-1068. (1994)

NAL Call #: 23 Au792; ISSN: 0816-1089

*Descriptors:* wetlands/ reviews/ pesticides/ bibliographies/ rice/ temperate zone/ invertebrates/ fertilizers/ agricultural practices/ microorganisms/ data collections/ rice fields/ pollution effects/ literature reviews/ agricultural pollution/ Invertebrata/ Invertebrata/ biodiversity/ rice fields/ pollution effects/ Invertebrata/ literature reviews/ agricultural pollution/ reviews/ rice/ temperate zone/ invertebrates/ agricultural practices/ data collections

*Abstract:* This review summarises information on the behaviour of pesticides and their impacts on microorganisms and non-target invertebrates that was collected in, or is applicable to, temperate wetland ricefields. An extensive bibliographic survey shows that current knowledge is fragmentary and partly outdated. Pesticides applied on soil at recommended levels rarely

had a detrimental effect on microbial populations or their activities. They had more effect on invertebrate populations, inducing the blooming of individual species of floodwater zooplankton and reducing populations of aquatic oligochaetes in soil. Available information raises concerns regarding the long-term effects of pesticides on (i) microorganisms, primary producers, and invertebrates of importance to soil fertility, (ii) predators of rice pests and vectors, and (iii) microbial metabolism of pesticides.

© CSA

**196. Effects of silvicultural activities on wetland biogeochemistry.**

Lockaby, B. G.; Trettin, C. C.; and Schoenholtz, S. H.

*Journal of Environmental Quality* 28(6): 1687-1698. (1999)

NAL Call #: QH540.J6; ISSN: 0047-2425

*Abstract:* The unique biogeochemistry of wetlands either causes or influences many landscape functions that are valued by society. Because of their critical ecological role and the importance of wetlands to commodity and noncommodity values, we have reviewed the current state of knowledge regarding influences of silviculture on nutrient circulation, transformation, and retention in forested wetlands. Our approach was to contrast riverine and depressional systems. Globally, there are few generalizations that can be made regarding the effects of silvicultural disturbance. This conclusion is primarily a result of too few studies on the mechanisms and processes controlling ecosystem responses. Most work to date has focused solely on characterizing responses of state variables, and therefore a basis for integration is often lacking. While studies do show that water quality functions are not degraded as a result of harvesting, many other aspects of ecosystem functionality are not clarified. As examples, there are significant gaps in our understanding of biogeochemical controls on net primary productivity, organic matter turnover, and hydrologic interactions. Considerable research is warranted to provide information for effective resource management and conservation.

© 2006 Elsevier B.V. All rights reserved.

**197. Effects of timber management on ecological functions of forest wetlands.**

Shepard, James P.

In: TAPPI Proceedings: International Environmental Conference. (Held 7 May 1995-10 May 1995 at Atlanta, Ga.); Vol. 1.

Atlanta, Ga.; pp. 299-305; 1995.

NAL Call #: TD899.P3T36; ISBN: 0898529360

*Abstract:* Forest wetlands are valued for the many ecological functions they perform. They are also important sources of wood for the forest products industry. Forest wetlands can be managed for timber production while protecting valuable ecological functions. This paper reviews the literature on effects of timber management on ecological functions in wetlands. Timber management affects wetland functions primarily through its manipulation of vegetation species composition and structure. Effects of forest management are most pronounced immediately following disturbances such as timber harvesting. Effects are generally brief for hydrological and biogeochemical functions, but can be more long-lasting for plant and wildlife habitat.

**198. Emerging effluent management strategies in marine fish-culture farms located in European coastal wetlands.**

Hussenot, J. M. E.

*Aquaculture* 226(1-4): 113-128. (Oct. 2003)

NAL Call #: SH1 .A6; ISSN: 0044-8486

*Descriptors:* wetlands/ mariculture/ marine fish/ fish farming/ waste management/ aquaculture systems/ effluents/ water quality/ wastewater treatment/ ponds/ biological treatment/ microalgae/ aquatic plant culture/ bioreactors/ recirculating systems/ Europe/ France

*Abstract:* Coastal wetlands are suitable sites for land-based fish culture in ponds and tanks, but environmental constraints on effluent discharges are stringent for these areas. In order to limit effluent loading, different techniques have been proposed and are beginning to be implemented by aquaculturists. On the Atlantic coast of Europe (France, Portugal, Spain, etc.), growout farms for sea bass (*Dicentrarchus labrax*), sea bream (*Sparus aurata*) or turbot (*Scophthalmus maximus*) are often located in wetlands where salt ponds were previously built. Downstream from the rearing ponds, sedimentation ponds are used to reduce particulate matter exportation. Using fish farm effluents, the continuous mass culture of microalgae has been the subject of experiments converting ammonia and phosphates into diatoms, with the systematic addition of required amounts of limiting nutrients (silicon as sodium silicate, or phosphorus as phosphoric acid). New physical treatments may be added if partial recirculation systems are employed, such as immersed foam fractionators, specifically developed for aquaculture ponds. Integrated systems may be emergent practices for reducing the effluent pollutant discharge without additional cost, in addition to producing a complementary income to that resulting from the production of the main culture species. This citation is from AGRICOLA.

**199. Environmental effects on wetlands of queletox registered applied to ploceid roosts in Kenya.**

Keith, J. O.; Ngondi, J. G.; Bruggers, R. L.; Kimball, B. A.; and Elliott, C. C. H.

*Environmental Toxicology and Chemistry* 13(2): 333-341. (1994)

*Descriptors:* wetlands/ environmental effects/ chemcontrol/ pesticides/ water sampling/ water analysis/ birds/ insecticides/ organophosphates/ residues/ Aves/ nontarget organisms/ queletox registered/ Kenya, Nakuru/ organophosphates/ residues/ fenthion/ pesticides (organophosphorus)/ nontarget organisms/ environmental effects/ chemcontrol/ birds

*Abstract:* Queletox registered (Fenthion) is widely used in Africa to kill birds that eat cereal crops. Applications of Queletox have been reported to kill nontarget animals and contaminate areas used by livestock and humans. In 1988, we evaluated Queletox treatments to wetland roosts at the Njoro dam (2.88 kg/ha) and Gicheha farm (12.0 kg/ha) near Nakuru, Kenya. Fenthion deposits measured in the roosts ranged up to 1,100 g/ha, but were >1.0 g/ha at distances of 100 m or more from roosts. Following applications, 61 birds of 14 species at the Njoro dam and 22 birds of eight species at the Gicheha farm were found dead or severely debilitated. However, the general abundance of waterfowl, wading birds, plovers, doves, and passerines seemed unaffected. Residues in crop contents of 11 dead birds ranged up to 11.0 ppm, substantiating death from fenthion.

Fenthion residues (2.2-750 µg) recovered from skin and feathers of 36 dead birds were sufficient to have been hazardous to predators and scavengers. Neither amphibians nor fishes were affected by treatments. At the Njoro dam, scarabids, dytiscids, and notonectids were killed, and their numbers decreased; many insects also were killed at the Gicheha farm. The abundance of these groups, however, had increased within 6 d post-treatment. Fenthion residues of 1.8 to 17 ppb were found in positive water samples for up to 5 d post-treatment. All sampled vegetation had temporarily hazardous residues; levels ranged up to 83 ppm on grasses but had decreased to <1.0 after 3 d.

© CSA

**200. Environmental hazards of nitrogen loading in wetland rice fields.**

Ghosh, B. C. and Bhat, R.

*Environmental Pollution* 102(suppl. 1): 123-126. (1998)

NAL Call #: QH545.A1E52; ISSN: 0269-7491

*Descriptors:* nitrogen fertilizers/ environmental impact/ rice/ crop production/ pollution/ Asia

This citation is from AGRICOLA.

**201. Environmental impacts of development on wetlands in arid and semi-arid lands.**

Hollis, G. E.

*Hydrological Sciences Journal* 35(4): 411-428. (Aug. 1990)

NAL Call #: 292.9 As7; ISSN: 0262-6667

*Descriptors:* wetlands/ ecological effects/ ecosystems/ environmental impact/ land/ development/ water resources development/ agriculture/ arid lands/ Greece/ New Zealand/ semiarid lands/ United States/ urbanization/ water resources management/ ecological impact of water development/ effects on water of human nonwater activities/ lakes

*Abstract:* Wetlands, as defined by the Ramsar (Greece) Convention, are productive ecosystems providing goods and services for people. Negative effects from the 'development' of wetlands are exemplified through adverse climatic effects (Aral Sea, USSR), inadvertent environmental changes (Canadian Prairie Potholes), non-sustainable alternative uses (South Chad Irrigation Scheme, Nigeria), exacerbation of problems (Garaet El Haouaria, Tunisia), detrimental effects on rare species (Mikri Prespa, Greece), social disruption (Kissingin Fadama, Nigeria), international obligations (Ichkeul, Tunisia), and sub-optimal management (Weija-Panbros, Ghana). The functions and values of wetlands are described in the 'Adamus approach,' and are exemplified even for the 'dry' areas of the Hadejia- Nguru wetlands (Nigeria) and Lake Hula (Israel). Wetlands are threatened by agricultural intensification, pollution, engineering schemes, and urban development. Since the societies and institutions that degrade wetlands are themselves complex systems, an understanding of hydrology and ecology is insufficient for a wetland manager. Wetland destruction can be aided by misconceptions, public subsidy, international funds, local-scale planning, sectoral approaches, and narrow disciplinary thinking. National Wetland Strategies are needed, on the order of those presently developed in New Zealand and the United States. Hydrologists should be more involved in wetlands and their sustainable utilization. 'Political hydrology' must complement 'scientific hydrology.'

© CSA

**202. Environmentally sensitive plot-scale timber harvesting: Impacts on suspended sediment, bedload and bank erosion dynamics.**

Stott, T.; Leeks, G.; Marks, S.; and Sawyer, A.  
*Journal of Environmental Management* 63(1): 3-25. (2001)  
 NAL Call #: HC75.E5J6; ISSN: 0301-4797  
*Descriptors:* wetlands/ logging/ forest management/ soil erosion/ monitoring/ clearcutting/ sediments/ Wales  
 This citation is from AGRICOLA.

**203. Establishment, growth and survival of natural regeneration after clearcutting and drainage on forested wetlands.**

Roy, V.; Ruel, J. C.; and Plamondon, A. P.  
*Forest Ecology and Management* 129(1-3): 253-267. (2000)  
 NAL Call #: SD1.F73; ISSN: 0378-1127  
*Descriptors:* wetlands/ clear cutting/ forest management/ ecosystem disturbance/ environment management/ logging/ forests/ regeneration/ growth rates/ clear-cutting/ plant growth/ survival/ drainage/ water table rise/ seedlings/ comparison studies/ soil types/ correlation analysis/ clear cutting  
*Abstract:* Natural regeneration may be disrupted by the rise of the water table in surface layers after clearcutting forested wetlands. A study was initiated on eight forested wetlands that were successively clearcut and drained 3 years later. The objectives were (1) to assess conifer and deciduous regeneration on waterlogged clearcut sites, (2) to determine the effect of water table level changes after clearcutting and drainage on the growth rate of advance regeneration, and (3) to determine if sphagnum moss growth rate was influenced by clearcutting, drainage and microrelief. 3 years after strip clearcutting, the area based inventory showed that softwood regeneration was abundant in the clearcut, but 84% of the seedlings were smaller than 30 cm and vulnerable to suppression from the competition. Indeed, the opening of the forest cover promoted massive invasion of pioneer species such as trembling aspen (*Populus tremuloides* Michx.) and white birch (*Betula papyrifera* Marsh.). Black spruce (*Picea mariana* (Mill.) B.S.P.) and red spruce (*Picea rubens* Sarg.) had difficulties maintaining their presence after clearcutting. The ratio hardwood stems: softwood stems changed from 1.1 in the forest to 3.8 in the clearcut. Balsam fir (*Abies balsamea* (L.) Mill.), larch (*Larix laricina* (Du Roi) K. Koch) and cedar (*Thuja occidentalis* L.) represented 93% of the softwood regeneration. 3 years after clearcutting, balsam fir advance regeneration had a significantly lower growth rate in the middle of the clearcut than near the edges of the clearcut. 2 years after drainage, seedling growth at 10 m from the drainage ditch was significantly greater than at 70 m from ditch. No significant differences were found between mineral and organic soil types, but height growth was positively correlated to C: N ratios of the individual site types. Abundant competition on richer sites limits the development of softwood regeneration. On a short term basis, competition more than watering-up seems a threat to softwood regeneration. Sphagnum growth rates measured with the crank-wire method showed no effect of clearcutting or drainage, but a higher growth rate in hollows (3.2 cm per year) compared to hummocks (2.0 cm per year). These growth rates indicate that sphagnum should not affect regeneration but could overgrow yearlings of slow growing species.

© CSA

**204. Fecal contamination of pastoral wetlands.**

Collins, R.  
*Journal of Environmental Quality* 33(5): 1912-1918. (2004)  
 NAL Call #: QH540.J6; ISSN: 0047-2425  
*Descriptors:* wetlands/ water pollution/ pollution control/ pastures/ streams/ hills/ slope/ fecal contamination/ coliform bacteria/ bacterial contamination/ *Escherichia coli*/ feces/ cattle/ grazing/ water quality/ statistical models/ runoff/ rain/ solar radiation/ winter/ air temperature/ New Zealand  
*Abstract:* Near-channel hill-country wetlands draining steep pastoral land in New Zealand exhibit high levels of fecal contamination at a range of flows. This contamination is attributed to both the transport of bacteria into a wetland from the surrounding catchment and the direct excretion of fecal material onto wetlands by grazing cattle. *E. coli* concentrations observed at low to moderate flow at 20 sites varied between  $0.5 \times 10^1$  and  $2 \times 10^4$  most probable number (MPN) 100 mL<sup>-1</sup>. High flow concentrations measured at two wetlands ranged up to  $6 \times 10^6$  MPN 100 mL<sup>-1</sup> and yielded storm period bacterial loads of between  $1 \times 10^6$  and  $3 \times 10^{10}$  MPN per event. Given the disproportionately large fraction of surface and subsurface flow from the catchment that passes through the wetlands, these yields represent a large proportion of the total loss of bacteria from steep grazed hillsides, across a range of storm events. Cattle are attracted to the smaller, shallower wetlands for grazing in both summer and winter. Excluding stock from shallow wetlands may therefore yield improvements in bacterial water quality, although accurately quantifying this improvement is difficult without long-term studies. Cattle are not attracted to larger, deeper wetlands, presumably for fear of entrapment, and fencing them is unlikely to realize significant improvements in bacterial water quality. A statistical model incorporating solar radiation and flow explains 87% of the variance in *E. coli* concentrations across five monitored rainfall events. A positive correlation was found between solar radiation and *E. coli* concentration. The study was conducted in winter when clear, sunny days are relatively cold. Solar radiation on these days appears to be too weak to promote die-off but the colder temperatures aid survival.  
 This citation is from AGRICOLA.

**205. Frog communities and wetland condition: Relationships with grazing by domestic livestock along an Australian floodplain river.**

Jansen, A. and Healey, M.  
*Biological conservation* 109(2): 207-219. (Feb. 2003)  
 NAL Call #: S900.B5; ISSN: 0006-3207  
*Descriptors:* wetlands/ man-induced effects/ environmental factors/ plant populations/ community composition/ water quality/ agriculture/ river basin management/ flooding/ habitat/ nature conservation/ flood plains/ management/ conservation/ Anura/ Australia, Murrumbidgee R./ livestock grazing intensity/ frogs/ toads/ conservation, wildlife management and recreation/ habitat community studies/ management  
*Abstract:* Frogs are in decline worldwide, and are known to be sensitive indicators of environmental change. Floodplains of the Murray-Darling Basin in southeastern Australia have been altered in many ways by livestock grazing, by the introduction of exotic fish, and by changes to flooding regimes. These changes have led to declines in wetland condition and hence to the availability of habitat for wetland frogs. This study examined relationships between

frogs, wetland condition and livestock grazing intensity at 26 wetlands on the floodplain of the Murrumbidgee River. Frog communities, species richness, and some individual species of frogs declined with increased grazing intensity. Wetland condition also declined with increased grazing intensity, particularly the aquatic vegetation and water quality components. There were clear relationships between frog communities and wetland condition, with several taxa responding to aquatic and fringing vegetation components of wetland condition. Thus, grazing intensity appeared to influence frog communities through changes in wetland habitat quality, particularly the vegetation. Reduced stocking rates may result in improved wetland condition and more diverse frog communities. River management to provide natural seasonal inundation of floodplain wetlands may also enhance wetland condition, frog activity and reproductive success.

© CSA

**206. Grassland ecotopes of the upper Meuse as references for habitats and biodiversity restoration: A synthesis.**

Grevilliot, F. and Muller, S.

*Landscape Ecology* 17(Supplement 1): 19-33. (2002)

NAL Call #: QH541.15.L35 L36; ISSN: 0921-2973

*Descriptors:* biodiversity/ conservation/ terrestrial ecology/ environmental sciences/ biodiversity restoration/ remediation method/ water level measurement/ measurement method/ agricultural practices/ conservation value/ cutting frequency reduction/ environmental factors/ fertilizer use/ flood duration/ floodplain/ floristic diversity/ grassland ecotopes/ grazing/ ground water table depth/ high water bed/ hydrologic functioning/ hydrological fluctuations/ natural ecosystem/ phytosociological studies/ reference habitats/ species richness/ topographical gradient/ wetland ecotope

*Abstract:* The river valley of the French upper Meuse and its floodplain, constitutes a relatively natural ecosystem which still contains many endangered species of high conservation value. For example, several birds (*Crex crex*, *Numenius arquata*) as well as plant species (*Gratiola officinalis*, *Inula britannica*, *Teucrium scordium*, *Ranunculus lingua* and *Mentha pulegium*) which have declined seriously in France in recent times are found in the upper Meuse floodplain. Phytosociological studies and water level measurements have shown that the floristic diversity is mainly influenced by hydrological fluctuations and agricultural practices. The plant communities are structured along a topographical gradient in the high water bed reflecting the duration of floods and the ground water table depth. Agricultural practices have influenced the vegetation changes by selecting species adapted to particular management practices (e.g., fertiliser use, grazing, cutting regime). The data collected in this study from the upper Meuse as enabled 13 grassland and wetland ecotopes to be defined which are correlated with different environmental factors. Fertiliser use, grazing and reduction in the frequency of the cutting lead to a lower species richness because they encourage competitive species. However, it is also demonstrated, that maximum biodiversity is not always synonymous with high conservation value because some impoverished ecosystems, e.g., sedges and tall forb formations, may contain endangered plant and bird species. Knowledge of the boundaries between the different plant communities enables likely changes in

floristic composition after modification of one or more site factors to be forecasted. Such factors include, water table depth and flood frequency, cutting regime, fertiliser use and grazing pressure. Thus, the definition of these ecotopes, corresponding to correlations between water regime, agricultural practice and vegetation composition, could lead to the establishment of guidelines for water and agricultural managements that could be involved in restoration projects.  
© The Thomson Corporation

**207. Grazing regime as a tool to assess positive side effects of livestock farming systems on wading birds.**

Tichit, M.; Renault, O.; and Potter, T.

*Livestock Production Science* 96(1 (Special Issue)): 109-117. (2005)

NAL Call #: SF1.L5; ISSN: 0301-6226

*Descriptors:* grazing intensity/ habitat conservation/ wading birds/ wet grasslands

*Abstract:* Wet grasslands support large populations of waders. As these birds are very sensitive to sward height and heterogeneity, grazing management is a key issue to their conservation. On a French coastal marsh consisting of 816 fields of wet grasslands, birds were monitored in spring and grazing regimes were assessed at three periods: year, spring, autumn. Each species was associated with a particular annual grazing index lower than the mean for all grazed fields. During spring, grazing intensity was significantly lower for fields occupied by birds than for those of the entire landscape. Different species of waders showed different preferences to grazing intensity with redshanks and curlews representing two extremes of a gradient going from low to high intensity. In early spring, the more precocious species selected fields with a significantly higher mean and variance in autumn stocking rate than for all grazed fields in previous autumn. These results highlight the need to maintain a variety of grazing regimes if conservation of the waders is to be achieved at the community level. On the basis of our analysis, useful indicators related to thresholds on livestock density and turn-out date can be derived to assess positive side effects of livestock farming systems.

© 2006 Elsevier B.V. All rights reserved.

**208. Human-environment interactions in agricultural land use in a South China's wetland region: A study on the Zhujiang Delta in the Holocene.**

Weng, Qihao

*Geojournal* 51(3): 191-202. (2000)

NAL Call #: QE1; ISSN: 0343-2521

*Descriptors:* wetlands/ population-environment relations/ agriculture/ land use/ climate/ sea level/ environmental changes/ population growth/ agricultural practices/ cultivation/ population dynamics/ water quality/ water level/ geologic time/ climatic data/ palaeo studies/ holocene/ deltas/ rice field aquaculture/ resource management/ environment management/ environmental conditions/ climatic changes/ palaeoclimate/ eustatic changes/ sea level changes/ flooding/ flood control/ embankments/ river engineering/ man-induced effects/ ecosystem disturbance/ land reclamation/ coastal zone management/ *oryza sativa*/ China, People's Rep., Guangdong Prov., Zhujiang Delta/ land pollution/ sources and fate of pollution/ conservation, wildlife management and recreation/ soil pollution: monitoring, control & remediation

**Abstract:** The formation and evolution of agricultural land uses in the Zhujiang Delta of South China are examined in the light of the dynamics of people and the environment and their interplay. The origin and propagation of agriculture are found to have a close relationship with the climate and sea level changes in the Holocene era. The development of rice cultivation, horticulture, and dike-pond system exemplifies human-environment interactions in a specified geographical and social context, which are manifested by the impact of environmental changes and population growth on agricultural innovations. The technologies of dike building and land reclamation, which represent local farmers effort to build a new and harmonious relationship with the changed environment, were critical to the agricultural success and sustainability. Imprudent use of a new agricultural technology could damage the environment, as evidenced by a frequent flooding that followed inappropriate dike building and premature reclamation. Diverse agricultural land uses are as a result of the adaptation of agricultural technology innovations to the environmental conditions.

© CSA

**209. Hydrology of an acid wetland before and after draining for afforestation, western New Zealand.**

Jackson, R. J.

In: Forest Hydrology and Watershed Management/ Swanson, R. H. Bernier P. Y. Woodard P. D. Wallingford, Oxfordshire, England: IAHS Press, 1987; pp. 465-474

NAL Call #: GB842.F67

**Descriptors:** wetlands/ forest hydrology/ land reclamation/ New Zealand/ acid streams/ planting management/ pine trees/ drainage/ precipitation/ runoff/ flood peak/ sediment yield/ effects on water of human nonwater activities/ conservation in agricultural use

**Abstract:** An intensive surface drainage system is used to improve establishment of plantations of *Pinus radiata* on wetlands in western South Island, New Zealand.

Downstream impacts of such drainage were assessed by comparing undisturbed and drained wetland basins in an area with 2440 mm/yr rainfall. Stream water is brown, naturally acid (pH c. 4.0), and has high concentrations of dissolved organic C (25-55 mg/L). The water table on undisturbed wetland was nearly always at <0.5 m depth and rose rapidly during rainfall to give widespread overland flow. Quickflow contributed 70% of the 1580 mm/yr runoff. The ridges formed by surface drainage works provided elevated, drier sites for trees, but the water table remained high beneath and between ridges. Drainings have higher flood peaks, and the frequency of peaks >10 L/s/ha increased greatly. Annual sediment yield increased from <1 to c. 10 t/ha. Increased peak flows caused instability of the channel downstream from the drained area.

(Author 's abstract)

© CSA

**210. The hydrology of wetlands and man's influence on it.**

Verry, E. S.

*Suomen Akatemian Julkaisuja* 5: 41-61. (1988); ISSN: 0358-9153.

**Notes:** In: Symposium on the Hydrology of Wetlands in Temperate and Cold Regions, Joensuu, Finland, 6-8 June 1988, Vol. 2

**Descriptors:** wetlands/ hydrology/ floods/ drainage/ land types

**Abstract:** Wetlands form where flat physiography or climate causes slow water movement, and where water is available at the surface of the earth. Water source determines wetland type. The quality, quantity, and periodicity of water at the site drives the ecologic development of wetlands. Climate determines wetland form (Aapa, Palsa, raised, etc.), but in both cold and temperate regions, groundwater can substitute for direct precipitation and ameliorate marginal climate. Wetlands evapotranspire at maximum potential rates when the water table is within 30 cm of hollow bottoms, and at a fraction of potential rates when the water table is greater than 40 cm below the hollow bottoms. Wetlands reduce flood peaks up to 75% compared to rolling topography when they occupy only 20% of the total basin. Streamflow response to tree harvest or growth is a function of whether the growing season water table is above or below the 30-40 cm depth-to-water-table norm prior to harvest. Drainage of wetlands with closed drains (tile or mole drains) will decrease flood peaks as much as 30% more. Drainage of wetlands with open channel ditches will not change, reduce (-30%), or greatly increase (up to +300%) flood peaks depending on the percent of total basin area drained. Significant increases begin when more than 30% of the total basin is drained with open channels. Downstream flood damage must be considered from the regional landscape perspective. This includes increased flood peaks from the conversion of mineral-soil mature forests to young forests (1-15 years old) or agricultural land; the nature of flood plains; amount and changes in reservoir capacity; and the relative amount of open straight channels in relation to drains and meandering channels.

© CAB International/CABI Publishing

**211. Impact of different sheep grazing intensities on salt marsh vegetation in northern Germany.**

Kiehl, K.; Eischeid, I.; Gettner, S.; and Walter, J.

*Journal of Vegetation Science* 7(1): 99-106. (1996)

NAL Call #: QK900.J67; ISSN: 1100-9233

**Descriptors:** plant ecology/ ecological succession/ halophytes/ vegetation/ species diversity/ salt marshes/ sheep/ grazing intensity/ natural resource management/ guidelines/ range management/ Germany

This citation is from AGRICOLA.

**212. The impact of grazing on plant communities, plant populations and soil conditions on salt marshes.**

Bakker, J. P.

*Vegetatio* 62(1/3): 391-398. (1985)

NAL Call #: 450 V52; ISSN: 0042-3106

**Descriptors:** plant density/ grazing/ mowing/ natural resource management/ soil analysis/ salt marshes/ Western European region

This citation is from AGRICOLA.

**213. Impact of immigrant pastoral herds to fringing wetlands of lake victoria in Magu District Mwanza Region, Tanzania.**

Hongo, H. and Masikini, M.

*Physics and Chemistry of the Earth* 28(20-27): 1001-1007. (2003)

NAL Call #: QE500.P5; ISSN: 1474-7065

**Descriptors:** immigrant pastoralists/ overgrazing/ wetland degradation lake pollution/ agriculture/ erosion/ soils/

vegetation/ pastoral herds/ agricultural practice/  
environmental impact/ land degradation/ livestock farming/  
overgrazing/ wetland/ Tanzania

**Abstract:** The assessment of impacts of pastoral herds to the fringing wetlands of Lake Victoria in Magu district in Mwanza region was carried out in 1999/2000. Lamadi village located along Speke Gulf of Lake Victoria was chosen. The main farming systems in the area are agriculture, agro-pastoralism, and pastoralism. The wetlands are heavily used for livestock grazing during the dry season. Since 1990s the area has been experiencing a high influx of immigrant pastoral herds from drought prone districts. The increasing livestock numbers have led into serious degradation of wetlands. The type of damages includes: soil erosion, loss of vegetation cover and deforestation. This led to pollution of Lake Victoria along the Speke gulf in particular as the wetlands was buffering a lot of pollutants from the catchments. The range condition at Lamadi was rated fair. The carrying capacity of rangelands was estimated at 3.57-6.75 ha/LU and the wetlands were seriously degraded causing heavy soil erosion and environmental pollution during rainy season. It was recommended to raise people's awareness on conservation of environment and mobilise communities to take responsibility on management of the environmental resources.

© 2006 Elsevier B.V. All rights reserved.

#### 214. Impact of land disturbance on the fate of arsenical pesticides.

Renshaw, C. E.; Bostick, B. C.; Feng, X.; Wong, C. K.; Winston, E. S.; Karimi, R.; Folt, C. L.; and Chen, C. Y. *Journal of Environmental Quality* 35(1): 61-67. (2006)  
NAL Call #: QH540.J6; ISSN: 0047-2425

**Descriptors:** wetlands/ orchards/ orchard soils/ disturbed soils/ soil pollution/ polluted soils/ arsenic/ lead/ lead arsenate/ bioavailability/ tillage/ streams/ sediment contamination/ soil erosion/ macroinvertebrates/ leaching/ water pollution/ New Hampshire  
This citation is from AGRICOLA.

#### 215. Impacts of drainage for forestry on runoff and water chemistry.

Lundin, L.

In: Proceedings of the International Symposium on the Hydrology of Wetlands in Temperate and Cold Regions. (Held 6 Jun 1988-8 Jun 1988 at Joensuu, Finland.); Vol. 1. Helsinki, Finland: Academy of Finland; pp. 197-205; 1988.

**Descriptors:** wetlands/ forest management/ drainage ditches/ drainage effects/ runoff/ water quality/ chemical properties/ peat bogs/ sweden/ hydrologic budget/ peat/ hydrogen ion concentration/ fens/ alkalinity/ phosphorus/ nitrogen/ sulfates/ nutrients/ forestry

**Abstract:** Drainage in forestry concerns both peatlands and wet mineral soils. In Sweden this drainage today is concentrated on mineral soils, i.e., clear-cut areas more or less waterlogged after clearfelling. The areas of interest to forest drainage often have organic soil horizons with peat character, and true peat areas often exist in connection with these areas. Drainage of larger peatlands is also performed. The drainage activities affect, among other things, the quantity and chemical composition of runoff. Effects of drainage on runoff and chemical composition of streamwater were studied together with calculations of water balance and chemical budgets. The investigations

were performed at a bog, a calcareous fen and two small sedge fens. These sedge fens showed similarities to mineral soil areas while the many small peatland units required many ditches penetrating the mineral soil. The investigations were performed as comparative studies before and after drainage between two peatland basins, of which one comprised a control area and the other was drained. The results show some similar effects of drainage at the different sites and some effects varying with both site and time. The distribution of precipitation and snowmelt influenced the results. Drainage influenced runoff with both increasing and decreasing mean and high discharges while the low discharges mainly increased. During some winters the low flow ceased. The changes of chemical composition of runoff were affected by the lagg-ditches penetrating the mineral soil beneath the peat. This often resulted in increased pH, alkalinity and concentrations of cations but also of sulfate. Effects on phosphorus and nitrogen varied with site. Nitrogen increased at the fens but decreased at the bog. Increases in the leachates of total-P and total-N were often found. Chemical budgets revealed net losses of HCO<sub>3</sub>, K, Ca, Cl, Al and organic C and retentions of H and N whereas variations occurred for SO<sub>4</sub> and P.

(Author 's abstract)

© CSA

#### 216. Impacts of grazing on wetlands and riparian habitat: A review of our knowledge.

Skovlin, J. M.

In: Developing Strategies for Rangeland Management/ National Research Council; Series: Westview special studies in agriculture science and policy.

Boulder, Colo.: Westview Press, 1984; pp. 1001-1103  
NAL Call #: SF85.3.D48

**Abstract:** In the context of western North America, discusses the effects of range livestock grazing on vegetation, watershed, and fish and wildlife. Grazing strategies to improve habitats are proposed for better decisions in allocating riparian zone uses. Comments are given by W.S.Platts & R.F.Raleigh, pp 1105-1117, L.H.Carpenter, pp 1119-1128, J.C.Malechek, pp 1129-1158, L.R.Rittenhouse, pp 1159-1166. -from Author  
© 2006 Elsevier B.V. All rights reserved.

#### 217. Impacts on wetlands of large-scale land-use changes by agricultural development: The Small Sanjiang Plain, China.

Liu, H.; Zhang, S.; Li, Z.; Lu, X.; and Yang, Q. *Ambio* 33(6): 306-310. (2004)

NAL Call #: QH540.A52; ISSN: 0044-7447

**Abstract:** The Small Sanjiang Plain (SSP), was formerly the largest wetland complex in China, located in the Northeastern part of Heilongjiang Province, China. Home to vast numbers of waterfowls, fish, and plants, the SSP is globally significant for biodiversity conservation. The loss and fragmentation of wetlands as a result agricultural development over 50 years has impacted wetland communities and their biodiversity. We used GIS to inventory large-scale land-use changes from 1950 to 2000, together with other statistical data. We found that 73.6% of the wetlands were lost due to agricultural development. Consequences of these land-use changes included: i) a rapid decline in waterfowl and plant species with the loss and fragmentation of natural wetlands and wetland ecosystem degradation; ii) greater variation in wetland

water levels as the result of land-use changes over the years; iii) disruption of the dynamic river-floodplain connection by construction of drainage ditches and levees; and iv) a decrease in floodplain area that caused increased flooding peak flows and runoff. Here we show how these changes affect wetland biodiversity and impact important wetland species.

© 2006 Elsevier B.V. All rights reserved.

**218. The importance of farmland for ortolan buntings nesting on raised peat bogs.**

Dale, Svein

*Ornis Fennica* 77(1): 17-25. (2000)

NAL Call #: 413.8 OR66; ISSN: 0030-5685

*Descriptors:* Fringillidae/ Passeriformes/ Emberiza hortulana/ agricultural crops/ behavior/ birds/ bogs/ breeding/ ecosystems/ farmland/ foods/ feeding/ home range/ territory/ microhabitat/ nests/ nesting habitat/ interactions with man/ conservation status/ threats/ social pattern: territory/ home range/ ortolan bunting/ microhabitat/ Europe/ Norway

*Abstract:* The majority of the Norwegian population of the endangered Ortolan bunting, *Emberiza hortulana*, breeds on raised peat bogs. The author studied whether their breeding site selection was affected by the availability of another habitat (farmland) close to bogs. At the landscape level, Ortolan buntings always chose peat bogs that had farmland <or= 50 m away. At the individual peat bog level, Ortolan buntings had territories in those parts of the bog that were closest to farmland, and territories were usually <or= 100 m from farmland. These results indicate that bog-breeding Ortolan buntings require farmland in close proximity to their territories. This conclusion was further supported by observations at the behavioral level. Ortolan buntings were frequently seen flying between territories on the peat bogs and adjacent farmland (oat fields), often returning with food in the bill. The author also analysed the distribution of Ortolan buntings in relation to peat bog size, availability of different bog microhabitats, and human use of peat bogs (peat extraction), but the effect of distance to farmland remained significant also in multiple analyses. Ortolan buntings apparently do not have the classical all-purpose territory typical of most passerine birds, but have more or less separated nesting and feeding areas. He discusses possible reasons for this pattern and also the conservation implications of the habitat selection of the Ortolan bunting.

© NISC

**219. Improved harvesting systems for wet sites.**

Stokes, Bryce J. and Schilling, Alvin

*Forest Ecology and Management* 90(2-3): 155-160. (1997)

NAL Call #: SD1.F73; ISSN: 0378-1127

*Descriptors:* bottomland hardwood/ timber harvesting/ wet site

*Abstract:* Environmentally acceptable and economical forest operations are needed for sustainable management of forest resources. Improved methods for harvesting and transporting timber are especially needed for wet sites. As the demand for hardwood lumber continues to increase, improved and alternative methods are needed to ensure acceptance of timber harvesting for the wet site conditions that are typical of bottomland hardwoods. Some alternative technological developments include grapple saw feller-bunchers, wide tires, larger forwarders, clambunk skidders,

two-stage hauling, mats, cable systems, helicopters and towed vehicles and air-cushioned vehicles. These developments have the potential to improve the performance of the harvesting system and to reduce the negative effects of conventional operations on conventional sites and on difficult sites such as wet areas. Although many of these new alternatives are now operational, others are just concepts or evolving prototypes. More research is still needed to optimize these alternative technologies and to reduce costs associated with their implementation.

© 2006 Elsevier B.V. All rights reserved.

**220. The influence of different grazing regimes on Phragmites- and shrub vegetation in the well-drained zone of a eutrophic wetland.**

Vulink, J. T.; Drost, H. J.; and Jans, L.

*Applied Vegetation Science* 3(1): 73-80. (2000)

NAL Call #: QK900 .A66; ISSN: 1402-2001

*Descriptors:* grazing/ vegetation/ range management/ Phragmites australis/ Cirsium arvense/ Urtica dioica/ Poa trivialis/ Sambucus nigra/ cattle/ horses/ conservation areas/ ecological succession/ species diversity/ colonizing ability/ stocking rate/ Netherlands

This citation is from AGRICOLA.

**221. Influence of groundwater development on the Donana National Park ecosystems (Spain).**

Suso, J. and Llamas, M. R.

*Journal of Hydrology (Amsterdam)* 141(1-3)(1993)

NAL Call #: 292.8 J82; ISSN: 0022-1694.

*Notes:* Conference: 28th Int. Geol. Congr. Symp., Washington, DC (USA), Jul 1989; Issue editors: Winter, T. C. and Llamas, M. R.

*Descriptors:* wetlands/ development projects/ agriculture/ environmental impact/ water table/ Spain, Guadalquivir R. Estuary, Donana Natl. Park/ groundwater/ mechanical and natural changes

*Abstract:* The Donana National Park (DNP) is located on the estuary of the Guadalquivir River. The functioning of the DNP's ecosystems is closely related to the geohydrology of the area. Under the central marshy area the aquifer system is confined below low-permeability estuary deposits. Around most of the marshland the aquifer crops out and is recharged by rainfall. The DNP has an area of 730 km super(2); part of it is in the marshland and part in the recharge area where the aquifer is phreatic. In the 1970s Spain's largest irrigation project using groundwater, covering a surface area of 240 km super(2), was planned in an area bordering the national park. The initial project has been scaled down to 100 km super(2), mainly as a result of protests by conservation groups. A review is presented of the various evaluations of the influence of groundwater extraction on the functioning of the wetlands. The authors consider that the water table decline as a result of pumpage for current irrigation could cause a large part of the ecotone -- situated at the contact-line between the marshland and the phreatic aquifer - to deteriorate. This ecotone exists because it is a natural groundwater discharge area. The small streams feeding the marshland will also be depleted by groundwater extraction.

© CSA

**222. Interactions of an insecticide, herbicide, and natural stressors in amphibian community mesocosms.**

Boone, M. D. and James, S. M.

*Ecological Applications* 13(3): 829-841. (2003)

NAL Call #: QH540.E23; ISSN: 1051-0761

*Descriptors:* wetlands/ insecticides/ herbicides/ body mass/ development/ survival/ food webs/ larval development/ biological stress/ ponds/ life cycle/ metamorphosis/ mesocosms/ chlorophylls/ environmental impact/ ecosystem disturbance/ *Rana sphenoccephala*/ *Bufo americanus*/ *Ambystoma maculatum*/ *Ambystoma texanum*/ Amphibia/ American toad/ spotted salamander/ small-mouthed salamander/ carbaryl

*Abstract:* Amphibians developing in wetlands embedded within or near agricultural lands may frequently encounter chemical mixtures. The objectives of our study were to determine the effects that post-application concentrations of an insecticide (carbaryl) and an herbicide (atrazine) have on body mass, development, and survival of two anuran species (southern leopard frog, *Rana sphenoccephala*; American toad, *Bufo americanus*) and two caudate species (spotted salamander, *Ambystoma maculatum*; small-mouthed salamander, *A. texanum*) reared in outdoor cattle tank mesocosms. In one experiment, we manipulated tadpole density (low or high), carbaryl exposure (0, 3.5, 7.0 mg/L), and atrazine exposure (0 or 200 µg/L) to test for effects on development, mass, and survival of larvae. In a second experiment, we manipulated pond hydroperiod (constant or drying), carbaryl exposure (0 or 5 mg/L), and atrazine exposure (0 or 200 µg/L) to test for effects on mass, time, and survival to metamorphosis. Salamanders were virtually eliminated in carbaryl treatments, indicating that at realistic levels, this insecticide could cause population declines for salamanders in contaminated habitats. Carbaryl also had negative effects on toad survival. Exposure to atrazine had negative effects on body size, development, and time to metamorphosis in anuran species, which were associated with reduced chlorophyll levels. Both chemicals interacted significantly with density or hydroperiod, indicating that the environmental conditions could influence the impact of a contaminant. A significant atrazine-by-carbaryl interaction resulted in smaller and less developed spotted salamander larvae than in control ponds. Atrazine exposure, however, appeared to moderate negative effects of carbaryl for spotted salamanders. Our research suggests that important changes in the community's food web result from chemical exposure, which influence the susceptibility of amphibian species to contaminants.

© CSA

**223. Landscape controls on phosphorus loading to boreal lakes: Implications for the potential impacts of forest harvesting.**

Devito, K. J.; Creed, I. F.; Rothwell, R. L.; and Prepas, E. E.

*Canadian Journal of Fisheries and Aquatic Sciences*

57(10): 1977-1984. (2000)

NAL Call #: 442.9 C16J; ISSN: 0706-652X

*Descriptors:* wetlands/ landscape/ nutrient loading/ lakes/ forests/ harvesting/ groundwater/ phosphorus/ groundwater flow/ nutrients/ boreal forests/ forest hydrology/ groundwater movement/ forest management/ Canada

*Abstract:* For 12 low-order lakes in the Western Boreal Forest of Canada, lake position in the groundwater flow

system and surface hydrologic connection to wetlands accounted for 57% of the variation in the change in postharvest (1997) relative to preharvest (1996) open-water median total phosphorous concentration ([TP]). Changes in [TP] decreased with calcium and magnesium concentrations, indicating that the largest increases in [TP] are likely to occur in lakes located in areas of groundwater recharge or shallow local discharge. Changes in [TP] increased with the area of wetland connected to the lake, a measure of near-surface hydrologic flushing of TP to the lake. However, the remaining variation (43%) in the TP response of lakes to harvest was not explained by landscape-based criteria. This study illustrates that in landscapes with complex hydrogeology, factors controlling the chemical responses of lakes to disturbance are complex, remain poorly understood, and require further study.

© CSA

**224. Livestock wastes as a source of estrogens and their effects on wildlife of Manko tidal flat, Okinawa.**

Tashiro, Y.; Takemura, A.; Fujii, H.; Takahira, K.; and Nakanishi, Y.

*Marine Pollution Bulletin* 47(1-6): 143-147. (2003)

NAL Call #: GC1000.M3; ISSN: 0025-326X

*Descriptors:* estrogens/ livestock/ wastes/ wildlife/ animal wastes/ rural areas/ water sampling/ marine pollution/ pollution effects/ migratory species/ manure/ animal manures/ mud flats/ piggeries waste waters/ livestock/ farms and farming/ birds (marine)/ sewages/ agricultural pollution/ organic wastes/ sex hormones/ tidal flats/ water analysis/ pollution detection/ nature conservation/ water pollution sources/ agricultural runoff/ data collections/ sediment contamination/ water pollution effects/ wilderness areas/ Aves/ Japan, Okinawa, Manko/ birds/ estrogens/ xeno-estrogens/ endocrine disruptors/ endocrine disruptors/ hormones

*Abstract:* The Manko tidal flat in the southern part of Okinawa Island is an important visiting and wintering area for migratory birds and was added to the Ramsar Convention Register of Wetlands in 1999. This area used to be an inlet extending to the inner part of Naha Port, but recent reclamation projects have restricted its connection to the East China Sea. As is typical in rural regions of subtropical islands, the inhabitants in the Manko basin raise livestock, especially pigs, without employing sufficient waste treatment methods. As sewage treatment works are considered to be one of the main sources of environmental estrogens in urban areas, the significance of livestock farming as a source of estrogens in rural area is examined in this study. In the present study, total estrogenic activities in water and sediment samples from the Manko tidal flat and its basin were measured using a recombinant yeast screen method. Estrogenic activities (equivalent to 17 beta-estradiol, E2) were around 10 ng l super(-1) in water samples and more than 10 µg kg super(-1) in some sediment samples. In addition, the concentrations of estrone (E1) and E2 in water samples measured using LC/MS/MS indicated a high contribution of environmental estrogens from livestock wastes.

© CSA

**225. Local and regional macroinvertebrate diversity in the wetlands of a cleared agricultural landscape in south-western Victoria, Australia.**

Robson, B. J. and Clay, C. J.

*Aquatic Conservation: Marine and Freshwater Ecosystems* 15(4): 403-414. (2005)

NAL Call #: QH541.5.W3A67; ISSN: 1052-7613

*Descriptors:* macroinvertebrates/ diversity/ agriculture/ seasonal wetlands/ biodiversity/ copepods/ ostracods/ collembolans/ arachnids/ notostracans/ chironomids/ beetles/ species lists/ aquatic environments/ fieldwork/ field experiments/ monitoring/ freshwater environments/ ecology/ invertebrates/ geography/ distribution/ biogeography/ Australia/ Victoria

*Abstract:* 1. Seasonal pasture wetlands are a common freshwater habitat in many agricultural landscapes, but their invertebrate diversity has rarely been examined compared with other freshwater habitats. Few studies have examined the role of seasonal wetlands for regional biodiversity or the pattern of change in assemblage composition across landscapes. 2. Invertebrates were sampled from 16 naturally occurring seasonal wetlands and three perennial wetlands in south-western Victoria, Australia. The wetlands were arranged in three clusters, separated by at least 20 km: two clusters each contained one perennial and four seasonal wetlands surrounded by pasture; the remaining cluster consisted of one perennial wetland and four seasonal wetlands on a property that has not been cleared of native vegetation, and four adjacent seasonal pasture wetlands cleared of native vegetation. 3. Presence/absence data showed that seasonal wetlands had fewer taxa than perennial wetlands, but both were taxon rich. Turnover of taxa was high at all three scales, i.e. between samples within a wetland, between wetlands, and between wetland clusters, but each cluster did not have a characteristic assemblage composition. Up to two-thirds of the invertebrate taxa found in perennial wetlands were also found in seasonal wetlands, showing that seasonal pasture wetlands could provide an expanded area of winter-spring habitat for many taxa. 4. Seasonal pasture wetlands contribute to biodiversity in highly managed and depauperate agricultural landscapes. There was little regionalization of the fauna, taxon turnover was high and ranges appeared relatively continuous. Biodiversity in pasture wetlands was comparable to perennial non-pasture wetlands elsewhere, despite being used for grazing livestock. This suggests that pasture wetlands may have substantial conservation value and should be managed to protect them from threatening processes such as drainage.  
© NISC

**226. Long-term changes in agricultural practices and wildfowling in an internationally important wetland, and their effects on the guild of wintering ducks.**

Duncan, P.; Hewison, A. J. M.; Houte, S.; Rosoux, R.; Tournebize, T.; Dubs, F.; Burel, F.; and Bretagnolle, V.

*Journal of Applied Ecology* 36(1): 11-23. (1999)

NAL Call #: 410 J828; ISSN: 0021-8901

*Descriptors:* wetlands/ Anas/ waterfowl/ habitat destruction/ agriculture/ grasslands/ water management/ France  
This citation is from AGRICOLA.

**227. Long-term changes of salt marsh communities by cattle grazing.**

Andresen, H.; Bakker, J. P.; Brongers, M.; Heydemann, B.; and Irmiler, U.

*Vegetatio* 89(2): 137-148. (1990)

NAL Call #: 450 V52; ISSN: 0042-3106

*Descriptors:* invertebrates/ vegetation/ sedimentation/ population density/ species diversity/ immigration/ succession/ food web/ dominance

*Abstract:* Over a period of 9 years a grazing experiment was carried out in the mainland salt marsh of the Leybucht (Niedersachsen) with three stocking rates, namely, 0.5 ha<sup>-1</sup>, 1 ha<sup>-1</sup>, and 2 cattle ha<sup>-1</sup>. These were also compared with an abandoned area. The results are based on sampling of the invertebrates in 1980, 1981, 1982, and 1988, and of the vegetation in 1980 and 1988. The rate of sedimentation is highest in the Puccinellia maritima-zone and decreases with the increase of stocking rates. The Elymus pycnanthus vegetation type becomes dominant in the higher salt marsh in the abandoned site. The canopy height decreases with increasing stocking rate, whereas a gradient in the structure of the vegetation develops with the lowest stocking rate. The population densities, the species-richness and the community diversity of invertebrates increases after the cessation of grazing. The high rate of sedimentation in the abandoned site promotes the immigration of species from higher salt marsh levels and adjacent grasslands, and eventually halotophilous species and communities may disappear. On the other hand grazing reduces numerous species living both in or on upper parts of the vegetation or being sensitive to trampling by cattle. The community structure shows that the salt marsh ecosystem changed from a food web dominated by plant feeding animals to a food web dominated by animals foraging on detritus. The salt marsh management has to be differentiated into both ungrazed and lightly grazed areas (each 50%) of an overall grazing in large areas with less than 0.5 cattle ha<sup>-1</sup>.

© The Thomson Corporation

**228. Long-term dynamics of vegetation and disturbance of a southern boreal spruce swamp forest.**

Segerstrom, U.

*Journal of Vegetation Science* 8(2): 295-306. (1997)

NAL Call #: QK900.J67; ISSN: 1100-9233

*Descriptors:* wetlands/ biodiversity/ nature conservation/ grazing/ swamps/ pollen analysis/ plant succession/ seral stages/ dynamics/ vegetation/ palynology/ charcoal/ peat/ bogs/ human activity/ effects/ forest fires/ agriculture/ cutting/ burning/ browsing/ felling/ fire effects/ dead wood/ vegetation types/ boreal forests/ palaeoecology/ pines

*Abstract:* Analysis of pollen, charcoal and loss-on-ignition in peat cores from a Picea abies-dominated swamp forest in central Sweden showed the vegetation changes and disturbance patterns over 9500 yr. Six major sequences of local vegetation development were identified: (A) Pinus period, ca. 9500-7000 cal. (calibrated years) BP; (B) open mire period, ca. 7000-4500 cal. BP; (C) Betula period, ca. 4500-2300 cal. BP; (D) Picea period, ca. 2300-1000 cal. BP; (E) human impact period, ca. 1000-100 cal. BP; and (F) period of human abandonment during the last ca. 100 yr. The swamp forest has been highly dynamic in response to various natural and anthropogenic disturbance agencies. Several fires have heavily influenced the vegetation development. During the last ca. 900 yr human influence

has been important, initially from grazing and trampling by domesticated animals (ca. 1000-500 cal. BP), and subsequently small-scale cereal growing (ca. 400-100 BP). Cutting, burning and animal browsing influenced the structure and dynamics of the swamp forest by creating a more open stand and suppressing tree regeneration. Recent cessation of human impact has led to increased tree regeneration and a denser swamp forest stand. The present high biodiversity, and subsequent conservation interest does not result from long-term stability or absence of fire and human impact. However, in spite of repeated disturbances, a continuity of old and senescent trees produced a forest type with abundant dead wood. With the relatively minor importance of fire over long periods of time, the swamp forest developed a structure maintaining a high biological diversity. An important issue for maintaining long-term biodiversity in the boreal landscape must be to create a mosaic where different forest types are present, with a variety of structures, substrates and processes, to provide a certain degree of freedom for species to move around in the landscape.

© CAB International/CABI Publishing

**229. Long-term response of northern pintails to changes in wetlands and agriculture in the Canadian Prairie Pothole Region.**

Podruzny, Kevin M.; DeVries, James H.; Armstrong, Llwellyn M.; and Rotella, Jay J.

*Journal of Wildlife Management* 66(4): 993-1010. (2002)  
NAL Call #: 410 J827; ISSN: 0022-541X

*Descriptors:* animals and man/ disturbance by man/ commercial activities/ ecology/ population dynamics/ habitat/ land and freshwater zones/ Nearctic region/ North America/ *Anas acuta* (Anatidae): farming and agriculture/ population size/ semiaquatic habitat/ Canada/ Canadian Prairie Pothole region/ long term response to changes in wetlands and agriculture/ Anatidae/ Anseriformes/ Aves/ birds/ chordates/ vertebrates

*Abstract:* From 1955 through the late 1970s, northern pintail (*Anas acuta*) populations closely tracked the abundance of spring ponds. Declines in numbers of both northern pintails (hereafter, pintails) and ponds were evident during years of drought. However, since the early 1980s, the strength of the relationship between pintails and ponds has weakened greatly. Agricultural expansion on primary breeding grounds has been implicated as the cause of sustained pintail declines, but previous studies investigated pintail response only at large geographic scales (e.g., prairie-wide, stratum level). Potentially important effects of localized or multiscale changes in wetlands and agriculture on pintails are not well understood. Using data from the Canadian Prairie Pothole Region for 1961 to 1996, we investigated spatial and temporal covariation of pintail numbers with environmental factors (pond numbers and wetness indices) and agriculture at various scales. Models best supported by the data indicated that pintails responded positively to winter precipitation but with important regional variation and positively to pond numbers in some locations (southwestern Saskatchewan and southern Alberta). Results also indicated that pintail settling was better explained (increases in R<sup>2</sup> values of 0.05-0.06) using information about specific agricultural practices than about overall increases in farmed area. At a prairie-wide scale, we detected a negative association between settling and

increased cropland area. At regional scales, settling was positively associated to various degrees with area in fallow (i.e., summerfallow - land tilled but not planted to crop in a given year). Both associations were strengthened with higher winter precipitation. Because cropland stubble is used readily as a nesting habitat by pintails and spring tillage of fields not used for summerfallow destroys nests, a shift from summerfallow to continuous cropping in the Prairie Pothole Region of Canada may have reduced the reproductive capacity of pintails in important breeding areas. In regions with characteristics that historically have attracted pintails to settle, we encourage land managers to promote agricultural practices that minimize use of spring tillage, convert cropland to perennial forages and pasture, and protect and restore wetland and upland habitat.  
© The Thomson Corporation

**230. Managing water quality in wetlands with forestry BMP's.**

Rummer, Bob

*Water, Air, and Soil Pollution* 4: 55-66. (2004)

NAL Call #: TD172 .W36; ISSN: 0049-6979

<http://www.srs.fs.usda.gov/pubs/viewpub.jsp?index=6412>

*Descriptors:* wetlands/ water quality/ nonpoint source pollution/ best management practices/ soil erosion

*Abstract:* Forested wetlands are uniquely critical areas in forest operations that present special challenges to protect water quality. These locations are a direct interface between the impacts of forest operations and water. BMP's are designed to minimize nonpoint source pollution, but much of the science behind current guidelines is based on an understanding of erosion processes in upland situations. In wetlands and around temporary stream crossings, redirection of flow, sedimentation processes, and alterations of flow velocity become important. Existing forested wetland BMP's appear to adequately address water quality protection. If existing BMP's became prescriptive regulations, however, there is potential for misapplication and unintended ecological impacts.

**231. Mechanical deep placement of nitrogen in wetland rice.**

Bautista, E. U.; Koike, M.; and Suministrado, D. C.

*Journal of Agricultural Engineering Research* 78(4): 333-346. (2001)

NAL Call #: 58.8 J82; ISSN: 0021-8634

*Descriptors:* *Oryza sativa*/ nitrogen fertilizers/ losses from soil/ pollution control/ rice/ flooded conditions/ literature reviews/ Asia

*Abstract:* Deep placement of nitrogenous fertilizer (N) is an alternative for increasing the N use efficiency of wetland rice besides minimizing the adverse effects of fertilizers on the environment. It has been found to limit the loss of N due to surface runoff, leaching, volatilization and denitrification that lead to reduction in applied N. Different machines as well as N materials (granular, urea supergranules or briquettes, liquid N) have been introduced for this method. Although deep placement of fertilizer increased N use efficiency in rice-growing countries, the machines meant for this purpose have not been well accepted due to problems in performance consistency and commercial unavailability or extra cost of recommended materials. Despite these problems, however, several prototypes have shown potential but their acceptance maybe limited unless these promising mechanisms are adapted into a system that

addresses the field and socio-economic conditions of Asian farmers. A fertilizer management system that combines machine deep placement, crop establishment and farmers' timing of application using the commercially available materials could enhance adoption of the technology. Further refinements of the promising devices as well as addressing farmers' constraints are, thus, recommended for a better acceptance of deep placement in the rice-growing countries of Asia.

This citation is from AGRICOLA.

**232. Microbial communities in the phyllosphere of grasses on fenland at different intensities of management.**

Behrendt, U.; Stauber, T.; and Muller, T.

*Grass and Forage Science* 59(2): 169-179. (June 2004)  
*NAL Call #:* 60.19 B773; *ISSN:* 0142-5242

*Descriptors:* pasture management/ harvest date/ extensive farming/ fen soils/ fens/ forage quality/ energy content/ phyllosphere/ microbial ecology/ microorganisms/ population density/ Germany

*Abstract:* The effects of changes from conventional grassland management on fenland in Germany to extensification due to reduced fertilizer inputs and cutting frequency on the microbial colonization in the phyllosphere were investigated. A delay in the first cut for silage and hay, required by a nature conservation programme, was accompanied by the senescence of grasses which significantly influenced certain microbial groups. Heterotrophic bacteria, aerobic and anaerobic spore-formers, as well as filamentous fungi, showed an increase in population densities on the mature herbage of the later cuts. Differences in the rate of fertilizer application and cutting frequency, which had an effect on the dry-matter yield, also influenced the population density of heterotrophic bacteria and, in certain circumstances, that of filamentous fungi. Chemical measures of forage quality were highly correlated with the population density of microbial groups and with the maturity of the herbage. In contrast to these results, the population dynamics of further groups of micro-organisms (yeasts, Micrococcaceae, listeria) did not show any relationship with pasture management.

This citation is from AGRICOLA.

**233. The microdistribution of three uncommon freshwater gastropods in the drainage ditches of British grazing marshes.**

Watson, Alisa M. and Ormerod, S. J.

*Aquatic Conservation: Marine and Freshwater Ecosystems* 14(3): 221-236. (2004)

*NAL Call #:* QH541.5.W3A67; *ISSN:* 1052-7613

*Descriptors:* wetlands/ spatial distribution/ grazing/ drainage systems/ habitat changes/ vegetation changes/ drainage ditches/ gastropods/ marshes/ benthos/ snails/ habitat selection/ drainage water/ freshwater molluscs/ rare species/ microhabitats/ ecological distribution/ dissolved oxygen/ plant populations/ vegetation cover/ environment management/ aquatic plants/ nature conservation/ environmental factors/ *Segmentina nitida*/ *Anisus vorticulus*/ *Valvata macrostoma*/ British Isles, England/ grazing marshes/ drainage ditches/ molluscs/ streamflow and runoff/ water resources and supplies/ behaviour/ conservation, wildlife management and recreation

*Abstract:* The gastropods *Segmentina nitida*, *Anisus*

*vorticulus* and *Valvata macrostoma* occur in drainage ditches on grazing marshes that are now among the most threatened wetland systems in western Europe. Although each of these species is listed in the UK Red Data Book (RDB) and Biodiversity Action Plan, influences on their distribution are poorly understood. 2. To improve management information, the within-channel distributions of the three snails were examined in 20 ditches in southeast England. Abundance, vegetation cover and other environmental factors were recorded across the ditch profile near the surface (<0.2m) and at depth (<0.15m from the benthos). 3. All three species were significantly more abundant near the surface than at depth. Below 0.6m, ditches had significantly reduced concentrations of dissolved oxygen (<0.6 mg L super(-1), <5% saturation), possibly sufficient to limit the occurrence of gastropods dependent wholly or partly on aqueous gas exchange. 4. There were no other systematic variations in abundance between the ditch margins and centre channel. However, across all ditches and samples in the survey, each species' abundance varied significantly with vegetation structure. *S. nitida* was most numerous where there was least open water and hence most vegetation, *V. macrostoma* among emergent stands and *A. vorticulus* in ditches with floating vegetation but few submerged plants. 5. These microdistributional data support large-scale surveys in illustrating the potential importance of vegetation management for these snails; providing that other requirements are satisfied, ditch management could favour each RDB species by optimizing particular vegetation features. Apparent preferences for vegetation structure rather than particular channel locations suggest that refuges left during ditch clearance could be located anywhere in the ditch. Factors that reduce oxygen concentrations below 1mg L super(-1), such as eutrophication, might be detrimental.

© CSA

**234. Mineralization of norflurazon in a cranberry bog soil: Laboratory evaluations of management practices.**

Savin, M. C. and Amador, J. A.

*Journal of Environmental Quality* 27(5): 1234-1239. (1998)  
*NAL Call #:* QH540.J6; *ISSN:* 0047-2425

*Descriptors:* wetlands/ bog soils/ herbicides/ organic compounds/ environment/ mineralization/ norflurazon/ soil/ management/ soil water/ fertilizers/ sand/ amendments/ respiration/ application rates/ chemical control/ weed control/ fruit crops/ temperate fruits

*Abstract:* The herbicide norflurazon is used in cranberry (*Vaccinium macrocarpon*) cultivation to control annual grasses, sedges, and broadleaf weeds, in New England, Wisconsin, and other parts of the northern USA. The potential effects of cranberry cultivation practices, soil moisture control, fertilization, sand addition, and herbicide application rate, on mineralization of norflurazon in a bog soil were evaluated in a laboratory study. Optimal soil moisture for norflurazon mineralization was between 80 and 90% of water-holding capacity (WHC) in soil from the Oi and A horizons. Saturating the soil reduced the rate of norflurazon mineralization significantly. By contrast, soil respiration was maximal at 25% of WHC in both horizons. Addition of inorganic P increased soil respiration, but did not affect norflurazon mineralization significantly. Addition of inorganic N plus P increased soil respiration in the A, but not Oi, horizon and significantly decreased norflurazon

mineralization in the Oi horizon. Sand addition had no significant effect on norflurazon mineralization. Mineralization was affected by herbicide application rate, with the rate of mineralization increasing proportionally with increasing concentration from 0.75 to 7.5 mg norflurazon/kg soil. The mineralization of <sup>14</sup>C-norflurazon was slow for all of the agronomic practices evaluated, indicating that the potential for norflurazon to accumulate in cranberry bog soils may be high.

© CAB International/CABI Publishing

**235. Mobilization of pesticides on an agricultural landscape flooded by a torrential storm.**

Donald, David B.; Hunter, Fraser G.; Sverko, Ed; Hill, Bernard D.; and Syrgiannis, Jim

*Environmental Toxicology and Chemistry* 24(1): 2-10. (2005)

NAL Call #: QH545.A1E58; ISSN: 0730-7268

*Descriptors:* natural disasters/ agrochemicals [analysis]/ herbicides [analysis]/ insecticides [analysis]/ water pollutants, chemical [analysis]/ ecosystem/ rain [chemistry]/ Saskatchewan/ solubility/ time factors

*Abstract:* Mobilization of pesticides into surface waters of flooded agricultural landscapes following extreme precipitation events has not been previously investigated. After receiving 96 mm of rain in the previous 45 d, the Vanguard area of southeastern Saskatchewan, Canada, was subjected to a torrential storm on July 3, 2000, that produced as much as 375 mm of rain in 8 h. The majority of herbicides, but no insecticides, would have been applied to crops in the Vanguard area during the four weeks preceding the storm. After the storm, 19 herbicides and insecticides were detected in flooded wetlands, with 14 of them detected in 50% or more of wetlands. Average concentrations ranged from 0.43 ng/L (endosulfan) to 362 ng/L (2,4-dichlorophenoxyacetic acid). The pesticides probably were from long-range transport, followed by deposition in rain, and from herbicides applied to crops within the area subjected to the storm (1,700 km<sup>2</sup>). In the following year, when only 62 mm of rain fell in the same 45 d, only five pesticides were detected in 50% or more of wetlands. We estimated that for the 1,700-km<sup>2</sup> storm zone, 278 kg of herbicide were mobilized into rain and by runoff into surface waters, and 105 kg were removed from the Vanguard area by discharge into Notukeu Creek.

Significant quantities of herbicides are mobilized to aquatic environments when prairie agricultural landscapes are subjected to torrential storms. In these circumstances, flooded wells and small municipal reservoirs used as sources of drinking water may be compromised by 10 or more pesticides, some at relatively high concentrations.

© NISC

**236. Modeling impacts of management on carbon sequestration and trace gas emissions in forested wetland ecosystems.**

Li, Changsheng and Cui, Jianbo

*Environmental Management* 33(Supplement 1): S176-S186. (2004)

NAL Call #: HC79.E5E5; ISSN: 0364-152X

<http://www.srs.fs.usda.gov/pubs/21358>

*Descriptors:* wetlands/ silvicultural practices/ lowland forests/ carbon sequestration/ gas emissions

*Abstract:* A process-based model, Wetland-DNDC, was modified to enhance its capacity to predict the impacts of

management practices on carbon sequestration in and trace gas emissions from forested wetland ecosystems. The modifications included parameterization of management practices (e.g., forest harvest, chopping, burning, water management, fertilization, and tree planting), inclusion of detailed anaerobic biogeochemical processes for wetland soils, and utilization of hydrological models for quantifying water table variations. A 150-year management scenario consisting of three stages of wetland forest, deforestation/drainage, and wetland restoration was simulated with the Wetland-DNDC for two wetlands in Minnesota and Florida, USA. The impacts of the management scenario on carbon ecosystem exchange, methane emission, and nitrous oxide emission were quantified and assessed. The results suggested that: (1) the same management scenario produced very different consequences on global warming due to the contrast climate conditions; and (2) methane and nitrous oxide fluxes played nonnegligible roles in mitigation in comparison with carbon sequestration. This citation is from Treesearch.

**237. Modelling water allocation between a wetland and irrigated agriculture in the Gediz Basin, Turkey.**

De Voogt, K.; Kite, G.; Droogers, P.; and Murray-Rust, H.

*International Journal of Water Resources Development* 16(4): 639-650. (2000)

NAL Call #: TD201.I56; ISSN: 0790-0627

*Descriptors:* wetlands/ irrigation/ birds/ wildlife management/ bromides/ agriculture/ water allocation/ base flow/ rivers/ water supply/ irrigation/ birds/ flow/ streams (in natural channels)/ water supplies/ Turkey

*Abstract:* The Kus Cenneti is a wetland in the Gediz River Delta in Turkey. Part of it needs a large supply of low saline water to ensure the survival of endangered bird species. Any increase must be supplied at the expense of the upstream irrigated agriculture. The effects of basin water reallocation on water availability and crop productivity were evaluated using a semi-distributed hydrological model (SLURP). It was found that, during the irrigation season, increased wetland water demand causes increased loss in yield to irrigated agriculture and, outside this period, the water supply is limited by the Gediz River minimum base flow.

© CSA

**238. Monitoring the hydrology of Canadian prairie wetlands to detect the effects of climate change and land use changes.**

Conly, F. M. and Van Der Kamp, G.

*Environmental Monitoring and Assessment* 67(1-2): 195-215. (Feb. 2001-Mar. 2001)

NAL Call #: TD194; ISSN: 0167-6369

*Descriptors:* environmental monitoring/ climatic changes/ hydrology/ prairies/ land use/ semi-arid environments/ agriculture/ environmental management/ prairie/ climate/ monitoring/ man-induced effects/ ecosystems/ water balance/ habitats/ waterfowl/ water level/ ecology/ climatic change influences on wetlands/ land use effects on wetlands/ wetlands hydrology/ Canada/ management/ environmental action/ water resources and supplies/ protective measures and control/ swamps, marshes

*Abstract:* There are millions of small isolated wetlands in the semi-arid Canadian prairies. These 'sloughs' are refuges for wildlife in an area that is otherwise intensively

used for agriculture. They are particularly important as waterfowl habitat, with more than half of all North American ducks nesting in prairie sloughs. The water levels and ecology of the wetlands are sensitive to atmospheric change and to changes of agricultural practices in the surrounding fields. Monitoring of the hydrological conditions of the wetlands across the region is vital for detecting long-term trends and for studying the processes that control the water balance of the wetlands. Such monitoring therefore requires extensive regional-scale data complemented by intensive measurements at a few locations. At present, wetlands are being enumerated across the region once each year and year-round monitoring is being carried out at a few locations. The regional-scale data can be statistically related to regional climate data, but such analyses cast little light on the hydrological processes and have limited predictive value when climate and land use are changing. The intensive monitoring network has provided important insights but it now needs to be expanded and revised to meet new questions concerning the effects of climate change and land use.

© CSA

**239. Movement and retention of propanil n-(3,4-dichlorophenyl)propanamide in a paddy-riverine wetland system in Sri Lanka.**

Perera, Ajantha; Burleigh, James R.; and Davis, Craig B. *Agriculture Ecosystems and Environment* 72(3): 255-263. (1999)

NAL Call #: S601.A34; ISSN: 0167-8809

*Descriptors:* agronomy: agriculture/ freshwater ecology: ecology, environmental sciences/ pesticides/ pollution assessment control and management/ paddy soil chemistry/ paddy riverine wetland system/ plant tissue chemistry/ water chemistry/ wetland biota safety/ wild edible plant contamination

*Abstract:* Propanil N-(3,4-dichlorophenyl)propanamide is commonly used as a post-emergent herbicide in paddy rice cultivation in Sri Lanka. This study examined propanil concentrations in paddy soil and water, in water and substrate of adjacent wetlands receiving runoff from the paddy and in tissues of two wetland macrophytes common in those wetlands. Field sampling was carried out during the wet season of 1993-1994 and the 1994 dry season. Propanil was detected in paddy soil and in paddy and wetland water samples as late as 14 days after treatment (DAT). It was not detected in the wetland substrate, but relatively high concentrations were found in leaf and stem tissues of the edible plants *Ipomoea aquatica* and *Limncharis flava* 52 DAT in the wet season, but it was not detectable by 132 DAT. Tissue concentrations during the dry season were less consistent. This accumulation and retention by macrophytes may be important factors in reducing propanil concentrations in the wetland water below levels shown to be acutely toxic to other wetland biota. But, propanil so retained may pose a danger to humans who gather and eat these wetland plants regularly and who may, over several months, accumulate sufficient propanil to be harmful to their health.

© The Thomson Corporation

**240. Nitrate behaviour in the groundwater of a headwater wetland, Chiba, Japan.**

Tang, Changyuan; Azuma, Kazuaki; Iwami, Yoshifumi; Ohji, Baku; and Sakura, Yasuo

*Hydrological processes* 18(16): 3159-3168. (2004)

NAL Call #: GB651.H93; ISSN: 0885-6087

*Descriptors:* chemistry of groundwater/ nitrate in groundwater/ chemistry of wetlands/ water pollution sources/ groundwater pollution/ nitrates/ seepage/ piezometers/ denitrification/ wastewater disposal/ groundwater basins/ fertilizers/ spring water/ groundwater recharge/ path of pollutants/ groundwater discharge/ Japan, Honshu, Chiba Prefect./ chemical and physico-chemical properties: hardness, taste and odour, salinity, chemical content/ sources and fate of pollution/ water pollution: monitoring, control & remediation

*Abstract:* A wetland is an important part of the headwater in the discharge area of a basin. It controls not only groundwater discharge such as seepage or springs, but also the migration of chemical matter from the basin. In order to make clear how and where natural attenuation processes happen in wetlands, a typical headwater in Chiba, Japan, was chosen for an investigation of the behaviour of nitrate in groundwater. From the viewpoint of hydro-geomorphology, the wetland in the study site can be divided into three zones: the shallow water-table zone, the seepage zone, and the spring zone along the downstream direction. There were six piezometer groups; each group contained four piezometers, individually set at depths of 1, 2, 3 and 4 m. Major ions and  $\text{NO}_3^-$  of groundwater from piezometers, wells and springs were analysed. It was found that nitrate in groundwater mainly came from the fertilizers used in the upstream recharge area of the study site. When the groundwater moved up across the wetland, nitrate concentration in the groundwater decreased rapidly in the shallow water-table zone due to denitrification. Nitrate-free water can be found at the seepage zone. However, the behaviour of nitrate in the spring water was different from that in the seepage zone, since both dilution and denitrification processes were involved in the decrease of nitrate concentration in groundwater. In particular, the dilution process mainly controlled the decline of nitrate at the location where the nitrate-free groundwater flowing horizontally from the seepage zone mixed with the high-nitrate groundwater flowing upward before emerging as a spring. It was also found that denitrification only occurs suddenly in a narrow zone or a thin layer of the order of a few metres.

© CSA

**241. Nutrient removals associated with harvesting peatland black spruce forest.**

Teng, Y.; Foster, N. W.; Hazlett, P.; and Morrison, I. K.

In: *Northern Forested Wetlands: Ecology and Management*/ Trettin, C. C.; Jurgensen, M. F.; Grigal, D. F.; Gale, M. R.; and Jeglum, J. K.

Boca Raton, Fla.: CRC Lewis, 1997; pp. 341-352.

Notes: ISBN: 1566701775

NAL Call #: SD410.9.N67 1997

*Descriptors:* *Picea mariana*/ Ontario

This citation is from AGRICOLA.

**242. Occurrence of aquatic invertebrates of the wheatbelt region of western Australia in relation to salinity.**

Pinder, A. M.; Halse, S. A.; McRae, J. M.; and Shiel, R. J. *Hydrobiologia* 543(1): 1-24. (2005)

NAL Call #: 410 H992; ISSN: 0018-8158

*Descriptors:* aquatic invertebrates/ salinisation/ salinity tolerance/ western Australia/ groundwater/ plants (botany)/ saline water/ surveying/ vegetation/ dryland salinity/ halophilic species/ salinization/ biodiversity/ conservation status/ wetland/ Australia/ fresh water/ ground water/ plants/ salinity/ surveying/ water animals/ water biology/ Australasia/ Eastern Hemisphere/ Animalia/ Invertebrata

*Abstract:* The wheatbelt region of Western Australia has been extensively cleared of indigenous vegetation for agriculture and is now severely affected by dryland salinity. Wetlands that were once freshwater are now saline and others are under threat, as are the animals and plants that inhabit them. Rising groundwater is also affecting the many naturally saline playas. To provide a framework for setting conservation priorities in this region a biological survey was undertaken, including sampling of aquatic invertebrates at 230 wetlands. In this paper, we have used data from the survey to summarise occurrence of species in relation to salinity. Total species richness at a wetland showed no response to salinity below 4.1 g l<sup>-1</sup> and then declined dramatically as salinity increased. When halophilic species were excluded from consideration, species richness was found to decline from 2.6 g l<sup>-1</sup>. These patterns are compared to previous studies of richness-salinity relationships. There is some evidence that the freshwater invertebrate fauna of the wheatbelt may be comparatively salt tolerant, with 46% of freshwater species collected at salinities above 3 g l<sup>-1</sup> and 17% above 10 g l<sup>-1</sup>, though these proportions differed between various invertebrate groups. While this tolerance will provide a buffer against the effects of mild salinisation, many species are at risk of regional extinction as salinisation becomes more widespread. © Springer 2005.

© 2006 Elsevier B.V. All rights reserved.

**243. Odonates as biological indicators of grazing effects on Canadian prairie wetlands.**

Foote, A. L. and Hornung, C. L. R.

*Ecological Entomology* 30(3): 273-283. (2005)

NAL Call #: QL461 .E4; ISSN: 0307-6946

*Descriptors:* Odonata/ aquatic invertebrates/ bioindicators/ grazing/ environmental impact/ prairies/ species diversity/ vegetation/ wetland plants/ emergent plants/ water quality/ Alberta

This citation is from AGRICOLA.

**244. Perspectives for incorporating biomass from non-intensively managed temperate flood-meadows into farming systems.**

Donath, Tobias W.; Hoelzel, Norbert; Bissels, Stephanie; and Otte, Annette

*Agriculture Ecosystems and Environment* 104(3):

439-451. (2004)

NAL Call #: S601.A34; ISSN: 0167-8809

*Descriptors:* agriculture/ biogeography: population studies/ climatology: environmental sciences/ soil science/ terrestrial ecology: ecology, environmental sciences/ biomass incorporation/ forage quality/ grassland restoration/

temperate flood meadow/ vegetation alliance  
arrhenatherion/ vegetation alliance cnidion/ vegetation alliance magnocaricon

*Abstract:* Due to their high value for biodiversity preservation, flood mitigation and nutrient retention, the re-creation of flood-meadows is presently one of the main targets in restoration projects along large central European lowland rivers. Like other semi-natural grasslands, flood-meadows depend on adequate agricultural management to fulfil these important ecological functions. To achieve this in an ecologically and economically sensible way, the prospects for incorporating management and biomass utilisation in farming systems appears to be a key issue. Differences in yield and forage quality in extensively-managed flood-meadows were studied with respect to vegetation type, site conditions, management history, species-richness and nature conservation value. The study covers the most important alluvial grassland communities in the floodplain of the northern Upper Rhine (alliances Arrhenatherion, Cnidion, Magnocaricion), which are typically ordered along an elevational gradient of increasing flooding frequency. Gradients in flooding frequency between the different grassland communities and difference between classes were clearly reflected by floristic composition in Detrended Correspondence Analysis. In contrast, there were only minor differences in terms of soil nutrient status, which are consistent with relatively small differences in yield and forage quality, particularly in the drier Arrhenatherion-communities. In Cnidion meadows, yield and fodder quality were both raised in classes of higher nature conservation value, most likely due to a shift in functional groups towards sedges, herbs and legumes. However, in contrast to hypotheses recently made by several authors, no general relationship between species-richness and productivity was found. We discuss the implications of the results for restoration practice, management strategies and agricultural utilisation of species-rich flood-meadows. Copyright 2004 Elsevier B.V. All rights reserved.

© The Thomson Corporation

**245. Pesticide inputs and risks in coastal wetlands.**

Clark, J. R.; Lewis, M. A.; and Pait, A. S.

*Environmental Toxicology and Chemistry* 12(12): 2225-2233. (1993)

NAL Call #: QH545.A1E58; ISSN: 0730-7268

*Descriptors:* wetlands/ pesticide pollution/ pesticides/ environmental effects/ ecosystems/ risks/ environmental impact/ coastal zone/ agricultural runoff/ ecological effects/ ecotoxicology/ agricultural runoff/ ecological effects/ coastal zones/ pesticide pollution/ risks/ environmental impact/ coastal zone/ environmental effects/ environmental impact/ sources and fate of pollution/ freshwater pollution/ environment/ characteristics, behavior and fate

*Abstract:* Coastal wetland habitats may receive pesticide inputs indirectly from agricultural and forest control of weeds and insects in upland drainage areas; indirectly or directly from weed, insect, and biofouling control from development of adjacent lands for agricultural, recreational, or residential uses; and directly from control activities practiced within wetlands for protection of public health or for nuisance abatement. Persistent and bioaccumulative pesticides used at upland sites have threatened coastal wetland biota. For more biodegradable contemporary pesticides, concerns for ecological impact are more a

function of the proximity of the site of application relative to the wetland, and time available for degradation and sorption. In addition, the rate and extent of localized mixing, flushing, and stratification within the wetland can greatly affect exposure concentrations and durations for wetland biota. The short-term, direct toxic effects of pesticides on aquatic biota inhabiting coastal wetlands have been characterized in laboratory and field studies; however, assessment of the cumulative and indirect effects of repeated exposures to multiple chemicals at sublethal concentrations is a major research need.

© CSA

**246. Pesticides in Esteros del Ibera (AR): Evaluation of impacts and proposal of guidelines for water quality protection.**

Silva, C.; Boia, C.; Valente, J.; and Borrego, C. *Ecological Modelling* 186(1): 85-97. (July 2005)  
NAL Call #: QH541.15.M3E25; ISSN: 0304-3800

*Descriptors:* wetlands/ pesticides/ insecticides/ models/ endosulfan/ water quality/ carbofuran/ aquatic ecosystems/ standards/ cultures/ model studies/ protection/ rice/ aquatic life/ mass spectrometry/ regulations/ ecosystems/ monitoring/ gas chromatography/ physicochemical properties/ lagoons/ evaluation/ modelling/ pollution monitoring/ chromatographic techniques/ rice fields/ man-induced effects/ oryza sativa/ Argentina/ rice/ modeling, mathematics, computer applications/ identification of pollutants/ characteristics, behavior and fate

*Abstract:* This work is within the framework of a project where the overall objective is to create the methodology for a sustainable management of an important wetland in Argentina, "Esteros del Ibera". Rice culture has been identified as the main anthropogenic activity, being necessary to evaluate the impacts of pesticides used in rice culture on the aquatic ecosystem. The purpose of this paper is to evaluate the impacts of pesticides used in rice culture through the use of a Mackay's model, to identify the potentially more contaminated environmental compartments, and identify their toxicological and physicochemical properties. Based on the results of the model, water samples were collected and two insecticides (endosulfan and carbofuran) were analysed using the solid-phase microextraction (SPME) extraction technique with detection by gas chromatography with mass spectrometry (GC-MS). To create a decision tool based on monitorization results, pesticide guidelines for water quality (drinking and for aquatic life protection) were calculated and compared with the available international regulations for pesticides; conservative guidelines are recommended. The results of pesticides analysis were compared with these guidelines; some results exceeded the international guidelines (mainly the values for protection of aquatic life) in particular those from samples taken close to the discharge points and due to the presence of the more toxic insecticide endosulfan; however, the impact of pesticides on most waters of the lagoon Ibera seems not yet to be very significant, but monitoring of impacts and careful use of pesticides, specially insecticides, should be observed in the future.

© CSA

**247. Phosphorus concentration and forms in surface and subsurface drainage water from wetland rice fields in the Shaoxing plain.**

Zhang, Mingkui; Jiang, Hong; and Liu, Xingmei  
*Pedosphere* 13(3): 239-248. (Aug. 2003)

NAL Call #: S590 .P43; ISSN: 1002-0160

*Descriptors:* wetlands/ subsurface drainage/ rice/ drought/ phosphorus/ surface drainage/ fertilization/ cultivated lands/ surface water/ limiting factors/ subsurface irrigation/ rapid flow/ agricultural runoff/ fertilizers/ soil profile/ preferential flow/ China, People's Rep./ sources and fate of pollution

*Abstract:* Phosphorus (P) is the limiting factor for eutrophication in most freshwater ecosystems. In China, P transported from intensively cultivated land has been reported as an important source of P in surface waters. In this study, we investigated P concentration and forms in surface and subsurface drainage from wetland rice fields in the Shaoxing plain, Zhejiang Province, China. From selected rice fields, surface drainage samples were collected at rice-growing, non-growing and fertilization periods, and subsurface drainage samples at drought and rewetting (irrigation or precipitation after 5-10 d drought period in the surface soils) and wet (drainage under long-term wet soil condition) periods. Water samples were characterized for their total reactive P (TRP), dissolved reactive P (DRP) and particulate reactive P (PRP). Concentrations of the TRP and DRP in the surface drainage ranged from 0.08 to 1.50 and 0.06 to 1.27 mg L super(-1), respectively. The TRP and DRP were dependent on field operation activities, and decreased in the order of fertilization period > rice-growing period > non-growing period. Phosphorus concentration of runoff receiving P fertilizer can be an environmental concern. The PRP concentration in the surface drainage, ranging from 0.01 to 0.57 mg L super(-1), accounted for 8%-78% of the TRP. Concentration of the TRP in the subsurface drainage was from 0.026 to 0.090 mg L super(-1), consisting of 29%-90% of the DRP and 10%-71% of the PRP. In the drought and rewetting period, the PRP accounted for, on average, 63% of the TRP, much higher than in the wet period (23%), suggesting that there was transport of P in preferential flow during drainage events after a short-term drought period in the surface soils. Therefore, P losses in particulate form may be important in the subsurface drainage from rice fields when surface soils form cracks and favor rapid flow downward through the soil profiles, suggesting the important role of water-dispersible colloid particles in mediating and co-transporting P in the subsurface drainage of rice fields.

© CSA

**248. Post-fire vegetation change and bird use of a salt marsh in coastal Argentina.**

Isacch, J. P.; Holz, S.; Ricci, L.; and Martinez, M. M.  
*Wetlands* 24(2): 235-243. (2004)

*Descriptors:* wetlands/ marshes/ burns/ fires/ salt marshes/ habitat/ vegetation/ biosphere reserves/ burning/ plant populations/ environmental impact/ community composition/ aquatic plants/ food availability/ man-induced effects/ fire/ ecosystem management/ biodiversity/ ecological succession/ coastal zone/ habitat selection/ Spartina/ structure/ birds/ habitats/ forages/ incineration/ species composition/ Juncus/ Spartina/ Spartina densiflora/ Aves/ Juncus acutus/ Argentina/ Argentina, Pampa/ birds

**Abstract:** Vegetation structure is an integral component of avian habitat selection. Therefore, structure changes caused by management practices can influence avian communities. The salt marshes of the pampas region of Argentina have experienced an increase in fire use as a management tool to improve cattle forage and to avoid accidental fires. A spring burn of 200 ha of salt marsh in Mar Chiquita Biosphere Reserve, Argentina, in September 1995, allowed us to compare the response of birds associated with two vegetation communities, one dominated by *Spartina densiflora* (Spartina marsh) and another dominated by *Juncus acutus* (Juncus marsh) from one month to one year post-burn. We recorded changes in plant species composition and vegetation structure (height and cover) at 40 days after the burn and every season for the subsequent year. Fire reduced total cover of both plant communities. *Juncus* marsh recovered pre-burn structure and bird community by one year post-fire. However, *Spartina* marsh recovery was incomplete in that period. Relative abundances of bird species that used unburned *Juncus* marsh were similar to those in burned *Juncus* marsh in the spring period one year after the burn. Plant height at the burned *Spartina* marsh did not reach that of the unburned *Spartina* in 12 months; red-capped wren-spinetail (*Spartonacoica maluroides*), a rare tall-grass-dependent species, settled burned parcels at lower relative abundances than in unburned habitat. Because species that first use the burned patches are very common and widespread in other habitats, and excessive burning may reduce available habitat for endangered or rare species, prescribed burns should be avoided in this region.

© CSA

**249. Potential mineralization of four herbicides in a ground water-fed wetland area.**

Larsen, L.; Joergensen, C.; and Aamand, J. *Journal of Environmental Quality* 30(1): 24-30. (2001)  
NAL Call #: QH540.J6; ISSN: 0047-2425

**Descriptors:** wetlands/ herbicides/ mineralization/ groundwater/ agriculture/ catchment areas/ atrazine/ anaerobically/ pollution (groundwater)/ aerobic conditions/ groundwater pollution/ water pollution sources/ slurries/ aquifers/ mecoprop/ metsulfuron-methyl/ redox potential/ isoproturon

**Abstract:** Herbicides may leach from agricultural fields into ground water feeding adjacent wetlands. However, only little is known of the fate of herbicides in wetland areas. The purpose of the study was to examine the potential of a riparian fen to mineralize herbicides that could leach from an adjacent catchment area. Slurries were prepared from sediment and ground water collected from different parts of a wetland representing different redox conditions. The slurries were amended with O sub(2), NO sub(3) super(-), SO sub(4) super(2-), and CO sub(2), or CO sub(2) alone as electron acceptors to simulate the in situ conditions and their ability to mineralize the herbicides mecoprop, metsulfuron-methyl, isoproturon and atrazine. In addition, the abundance of bacteria able to utilize O sub(2), NO sub(3) super(-), SO sub(4) super(2-) + CO sub(2), and CO sub(2) as electron acceptors was investigated along with the O sub(2)-reducing and methanogenic potential of the sediment. The recalcitrance to bacterial degradation depended on both the type of herbicide and the redox conditions pertaining. Mecoprop was the most readily degraded herbicide, with 36% of [ring-U-

super(14)C]mecoprop being mineralized to super(14)CO sub(2) under aerobic conditions after 473 d. In comparison, approximately 29% of [phenyl-U- super(14)C]metsulfuron-methyl and 16% of [ring-U- super(14)C]isoproturon mineralized in aerobic slurries during the same period. Surprisingly, 8 to 13% of mecoprop also mineralized under anaerobic conditions. Neither metsulfuron-methyl nor isoproturon were mineralized under anaerobic conditions and atrazine was not mineralized under any of the redox conditions examined. The present study is the first to report mineralization of mecoprop in ground water in a wetland area, and the first to report mineralization of a phenoxyacetic acid herbicide under both aerobic and anaerobic conditions.

© CSA

**250. A preliminary study of the effects of drainage and harvesting on water quality in ombrotrophic bogs near Sept-Iles, Quebec.**

Moore, T. R.

*Water Resources Bulletin* 23(5): 785-791. (1987)

NAL Call #: 292.9 AM34; ISSN: 0043-1370

**Descriptors:** wetlands/ bogs/ drainage/ peat/ harvesting/ water quality/ runoff/ groundwater/ nutrients/ acidity/ Quebec

This citation is from AGRICOLA.

**251. Regional biodiversity in an agricultural landscape: The contribution of seminatural habitat islands.**

Duelli, P. and Obrist, M. K.

*Basic and Applied Ecology* 4(2): 129-138. (2003)

NAL Call #: QH540 .B37

**Descriptors:** arthropods/ biological diversity/ dispersal/ ecological compensation/ fauna/ greenveining

**Abstract:** An important goal of ecological compensation measures in agricultural areas is the conservation and enhancement of regional species diversity. However, some current European agri-environment schemes seem to be rather ineffective. A likely explanation is the lack of source populations in intensely cultivated landscapes. Remnants of natural and seminatural habitats can contribute to regional biodiversity in various ways: as essential habitats for specialised species, as stepping stones, and as temporary habitats for hibernation, larval development, or preovipository feeding. The overall percentage of arthropod species, for which seminatural habitats are an essential prerequisite for living in an agricultural landscape, was assessed with a 5 km long transect of 18 standardised trapping stations. The transect extended from an isolated area of wetland through intensely managed crop fields and grassland to an isolated semiarid meadow bordered by mixed forest. For more than 1000 arthropod species the spatial and temporal distribution of a one year's catch along the transect was interpreted with regard to their affinity to seminatural habitats. Experts were asked to judge questionable cases of apparent ubiquitous species. All in all, more than 63% of all animal species (except for soil and water fauna) living in the agriculturally managed areas of the Limpach valley seem to depend on the presence of seminatural habitats. We conclude that remnant islands of natural or seminatural habitats provide the most important source populations for agri-environment schemes in order to enhance biodiversity in an otherwise depleted agricultural landscape.

© 2006 Elsevier B.V. All rights reserved.

**252. Response of advance regeneration to intensity of harvest and fertilization on boreal wetlands.**

Teng, Y.; Bailey, S. E.; Foster, N. W.; and Hazlett, P. W. *Forestry Chronicle* 79(1): 119-126. (2003)  
 NAL Call #: 99.8 F7623; ISSN: 0015-7546  
 Descriptors: black spruce/ clearcut/ nitrogen/ phosphorus/ potassium

**Abstract:** Post-harvest nutrient status and growth of understory black spruce (*Picea mariana* [Mill.] B.S.P.) advance regeneration during the first seven years after harvest with advance regeneration protection (HARP) was evaluated on two boreal wetlands in northeastern Ontario. Three intensities of HARP were investigated: light, medium and heavy, corresponding to 35, 50, 100% basal area removal of merchantable trees. Limiting nutrients were diagnosed with a nitrogen (N), phosphorus (P) potassium (K) fertilization trial. Release by HARP significantly improved foliar N by 43-214%, and P by 40-317%, stimulated needle mass by 13-114% and annual height increment of spruce by 6-50% on all three HARP treatments. Growth of spruce was statistically greater after heavy release than the other two HARP treatments by the sixth year. Fertilization with a combination of N and P further increased needle biomass and height increment by 23-46% and 16-26%, respectively. Nitrogen and, secondly, P were limiting for rapid natural reestablishment of black spruce stands on boreal peatlands.  
 © 2006 Elsevier B.V. All rights reserved.

**253. Restoration of riparian habitat using experimental flooding.**

Sprenger, M. D.; Smith, L. M.; and Taylor, J. P. *Wetlands* 22(1): 49-57. (Mar. 2002)  
 NAL Call #: QH75.A1W47; ISSN: 0277-5212  
 Descriptors: wetlands/ USA, New Mexico, Rio Grande River/ reservoirs/ riparian vegetation/ vegetation regrowth/ trees/ species composition/ survival/ mechanical control/ chemcontrol/ comparison studies/ drawdown/ environmental restoration/ riparian environments/ flooding/ herbicides/ pesticide applications/ habitat/ seedlings/ chemical treatment/ imazapyr/ impoundments/ endemic species/ water levels/ habitat improvement/ *Tamarix ramosissima*/ *Populus deltoides*/ USA, New Mexico, Rio Grande Valley/ saltcedar trees/ Eastern cottonwood/ control of water on the surface/ reclamation/ environmental action/ mechanical and natural changes/ general environmental engineering/ water and plants

**Abstract:** We evaluated treatments designed to remove saltcedar (*Tamarix ramosissima*) monocultures from riparian habitats using root plows (mechanical treatment) and aerial applications of the herbicide imazapyr (chemical treatment) within twelve 4-ha impoundments in the Middle Rio Grande Valley in central New Mexico, USA. Following these treatments, impoundments were flooded and water levels were reduced to stimulate native species re-establishment from seed. Water manipulations within saltcedar-removal areas consisted of stage drawdowns of 5 cm/day and 10 cm/day. Mechanically cleared areas had fewer saltcedar resprouts (26 resprouts/ha) than chemically treated areas (2,500 resprouts/ha). Saltcedar and cottonwood (*Populus deltoides* subsp. *wislizini*) seedling density and cottonwood survival were greater in mechanically treated areas than in chemically treated areas. This effect is attributed to soil disturbance resulting from root plowing. Cottonwood seedling density and

survival did not differ between 5 cm/day and 10 cm/day stage drawdowns and decreased throughout summer as a result of excessive moisture stress. The absence of a drawdown treatment effect indicates that both drawdowns were too fast for seedling roots to keep up with declining water tables. Seedlings that survived were using moisture from the unsaturated zone.  
 © CSA

**254. A review of the effects of agricultural and industrial contamination on the Ebro Delta biota and wildlife.**

Manosa, S.; Mateo, R.; and Guitart, R. *Environmental Monitoring and Assessment* 71(2): 187-205. (2001)  
 NAL Call #: TD194; ISSN: 0167-6369

**Descriptors:** wildlife/ pesticides (organochlorine)/ pesticides (carbamates)/ industrial pollution/ pollution effects/ PCB/ pesticides/ pollution/ plants/ reviews/ contamination/ biota/ organochlorine compounds/ PCB compounds/ biological diversity/ rice fields/ aquatic birds/ deltas/ marine birds/ pollution monitoring/ pollution dispersion/ river discharge/ industrial wastes/ agricultural pollution/ agricultural runoff/ insecticides/ chlorinated hydrocarbons/ organic compounds/ phosphorus compounds/ water pollution sources/ polychlorinated biphenyls/ ecological effects/ aquatic populations/ water birds/ accumulation/ species diversity/ pollutants/ agriculture/ aquatic organisms/ environmental pollution/ wetlands pollution/ agricultural effects on surface waters/ industrial pollutants/ river water pollution/ pesticide environmental pollution/ herbicides in runoff/ polychlorinated biphenyls in soil/ Spain, Ebro R.  
**Abstract:** The Ebro Delta (NE Spain) is a 320 km super(2) wetland area of international importance for conservation. The area is devoted to rice farming and receives large amounts of pesticides. Industrial pollutants are also carried to the delta by the river. The information accumulated during the last 25 year on the effect of such pollution on the biota is reviewed in order to identify the existing gaps and needs for management. Organochlorine pesticides were legally used until 1977, which has resulted in the widespread presence of these compounds in the Ebro Delta biota. Lethal, sublethal or other detrimental effects of these pesticides on wildlife in the area were poorly investigated, but negative effects on the reproduction of ducks and herons were reported. Nowadays, polychlorinated biphenyls (PCBs) are the main responsible of organochlorine pollution in the area: concentrations in biota samples are higher than levels observed in nearby coastal areas, as a result of the significant PCB inputs by the river which, in 1990, were evaluated at 126 kg yr super(-1). The massive use of herbicides is thought to have contributed to the elimination of macrophyte vegetation in the lagoons during the eighties, which had strong consequences on diving ducks and coot populations. Weed control is also related to the loss of biodiversity held by rice fields. The massive and inadequate use of organophosphorus and carbamate pesticides (involving more than 20 000 t yr super(-1)) has produced some waterbird mortality events, and may have direct and indirect effects on other non-target organisms. The accumulation in the soil of lead pellets used in waterfowl shooting is estimated to kill some 16 300 waterbirds in the Ebro delta every year.  
 © CSA

**255. The role of grazing in creating suitable sward structures for breeding waders in agricultural landscapes.**

Tichit, M.; Durant, D.; and Kerneis, E.  
*Livestock Production Science* 96(1): 119-128. (2005)  
 NAL Call #: SF1.L5; ISSN: 0301-6226  
*Descriptors:* wetlands/ animal production/ coastal areas/ grass sward/ grazing/ habitats/ marshes/ nitrogen fertilizers/ plant height/ stand structure/ stocking rate  
*Abstract:* French wet grasslands support important populations of lapwings and other waders. Grazing management is a key issue in the use of grasslands by these birds since they are very sensitive to sward structure (height and heterogeneity). To assess the impact of different grazing regimes on sward structure during spring, sward height was repeatedly measured in a coastal marsh for 2 years. Sward structure was characterised by variables related to height classes and an index of heterogeneity. Grazing regimes were described by stocking rates per period and N fertilisation level. Heterogeneity index was quadratically related to mean sward height both years. Four types of sward structures were characterised through principal component analysis. Co-inertia analysis showed a strong relationship between grazing regimes and sward structure. However, during spring, the relationship between stocking rate and sward structure differed according to year, impact of grazing being greater during drought year. Suitable sward structures were observed for both lapwings and redshanks. Wader habitat management through grazing calls for more attention to be paid to the delayed effects of autumn and winter grazing regimes. Sward heterogeneity emerges as a new characteristic to control, because it may introduce new constraints for livestock production.  
 © CAB International/CABI Publishing

**256. The role of herbicides in the erosion of salt marshes in eastern England.**

Mason, C. F.; Underwood, G. J. C.; Baker, N. R.; Davey, P. A.; Davidson, I.; Hanlon, A.; Long, S. P.; Oxborough, K.; Paterson, D. M.; and Watson, A.  
*Environmental Pollution* 122(1): 41-49. (2003)  
 NAL Call #: QH545.A1E52; ISSN: 0269-7491  
*Descriptors:* agricultural development/ photosynthesis/ growth/ vegetation/ herbicides/ agriculture/ saltmarsh habitat/ impact of forestry or agriculture/ pollution, toxicity/ laboratory experiments/ fieldwork, field experiments/ Europe/ United Kingdom/ England  
*Abstract:* Laboratory studies and field trials were conducted to investigate the role of herbicides on saltmarsh vegetation, and their possible significance to saltmarsh erosion. Herbicide concentrations within the ranges present in the aquatic environment were found to reduce the photosynthetic efficiency and growth of both epipellic diatoms and higher saltmarsh plants in the laboratory and in situ. The addition of sublethal concentrations of herbicides resulted in decreased growth rates and photosynthetic efficiency of diatoms and photosynthetic efficiency of higher plants. Sediment stability also decreased due to a reduction in diatom EPS production. There was qualitative evidence that diatoms migrated deeper into the sediment when the surface was exposed to simazine, reducing surface sediment stability by the absence of a cohesive biofilm. Sediment loads on leaves severely reduced photosynthesis in *Limonium vulgare*.

This, coupled with reduced carbon assimilation from the effects of herbicides, could have large negative consequences for plant productivity and over winter survival of saltmarsh plants. The data support the hypothesis that sublethal herbicide concentrations could be playing a role in the increased erosion of salt marshes that has occurred over the past 40 years.  
 © NISC

**257. The role of the Conservation Reserve Program in relation to wildlife enhancement, wetlands and adjacent habitats in the northern Great Plains.**

Higgins, K. F.; Nomsen, D. E.; and Wentz, W. A.  
 In: General Technical Report RM; Vol. 159.  
 Fort Collins, Colo.: Rocky Mountain Forest and Range Experiment Station, 1987  
*Descriptors:* Conservation Reserve Program/ regional conservation programs/ northern Great Plains  
*Abstract:* Focused on the value of CRP grasslands directly related to wetlands and their associated wildlife (primary migratory birds).

**258. Sampling of agrochemicals for environmental assessment in rice paddies: Dry tropical wetlands, Costa Rica.**

Loaiciga, H. A. and Robinson, T. H.  
*Ground Water Monitoring & Remediation* 15(3): 107-118. (1995)  
 NAL Call #: GB1001.G76; ISSN: 1069-3629  
*Descriptors:* wetlands/ paddy soils/ pesticides/ fertilizers/ water quality/ water pollution/ soil pollution/ sampling/ tropics/ Costa Rica  
*Abstract:* This paper presents results from a preliminary sampling strategy developed to track agricultural contaminants found in surface and subsurface media and used commonly in rice paddy cultivation in the dry, tropical forest coastal region of Guanacaste, Costa Rica. The emphasis is on the impact of eight indicator pesticides, five forms of nitrogen and phosphorus that are common nutrients found in fertilizers. After the field sampling strategy was developed, soil and water samples were collected twice: once during the beginning of the wet season and once during the initiation of the dry season. Hydrological parameters, soil classifications, agricultural product toxicology, irrigation and drainage networks, cultivated areas, land ownership, and pristine environments have been studied, mapped, and entered into a database in order to understand the spatial and temporal distribution of potential contaminants and their pending ecological degradation. Alternative crops and agricultural practices are suggested to reduce or eliminate impacts on biological preserves. Database development and basin characteristics have been entered into a Geographic Information System (GIS) that is capable of fully integrating suggested site modeling. Field sampling results indicate that proposed rice paddy cultivation in a relatively undisturbed basin is likely to have minimal impact on downstream biological preserves.  
 This citation is from AGRICOLA.

**259. Simulating the impact of irrigation management on the water and salt balance in drained marsh soils (Marismas, Spain).**

Andreu, L.; Jarvis, N. J.; Moreno, F.; and Vachaud, G. *Soil Use and Management* 12(3): 109-111. (1996)  
*Descriptors:* marshes/ wetland soils/ clay soils/ drained conditions/ irrigation/ water management/ irrigation water/ irrigation scheduling/ soil water balance/ soil salts/ chlorides/ leaching/ water table/ simulation models/ application rate/ Spain  
*Abstract:* Using the simulation model MACRO, this paper investigates the likely consequences of reduced irrigation inputs on the water and salt balance and crop growth in a drained, saline clay in a Mediterranean climate (Marismas, SW Spain). The model was first successfully validated against field measurements of the soil water and chloride balance, water table depths and drain outflows in the 1989 growing season. Three-year simulations were then performed assuming two different irrigation applications (60 and 75% reductions from the 1989 amount) and two different frequencies (12 or 6 irrigations per growing season). The model predictions suggested that reduced irrigation may lead to up to a 15% increase in the chloride content of the soil profile after 3 years. Also, despite overall reductions in water discharge, slight increases in chloride leaching via field drains (c. 4 to 8%) were predicted. The model demonstrated that encroachment of salt into the soil profile may be exacerbated by the non-equilibrium nature of water flow and solute transport ('by-passing flow') in structured clays. With reduced water supply for irrigation, more frequent applications may give marginally better crop yields for the same quantity of irrigation but at the expense of slightly increasing salt concentration in the root zone. This citation is from AGRICOLA.

**260. Soil carbon in northern forested wetlands: Impacts of silvicultural practices.**

Trettin, C. C.; Jurgensen, M. F.; Gale, M. R.; and McLaughlin, J. W.  
 In: Carbon Forms and Functions in Forest Soils/ McFee, W. W. and Kelly, J. M.  
 Madison, Wis.: Soil Science Society of America, 1995; pp. 437-461  
*NAL Call #:* SD390.N67 1993  
*Abstract:* This paper has three objectives: (i) review the distribution and function of C in northern forested wetlands, (ii) review how different silvicultural practices affect soil C levels, and (iii) consider the potential for recovery of soil C following disturbance by silvicultural practices. -Authors

**261. Soil physical behaviour and crop responses to tillage in lowland rice soils of varying clay content.**

Mambani, B.; De Datta, S. K.; and Redulla, C. A. *Plant & Soil* 126(2): 227-235. (1990); *ISSN:* 1573-5036  
*Abstract:* The influence of various tillage methods on two wetland rice soils in the Philippines is reported. The soils differed principally in clay content, 38% for the clay loam, while 56% for the clay. This had a marked effect on their response to tillage and varying water regime. The clay soil, under field conditions, showed little change in pore size distribution or soil water behaviour with different tillage methods. Crop yields were unaffected by tillage. In contrast, tillage effects were very marked in the clay loam soil, which consisted of a greenhouse and a field trial.  
 © 2006 Elsevier B.V. All rights reserved.

**262. Soil, surface water and ground water phosphorus relationships in a partially harvested Boreal Plain aspen catchment.**

Macrae, M. L.; Redding, T. E.; Creed, I. F.; Bell, W. R.; and Devito, K. J. *Forest Ecology and Management* 206(1-3): 315-329. (2005)  
*NAL Call #:* SD1.F73; *ISSN:* 0378-1127  
*Descriptors:* aspen/ Boreal Plain/ forest/ ground water/ phosphorus/ soil/ sub-humid/ surface-water/ timber harvest/ topography  
*Abstract:* Soil phosphorus (water-extractable) measured in harvested and forested areas of a headwater aspen forested catchment in north-central Alberta was related to surface and ground water total dissolved phosphorus (TDP). No differences in water-extractable soil phosphorus concentrations ([ext-P]) were observed between harvested and forested areas. Topographic position explained most of the variance in the [ext-P] of surface soils. Soil [ext-P] in surface horizons was large in upslope areas compared to low-lying areas, ephemeral draws, and wetlands. Forest floor and surface organic soils (0-10 cm) had greater concentrations of ext-P (>70 ?g g<sup>-1</sup>) and total P (tot-P) (>1000 ?g g<sup>-1</sup>) than mineral soils ([ext-P] <2 ?g g<sup>-1</sup> and [tot-P] <300 ?g g<sup>-1</sup>). Phosphorus buffering capacity was small in organic surface soils (EPC0 > 5000 ?g L<sup>-1</sup>) and large in mineral soils (EPC0 A horizon = 100-400 ?g L<sup>-1</sup>; EPC0 B horizon < 100 ?g L<sup>-1</sup>). This was reflected in greater levels of TDP in surface water (range = 2-2350 ?g L<sup>-1</sup>, median = 85 ?g L<sup>-1</sup>) and soil water (range = 22-802 ?g L<sup>-1</sup>, median = 202 ?g L<sup>-1</sup>) which flowed through organic soils, compared with small concentrations of TDP in ground water which flowed through mineral soils (range = 0-1705 ?g L<sup>-1</sup>, median = 23 ?g L<sup>-1</sup>). Our results indicate that increases in ground water TDP following harvest are unlikely due to the large adsorption affinity of mineral soils. Phosphorus-rich surface soils have a large potential for phosphorus release to surface water but this does not differ between harvested and forested areas. Sub-humid climatic conditions and rapid aspen regeneration lead to soil moisture deficits and limited surface runoff which may reduce harvesting effects on P mobilization on the Boreal Plain.  
 © 2006 Elsevier B.V. All rights reserved.

**263. Temporal changes in macroinvertebrate assemblages following experimental flooding in permanent and temporary wetlands in an Australian floodplain forest.**

Hillman, T. J. and Quinn, G. P. *River Research and Applications* 18(2): 137-154. (Mar. 2002-Apr. 2002)  
*NAL Call #:* TC530 .R43; *ISSN:* 1535-1459  
*Descriptors:* wetlands/ flooding/ community composition/ forests/ rivers/ regulated rivers/ flood plains/ ecological effects/ macroinvertebrates/ species composition/ temporal distribution/ habitats/ comparison studies/ floodplains/ floods and flooding/ ecology/ animals (invertebrates)/ time dependent/ habitat/ comparative studies/ environmental impact/ fauna/ Animalia/ Australia, New South Wales, Murray R./ temporal variations/ aquatic entomology/ ecological impact of water development/ water resources and supplies/ habitat community studies  
*Abstract:* The River Murray, Australia, is a highly regulated river from which almost 80% of mean annual flow is removed for human use, primarily irrigated agriculture.

Consequent changes to the pattern and volume of river flow are reflected in floodplain hydrology and, therefore, the wetting/drying patterns of floodplain wetlands. To explore the significance of these changes, macroinvertebrate samples were compared between permanent and temporary wetlands following experimental flooding in a forested floodplain of the River Murray. Weekly samples from two permanent wetlands and four associated temporary sites were used to track changes in macroinvertebrate assemblage composition. Non-metric multidimensional scaling was used to ordinate the macroinvertebrate data, indicating consistent differences between the biota of permanent and temporary wetlands and between the initial and later assemblages in the temporary sites. There were marked changes over time, but little sign that the permanent and temporary assemblages were becoming more alike over the 25-week observation period. The apparent heterogeneity of these systems is of particular importance in developing river management plans which are likely to change flooding patterns. Such plans need to maintain a mosaic of wetland habitats if floodplain biodiversity is to be supported.

© CSA

**264. Timber harvest in wetlands: Strategies and impact assessment.**

Prenger, Joseph P. and Crisman, Thomas L.  
In: Bioassessment and management of North American freshwater wetlands/ Rader, Russell B.; Batzer, Darold P.; and Wissinger, Scott A.

New York: John Wiley & Sons, 2001; pp. 429-449.

Notes: ISBN: 0471352349

NAL Call #: QH77.N56 B56

Descriptors: animals and man/ disturbance by man/ commercial activities/ habitat/ terrestrial habitat/ land and freshwater zones/ Nearctic region/ North America/ comprehensive zoology: forestry/ timber harvesting/ ecological impact/ semiaquatic habitat/ forest and woodland/ USA, Southeast/ ecological impact of timber harvesting/ forested wetlands

© The Thomson Corporation

**265. Toxicity assessment of water from lakes and wetlands receiving irrigation drain water.**

Dickerson, K. K.; Hubert, W. A.; and Bergman, H. L.

*Environmental Toxicology and Chemistry* 15(7): 1097-1101. (1996)

NAL Call #: QH545.A1E58; ISSN: 0730-7268

Descriptors: wetlands/ drainage water/ irrigation water/ contaminants/ toxicity/ Ceriodaphnia dubia/ Pimephales promelas/ mortality/ water quality/ lakes/ water pollution/ Colorado/ Wyoming/ Montana

Abstract: A method for reconnaissance-level assessments of the potential toxicity of water in lakes and wetlands that receive irrigation drain water is needed. We evaluated a model that predicts toxicity to aquatic organisms due to major ionic composition as a primary means of assessing water quality. The model was used in conjunction with acute toxicity tests and trace element analyses. Mortality of *Ceriodaphnia dubia* and fathead minnows (*Pimephales promelas*) observed in acute toxicity tests was compared to mortality predicted by the model. The method was applied at 22 lakes and wetlands on federally administered lands in Colorado, Montana, Utah, and Wyoming. Fourteen of 22 locations had water that was not toxic to test organisms. Six

locations had undiluted water that was toxic to *C. dubia* due to major ionic composition, and two locations had undiluted water that showed toxic effects caused by factors other than elevated levels of major ions. The model for *C. dubia* seemed to be sufficiently accurate for future application using our approach to assess lakes and wetlands receiving irrigation drain water.

This citation is from AGRICOLA.

**266. The transport of the pesticide atrazine from the fresh water of the wetlands of Brittany to the salt water of the bay of Mont St. Michel (France).**

Gueune, Y. and Winnett, G.

*Journal of Environmental Science and Health, Part A: Environmental Science and Engineering & Toxic and Hazardous Substance Control* A29(4): 753-768. (1994)  
NAL Call #: TD172.J6; ISSN: 0360-1226

Descriptors: wetlands/ pesticides/ water pollution/ agricultural chemicals/ fate of pollutants/ atrazine/ seawater/ agrochemicals/ sediment pollution/ freshwater pollution/ pollution dispersion/ agricultural pollution/ pollutant persistence/ fate/ France, Brittany/ atrazine

Abstract: This paper is concerned with possible environmental hazards connected with the use of agricultural chemicals (pesticides) in the agriculture of the reclaimed lands of northeastern Brittany (France). The transport of atrazine from the site of use in the polders of Brittany by freshwater and sediment to the salt water of the Bay of Mont St. Michel is examined.

© CSA

**267. Tree community diversity of lowland swamp forest in northeast Costa Rica, and changes associated with controlled selective logging.**

Webb, E. L. and Peralta, R.

*Biodiversity and Conservation* 7(5): 565-583. (1998)

NAL Call #: QH75.A1 B562; ISSN: 0960-3115

Descriptors: *Carapa nicaraguensis*/ Costa Rica/ diversity/ logging/ swamp/ tree community

Abstract: In the Atlantic lowlands of Northeast Costa Rica, logging occurs in tracts of poorly drained wet forest ('swamp forest'), yet little is known about factors affecting swamp forest diversity or the potential for biodiversity retention during harvest. This paper quantitatively describes the species composition and diversity of the swamp forest habitat, and reports the immediate impact of controlled, selective logging on tree community diversity. *Pentaclethra macroloba* (Leguminosae), *Carapa nicaraguensis* (Meliaceae) and *Pterocarpus officinalis* (Leguminosae) accounted for >70% of the primary swamp forest basal area. Nevertheless, 225 species from 53 families with individuals >10 cm dbh were encountered in 16.4 ha; most species had very low abundances. Gamma diversity is a component of overall swamp forest diversity. Extraction of 49.2 m<sup>3</sup> ha<sup>-1</sup> (5.5 trees ha<sup>-1</sup>) of timber from a 4 ha plot reduced species richness by 14, supporting assertions that random mortality during logging can affect the distribution of rare species. However, tree community diversity as measured by rarefaction was not greatly affected by selective logging. Total post-logging stem recruitment over a 3-year period was greater in logged plots than in undisturbed plots; the recruitment of the ruderal species *Ochroma lagopus* (Bombacaceae) was the most clearly affected by logging. Any localized dominance by this species will be limited in space and time in a carefully

managed forest. The results suggest that controlled selective logging can be consistent with biodiversity conservation, and complement protected areas in Northeast Costa Rica.

© 2006 Elsevier B.V. All rights reserved.

**268. The use of fertilizer-free grass buffer strips to attenuate nitrate input to marshland dykes.**

White, S. K.; Cook, H. F.; and Garraway, J. L.

*Water and Environmental Management* 12(1): 54-59. (1998)

NAL Call #: TD420.W374; ISSN: 0951-7359

*Descriptors:* nitrates/ nutrient uptake/ alluvial soils/ pollution control/ wetland soils/ drainage/ nitrate nitrogen/ saturated flow/ unsaturated flow/ groundwater/ groundwater flow/ groundwater contamination

*Abstract:* Fertilizer-free buffer strip establishment has proved to be effective in attenuating nitrates which are mobile in shallow water-tables feeding watercourses of conservation potential. This paper demonstrates their effectiveness on reclaimed alluvial marshland soils. This citation is from AGRICOLA.

**269. Using the shelterwood method to mitigate water table rise after forest harvesting.**

Pothier, D.; Prevost, M.; and Auger, I.

*Forest Ecology and Management* 179(1-3): 573-583. (2003)

NAL Call #: SD1.F73; ISSN: 0378-1127

*Descriptors:* wetlands/ water table/ harvesting/ forest management/ forest industry/ ecosystem disturbance/ forests/ environmental impact/ restoration/ logging/ Canada/ shelterwood/ shelterwood method

*Abstract:* The groundwater level of a conifer stand established on a lowland in eastern Canada was periodically measured using water wells installed in an experimental design composed of four completely randomized blocks and five levels of cutting (0, 40, 50, 60, and 100% of basal area (BA) removed). The three partial cutting treatments were applied following the principles of low thinning, but with the seed cutting objectives of the shelterwood method. Before cutting, highly similar values for groundwater level were recorded for plots targeted to receive the planned treatments. During the first growing season after cutting, the water table rise was linearly related to the percentage of cutting, and this effect was more apparent at the lower levels recorded for the control water table. This finding is partly explained by the leaf biomass of residual trees that intercepted an increasing proportion of rainfall with decreasing cutting intensity. Five years after cutting, although the water table of clearcut experimental units (EU) was still higher than that of the controls, it was no longer related to cutting intensity. During the 5 years following cutting, the slopes of the relationship between the water table depth of the control plots and those of any treatment gradually approached the value calculated before cutting. This water table recovery was related to the increasing leaf biomass of the regeneration stratum over time, rather than to the crown expansion of residual trees. The shelterwood method should be considered for forest management of wetlands, since it mitigates water table rise after the first cut and promotes a vigorous regeneration stratum which should also mitigate water table rise following the final cut.

© CSA

**270. Vegetation and threatened plant dynamics of wet abandoned rice fields in Nakaikemi, Fukui Prefecture, Japan.**

Shimoda, M. and Nakamoto, M.

*Japanese Journal of Ecology* 53(3): 197-217. (Dec. 2003)

NAL Call #: 410 J272; ISSN: 0021-5007

*Descriptors:* wetlands/ plant communities/ vegetation patterns/ vegetation changes/ succession/ old fields/ rice fields/ environment management/ ecological succession/ nature conservation/ rare species/ soils/ water content/ community composition/ plant populations/ species diversity/ marshes/ seeds/ vegetation cover/ environmental conditions/ dominant species/ agriculture/ herbicides/ aquatic plants/ Typha/ Phragmites/ Zizania/ Oryza sativa/ Japan, Honshu, Fukui Prefect./ rice/ conservation, wildlife management and recreation/ other aquatic communities

*Abstract:* Nakaikemi, in Fukui Prefecture, central Japan, is a basin with an area of about 25 hectares. Rice has been cultivated in wet paddy fields throughout Nakaikemi since the Edo period (1603-1867). The traditional wet fields always supported a diversity of aquatic and wetland plants, including threatened species. Recently, abandoned rice fields have continued to increase because the environmental conditions they provide are inconvenient for modern agriculture. A four-year vegetation survey (1997-2000) of Nakaikemi confirmed that the area of cultivated fields decreased from 1.2 ha to 0.3 ha. A wide distribution of tall reedy communities dominated by Phragmites, Zizania and Typha, and short herbaceous communities were observed on the abandoned wet rice fields. Non-wetland communities dominated by Solidago and creeper plants (Pueraria and Humulus) increased on drier habitats. The tall reedy communities usually developed within two to five years after abandonment. In some fields, no tall reedy communities developed during the survey period. The distribution of plant communities changed with time and soil moisture conditions. A continuous survey of threatened plant habitats showed that in cultivated and young abandoned fields, tall perennial plants succeeded and dominated the small plant species. The number of threatened species was higher in plowed plots than in non-plowed plots. These survey results suggest that the factors affecting Nakaikemi's vegetation and flora are the period elapsed after abandonment, soil moisture, management tasks and surrounding vegetation. Seed bank species composition and use of herbicides also affect plants in both the cultivated and young abandoned fields. To conserve the diverse wetland flora of Nakaikemi, appropriate land management is needed to control the vegetation.

© CSA

**271. Vegetation change in a man-made salt marsh affected by a reduction in both grazing and drainage.**

Esselink, P.; Fresco, L. F. M.; and Dijkema, K. S.

*Applied Vegetation Science* 5(1): 17-32. (2002)

NAL Call #: QK900 .A66; ISSN: 1402-2001

*Descriptors:* salt marshes/ vegetation/ grazing/ drainage/ botanical composition/ ecological succession/ conservation areas/ cattle/ plant communities/ soil water content/ grazing intensity/ flooded conditions/ frequency/ Netherlands

This citation is from AGRICOLA.

**272. Vegetation change in an ombrotrophic mire in northern England after excluding sheep.**

Smith, R. S.; Charman, D.; Rushton, S. P.; Sanderson, R. A.; Simkin, J. M.; and Shiel, R. S.

*Applied Vegetation Science* 6(2): 261-270. (2003)

NAL Call #: QK900.A66; ISSN: 1402-2001

*Descriptors:* wetlands/ bogs/ grassland management/ grasslands/ grazing/ moorlands/ nature conservation/ plant succession

*Abstract:* The role of sheep grazing on vegetation change in upland mires removed from livestock farming and surrounded by conifer plantation was investigated with a grazing trial at Butterburn Flow in northern England. Paired grazed and ungrazed plots from central and peripheral locations were compared over 14 years (1988-2002). Vegetation data from 34 mires in Kielder Forest provided an ordination framework within which vegetation trends were investigated. A gradient from dry moorland/hummock to wet mire/hollow vegetation dominated this framework and may reflect hydrological variability and structural vegetation differences between the mires. Some species were significantly affected by change in grazing intensity and there were differences between the edge and the centre of the mire. Overall vegetation change depended upon the grazing management and the position of the plots such that the removal of sheep grazing decreased the cover of species typical of wet ombrotrophic conditions, but only at the periphery of the mire. The vegetation in one plot became very similar to that of mires elsewhere in Kielder Forest where sheep were removed several decades ago. Cessation of grazing on upland mires is likely to lead to slow structural and species change in vegetation at the mire edge with a long-term loss of ombrotrophic species. The nature conservation significance of these changes will depend upon whether or not management objectives target natural conditions or wish to maximize ombrotrophic vegetation. The context of external factors such as climate and pollution may, however, be more important in determining site condition on the wettest mires.

© CAB International/CABI Publishing

**273. Vegetation dynamics and plant species interactions under grazed and ungrazed conditions in a western European salt marsh.**

Tessier, M.; Vivier, J.-P.; Ouin, A.; Gloaguen, J.-C.; and Lefevre, J.-C.

*Acta Oecologica* 24(2): 103-111. (2003)

NAL Call #: QH540.A27; ISSN: 1146-609X

*Descriptors:* exclosures/ halophyte/ nitrogen addition/ plant interactions/ plant succession

*Abstract:* Experiments in exclosures were conducted on a salt marsh in a macrotidal system in western France. The aim of this study was threefold: (1) to compare vegetation dynamics over a period of 8 years in grazed and ungrazed conditions (2) to investigate the response of annual species to grazing duration during seedling establishment (3) to test the effect of an increase in soil nitrogen availability after cessation of grazing on interactions between *Suaeda maritima* and *Puccinellia maritima*. In grazed conditions, during all the survey, vegetation was dominated by a short *P. maritima* sward with the annual *Salicornia europaea* in the lower and middle marshes. However, after cessation of grazing in 1994, a homogeneous matrix of the forb *Halimione portulacoides*, quickly replaced *P. maritima* in the well drained lower marsh. At the middle marsh level, fine

sediment and poor drainage maintained *P. maritima* while the annual *S. maritima* which tolerates taller and denser vegetation replaced *S. europaea*. *Elymus pungens* cover was limited till 2000 but its rising in 2001 let expect its dominance in the future. While *P. maritima* abundance remained high, spring abundance of annual species such as *S. europaea* and *S. maritima* globally decreased with sheep grazing duration on the salt marsh between February and June. Experiments with monocultures of *P. maritima* and *S. maritima* demonstrated that nitrogen was a limiting factor on the salt marsh. In a mixed community, a moderate application of nitrogen (15 g N m<sup>-2</sup> year<sup>-1</sup> as NH<sub>4</sub>-NO<sub>3</sub>) promoted growth of *P. maritima* and limited the biomass of *S. maritima*, but growth of the latter was enhanced by a high application of nitrogen (30 g N m<sup>-2</sup> year<sup>-1</sup>). An increase in the abundance of annuals such as *S. maritima* on the salt marsh is discussed.

© 2006 Elsevier B.V. All rights reserved.

**274. Water quality effects of irrigation with drain water.**

Faulkner, B. R. and Guitjens, J. C.

*Applied Engineering in Agriculture* 17(3): 293-301. (2001)

NAL Call #: S671.A66; ISSN: 0883-8542

*Descriptors:* wetlands/ irrigation/ drainage water/ irrigation water/ irrigated farming/ *Triticum aestivum*/ soil chemistry/ cations/ leaching/ geochemistry/ salinity/ evaporation/ aquifers/ Nevada

*Abstract:* Wetlands that receive drainage from irrigated agriculture are often adversely affected by elevated salinity. Management of drain water salinity from irrigated areas requires an understanding of the thermodynamic effects of evapoconcentration and the subsurface geochemical and hydrodynamic setting. This article presents results from a demonstration of a Lahontan Valley field irrigated conjunctively with drain water and canal water, and an evaluation of the potential effects of irrigating with drain water on the existing aqueous environment. Major ions of soil saturation paste measurements during an irrigation season provide insight into the geochemical and hydrodynamic processes that control the salinity of drain water. Data demonstrate that use of drain water for irrigation is a viable alternative to conventional irrigation solely with canal water, that should produce few adverse effects in well-drained soils of the Lahontan Valley while providing water quality mitigation of wetlands receiving saline outflows from the shallow aquifer recharged by irrigation drainage.

This citation is from AGRICOLA.

**275. Wetland and aquatic habitats.**

Mathias, M. E. and Moyle, P.

*Agriculture, Ecosystems & Environment* 42(1-2): 165-176. (1992)

NAL Call #: S601.A34; ISSN: 0167-8809.

*Notes:* Special issue: Integrating conservation biol. & agric. production.

*Descriptors:* wetlands/ riparian environments/ dispersal/ agricultural practices/ biological diversity/ species diversity/ ecosystem management/ environmental impact/ agriculture/ dispersion/ man-induced effects/ man-induced effects/ dispersal/ agricultural practices/ biological diversity/ mechanical and natural changes

**Abstract:** Riparian wetland areas often represent critical corridors for animal and plant dispersion in wildland watersheds and downstream river systems. It is essential that integrated management of riparian wetland areas be developed to reverse the loss of biological diversity. Agricultural and urban uses, and related water developments, have led to a marked decline of stream-side wetland habitats. Six major ways are discussed in which conventional agriculture alters wetlands and aquatic habitats: wetland drainage, water diversions, stream channelization, bank stabilization, grazing, and the release

of agricultural pollutants. This article discusses these practices and suggests ways biological diversity can be protected, or even enhanced. In addition, aquaculture is discussed as a new force which affects the diversity of aquatic organisms. Aquaculture methods range in intensity of management from low to high. Management for biological diversity as well as for food production should be encouraged.

© CSA

## Wetlands as Agricultural Conservation Practices

### 276. Agricultural drainage and wetland management in Ontario.

Walters, D. and Shrubsole, D.

*Journal of Environmental Management* 69(4): 369-379. (2003)

NAL Call #: HC75.E5J6; ISSN: 0301-4797

**Descriptors:** agricultural drainage/ policy analysis/ wetland management

**Abstract:** Land drainage is recognized as an integral part of agricultural activity throughout the world. However, the increase in agricultural production has resulted in the loss of wetland functions and values. Therefore, wetland management and agricultural drainage illustrate the conflict between economic development and natural values. This research assesses the approval process for agricultural land drainage in Ontario, Canada, to determine how the benefits of increased agricultural production are balanced against the loss of wetland values. A permit review of drainage applications was conducted from 1978 to 1997 in Zorra Township, Ontario, Canada. Data collection also included the document reviews, interviews with government agencies and wetland evaluation files. The selected criteria include efficiency, equity, consistency and adequacy. The results indicate that while the process is efficient, fundamental problems remain with the bargaining process. © 2006 Elsevier B.V. All rights reserved.

### 277. Agricultural reuse of the secondary effluent polished by an algal pond system coupled with constructed wetland.

Kim, Y.; Lee, D. R.; and Giokas, D.

*Water Science and Technology* 50(6): 79-86. (2004)

NAL Call #: TD420.A1P7; ISSN: 0273-1223

**Descriptors:** effluents/ artificial wetlands/ coliforms/ organic matter/ bacteria/ water reuse/ nutrient removal/ phosphorus/ wastewater irrigation/ secondary wastewater treatment/ water quality/ irrigation water/ recycling/ secondary treatment/ nutrients/ irrigation/ agriculture/ nitrogen/ Korea, Rep./ wastewater treatment processes/ protective measures and control/ waste management/ water & wastewater treatment

**Abstract:** In this paper, reuse potentials of the secondary effluents as irrigation water was evaluated through field sampling trips. Water quality parameters significantly deviating from its guidelines were Total coliform bacteria and organic matter. Even though nutrients are not regulated in Korea, their removal would be required because they have been a barrier for secondary effluent irrigation through

governmental intervention. The results of treatment study with aquatic ponds show that in spite of its poor biodegradability, organic matter in soluble form was reduced by 20% during 10 days of HRT. On the other hand, reduction of nutrients was remarkable. On average 85% of total nitrogen and 89% of total phosphorus were removed, respectively, which abates the worries of farmers for overgrowth or reduction in crop yield. However, coliform bacteria, although slightly reduced due to their propagation at the constructed wetlands still need further treatment.

© CSA

### 278. Ammonia effects on the biomass production of five constructed wetland plant species.

Hill, D. T.; Payne, V. W. E.; Rogers, J. W.; and Kown, S. R.

*Bioresource Technology* 62(3): 109-113. (1997)

NAL Call #: TD930.A32; ISSN: 0960-8524

**Descriptors:** waste treatment/ biological treatment/ aquatic plants/ animal manures/ excreta

**Abstract:** The effect of four levels of ammonia concentration on the biomass production of *Sagittaria latifolia* (arrowhead), *Phragmites australis* (common reed), *Scirpus acutus* (bullrush), *Typha latifolia* (cattail), and *Juncus roemerianus* (common rush) was studied using field scale constructed wetland ponds of 3.05 x 0.6 m. These species of plants are common in constructed wetlands treating animal waste lagoon effluent. Twenty ponds were constructed to accommodate the five species and four ammonia levels. The experiment had three repetitions in time. Effluent from the second cell of a two cell anaerobic lagoon system treating flushed swine waste was utilized at four dilution levels, providing mean ammonia concentrations of 20.5, 41.1, 61.6 and 82.4 mg NH<sub>3</sub>-N/L for the study. Biomass production was determined by harvesting the plants at specified time intervals and measuring dry weight production. The ponds were operated as standard constructed wetlands with a water depth of 10-15 cm. After the 3 month field study was completed, statistical analysis of the data was performed. This analysis showed that the only species affected by ammonia concentration was *Scirpus acutus*. The remaining four species were statistically unaffected. Data from the study also shows a significant difference in the biomass production between species.

This citation is from AGRICOLA.

**279. Aquaculture sludge removal and stabilization within created wetlands.**

Summerfelt, S. T.; Adler, P. R.; Glenn, D. M.; and Kretschmann, R. N.

*Aquacultural Engineering* 19(2): 81-92. (1999)

NAL Call #: SH1.A66; ISSN: 0044-8486

*Descriptors:* wetlands/ wastewater treatment/ sludge/ aquaculture effluents/ pollution control/ environmental protection/ prevention and control/ aquaculture/ pollution: control and prevention

*Abstract:* The objective of this research was to investigate treatment of the concentrated solids discharge produced during clarifier backwash within an aquaculture facility. Solids removal and stabilization were investigated within two types of created wetlands where water flowed either: (1) vertically, down through a porous substrate; or (2) horizontally, over soil and through plant hedges. Six 3.7 x 1.2 x 0.8-m (L x W x H) wetland cells were used to provide three replicates for both types of wetland. Approximately equal numbers of vetiver grass (*Vetiveria zizanioides*) tillers were planted on both wetlands types in November of 1994. Sludge (7500 mg 1 super(-1) solids) was loaded onto both wetland types six times day super(-1), with no scheduled drying cycle, from 12 May 1995 until 28 February 1996. Sludge was applied at a rate of about 1.35 cm day super(-1), or about 30 kg dry solids m super(-2) year super(-1). Results from this short study indicated that the vertical flow and horizontal flow wetlands, respectively, removed 98 and 96% TSS, 91 and 72% total COD, and 81 and 30% dissolved COD. Both types of wetland cells removed most (82-93%) of the total kjeldahl nitrogen, phosphorus, and dissolved phosphate. Measurements of sludge depths and TVS at the end of the study indicated considerable mineralization occurred in the wetlands; stored sludge at the end of the study had 50% less TVS than untreated sludge.

© CSA

**280. Assessing sediment removal capacity of vegetated and non-vegetated settling ponds in prawn farms.**

Halide, H.; Ridd, P. V.; Peterson, E. L.; and Foster, D.

*Aquacultural Engineering* 27(4): 295-314. (2003)

NAL Call #: SH1.A66; ISSN: 0144-8609

*Descriptors:* wetlands/ prawn culture/ warm-water aquaculture/ wastewater treatment/ mangroves/ ponds/ sedimentation/ shellfish culture/ shellfish culture

*Abstract:* Sediment removal capacity is assessed for a constructed mangrove wetland, and a non-vegetated settling pond that are both used for filtering water in tropical aquaculture. The assessment is performed through sediment budget analysis using data of suspended sediment concentration collected from optical backscatter sensors. The sensors were deployed at the pond's inlet and outlet. These data sets provide a measure of trapping efficiency of each pond with different flow regimes and settling areas. The tides influenced flow in the wetland but none was felt in the settling pond. The average trapping efficiency obtained for the vegetated and the non-vegetated ponds was (40 + or - 33) and (70 + or - 36)%, respectively. The deposition rate calculated for the vegetated and non-vegetated pond ranges between 13-174 g/m super(2) per h (average = 63 g/m super(2) per h) and 10-19 g/m super(2)

per h (average = 14 g/m super(2) per h), respectively. The efficiency of vegetated and non-vegetated ponds is likely to be improved by decreasing the aspect ratio (length/width) from the current value of 6 to 1 and of 5 to 1, respectively.  
© CSA

**281. The assessment of herbaceous plant cover in wetlands as an indicator of function.**

Cole, C. A.

*Ecological Indicators* 2(3): 287-293. (2002);

ISSN: 1470-160X

*Descriptors:* wetlands/ function/ mitigation/ structure

*Abstract:* In the United States, wetlands are often created (as compared with restored) as mitigation for damage done to natural wetlands by development or other activities. There is increasing concern that these created sites do not function as do natural wetlands, even after a period of years. Monitoring of these created wetlands often consists of an assessment of the percent herbaceous plant cover as some indicator of the functional success of the wetland. However, it is not at all clear that assessment of herbaceous cover translates into an accurate indicator of wetland function. In this paper I review several functions commonly ascribed to wetlands and assess the reported relationship of percent herbaceous cover to those functions (if any). Of six functions reviewed, only one has a probable (though indirect) positive relationship with the percent herbaceous plant cover on a site. More useful assessments of wetland function might be made with other structural indicators, such as basin morphometry, tree density, or basal area.

© 2006 Elsevier B.V. All rights reserved.

**282. Atrazine degradation by bioaugmented sediment from constructed wetlands.**

Runes, H. B.; Jenkins, J. J.; and Bottomley, P. J.

*Applied Microbiology and Biotechnology* 57(3):

427-432. (Oct. 2001)

NAL Call #: QR1.E9; ISSN: 0175-7598

*Descriptors:* wetlands/ atrazine/ pesticides/ herbicides/ biodegradation/ sediments/ water pollution/ water pollution treatment/ microorganisms/ sediment chemistry/ sediment contamination/ bacteria/ atrazine/ bacteria/ microbial degradation/ waste treatment, environment, pollution/ freshwater pollution/ protective measures and control/ physiology, biochemistry, biophysics/ water quality control/ water & wastewater treatment

*Abstract:* The potential to establish pesticide biodegradation in constructed wetland sediment was investigated. Under microcosm conditions, bioaugmentation of sediment with small quantities of an atrazine spill-site soil (1:100 w/w) resulted in the mineralization of 25-30% of super(14)C ethyl atrazine (1-10 mu g g super(-1) sediment) as super(14)CO sub(2) under both unsaturated and water-saturated conditions; atrazine and its common metabolites were almost undetectable after 30 days incubation. By comparison, unbioaugmented sediment supplemented with organic amendments (cellulose or cattail leaves) mineralized only 2-3% of super(14)C ethyl atrazine, and extractable atrazine and its common metabolites comprised approximately 70% of the original application. The

population density of atrazine-degrading microorganisms in unbioaugmented sediment was increased from similar to 10 super(2)/g to 10 super(4)/g by bioaugmentation (1:100 w/w), and increased by another 60-fold (6.0 x 10 super(5) g super(-1)) after incubation with 10 mu g g super(-1) of atrazine. A high population of atrazine degraders (similar to 10 super(6) g super(-1)) and enhanced rates of atrazine mineralization also developed in bioaugmented sediment after incubation in flooded mesocosms planted with cattails (*Typha latifolia*) and supplemented with atrazine (3.2 mg l super(-1), 1 mu g g super(-1) sediment). In the absence of atrazine, neither the population of atrazine degraders, nor the atrazine mineralizing potential of bioaugmented sediment increased, regardless of the presence or absence of cattails. Bioaugmentation might be a simple method to promote pesticide degradation in nursery run-off channeled through constructed wetlands, if persistence of degraders in the absence of pesticide is not a serious constraint.  
© CSA

**283. Atrazine remediation in wetland microcosms.**

Runes, Heather B.; Bottomley, Peter J.; Lerch, Robert N.; and Jenkins, Jeffrey J.

*Environmental Toxicology and Chemistry* 20(5): 1059-1066. (2001)

NAL Call #: QH545.A1E58; ISSN: 0730-7268

*Descriptors:* freshwater ecology: ecology, environmental sciences/ pesticides/ pollution assessment control and management/ toxicology/ most probable number assay/ bioassay method: sediment sample analysis/ analytical method/ field scale constructed wetland/ laboratory wetland microcosms

*Abstract:* Laboratory wetland microcosms were used to study treatment of atrazine in irrigation runoff by a field-scale- constructed wetland under controlled conditions. Three experiments, in which 1 ppm atrazine was added to the water column of three wetland, one soil control, and one water control microcosm, were conducted. Atrazine dissipation from the water column and degradate formation (deethylatrazine (DEA); deisopropylatrazine (DIA); and hydroxyatrazine (HA)) were monitored. Atrazine dissipation from the water column of wetland microcosms was biphasic. Less than 12% of the atrazine applied to wetland microcosms remained in the water column on day 56. Atrazine degradates were observed in water and sediment, with HA the predominant degradate. Analysis of day 56 sediment samples indicated that a significant portion of the initial application was detected as the parent compound and HA. Most probable number (MPN) assays demonstrated that atrazine degrader populations were small in wetland sediment. Wetland microcosms were able to reduce atrazine concentration in the water column via sorption and degradation. Based on results from this study, it is hypothesized that plant uptake contributed to atrazine dissipation from the water column.

© The Thomson Corporation

**284. Bacterivory in ciliates isolated from constructed wetlands (reed beds) used for wastewater treatment.**

Decamp, O. and Warren, A.

*Water Research* 32(7): 1989-1996. (July 1998)

NAL Call #: TD420.W3; ISSN: 0043-1354

*Descriptors:* artificial wetlands/ wastewater treatment/ bacteria/ protozoa/ root zone/ grazing/ food webs/ trophic relationships/ food preferences/ pollution control/

pathogenic bacteria/ Ciliata/ constructed wetlands/ bacteria/ wastewater treatment processes/ nutrition and feeding habits/ protozoa

*Abstract:* The bacterivorous activity of ciliates, isolated from constructed wetlands employing the root zone method of wastewater treatment, was investigated by measuring their grazing rates upon fluorescently-labelled bacteria (FLB), specifically *Escherichia coli*. The highest mean grazing rates were recorded for *Paramecium* spp (1.85 FLB/cell/min), which was the largest ciliate used in the study, followed by oxytrichids (1.104 FLB/cell/min), *Halteria* (0.648 FLB/cell/min) and scuticociliates (0.433 FLB/cell/min), the smallest ciliates used in the study. Lowest feeding rates were found in the anaerobes *Plagiopyla* and *Caenomorpha*, although the experimental conditions are likely to have adversely affected these forms. Large variations in grazing rates between individual cells from the same populations were observed. The proportion of empty cells, i.e. those without ingested FLB, and the decrease in the proportion of empty cells with incubation time, showed large differences between taxa. The present study indicates that ciliates are capable of all observed *E. coli* removal from wastewaters treated in constructed wetlands using the root zone method. However, it is unlikely that ciliates in situ continuously maintain maximum feeding rates. A variety of other processes, biotic and abiotic, are thought to be involved in the removal of pathogenic and indicator bacteria such as *E. coli*.  
© CSA

**285. Benefits to downstream flood attenuation and water quality as a result of constructed wetlands in agricultural landscapes.**

De Laney, T. A.

*Journal of Soil and Water Conservation* 50(6):

620-626. (1995)

NAL Call #: 56.8 J822; ISSN: 0022-4561

*Descriptors:* water quality/ flood control/ agricultural practices/ watershed management/ water policy/ flood plain management/ nonstructural alternatives/ benefits/ hydrology/ river basin management/ USA/ constructed wetlands/ agricultural practices/ watershed management/ flood plain management/ nonstructural alternatives/ benefits/ streamflow and runoff/ dynamics of lakes and rivers

*Abstract:* The evolution of agricultural practices in America has a direct correlation with improvements in the mechanization of farm equipment and the development of transportation routes. As artificially constructed systems evolved, they were rigorously imposed on the natural landscape with little thought to their effect on the hydrologic system. Soggy fields and drowned crops were viewed as problems needing remediation. Flat, forested, fertile, bottomland was assumed to be unproductive and needed to "pay its way." Deforestation, stream channelization, levees, field terracing, and drainage systems (drain tiles) have become testaments to our corrective actions. The cumulative effect of these corrective measures has been to significantly reduce the ability of most watersheds to absorb water, detain sediments, and remove nutrients. Our command and control approach to watershed management cannot necessarily be viewed as a success as evidenced by the flood of 1993 and 1995 in the Midwest and the fact that today, 30 percent of assessed U.S. surface waters do not "fully support" their designated uses (USEPA 1988).

Because of our inadequate watershed management, the Federal Emergency Management Agency (FEMA) and other agencies have hinted that America's flood and water quality policies must change. The purchase of flood-prone property and the rebuilding of levees away from the immediate river bank are signals that nontraditional approaches are being considered. Although these alternative strategies have occurred only on a small scale, this new philosophy in floodplain management is encouraged by the federal government's report "Sharing the Challenge: Floodplain Management into the 21st Century." It recommends that nonstructural measures be incorporated into America's flood management policies. Although many of the nonstructural measures may take the shape of property purchases, new agricultural practices, and incentive payments, the net effect will be the reinstatement of biological and hydraulic processes that reduce flooding and improve water quality.

© CSA

**286. Beta-HCH mobilization in polluted wetland soils as influenced by dissolved organic matter.**

Kalbitz, Karsten; Popp, Peter; Geyer, Wolfgang; and Hanschmann, Guenter

*Science of the Total Environment* 204(1): 37-48. (1997)

NAL Call #: RA565.S365; ISSN: 0048-9697

*Descriptors:* biochemistry and molecular biophysics/ freshwater ecology: ecology, environmental sciences/ pest assessment control and management/ pollution assessment control and management/ soil science/ analytical method/ beta isomer/ dissolved organic matter/ grassland soils/ HCH/ lindane/ pesticides/ pollution/ soil pollution/ synchronous fluorescence spectroscopy/ water logging/ wetland soils/ 1,2,3,4,5,6 hexachlorocyclohexane

*Abstract:* The beta isomer of 1,2,3,4,5,6-hexachlorocyclohexane (beta-HCH) which is formed during synthesis of the pesticide lindane shows high mobility in polluted soils despite its low water solubility. Therefore, we studied the correlation between the quantity and quality of dissolved organic matter (DOM) and the mobilization and transport of beta-HCH in two soil profiles used as grassland and in incubation experiments. From our results we conclude that beta-HCH was mobilized and transported to deeper soil horizons probably by coupling between beta-HCH and DOM. The interaction of beta-HCH with DOM as indicated by the measured high partition coefficient between beta-HCH and DOM ( $\log K_{DOC} = 4.39$ ) was much higher than would be expected from the physicochemical properties of beta-HCH. As suggested from synchronous fluorescence spectroscopy data, the capacity of DOM to bind beta-HCH increases as the more extended aromatic regions of DOM are accessible in the aqueous extracts. The addition of lime and fresh organic matter to the grassland soils did not affect the measured coupling between beta-HCH and DOM. Long drying periods increased the coupling up to 9.9  $\mu\text{g}$  beta-HCH per mg DOC. Water-logging destroyed the binding between DOM and beta-HCH despite increasing DOC contents. Our main conclusion is that qualitative differences in DOM due to changed environmental conditions can drastically change the coupling of hydrophobic organic pollutants to DOM and greatly affect pollutant mobilization and translocation.

© The Thomson Corporation

**287. Biological responses to wetland restoration: Implications for wildlife habitat development through the Wetlands Reserve Program.**

Rewa, C.

In: A comprehensive review of Farm Bill contributions wildlife conservation, 1985-2000/ Heard, L. P.; Hohman, W. L.; Halloum, D. J.; and Wildlife Habitat Management Institute (U.S.); Series: Technical Report USDA/NRCS/WHMI.

Madison, MS: U.S. Department of Agriculture, 2000; pp. 95-116

NAL Call #: aS604.6 .C66 2000

*Descriptors:* Wetland Reserve Program/ riparian areas/ wildlife habitats/ California/ Mississippi

**288. Can constructed wetlands reduce the diffuse phosphorus loads to eutrophic water in cold temperate regions?**

Braskerud, B. C.; Blankenberg, A.-G. B.; Tonderski, K. S.; Wedding, B.; Bakke, R.; Ulén, B.; and Koskiaho, J.

*Journal of Environmental Quality* 34(6): 2145-2155. (2005)

NAL Call #: QH540.J6; ISSN: 0047-2425

*Abstract:* Construction of wetlands is a possible supplement to best management practices (BMP) at the field level to mitigate phosphorus (P) pollution from agricultural areas. In this paper, annual results from 17 intensively studied wetlands in the cold temperate or boreal climatic zone are reported and analyzed. Surface areas varied from 0.007 to 8.7% of the catchment area. The average total phosphorus (TP) retention varied from 1 to 88%, and the dissolved reactive phosphorus (DRP) retention from -19 to 89%. Retention varied substantially from site to site, indicating the existence of site-specific factors in the catchment and wetlands that influenced the P removal. Factors important for P retention in wetlands were evaluated through multiple statistical analyses by dividing P into two fractions: particulate phosphorus (PP) and DRP. Both relative (%) PP and DRP retention increased with wetland surface area. However, PP retention was not as sensitive as DRP in terms of wetland size and retention: specific PP retention (gram P retention per m<sup>2</sup> and year) decreased as wetland area (AW) increased, suggesting the existence of a site-specific optimal wetland to catchment area (Ac) ratio. Particulate P retention decreased with increasing DRP to TP ratio, while the opposite was found for DRP. Dissolved reactive P retention was higher in new than in old wetlands, while increasing age did not influence PP retention negatively. Effective BMP in the catchment is important to keep the P loss low, because the outlet concentration of P from wetlands is often positively correlated to the input concentration. However, wetlands act as the last buffer in a catchment, since the retention often increases as the P concentration in streams increases. © ASA, CSSA, SSSA.

© 2006 Elsevier B.V. All rights reserved.

**289. Carbon, plant, and temperature control of nitrate removal from wetland mesocosms.**

David, Mark B.; Gentry, Lowell E.; Smith, Karen M.; and Kovacic, David A.

*Transactions of the Illinois State Academy of Science* 90 (3-4): 103-112. (1997)

NAL Call #: 500 I16; ISSN: 0019-2252

*Descriptors:* biochemistry and molecular biophysics/ conservation/ pollution assessment control and

management/ wildlife management: conservation/ agricultural non point source pollution/ bioprocess engineering/ carbon availability/ constructed wetlands/ nitrate/ pollution/ temperature/ tile drainage waters

**Abstract:** Constructed wetlands have been developed to remove agricultural non-point source pollution from tile drainage waters in the Midwest, but their effectiveness and function are not known. This study investigated the interaction of C availability and temperature on NO<sub>3</sub>- removal from water columns in a constructed wetland. Experimental mesocosms (20.32 cm diameter PVC pipes) were buried upright to a depth of 15 cm into wetland sediments to enclose a 7.5 L water column (23 cm depth). Six mesocosms were placed in areas with bare soil and six were placed in areas supporting reed canary grass (*Phalaris arundinacea*). Treatments were either NO<sub>3</sub>- additions (10 mg NO<sub>3</sub>-N L<sup>-1</sup> increase in concentration in water column) or NO<sub>3</sub>- Plus glucose additions (10 mg NO<sub>3</sub>-N L<sup>-1</sup> and 50 mg C L<sup>-1</sup> increases in water column) to the mesocosms during April and June. In April, (11- 12 degree C water temperature) over a 7 day time span, NO<sub>3</sub>- concentrations in the overlying water decreased approximately 50% in non-grass treatments, with or without glucose additions. All or nearly all of the NO<sub>3</sub>- was removed from the grass mesocosms in April, and glucose additions did not increase the removal rate. In June (27 degree C water temperature) NO<sub>3</sub>- concentrations decreased to zero for all treatments in 48 hours or less. Presence of grass did not affect the rate of NO<sub>3</sub>- decrease; however, glucose additions increased the rate to 1/24 hours. When calculated on a mass basis in the NO<sub>3</sub>- only mesocosms, removal of NO<sub>3</sub>- was 0.25 and 0.42 g NO<sub>3</sub>-N m<sup>-2</sup> d<sup>-1</sup> in the April non-grass and grass treatments, respectively, and 1.6 and 1.4 g NO<sub>3</sub>-N m<sup>-2</sup> d<sup>-1</sup> in the June corresponding treatments. Calculated Q<sub>10</sub> values of NO<sub>3</sub>- removal per day for non-grass and grass treatments were 3.3 and 2.2, respectively. Depending on amounts and seasonal timing of inputs of NO<sub>3</sub>- to the wetlands, mesocosm results suggest that large amounts of NO<sub>3</sub>- can be removed from the overlying water by a combination of sediment and plant mechanisms.

© The Thomson Corporation

**290. Characterization of microbial communities and composition in constructed dairy wetland wastewater effluent.**

Ibekwe, A. M.; Grieve, C. M.; and Lyon, S. R.  
*Applied and Environmental Microbiology* 69(9): 5060-5069. (2003)  
 NAL Call #: 448.3 Ap5; ISSN: 0099-2240  
*Descriptors:* agricultural wastes/ ammonia oxidisers/ artificial wetlands/ BOD [biochemical oxygen demand]/ characterisation/ COD [chemical oxygen demand]/ community composition/ contaminant removal/ dairy waste water/ DGGE [denaturing gradient gel electrophoresis]/ faecal coliforms/ microbial communities/ monooxygenase gene/ nitrates/ PCR amplification/ proteobacteria/ soil samples/ SS [suspended solids]/ water processing/ water treatment/ microbiology/ biotechnology/ ecology/ waste water/ rivers/ lakes/ impacts of forestry or agriculture/ water quality/ Insertae/ Sedis/ Bacillus spp./ Gymnamoebia/ Clostridium spp./ Insertae/ Sedis/ Mycoplasma spp./ Insertae/ Sedis/ Eubacterium spp.  
**Abstract:** Constructed wetlands have been recognized as a removal treatment option for high concentrations of

contaminants in agricultural waste before land application. The goal of this study was to characterize microbial composition in two constructed wetlands designed to remove contaminants from dairy washwater. Water samples were collected weekly for 11 months from two wetlands to determine the efficiency of the treatment system in removal of chemical contaminants and total and fecal coliforms. The reduction by the treatment was greatest for biological oxygen demand, suspended solids, chemical oxygen demand, nitrate, and coliforms. There was only moderate removal of total nitrogen and phosphorus. Changes in the total bacterial community and ammonia-oxidizing bacterial composition were examined by using denaturing gradient gel electrophoresis (DGGE) and sequencing of PCR-amplified fragments of the gene carrying the a subunit of the ammonia monooxygenase gene (*amoA*) recovered from soil samples and DGGE bands. DGGE analysis of wetlands and manure samples revealed that the total bacterial community composition was dominated by bacteria from phylogenetic clusters related to *Bacillus*, *Clostridium*, *Mycoplasma*, *Eubacterium*, and *Proteobacteria* originally retrieved from the gastrointestinal tracts of mammals. The population of ammonia-oxidizing bacteria showed a higher percentage of *Nitrosospira*-like sequences from the wetland samples, while a higher percentage of *Nitrosomonas*-like sequences from manure, feces, raw washwater, and facultative pond was found. These results show that the wetland system is a natural process dependent upon the development of healthy microbial communities for optimal wastewater treatment.

© NISC

**291. A constructed vertical macrophyte system for the retention of nitrogen in agricultural runoff.**

Farahbakhshazad, N. and Morrison, G. M.  
*Environmental Technology* 21(2): 217-223. (Feb. 2000)  
 NAL Call #: TD1.E59; ISSN: 0959-3330  
*Descriptors:* wetlands/ macrophytes/ wastewater treatment/ nitrogen/ phosphorus/ agricultural runoff/ ammonia/ agriculture/ runoff (agricultural)/ nutrients/ *Phragmites australis*/ wastewater treatment processes/ water treatment/ freshwater pollution  
**Abstract:** Recent evidence for the importance of luxury rhizome accumulation of N by the common reed *Phragmites australis* opens the possibility for N retention in constructed vertical wetlands. The removal of nutrients (N and P) from agricultural runoff was investigated in columns planted with *P. australis* in a sand bed. Nitrate demonstrated a linear removal with detention time (60-300 min) and was accounted for by membrane-limited root uptake. Ammonia was effectively removed from agricultural runoff, with nitrate removed at longer detention times. Detention time based on a targeted nitrate removal therefore represents a suitable design parameter for a vertical macrophyte system. On the other hand, ammonia was more effectively removed at low concentrations, but ineffectively removed at higher concentrations. Nitrogen is effectively accumulated in rhizomes which could be mechanically ground, composted and returned to agriculture.

© CSA

**292. Constructed wetland attenuation of nitrogen exported in subsurface drainage from irrigated and rain-fed dairy pastures.**

Tanner, C. C.; Nguyen, M. L.; and Sukias, J. P. S. *Water Science and Technology* 51(9): 55-61. (2005)  
 NAL Call #: TD420.A1P7; ISSN: 0273-1223.  
 Notes: Conference: 9. IWA Intl. Specialised Conf. on Wetland Systems for Water Pollution Control, Avignon (France), 26-30 Sep 2004; ISBN: 1843394987; Issue editor: Lienard, A.

*Descriptors:* drainage/ catchment areas/ artificial wetlands/ subsurface drainage/ hydraulic loading/ export/ pastures/ water pollution control/ sampling/ rainfall/ soil water/ continuous flow/ nitrogen removal/ irrigation water/ nitrates/ nitrogen compounds/ catchments/ nitrogen/ pasture/ dairies/ irrigation/ seasonal variations/ New Zealand, North I.

*Abstract:* Nitrogen removal performance is reported for constructed wetlands treating subsurface drainage from irrigated and rain-fed dairy pastures in North Island, New Zealand. Flow-proportional sampling of inflow and outflow concentrations were combined with continuous flow records to calculate mass balances for the wetlands. Drainage flows from the irrigated catchment were 2.5-4 fold higher and N exports up to 5 fold higher per unit area than for the rain-fed catchment. Hydraulic and associated N loadings to the wetlands were highly pulsed, associated with rainfall, soil water status, and irrigation events. Transient pulses of organic nitrogen were an important form of N loss from the rain-fed landscape in the first year, and were very effectively removed in the wetland (> 90%). Median nitrate concentrations of similar to 10 g m<sup>super(-3)</sup> in the drainage inflows were reduced by 15-67% during passage through the wetlands and annual nitrate-N loads by 16-61% (38-317 g N m<sup>super(-2)</sup> y<sup>super(-1)</sup>). Generation in the wetlands of net ammoniacal-N and organic-N (irrigated site) partially negated reduction in nitrate-N loads. The results show that constructed wetlands comprising 1-2% of catchment area can provide moderate reductions in TN export via pastoral drainage, but performance is markedly influenced by variations in seasonal loading and establishment/maturation factors.

© CSA

**293. Constructed wetlands for animal waste treatment: A manual on performance, design, and operation with case histories.**

CH2M Hill, Inc.; Payne Engineering; Gulf of Mexico Program (U.S.); Nutrient Enrichment Committee; Alabama Soil and Water Conservation Committee; and National Council of the Paper Industry for Air and Stream Improvement (U.S.).

Washington, D.C.: U.S. Environmental Protection Agency, Gulf of Mexico Program. (1997)

*Notes:* "Prepared for the Gulf of Mexico Program Nutrient Enrichment Committee, under a contract to the Alabama Soil and Water Conservation Committee (ASWCC) and National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI)." "June 1997." Includes bibliographical references.

NAL Call #: TD930.2.C64 1997

*Descriptors:* animal waste---management/ constructed wetlands/ Mexico, Gulf of---nutrients

This citation is from AGRICOLA.

**294. Constructed wetlands for livestock wastewater management.**

Knight, R. L.; Payne, V. W. E.; Borer, R. E.; Clarke, R. A.; and Pries, J. H.

*Ecological Engineering* 15(1-2): 41-55. (2000)

NAL Call #: TD1.E26; ISSN: 0925-8574

*Descriptors:* agricultural engineering/ confined animal feeding operation/ livestock/ nutrient reduction/ treatment wetland/ water quality management

*Abstract:* In 1995, the Gulf of Mexico Program (GMP) sponsored efforts by the Alabama Soil and Water Conservation Committee and the National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI) to conduct a review of the literature concerning the use of constructed wetlands for treating concentrated livestock wastewaters. The scope of the literature review and summary of design/operation data included all of North America. Both published and unpublished data have been provided by researchers to be included in the database. The database format used for the GMP project is only slightly modified from the format developed for the US Environmental Protection Agency (EPA) North America Treatment Wetland Database, which includes information from municipal, industrial and stormwater treatment wetlands. The GMP Livestock Wastewater Treatment Wetland Database includes information from 68 sites with a total of 135 pilot and full-scale wetland systems (systems include parallel units at individual research facilities). Types of livestock wastewater being treated by constructed wetlands include dairy manure and milkhouse wash water, runoff from concentrated cattle-feeding operations, poultry manure, swine manure and catfish pond water. Over 1300 operational data records are summarized in the database. These data indicate that removal rates for 5-day biochemical oxygen demand (BOD<sub>5</sub>), total suspended solids (TSS), ammonium nitrogen (NH<sub>4</sub>-N), total nitrogen (TN), total phosphorus (TP), chemical oxygen demand (COD) and fecal coliforms are potentially very high in constructed wetlands receiving animal wastewaters. Average concentration reduction efficiencies were: BOD<sub>5</sub> 65%, TSS 53%, NH<sub>4</sub>-N 48%, TN 42%, and TP 42%. Removals are a function of inlet concentrations and hydraulic loading rates. Successful wetland design must include adequate pretreatment to protect the health of the wetland biota and must include adequate wetland area to meet the quality goals.

© 2006 Elsevier B.V. All rights reserved.

**295. Constructed wetlands for livestock wastewater management: Literature review, database, and research synthesis.**

Gulf of Mexico Program (U.S.); Nutrient Enrichment Committee; CH2MHILL (Firm); and Payne Engineering (Firm)

Washington, D.C.: U.S. Environmental Protection Agency; 1 v. (various pagings): ill. (1997)

*Notes:* "Prepared under contract to National Council of the Paper Industry for Air and Stream improvement (NCASI) and Alabama Soil and Water Conservation Committee." "January 1997." Includes bibliographical references.

NAL Call #: TD930.2.C65 1997

*Descriptors:* animal waste---management/ constructed wetlands

This citation is from AGRICOLA.

**296. Constructed wetlands for wastewater treatment in cold climates.**

Mander, U. and Jenssen, P. D.

Southampton, UK: WIT Press; Series: Advances in ecological sciences 1369-8273 11; 325 p. (2003)

NAL Call #: QH540 .I67 v. 11; ISBN: 1853126519

*Descriptors:* constructed wetlands---cold weather conditions/ sewage---purification---biological treatment/ sewage---purification---cold weather conditions

This citation is from AGRICOLA.

**297. Constructed wetlands for water treatment in aquaculture.**

Massingill, M. J.; Kasckow, E. M.; Carlberg, J. M.; Chamberlain, R. J.; and Van Olst, J. C.

In: Proceedings of the 2nd International Conference on Recirculating Aquaculture. (Held 16 Jul 1998-19 Jul 1998 at Roanoke, VA (USA).) Libey, G. S. and Timmons, M. B. (eds.); Vol. VSGCP-C-00-001; VSG-98-02.: Virginia Sea Grant; 2002.

*Descriptors:* wetlands/ aquatic plants/ removal/ aquaculture effluents/ recirculating systems/ water quality control/ wastewater treatment/ pollution control/ aquaculture/ aquatic macrophytes/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ prevention and control/ aquaculture/ industrial effluents/ water & wastewater treatment/ conservation and environmental protection

*Abstract:* Natural wetlands have long been regarded as important ecosystems that provide habitat for many types of aquatic and riparian plants and animals. In addition, natural wetlands play an important role in restoring the quality of the water that passes through them by reducing suspended solids, removing nitrogen and phosphorous nutrients, and trapping or converting other natural or man-made pollutants. Considerable interest has developed in trying to understand the mechanisms at work within natural wetlands, and to model and incorporate their positive water treatment features into artificial or "constructed" wetlands. Within the last decade, numerous constructed wetlands have been built to replace the loss of natural wetlands, to provide additional plant and animal habitat, to provide new aesthetic and recreational environments for people, and for use as water treatment systems for several types of municipal, industrial, and agricultural wastewater.

© CSA

**298. Constructed wetlands to treat wastewater from dairy and swine operations: A review.**

Cronk, J. K.

*Agriculture, Ecosystems & Environment* 58(2-3): 97-114. (July 1996)

NAL Call #: S601 .A34; ISSN: 0167-8809

*Descriptors:* dairy industry/ wastewater treatment/ waste management/ barn wastewater/ eutrophication/ design standards/ cost analysis/ maintenance/ artificial wetlands/ dairies/ constructed wetlands/ dairy industry/ artificial wetlands/ Wastewater treatment processes/ Pollution control/ Sewage & wastewater treatment

*Abstract:* Animal wastewater can be a major contributor to the cultural eutrophication of surface waters. Constructed wetlands are under study as a best management practice to treat animal wastewater from dairy and swine operations. Preliminary results are promising when wetlands are a component of a farm-wide waste management plan, but

they are ineffective without pretreatment of the wastewater. The feasibility of constructed wetlands varies with waste characteristics and climate. While the cost of wetland construction is low, the site must be maintained in order for the initial investment in the wetland to be worthwhile. In addition, several design iterations may be necessary before effective treatment is obtained. The design of animal wastewater treatment wetlands is still being researched and a number of the present projects will help provide recommendations for the use of constructed wetlands at animal operations.

© CSA

**299. Constructing wetlands in the Intermountain West: Guidelines for land resource managers.**

Olson, Richard Arnold

Laramie, Wyo.: University of Wyoming; Series: B (Laramie, Wyo.) 1078. (1999)

*Notes:* Title from title page of source document. Includes bibliographical references.

NAL Call #: 100 W99 (1) no. 1078

<http://www.uwyo.edu/ces/PUBS/B-1078.pdf>

*Descriptors:* constructed wetlands---West---United States/ constructed wetlands---Rocky Mountains

This citation is from AGRICOLA.

**300. Control of microbial methane production in wetland rice fields.**

Conrad, Ralf

*Nutrient Cycling in Agroecosystems* 64(1-2): 59-69. (2002)

NAL Call #: S631 .F422; ISSN: 1385-1314

*Descriptors:* agronomy: agriculture/ climatology: environmental sciences/ pollution assessment control and management/ soil science/ nitrogen fertilization/ applied and field techniques/ organic carbon fertilization/ water management/ anaerobic degradation process: carbon flow, electron flow/ microbiological data/ microscopic processes/ reaction thermodynamic constraints/ rice straw/ soil redox potential/ soil type/ syntrophy/ temperature/ wetland rice fields

*Abstract:* Methane emission rates are a function of production, transport and oxidation of CH<sub>4</sub> in the rice field. Production of CH<sub>4</sub> is the prerequisite for any flux. The most important variables that control CH<sub>4</sub> production include soil type, rice variety, temperature, soil redox potential, water management and fertilization with organic carbon or nitrogen. The effects of these variables have empirically been assessed on a macroscopic scale. However, the actual mechanisms by which these variables affect the microbial CH<sub>4</sub> production on a microscopic scale are little understood. The purpose of the present contribution is to review existing knowledge of microbiological data and microscopic processes that are relevant for the control of CH<sub>4</sub> production. These include the flow of carbon and electrons during the anaerobic degradation process, thermodynamic constraints of reactions in-situ and changes in the composition of the microbial community.

© The Thomson Corporation

**301. Controlled drainage and wetlands to reduce agricultural pollution: A lysimetric study.**

Borin, M.; Bonaiti, G.; and Giardini, L.

*Journal of Environmental Quality* 30(4): 1330-1340. (2001)

NAL Call #: QH540.J6; ISSN: 0047-2425

*Descriptors:* wetlands/ water quality (natural waters)/ pollution (water)/ pollution control/ case study/ environmental issues/ samples/ ground-water quality/ pollution (groundwater)/ water pollution control/ agricultural runoff/ controlled drainage/ experimental data/ lysimeters/ water table/ water management/ nitrates/ dissolved solids/ agricultural pollution/ nitrogen/ drainage/ irrigation/ groundwater pollution/ Itay/ water table

*Abstract:* Controlled drainage and wetlands could be very effective practices to control nitrogen pollution in the low-lying agricultural plains of northeast Italy, but they are not as popular as in other countries. An experiment on lysimeters was therefore carried out in 1996-1998, with the double aim of obtaining local information to encourage the implementation of these practices and to gain more knowledge on the effects involved. Controlled drainage + subirrigation and wetlands were all considered as natural systems where alternative water table management could ameliorate water quality, and were compared with a typical water management scheme for crops in the open field. Eight treatments were considered: free drainage on maize (*Zea mays* L.) and sugarbeet (*Beta vulgaris* L.), two treatments of controlled drainage on the same crops, and five wetland treatments using common reed [*Phragmites australis* (Cav.) Trin. ex Steud.], common cattail (*Typha latifolia* L.), and tufted sedge (*Carex elata* All.), with different water table or flooding levels. Lysimeters received about 130 g m<sup>-2</sup> of N with fertilization and irrigation water, with small differences among treatments. The effects of treatments were more evident for NO<sub>3</sub><sup>-</sup>-N concentrations than for the other chemical parameters (total Kjeldahl nitrogen, pH, and electrical conductivity), with significantly different medians among free drainage (33 mg L<sup>-1</sup>), controlled drainage (1.6 and 2.6 mg L<sup>-1</sup>), and wetlands (0.5-0.7 mg L<sup>-1</sup>). Referring to free drainage, NO<sub>3</sub><sup>-</sup>-N losses were reduced by 46 to 63% in controlled drainage and 95% in the average of wetlands. Wetlands also reduced losses of total dissolved solids from 253 g m<sup>-2</sup> (average of crop treatments) to 175 g m<sup>-2</sup> (average of wetlands).

© CSA

**302. Cycling and retention of nitrogen and phosphorous in wetlands: A theoretical and applied perspective.**

Howard-Williams, C.

*Freshwater Biology* 15(4): 391-431. (1985)

NAL Call #: QH96.F6; ISSN: 0046-5070

*Descriptors:* wetlands/ cycling nutrients/ nutrient removal/ wastewater disposal/ limnology/ nitrogen/ phosphorous/ ecosystems/ ecology/ groundwater/ nutrients/ fauna/ literature review/ detritus/ sediments/ evapotranspiration/ vegetation/ hydrology/ floods/ microorganisms

*Abstract:* This review considers the internal fluxes and transformations of nitrogen and phosphorous in wetland ecosystems. Emphasis is placed on the dynamic nature of nutrient cycling and the review stresses the possible use of wetlands as sinks for unwanted nutrients. Successional time scales, exchange equilibria and the concepts of storage and throughflow, resource consumption and supply

are explained. Descriptions of the basic pathways of nutrients through different types of wetland systems are given with the emphasis placed on the movement into and out of the major storage compartments of wetland systems. The problems of conversion of qualitative information on nutrient movements and transformations, into data on mass flows are then discussed. The review then considers the effects of adding nutrients to wetlands. The concept of the loading capacity is discussed in relation to the length of time a wetland can continue to remove nutrients from throughflow. Recent studies show that artificially created wetlands can be effective systems for nutrient removal only if their internal removal mechanisms are understood and if these are optimized by management techniques. (Author's abstract)

© CSA

**303. Denitrification in constructed free-water surface wetlands: II. Effects of vegetation and temperature.**

Bachand, P. A. M. and Horne, A. J.

*Ecological Engineering* 14(1-2): 17-32. (Jan. 2000)

NAL Call #: TD1.E26; ISSN: 0925-8574.

*Notes:* Special Issue: Nitrogen & phosphorus retention in wetlands

*Descriptors:* wetlands/ denitrification/ vegetation cover/ temperature effects/ wastewater treatment/ aquatic plants/ North America/ free surfaces/ artificial wetlands/ productivity/ vegetation effects/ databases/ cattails/ cost analysis/ dissolved oxygen/ grazing/ decomposition/ organic carbon/ evapotranspiration/ dissolved solids/ vegetation/ temperature/ organic matter/ aquatic macrophytes (Typhaceae)/ economics/ oxygen (dissolved)/ dissolved solids/ *Scirpus*/ *Typha*/ North America/ characteristics, behavior and fate/ wastewater treatment processes/ sewage and wastewater treatment/ water treatment/ water and wastewater treatment

*Abstract:* Constructed wetlands are increasingly being used for treating nitrogen-rich wastewaters. Of the 115 treatment wetlands listed in the North American Treatment Wetland Database which record nitrogen data, a large portion are used for treating secondary treated or lower quality (e.g. primary, agricultural runoff, stormwater) wastewater. Twenty-five percent treat agricultural and stormwater runoff, and only seven are used for either advanced secondary or tertiary treatment. Yet constructed wetlands may provide an attractive and economical alternative to conventional treatment plants for denitrifying high quality, nitrified wastewater. In populated areas where this is most needed, high land costs will increase the capital costs of this technology. Moreover, in semi-arid regions like the western and southwestern USA, high evaporation and evapotranspiration rates may hinder this technology by concentrating total dissolved solids (TDS) and dissolved organic carbon (DOC) concentrations. Implementation of management and design practices for denitrification may be one method to increase efficiencies, reduce costs and increase reliability. One relatively unknown variable in denitrification is the role of different plant species. If one plant provides substantially better conditions for denitrification, wetlands designed for denitrification could be smaller and less expensive. Three commonly used free-surface marsh vegetation treatments (bulrush *Scirpus* spp., cattail *Typha* spp., and a mixed stand of macrophytes and grasses) were used in replicated macrocosms to determine nitrate removal rates. Nitrate removal rates between

vegetation types were large and differed significantly ( $P < 0.001$ ; cattails = 565 mg N m super(-2) day super(-1), bulrush = 261 mg N m super(-2) day super(-1), and mixed = 835 mg N m super(-2) day super(-1)). Mass balance calculations demonstrated that bacterial denitrification rather than plant uptake was the main mechanism for nitrate removal. Both water temperature (temperature-activity coefficient  $\theta = 1.15$ -1.22) and organic carbon availability affected denitrification rates whereas surface water dissolved oxygen (DO) and nitrogen concentrations did not. This experiment could not distinguish why the different vegetation types resulted in different denitrification rates. Plant productivity differed between treatments. Plant physical structure, waterfowl grazing pressures and wind disturbance affected the rate litter entered the water column. The literature reports that plant decomposition rates depend upon the plants C:N sub(litter) ratio and the plant fiber content. All these factors likely affected the rate bioavailable organic carbon was made available to microbial denitrifiers. Based on our study and a literature review, in organic carbon-limited free-surface wetlands, a mixture of labile (submergent, floating) and more recalcitrant (emergent, grasses) are recommended for improving denitrification rates.

© CSA

#### 304. Denitrification variability and control in a riparian fen irrigated with agricultural drainage water.

Ambus, P. and Christensen, S.

*Soil Biology and Biochemistry* 25(7): 915-923. (1993)

NAL Call #: S592.7.A1S6; ISSN: 0038-0717

*Descriptors:* wetlands/ riparian environments/ soil/ denitrification/ reduction/ agricultural land/ runoff/ sediment chemistry/ nitrogen cycle/ pore water/ irrigation/ agricultural wastes/ recycling/ chemical analysis/ soils/ riparian vegetation/ Denmark/ nitrate/ soils/ riparian vegetation/ soil/ agricultural land/ agricultural wastes/ recycling/ riparian environments/ reduction/ sediment chemistry/ pore water/ nitrogen cycle/ prevention and control/ geochemistry of sediments/ ecosystems and energetics/ use of water of impaired quality

*Abstract:* Denitrification was measured by the C sub(2)H sub(2) inhibition technique in a riparian fen irrigated with agricultural drainage water. 16 h after C sub(2)H sub(2) treatment 88% of the total N sub(2)O contained in water-saturated cores could be accounted for by assuming equilibrium between the gas phase and the liquid phase. The denitrification activity averaged 2.8 and 8.8 mg N sub(2)O-N/m super(2)/day in the control plot and 1.6 and 21.9 mg N sub(2)O-N/m super(2)/day in the irrigated plot during the dry and the runoff periods respectively. Four percent of the incoming NO sub(3) super(-) was reduced to gaseous N. The spatial variability was often high, with coefficients of variation >100% and was independent of seasonal changes in soil anaerobiosis. Soil NO sub(3) super(-) and denitrification were poorly related, and bulk concentrations of NO sub(3) super(-) below 200  $\mu$  M suggested that the process was strongly limited by diffusion of NO sub(3) super(-) into the soil during periods of flooding. Mean denitrification and water-filled pores correlated positively,  $r = 0.71^{***}$  for the control and  $r = 0.68^{***}$  for the irrigated plots. Water-soluble C was not related to denitrification. Multiple regression models including soil water, 2NO sub(3) super(-), soluble C and temperature as independent variables, predicted between

21 and 55% of the denitrification, the highest value found when only mean data was considered. Water-filled pores was the most important variable. The observations on which 2 variables controlled denitrification were supported by laboratory experiments with manipulated cores. Water additions increased denitrification only in samples collected during the dry period. Anaerobic incubation of saturated cores did not affect the process. Restricted NO sub(3) super(-) availability was clearly illustrated by the 25-41-fold increase obtained when NO sub(3) super(-) was injected into cores at ambient and high carbon respectively. A response of up to 13-fold was observed when substrate-amended cores were made into slurries. Glucose did not increase denitrification by more than a factor of three.

© CSA

#### 305. Denitrifying sites in constructed wetlands treating agricultural industry wastes: A note.

Russell, J. M.; van Oostrom, A. J.; and Lindsey, S. B.

*Environmental Technology* 15(1): 95-99. (1994)

NAL Call #: TD1.E59; ISSN: 0959-3330

*Descriptors:* wetlands/ construction/ wastewater treatment/ nitrates/ industrial wastes/ waste disposal/ denitrification/ agricultural wastes/ denitrification/ agricultural wastes/ nitrates/ ultimate disposal of wastes/ sewage & wastewater treatment/ characteristics, behavior and fate/ non-patents/ pollution control

*Abstract:* The denitrification potential (rate of denitrification under anoxic conditions and in the presence of excess nitrate and glucose) was measured in different zones of constructed wetlands receiving anaerobic/aerobic treated meat processing and dairy-shed effluents. The wetland receiving meat processing effluent was of the surface flow type and about 67% of the influent nitrogen was in the nitrate form. Most of the denitrifying potential in this wetland was in the surface mat of decaying plant material. The dairy-shed wetland was of the subsurface flow type and received an effluent that contained little nitrate (< 1%). In this wetland denitrifying potential increased from the inlet to the outlet. The patterns of denitrifying activity suggest that nitrogen removal in wetland systems may be improved by better contact between the effluent and decaying plant material on the wetland surface.

© CSA

#### 306. Depth-area-volume and hydroperiod relationships of ephemeral (vernal) forest pools in southern New England.

Brooks, Robert T. and Hayashi, Masaki

*Wetlands* 22(2): 247-255. (2002)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

*Descriptors:* freshwater ecology: ecology, environmental sciences/ depth are volume relationship/ ephemeral forest pools/ evapotranspiration/ groundwater exchange/ hydroperiod/ pool morphometry/ precipitation/ vernal forest pools/ wetlands ecology

*Abstract:* Ephemeral or "vernal" pools occur commonly throughout the forests of the northeastern United States and adjacent eastern Canada. These pools are critical breeding habitat for a number of amphibian species and support a diverse invertebrate community. The hydroperiod or duration of surface water of vernal pools affects faunal composition and reproduction. We conducted bathymetric surveys of 34 vernal pools located in central Massachusetts in early spring when the pools were at maximum extent

after receiving snowmelt runoff. With these data, we estimated maximum pool depths, surface areas, perimeters, volumes, and basin profile coefficients. We calculated relative hydroperiod indices for the pools based on the presence or absence of surface water during periodic pool visits over the three-year study. The ranges of estimated pool morphological parameters were 0.11-0.94 m for maximum depth, 68-2941 m<sup>2</sup> for maximum surface area, 6-506 m<sup>3</sup> for maximum volume, and 30-388 m for maximum perimeter. Basin profile coefficients ranged between 0.60 (convex) and 2.24 (concave), with a median value of 1.02 (straight slope). Maximum pool depth was positively correlated with area and perimeter, but the correlations were only moderately strong, and there were many shallow pools with large surface areas. Correlations between basin profile coefficients and other morphological parameters were weak or non-significant. Maximum pool volume was proportional to the product of area and depth, but the proportionality constant was dependent on the basin profile coefficient. Relative hydroperiod was weakly correlated with pool morphometry; the strongest relationship was found between hydroperiod and maximum pool volume. In general terms, pools with a maximum depth greater than 0.5 m, a maximum surface area larger than 1000 m<sup>2</sup>, or a maximum volume greater than 100 m<sup>3</sup> had surface water more than 80% of the times they were visited. In contrast, shallower pools, smaller pools, or pools with lesser volumes had varying hydroperiods. The weak relationships between pool morphometry and hydroperiod indicate that other factors, including temporal patterns of precipitation and evapotranspiration and ground-water exchange may have significant influence on vernal pool hydrology and hydroperiod.

© The Thomson Corporation

**307. Design considerations for increased sedimentation in small wetlands treating agricultural runoff.**

Braskerud, B. C.

*Water Science and Technology* 45(9): 77-85. (2002)

NAL Call #: TD420.A1P7; ISSN: 0273-1223.

Notes: Conference: 5. International Conference on Diffuse Pollution, Milwaukee [USA], 10-15 Jun 2001; Source: Diffuse/Non-Point Pollution and Watershed Management; ISBN: 1843394154

Descriptors: Norway/ water pollution control/ nonpoint pollution sources/ artificial wetlands/ agricultural runoff/ sedimentation/ optimization/ design criteria/ water depth/ vegetation/ data collections/ reviews/ pollution (nonpoint sources)/ runoff (agricultural)/ design data/ water quality control/ water quality/ water pollution: monitoring, control & remediation

Abstract: Some suggestions to increase the sedimentation of non-point source pollution in small surface flow wetlands are presented. The recommendations are based on results from seven Norwegian constructed wetlands (CWs) after 3-7 years of investigation, and a literature review. The wetlands were located in first and second order streams. Surface areas were 265-900 m<sup>2</sup>, corresponding to 0.03-0.4% of the watershed. Each CW had a volume proportional composite sampler in the inlet and outlet, in addition to sedimentation plates. The mean annual retention of soil particles, organic particles and phosphorus was 45-75%, 43-67% and 20-44%, respectively. Results showed that erosion and transportation processes in arable

watersheds influenced the retention. Sedimentation was the most important retention process, and increased with runoff, because the input of larger aggregates increased. Retention of nitrogen did not follow the same pattern, and was only 3-15%. Making CWs shallow (0-0.5 m) can optimize sedimentation. The hydraulic efficiency can be increased by aquatic vegetation, large stones in the inlet, baffles and water-permeable, low dams. Vegetation makes it possible to utilize the positive effect of a short particle settling distance, by hindering resuspension of sediments under storm runoff conditions. As a result, the phosphorus retention in shallow CWs was twice that of deeper ponds.

© CSA

**308. Designing constructed wetlands systems to treat agricultural nonpoint source pollution.**

Hammer, D. A.

*Ecological Engineering* 1(1-2): 49-82. (1992)

NAL Call #: TD1.E26; ISSN: 0925-8574.

Notes: Conference: US EPA Workshop on the Role of Created and Natural Wetlands in Controlling Nonpoint Source Pollution, Arlington, VA (USA), 10-11 Jun 1991

Descriptors: wetlands/ pollution control/ agricultural pollution/ environmental engineering/ agricultural pollution/ environmental engineering/ modeling, mathematics, computer applications/ freshwater pollution/ prevention and control/ reclamation/ pollution control

Abstract: Increasingly concentrated animal husbandry practices and more intensive row crop farming have expanded agricultural pollution problems. Implementing accepted best management practices (BMPs) for erosion control and waste handling along with a combination of (1) onsite constructed wetlands, (2) nutrient-sediment control systems in small watersheds, and (3) natural wetlands along streams and at strategic locations in large watersheds may provide low-cost, efficient control. Design recommendations and examples are included.

© CSA

**309. Designing constructed wetlands to remove phosphorus from barnyard runoff: A comparison of four alternative substrates.**

Hill, Cynthia M.; Duxbury, John; Geohring, Larry; and Peck, Theodore

*Journal of Environmental Science and Health, Part A: Toxic Hazardous Substances and Environmental Engineering* A35(8): 1357-1375. (2000)

NAL Call #: TD172.J6; ISSN: 1093-4529

Descriptors: terrestrial ecology: ecology, environmental sciences/ pollution assessment control and management/ waste management: sanitation/ constructed wetland/ design, wastewater treatment method/ norlite: wetland substrate/ agricultural ecosystems/ crushed limestone: wetland substrate/ dairy farm/ mesic Glossic Hapludalf: wetland substrate/ Wollastonite mining tailings: wetland substrate

Abstract: While constructed wetlands can be a cost-effective method for reducing the export of P from agricultural ecosystems, removal rates vary widely. The objective of this research was to evaluate substrates that could consistently improve P treatment in these wetlands. We built eight 55 m<sup>2</sup> subsurface wetland cells on an 800-head dairy farm in Newark, NY, USA, to test alternative substrates for removing soluble P from dairy barnyard runoff. The four media were (1) a fine loamy, mixed, mesic

Glossic Hapludalf, (2) crushed limestone, (3) Norlite, lightweight coarse aggregates of fired shale, and (4) wollastonite (calcium metasilicate) mining tailings. Based on this research, we recommend Norlite for P removal in agricultural ecosystems. The native soil retained more soluble P but could not sustain subsurface flow. Wollastonite tailings warrant further research. They adsorbed 2 mg P/g in the laboratory but performed less well in the field, probably because of preferential flow.

© The Thomson Corporation

**310. Deterministic and stochastic aspects of constructed wetland performance and design.**

Kadlec, Robert H.

*Water Science and Technology* 35(5): 149-156. (1997)

NAL Call #: TD420.A1P7; ISSN: 0273-1223

*Descriptors:* biochemistry and molecular biophysics/ climatology: environmental sciences/ mathematical biology: computational biology/ models and simulations: computational biology/ waste management: sanitation/ chemical oxygen demand/ constructed wetlands/ deterministic modeling/ hydraulic loading/ irrigation requirement/ models and simulations/ Monte Carlo modeling/ organic nitrogen/ parametric variation/ seasonal growth pattern/ temperature/ waste management/ wetland design

*Abstract:* Potato processing wastewater contains high concentrations of COD, TSS and TKN. A combination of surface flow wetlands, intermittent vertical flow wetlands, ponds and land application has been used for treatment. This engineered natural system balances irrigation requirements, nitrogen supply and seasonal growth patterns to provide effective year-round operation. A first pilot wetland was operated to determine operability, effectiveness, and plant survival at high COD and nitrogen concentrations. A second pilot system of four wetlands in series was operated to obtain design and operating information. Two surface flow wetlands provided TSS and COD reduction, and ammonified the organic nitrogen. Subsequently, nitrification occurred in the vertical flow wetlands, followed by denitrification in a surface flow wetlands. The design target was a balanced nitrogen and irrigation supply for application to crops. Winter storage as used to match the crop application period to the growing season. Both pilot projects met design objectives, and a full scale system has begun operation.

© The Thomson Corporation

**311. Developing design guidelines for constructed wetlands to remove pesticides from agricultural runoff.**

Rodgers, J. H. and Dunn, A.

*Ecological Engineering* 1(1-2): 83-95. (1992)

NAL Call #: TD1.E26; ISSN: 0925-8574.

*Notes:* Conference: US EPA Workshop on the Role of Created and Natural Wetlands in Controlling Nonpoint Source Pollution, Arlington, VA (USA), 10-11 Jun 1991

*Descriptors:* wetlands/ pollution clean-up/ pesticides/ runoff/ pollution control/ environmental engineering/ agricultural pollution/ environmental engineering/ agricultural pollution/ pollution clean-up/ modeling, mathematics, computer applications/ freshwater pollution/ prevention and control/ reclamation/ pollution control

*Abstract:* This paper presents a research strategy for evaluating the capability of constructed, restored, and natural wetlands to assimilate and process pesticides

associated with agricultural runoff from croplands. A modeling approach that is central to this research strategy is presented and the mathematical foundation is explicitly stated. This approach generates predictions that can be experimentally and rigorously tested. Criteria for selection of "model" pesticides for experimentation include factors such as use patterns and amounts as well as intrinsic characteristics of the pesticide. The design of the experimental constructed wetlands cells for this research includes water flow and depth control, clay liners to prevent infiltration, and wetland vegetation as a variable. The experimental strategy should permit optimal transfer of study results from site to site and ultimately provide recommendations for pesticides that are compatible with wetlands as well as design characteristics for constructed wetlands to be used with specific crop-pesticide combinations.

© CSA

**312. Distribution of soil carbon stocks in Canada's forests and wetlands simulated based on drainage class, topography and remotely sensed vegetation parameters.**

Ju, W. and Chen, J. M.

*Hydrological Processes* 19(1): 77-94. (2005)

NAL Call #: GB651.H93; ISSN: 0885-6087

*Descriptors:* drainage class/ forest carbon/ remote sensing/ soil carbon/ topography/ wetland

*Abstract:* A quasi-three-dimensional hydrological model was developed and integrated into the integrated terrestrial ecosystem carbon-budget model (InTEC V3-0) to improve the estimation of the carbon (C) dynamics in Canadian forests and wetlands. Climate, soil, digital elevation map, and drainage class data, in conjunction with remotely sensed vegetation parameters, including leaf area index, land cover type, and stand age, are used to drive the model. Soil is divided into three layers, for which temperature and moisture dynamics are simulated. Individual 1 km x 1 km pixels are hydrologically linked with neighbouring pixels through subsurface saturated base-flow, which is simulated using a TOPMODEL-based scheme. Soil C and nitrogen (N) dynamics are simulated using the soil submodel of CENTURY suitably modified for forests and wetlands. The interannual variation in net primary productivity is iteratively computed after integrating the effects of N, climate, stand age and atmospheric CO<sub>2</sub> concentration on productivity. Compared with data in the Soil Landscape of Canada, the newly updated InTEC V3-0 can capture 66-6% of spatial variations in soil C and effectively alleviate soil C underestimation in wetland areas from its predecessor (InTEC V2-0) by considering the lateral water flow and the water table variation. Copyright 2005 John Wiley & Sons, Ltd.

© 2006 Elsevier B.V. All rights reserved.

**313. Ecodepuration performances of a small-scale experimental constructed wetland system treating and recycling intensive aquaculture wastewater.**

Panella, S.; Cignini, I.; Battilotti, M.; Falcucci, M.; Hull, V.; Milone, N.; Monfrinotti, M.; Mulas, G. A.; Pipornetti, G.; Tancioni, L.; and Cataudella, S.

*Annals of the New York Academy of Sciences* 879: 427-431. (1999)

NAL Call #: 500 N484; ISSN: 0077-8923.

*Notes:* Issue title: Tempos in science and nature:

Structures, relations, and complexity; Meeting Information: Conference, Siena, Italy; September 23-26, 1998; Publisher: New York Academy of Sciences; Other number: 15733119601573311979

*Descriptors:* aquaculture/ waste management: sanitation/ aquaculture self depurating system/ aquaculture wastewater: recycling, treatment/ experimental constructed wetland system/ book chapter/ meeting paper/ meeting poster

© The Thomson Corporation

**314. Ecological restoration of aquatic and semi-aquatic ecosystems in the Netherlands (NW Europe).**

Nienhuis, P. H. and Gulati, R. D.; Series: Developments in Hydrobiology 166; 256- pp. (2003)

*Notes:* ISSN: 0167-8418

*Descriptors:* wetlands/ habitat improvement/ environment management/ grazing/ colonization/ restoration/ aquatic communities/ marshes/ ecosystem resilience/ seeds/ transplantation/ historical account/ Salmonidae/ Plantae/ Netherlands/ Europe/ salmonids/ other aquatic communities/ protective measures and control

*Abstract:* This work presents the state of the art of aquatic and semi-aquatic ecological restoration projects in The Netherlands. Starting from the conceptual basis of restoration ecology, the successes and failures of hundreds of restoration projects are described. Numerous successful projects are mentioned. In general ecological restoration endeavours greatly benefit from the progressive experience achieved in the course of the years. Failures mainly occur through insufficient application of physical, chemical or ecological principles. Spontaneous colonization by plants and animals, following habitat reconstruction, is preferred. However, sometimes the re-introduction of keystone species (e.g. eelgrass, salmon, beaver) is necessary in case the potential habitats are isolated or fragmented, or if a seed bank is lacking, thus not allowing viable populations to develop. Re-introducing traditional management techniques (e.g. mowing without fertilization, low intensity grazing) is important to rehabilitate the semi-natural and cultural landscapes that are so characteristic for The Netherlands.

© CSA

**315. Effect of loading rate and planting on treatment of dairy farm wastewaters in constructed wetlands: 1. Removal of oxygen demand, suspended solid and faecal coliforms.**

Tanner, C. C.; Clayton, J. S.; and Upsdell, M. P.

*Water Research* 29(1): 17-26. (1995)

*NAL Call #:* TD420.W3; *ISSN:* 0043-1354

*Descriptors:* dairy wastes/ wastewater treatment/ artificial wetlands/ coliforms/ agriculture/ water quality/ suspended solids/ chemical oxygen demand/ biological oxygen demand/ retention time/ biochemical oxygen demand/ suspended load/ dairies/ suspended particulate matter/ fecal coliforms/ constructed wetlands/ dairy wastes/ dairies/ suspended particulate matter/ fecal coliforms/ artificial wetlands/ suspended solids/ retention time/ suspended load/ coliforms/ biological oxygen demand

*Abstract:* The effect of influent loading rate on mass removal of BOD, SS and faecal coliforms (FC) from dairy parlour wastewaters was compared in four pairs of planted (*Schoenoplectus, validus*) and unplanted gravel-bed wetlands (each 19 m super(2)). The wetlands were

operated at nominal retention times of 7, 5.5, 3 and 2 days, with in and outflows sampled fortnightly over a 20 month period. Hydraulic flows were monitored to enable calculation of the mass flows of pollutants. Influent water quality varied markedly over the trial period (CBOD sub(5) 20-300 g m super(-3); SS, 60-250 g m super(-3); FC, 10 super(3)-10 super(6) MPN (100 ml super(-1)). NBOD was an important component of total BOD, being around 1.5 times higher than the influent CBOD sub(5), and 2-10 times higher than the effluent CBOD sub(5). Outflow levels of CBOD sub(5), SS and faecal coliforms rapidly mirrored changes in influent loadings. Mean mass removal of CBOD sub(5) increased from 60-75% to 85-90%, total BOD (CBOD sub(5) + NBOD) from 50 to 80% and FC from 90-95 to >99% with increasing wetland retention time during the first 12 months of monitoring. Mean annual SS removals of 75-85% were recorded irrespective of loading rate. High levels of dissolved humic colour in the wastewaters were little affected by passage through the wetland at short retention times, but were reduced by up to 40% at longer retentions. Mass removals of CBOD sub(5), SS and FC showed monotonic relationships to mass loading rates, with little difference between the performance of planted and unplanted wetlands, except for CBOD sub(5) at high loadings (> 3 g m super(-2) d super(-1)). The planted wetlands showed significantly improved removal rates for CBOD sub(5) at higher loadings, and 1.3 to 2.6 fold higher mass removals of total BOD.

© CSA

**316. Effect of loading rate and planting on treatment of dairy farm wastewaters in constructed wetlands: 2. Removal of nitrogen and phosphorus.**

Tanner, C. C.; Clayton, J. S.; and Upsdell, M. P.

*Water Research* 29(1): 27-34. (1995)

*NAL Call #:* TD420.W3; *ISSN:* 0043-1354

*Descriptors:* dairy wastes/ wastewater treatment/ artificial wetlands/ nitrogen removal/ phosphorus removal/ plants/ retention time/ agriculture/ nutrients/ water pollution/ dairies/ pollution control/ nutrients (mineral)/ artificial wetlands/ dairy wastes/ dairies/ pollution control/ nutrients (mineral)/ retention time/ nitrogen removal/ phosphorus removal/ plants/ nutrients

*Abstract:* The effect of influent loading rate on mass removal of nitrogen and phosphorus from dairy parlour wastewaters was compared in four pairs of planted (*Schoenoplectus, validus*) and unplanted gravel-bed wetlands (each 19 m super(2)). The wetlands were operated at nominal retention times of 7, 5.5, 3 and 2 days, with in and outflows sampled fortnightly over a 20 month period. Hydraulic flows were monitored to enable calculation of the mass flows of nutrients, and plant biomass and tissue nutrient levels sampled to evaluate plant nutrient uptake. Influent water quality varied markedly during the trial period (TN, 10-110; NH sub(4)-N, 5-70; and TP 8-18 g m super(-3)). As theoretical wastewater retention times increased from 2 to 7 days, mean reduction of TN increased from 12 to 41% and 48 to 75% in the unplanted wetlands and planted wetlands, respectively, and TP removal increased from 12 to 36% and 37 to 74% respectively. In the planted wetlands, mean annual removal rates of TN (0.15-1.4 g m super(-2) d super(-1)) and TP (0.13-0.32 g m super(-2) d super(-1)), increased gradually with mass loading rates. The unplanted wetlands showed a marked decline in TN and TP removal at high loadings. Net

storage by plants in the first year of monitoring accounted for between 3 and 20% of the greater N removal and between 3 and 60% of the greater P removal in the planted wetlands.

© CSA

**317. Effectiveness of a constructed wetland for retention of nonpoint-source pesticide pollution in the Lourens River Catchment, South Africa.**

Schulz, R. and Peall, S. K. C.

*Environmental Science and Technology* 35(2): 422-426. (Jan. 2001)

*Descriptors:* wetlands/ nonpoint sources/ pollution/ surface water/ agrochemicals/ runoff/ pesticides/ catchment areas/ water pollution/ pollution control/ stormwater runoff/ bioassays/ nonpoint pollution/ catchments/ agricultural pollution/ nitrates/ endosulfan/ chlorpyrifos/ freshwater environments/ nontarget organisms/ south africa/ pollution (nonpoint sources)/ precipitation (atmospheric)/ pesticides/ aurelia/ toxicity/ bioassay/ toxicity/ aquatic insects/ water pollution effects/ nonpoint pollution sources/ artificial wetlands/ Chironomus/ Chironomidae/ South Africa, Lourens R./ constructed wetlands/ Diptera/ midges/ environmental impact/ prevention and control/ freshwater pollution/ aquatic entomology/ water quality/ sources and fate of pollution

*Abstract:* Constructed wetlands have been widely used to control both point- and nonpoint-source pollution in surface waters. However, our knowledge about their effectiveness in retaining agricultural pesticide pollution is limited. A 0.44-ha vegetated wetland built along a tributary of the Lourens River, Western Cape, South Africa, was studied to ascertain retention of runoff-related agricultural pollution. Total suspended solids, orthophosphate, and nitrate were retained in the wetland in the proportions 15, 54, and 70%, respectively, during dry weather conditions (with rainfall less than 2 mm/d) and 78, 75, and 84% during wet conditions (with rainfall between 2 and 35 mm/d). Retention of water-diluted azinphos-methyl introduced via runoff at a level of 0.85  $\mu\text{g/L}$  was between 77 and 93%. Chlorpyrifos and endosulfan were measured during runoff in inlet water at 0.02 and 0.2  $\mu\text{g/L}$ , respectively. However, both pesticides were undetectable in the outlet water samples. During a period of 5 months, an increased concentration of various insecticides was detected in the suspended particles at the wetland inlet: azinphos-methyl, 43  $\mu\text{g/kg}$ ; chlorpyrifos, 31  $\mu\text{g/kg}$ ; and prothiofos, 6  $\mu\text{g/kg}$ . No organophosphorus pesticides were found in the outlet suspended-particle samples, highlighting the retention capability of the wetland. A toxicological evaluation employing a Chironomus bioassay in situ at the wetland inlet and outlet revealed an 89% reduction in toxicity below the wetland during runoff.

© CSA

**318. The effectiveness of a small constructed wetland in ameliorating diffuse nutrient loadings from an Australian rural catchment.**

Raisin, G. W.; Mitchell, D. S.; and Croome, R. L.

*Ecological Engineering* 9(1-2): 19-35. (Sept. 1997)

*Descriptors:* wetlands/ nutrient loading/ catchments/ hydrology/ nitrogen/ phosphorus/ nonpoint pollution/ environment management/ catchment area/ eutrophication/ storms/ agricultural runoff/ catchment areas/ artificial wetlands/ nonpoint pollution sources/ Australia, Victoria/

freshwater pollution/ characteristics, behavior and fate/ sources and fate of pollution/ reclamation

*Abstract:* This paper assesses the capacity of a small (450 m super(2)) constructed wetland in Victoria, Australia, to decrease nutrient loads generated by both background flows and storm events within the period March 1993 to January 1995. Under Australian conditions the effectiveness of wetlands in controlling diffuse pollution is influenced by extreme hydrological events which often carry a large proportion of the annual load from the catchment. The wetland retained a varying proportion of the nitrogen and phosphorus load over a range of hydrological events and seasonal conditions. The wetland also acted as a source of these nutrients on occasions. An annual nutrient budget was calculated for the period February 1994 to January 1995 by measuring all loads between and during storm events entering and leaving the wetland. The wetland 'retained' 10 kg N yr super(-1) (23 g N m super(-2) yr super(-1)) of nitrogen and 1.24 kg P yr super(-1) (2.80 g P m super(-2) yr super(-1)) of phosphorus, representing 11 and 17%, respectively of the incoming nutrient loads for the budget period. Storm event size influenced the impact of the wetland on the nutrient loads generated in these events. Increasing event volumes generally resulted in decreased nutrient interception. The results of this study indicate that for significant load reduction to occur the scale of the wetland should be such that there is sufficient residence time to enable wetland processes to operate. Small strategically located wetlands high up in catchments which will have a cumulative impact on runoff generated in large storm events are likely to be more effective in intercepting nutrient loads than larger downstream structures.

© CSA

**319. Effects of encapsulated calcium carbide on dinitrogen nitrous oxide methane and carbon dioxide emissions from flooded rice.**

Bronson K. F. and Mosier, A. R.

*Biology and Fertility of Soils* 11(2): 116-120. (1991)

NAL Call #: QH84.8.B46; ISSN: 0178-2762

*Descriptors:* agronomy: agriculture/ metabolism/ nutrition/ soil science/ Oryza sativa/ nitrogen/ fertilizer use efficiency/ nitrification inhibitor/ wetland rice/ greenhouse gas/ urea

*Abstract:* The efficiency of N use in flooded rice is usually low, chiefly due to gaseous losses. Emission of CH<sub>4</sub>, a gas implicated in global warming, can also be substantial in flooded rice. In a greenhouse study, the nitrification inhibitor encapsulated calcium carbide (a slow-release source of acetylene) was added with 75, 150, and 225 mg of 75 atom % 15N urea-N to flooded pots containing 18-day-old rice (*Oryza sativa* L.) plants. Urea treatments without calcium carbide were included as controls. After the application of encapsulated calcium carbide, 3.6  $\mu\text{g}$ , N<sub>2</sub>, 12.4  $\mu\text{g}$  N<sub>2</sub>O-N, and 3.6  $\mu\text{g}$  CH<sub>4</sub> were emitted per pot in 30 days. Without calcium carbide, 3.0 mg N<sub>2</sub>, 22.8  $\mu\text{g}$  N<sub>2</sub>O-N, and 39.0 mg CH<sub>4</sub> per pot were emitted during the same period. The rate of N added had a positive effect on N<sub>2</sub> and N<sub>2</sub>O emissions, but the effect on CH<sub>4</sub> emissions varied with time. Carbon dioxide emissions were lower with encapsulated calcium carbide than without. The use of encapsulated calcium carbide appears effective in eliminating N<sub>2</sub> losses, and in minimizing emissions of the "greenhouse gases" N<sub>2</sub>O and CH<sub>4</sub> in flooded rice.

© The Thomson Corporation

**320. Effects of seasonal flooding and grazing on the vegetation of former ricefields in the Rhone delta (southern France).**

Mesleard, F.; Lepart, J.; Grillas, P.; and Mauchamp, A.

*Plant Ecology* 145(1): 101-114. (1999)

NAL Call #: QK900.P63; ISSN: 1385-0237

*Descriptors:* wetlands/ abandoned land/ *Oryza sativa*/ seasonal variation/ grazing/ vegetation/ water management/ ecological succession/ salinity/ rain/ cattle/ land management/ horses/ plant communities/ irrigation/ botanical composition/ France

*Abstract:* Six management regimes were tested during 5 years in 18 abandoned ricefields in the Rhone delta, France: two artificial floodings for 6 months (winter and summer flooding, 10 cm deep) and a control only flooded by rain, each flooding treatment either with or without grazing by cattle and horses. In the absence of artificial flooding and in presence of grazing by domestic herbivores (i.e., maintaining the initial management since the abandonment) no significant change in plant communities was recorded after 5 years. The vegetation was mainly composed of halophytes (*Salicornia fruticosa* and *Inula crithmoides*). The removal of grazing led to the dominance of a salt tolerant grass: *Aeluropus litoralis*. Flooding favoured the dominance of clonal plants and led to a decrease in the number of species. In the ungrazed fields, changes in plant communities were related to the height of species with *Bolboschoenus maritimus* and *Phragmites australis* becoming dominant. When grazing was combined with summer flooding, *B. Maritimus* dominated the first two years of the experiment, but with a low cover, and was replaced in the 3rd year by *Typha angustifolia*. When grazing was combined with winter and early spring flooding the competitive exclusion of *B. maritimus* by *Juncus gerardii* slowed the establishment of the former. The management of former ricefields led to the establishment and dominance of emergent species common to Mediterranean wetlands. Although it is subordinate to the maintenance of artificial flooding, the project may be considered a restoration (or a rehabilitation) of seasonally flooded marshes as original functions existing before the land was put under cultivation are re-established.

This citation is from AGRICOLA.

**321. Enhanced prairie wetland effects on surface water quality in Crowfoot Creek, Alberta.**

Ontkcan, G. R.; Chanasyk, D. S.; Riemersma, S.; Bennett, D. R.; and Brunen, J. M.

*Water Quality Research Journal of Canada* 38(2): 335-359. (2003); ISSN: 1201-3080

*Descriptors:* wetlands/ water quality/ surface water/ habitat/ aquatic birds/ watersheds/ nutrient concentrations/ fecal coliforms/ surface water/ water quality (natural waters)/ catchment areas/ nutrients/ bacteria (faecal)/ birds (waterfowl)/ monitoring/ fate of pollutants/ prairies/ data collections/ spatial distribution/ temporal distribution/ suspended solids/ bacteria/ Canada, Alberta, Crowfoot Creek

*Abstract:* A three-year study was conducted to examine the effects of a prairie wetland enhanced for waterfowl habitat on surface water quality in the Crowfoot Creek watershed in southern Alberta, Canada. Monitoring was carried out at the Hilton wetland from mid-March to the end of October in 1997 to 1999 at two inflow sites and one outflow site. Data were collected on flow, total phosphorus (TP), total nitrogen

(TN), total suspended solids (TSS), and fecal coliform (FC) bacteria. Nutrient concentrations were highest in the spring, and decreased during the remainder of the monitoring period each year. Nutrient concentrations did not change significantly within the wetland due to the form of nutrient, reduced retention times for nutrient uptake, and the addition of nutrients to the water through sediment release and decomposition of organic matter. The wetland acted as both a source and a sink for nutrients, depending on flow volumes. TSS concentrations decreased significantly from inflow to outflow, indicating sedimentation occurred in the wetland. FC bacteria levels were lowest in the spring and increased during the post-spring runoff (PSRO) period. FC bacteria counts decreased significantly within the wetland throughout the entire year. The Hilton wetland was effective in reducing the amounts of TSS and FC bacteria exported from the wetland; however, there was no significant change in nutrient status.

© CSA

**322. Estimating inorganic and organic nitrogen transformation rates in a model of a constructed wetland purification system for dilute farm effluents.**

Mcgechan, M. B.; Moir, S. E.; Sym, G.; and Castle, K.

*Biosystems Engineering* 91(1): 61-75. (2005)

NAL Call #: S671 .B567; ISSN: 1537-5129

*Descriptors:* ammonium/ BOD/ biochemical oxygen demand/ dairy farms/ denitrification/ hydrology/ kinetics/ nitrates/ nitrogen cycling models/ nitrous oxides/ reedbeds/ wetland systems/ microbiology/ biotechnology/ forestry/ agriculture/ mathematical models/ equations

*Abstract:* This paper describes some of the concepts that are being built into a model of a subsurface flow constructed wetland system based on reedbeds. A nitrogen (N) cycling submodel has been adapted from a soil N model, with pools representing organic material with high biological oxygen demand (BOD), ammonium and nitrate. Microbiologically controlled transformations between pools are represented by first-order exponential kinetics, with N finally lost to the atmosphere either by ammonia volatilisation, or by denitrification to gaseous N<sub>2</sub> or nitrous oxide. Hydrology has been represented for both horizontal and vertical reedbeds, with contrasting partially anaerobic or fully aerobic conditions at each stage. The model has been set up to represent an experimental system with one horizontal and three vertical reedbeds, being tested for purification of dirty water from a dairy farm. Rate constant values have been selected so that simulated results are a reasonable approximation to measurements from the experimental system. The model has been developed to assist in optimising design parameters for new systems, including the numbers and sequence of reedbed types, dimensions and flowrates, for various incoming contaminant concentrations and target water purity standards.

© NISC

**323. Evaluating sustainability of watershed resources management through wetland functional analysis.**

Zalidis, G. C. and Gerakis, A.

*Environmental Management* 24(2): 0193-0207. (1999)

NAL Call #: HC79.E5E5; ISSN: 0364-152X

*Descriptors:* wetlands/ water management/ water supplies/ agricultural practices/ watersheds/ sustainable development/ soil conservation/ agriculture/ government

policies/ evaluation/ resources management/ watershed management/ groundwater/ hydrology/ drainage/ resource management/ ecosystem disturbance/ environmental restoration/ sustainable agriculture/ agricultural policy/ flood control/ ground water/ microclimate/ Greece/ Mediterranean Region/ Greece, Karla/ management/ environmental action/ evaluation process/ conservation, wildlife management and recreation/ land/ general environmental engineering

**Abstract:** Unsustainable agricultural policies and water and soil resource schemes have drained two thirds of Mediterranean wetlands since 1920. An outstanding example is Karla in Greece, a former internationally important wetland that was drained in 1962 causing environmental, social, and water and soil problems. The objective of this study was to assess the functions and values of Karla, at three periods of its history, and to relate them to major events in the management of the water and soil resources of its watershed. Information on wetland and watershed features was collected from historical records and field visits. The results showed that the wetland in its pristine state had performed five functions to a high degree, one (groundwater recharge) to a moderate degree, and one (flood storage) to a low degree. Flood-control works, uncontrolled pumping, etc., in 1936-1961 degraded all functions except microclimate modification while, the bird support function was moderately altered. Drainage works in 1962 left a very small artificially flooded wetland with only four functions performed to an insignificant degree. Value degradation followed function degradation. It was concluded that past resource management has been nonintegrated. No consideration was given to the multiple functions and values of Karla. Previous restoration proposals involved the reinstatement of one or two functions only. The appropriate restoration scheme for Karla must be multiobjective and based on the integrated resource management of its own and the neighboring watersheds.

© CSA

#### 324. Fate of super(15) N-nitrate in unplanted, planted and harvested riparian wetland soil microcosms.

Matheson, F. E.; Nguyen, M. L.; Cooper, A. B.; Burt, T. P.; and Bull, D. C.

*Ecological Engineering* 19(4): 249-264. (2002)

NAL Call #: TD1.E26; ISSN: 0925-8574

**Descriptors:** wetlands/ riparian environments/ nutrient uptake/ nitrate/ environment management/ ecosystem management/ nutrients (mineral)/ uptake/ agricultural pollution/ agricultural runoff/ soils/ nitrogen isotopes/ denitrification/ plant populations/ riparian vegetation/ biogeochemical cycle/ nitrates

**Abstract:** Riparian wetlands are important for the protection of river water quality in agricultural landscapes by intercepting and removing nutrients, such as nitrate (NO sub(3) super(-)), in runoff. However, limited information is available on the relative importance of biological NO sub(3) super(-) removal processes in these ecosystems. In this study the fate of super(15)N-NO sub(3) super(-) was investigated for 32 days in three types of wetland soil microcosm (unplanted, planted, and planted with shoot harvest) in order to identify the key processes responsible for NO sub(3) super(-) removal, elucidate the role of the wetland plant and determine the effect of shoot harvest. super(15)N-NO sub(3) super(-) solution (7.9 mg N l super(-) 1), 99 at.% super(15)N) was added to each microcosm at a

rate of 0.5 mu g N g super(-1) soil every 2 days. In both types of plant-inhabited microcosm, similar proportions of added super(15)N-NO sub(3) super(-) were denitrified (61-63%), soil-immobilised (24-26%), plant-assimilated (11-15%) and reduced to ammonium (NH sub(4) super(+)) (<1%). However, in unplanted microcosms, 49% was reduced to NH sub(4) super(+), 29% denitrified and 22% immobilised. Elevated denitrification in the presence of the plant, glaucous sweetgrass (*Glyceria declinata*), was attributed to a higher degree of soil oxidation, which is considered to be the principal regulator of NO sub(3) super(-) partitioning between denitrification and DNRA. Shoot harvest did not affect the fate of super(15)N-NO sub(3) super(-), but it decreased new shoot production (by a factor of 3.9), inhibited new root production, and increased the NO sub(3) super(-) assimilation capacity of shoots (by a factor of 5.2). Although this study lasted for only 1 month, the results have important implications for riparian ecosystem management, restoration and design. The water quality protection afforded by riparian wetlands might be substantially enhanced by maximising vegetation cover with plants like *G. declinata* that promote high denitrification nitrogen (N) losses. In contrast, shoot harvest as a mechanism of permanent N loss may be much less important.

© CSA

#### 325. The fate of traditional extensive (gei wai) shrimp farming at the Mai Po Marshes Nature Reserve, Hong Kong.

Cha, M. W.; Young, L.; and Wong, K. M.

*Hydrobiologia* 352(1-3): 295-303. (Sept. 1997)

NAL Call #: 410 H992; ISSN: 0018-8158.

**Notes:** Conference: Asia-Pacific Conf. on Science and Management of Coastal Environment, Hong Kong (People's Rep. China), 25-28 Jun 1996

**Descriptors:** wetlands/ extensive culture/ shrimp culture/ pond culture/ aquaculture techniques/ water quality/ pollution effects/ habitat improvement/ coastal zone/ mangrove swamps/ Hong Kong, Mai Po Marshes Nature Reserve/ shrimp/ aquaculture/ larval growth stage/ water pollution effects/ ponds/ marshes/ seasonal variations/ fish/ predation/ water birds/ wildlife management/ *Metapenaeus ensis*/ *Mugil cephalus*/ Hong Kong/ greasyback shrimp/ striped mullet/ shellfish culture/ shellfish culture/ aquaculture

**Abstract:** Extensive shrimp farming around Deep Bay, Hong Kong, began in the mid-1940's after the construction of intertidal ponds (gei wai) among the coastal mangroves. The ponds are increasingly being seen as an example of how wetlands can be used sustainably since they are naturally stocked with shrimp postlarvae (e.g. *Metapenaeus ensis*) and young fish (e.g. *Mugil cephalus*) flushed into the ponds from Deep Bay. Once inside, these shrimps and fish feed on naturally occurring detritus on the pond floor. The only gei wai remaining in the Territory, are those at the WWF Hong Kong Mai Po Marshes Nature Reserve, adjacent to Deep Bay. Analysis of the shrimp production between 1990-1995 showed that there were two seasonal peaks, from April-June (Recruitment-I) and from July-October (Recruitment-II). The second peak was significantly lower than the first ( $p < 0.001$ ), especially from those gei wai in the southern part of the reserve which are much closer to a polluted river. The average harvest from each gei wai had also significantly declined from 40.9 plus

or minus 6.0 kg ha super(-1) yr super(-1) in 1990 to 15.1 plus or minus 3.6 kg ha super(-1) yr super(-1) in 1995 ( $p < 0.01$ ). This decline can be attributed to the abundance of predatory fish in the gei wai, and increasing water pollution in Deep Bay which adversely affects the amount of shrimp larvae for stocking the gei wai, as well as the quality of water for flushing the ponds during the rearing and harvesting seasons. Despite this, those gei wai which are not-commercially viable can still support many non-commercial, more pollution tolerant fish and shrimp species. As a result, the management of these gei wai has been altered such that their objective is to provide feeding habitat for piscivorous waterbirds, which is also in line with the aims of the nature reserve.

© CSA

**326. Gaseous carbon dioxide and methane, as well as dissolved organic carbon losses from a small temperate wetland under a changing climate.**

Clair, T. A.; Arp, P.; Moore, T. R.; Dalva, M.; and Meng, F. R.

*Environmental Pollution* 116(Supplement 1): S143-S148. (2002)

NAL Call #: QH545.A1E52; ISSN: 0269-7491

*Descriptors:* freshwater ecology: ecology, environmental sciences/ pollution assessment control and management/ terrestrial ecology: ecology, environmental sciences/ changing climate/ climatic variables/ dissolved organic carbon [DOC]: wetland losses/ hydrologic variables/ poor fen: mixed hardwood softwood forest drainage/ precipitation/ small temperate wetland: carbon budget, passive carbon storage area, potential active greenhouse gas source/ temperate forests/ temperature

*Abstract:* Temperate forests can contain large numbers of wetlands located in areas of low relief and poor drainage. These wetlands can make a large contribution to the dissolved organic carbon (DOC) load of streams and rivers draining the forests, as well as the exchange of methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) with the atmosphere. We studied the carbon budget of a small wetland, located in Kejimikujik National Park, Nova Scotia, Canada. The study wetland was the Pine Marten Brook site, a poor fen draining a mixed hardwood-softwood forest. We studied the loss of DOC from the wetland via the outlet stream from 1990 to 1999 and related this to climatic and hydrologic variables. We added the DOC export information to information from a previously published model describing CH<sub>4</sub> and CO<sub>2</sub> fluxes from the wetland as a function of precipitation and temperature, and generated a new synthesis of the major C losses from the wetland. We show that current annual C losses from this wetland amount to 0.6% of its total C mass. We then predicted that under climate changes caused by a doubling of atmospheric CO<sub>2</sub> expected between 2040 and 2050, total C loss from the wetland will almost double to 1.1% of total biomass. This may convert this wetland from what we assume is currently a passive C storage area to an active source of greenhouse gases.

© The Thomson Corporation

**327. Growth and nutrient dynamics of soft-stem bulrush in constructed wetlands treating nutrient-rich wastewaters.**

Tanner, C. C.

*Wetlands Ecology and Management* 9(1): 49-73. (2001)

NAL Call #: QH541.5.M3 W472; ISSN: 0923-4861

*Descriptors:* wetlands/ nutrient dynamics/ waste water/ nutrients/ vegetation/ nutrient removal/ wastewater treatment/ agricultural runoff/ agricultural pollution/ aquatic plants/ nutrients (mineral)/ nutrient cycles/ plant nutrition/ water pollution treatment/ environment management/ biochemical composition/ *Schoenoplectus tabernaemontani*/ reclamation/ wastewater treatment processes/ reproduction and development/ protective measures and control

*Abstract:* The growth characteristics and nutritional status of *Schoenoplectus tabernaemontani* (C.C. Gmelin) Palla (softstem bulrush or lake clubrush) were investigated during the second and third growth seasons in four equivalent subsurface-flow, gravel-bed constructed treatment wetlands. Each wetland was supplied with a different hydraulic loading rate of agricultural wastewater, covering the range commonly applied to such systems. Harvest and demographic techniques were combined to determine seasonal patterns and gradients of growth and nutrient allocation, and net annual primary productivity (NAPP). Marked seasonal patterns of early spring emergence, summer growth and autumn senescence were observed, with little over-wintering of live above-ground biomass. Starch, the dominant long-term storage substance, comprised similar to 20% of rhizome dry weight (DW) in autumn. Mobilization during spring reduced concentrations by around half, with a trend of increasing depletion in the higher loaded wetlands. NAPP, including above-ground mortality, during the second growth season ranged between similar to 2.5 and 3.5 kg DW m super(-2), with 10-23% allocated to below-ground growth. Mean above-ground live and dead biomass ranged between similar to 1.75 and 2.65 kg DW m super(-2) by mid-summer, with below to above-ground biomass ratios similar in all wetlands at between 0.6 and 0.7. Rhizomes, which comprised around 80% of the below-ground biomass, were generally restricted to the upper 10 cm of the substratum and over half the root biomass also occurred in this zone, with very few roots penetrating below 30 cm depth. High culm concentrations of N, P, Mg and Zn in spring declined markedly over the growth season, while S and Ca showed general increases, and K, Fe and Cu remained relatively stable. Gradients of decreasing tissue concentration of most macronutrients were noted with increasing distance from wastewater inflows. Plant accumulation of N rose by 20-35 g m super(-2) and P by 4-9 g m super(-2) with seasonal regrowth of above-ground shoots. Net plant N and P uptake rates rose to maximum values of 0.3 g N m super(-2) d super(-1) and 0.1 g P m super(-2) d super(-1) in early summer, declining markedly during late summer and autumn. Mass balance assessments of N and P accumulation in plants at near maximum seasonal biomass, after three growth seasons, showed that only 6 to 11% of the N removal and 6 to 13% of the P removal recorded from wastewaters applied to the wetlands could be ascribed to plant uptake and accumulation.

© CSA

**328. Hydrological modelling of a drained grazing marsh under agricultural land use and the simulation of restoration management scenarios.**

Al-Khudhairy, D. H. A.; Thompson, J. R.; Gavin, H.; and Hamm, N. A. S.

*Hydrological Sciences Journal* 44(6): 943-971. (1999)

NAL Call #: 292.9 As7; ISSN: 0262-6667

*Descriptors:* agriculture/ computer simulation/ drainage/ land use/ mathematical models/ moisture/ rain/ runoff/ soils/ watersheds/ catchments/ water resources management/ hydrology/ agricultural land/ hydrological modeling/ marsh/ restoration ecology/ wetland management/ United Kingdom

*Abstract:* The capability of the spatially-distributed, physically-based, rainfall-runoff modelling system, MIKE SHE, to simulate the hydrological behaviour of the natural and drained parts of the North Kent Grazing Marshes, UK, is investigated. The MIKE SHE code is applied to Bells Creek, a small, underdrained, agricultural catchment located within the marshes. The model is used to both provide insights into the essential parameters that control the hydrological processes in the catchment, and predict the influence of various, hypothetical, water management strategies (land use and drainage) on pumped discharge and soil moisture storage in the catchment. The water table model predictions arising from these hypothetical scenarios are also compared against field data obtained from on-going hydrological research on the neighbouring, natural, Elmley Marshes. The comparison is found to be favourable. The results of this study indicate the potential of the MIKE SHE system to simulate the hydrological regime of these wetlands, and hence to play an important role as a tool that can assist environmental and conservation agencies in the sound management of wetland resources. The capability of the spatially-distributed, physically-based, rainfall-runoff modelling system, MIKE SHE, to simulate the hydrological behaviour of the natural and drained parts of the North Kent Grazing Marshes, UK, is investigated. The MIKE SHE code is applied to Bells Creek, a small, underdrained, agricultural catchment located within the marshes. The model is used to both provide insights into the essential parameters that control the hydrological processes in the catchment, and predict the influence of various, hypothetical, water management strategies (land use and drainage) on pumped discharge and soil moisture storage in the catchment. The water table model predictions arising from these hypothetical scenarios are also compared against field data obtained from on-going hydrological research on the neighbouring, natural, Elmley Marshes. The comparison is found to be favourable. The results of this study indicate the potential of the MIKE SHE system to simulate the hydrological regime of these wetlands, and hence to play an important role as a tool that can assist environmental and conservation agencies in the sound management of wetland resources.

© 2006 Elsevier B.V. All rights reserved.

**329. An integrated constructed wetland to treat contaminants and nutrients from dairy farmyard dirty water.**

Dunne, E. J.; Culleton, N.; O'Donovan, G.; Harrington, R.; and Olsen, A. E.

*Ecological Engineering* 24(3): 219-232. (2005)

NAL Call #: TD1.E26; ISSN: 0925-8574

*Descriptors:* artificial wetlands/ biochemical oxygen

demand/ dairy effluent/ dairy wastes/ eutrophication/ farmyard manure/ nutrients/ phosphorus/ pollutants/ polluted water/ runoff/ suspended solids/ water pollution/ water quality

*Abstract:* Water pollution by agriculture can include inappropriately managed dairy farmyard dirty water. In Ireland, dairy farmyard dirty water includes farmyard runoff, parlour washings, and silage/farmyard manure effluents. The objectives of this study were to determine (i) the quality and quantity of dirty water generated at a farm-scale and (ii) the seasonal effectiveness of a constructed wetland to treat farmyard dirty water. The wetland system was 4800 m<sup>2</sup> in area and treated dirty water from a 42-cow organic dairy unit with an open yard area of 2031 m<sup>2</sup>. Monthly dirty water inflow rate to the wetland ranged between 3.6 and 18.5 m<sup>3</sup> d<sup>-1</sup>. Farmyard dirty water accounted for 27% of hydrological inputs to the wetland, whereas rainfall on wetland, along with wetland bank inflows accounted for 45 and 28%, respectively. Farmyard dirty water quality and quantity did not vary with season. Yearly mass loads discharged to the wetland were 47±10 kg yr<sup>-1</sup> of soluble reactive phosphorus (SRP), 128±35 kg yr<sup>-1</sup> of NH<sub>4</sub><sup>+</sup>, 5484±1433 kg yr<sup>-1</sup> of organic material as measured by five-day biological oxygen demand (BOD<sub>5</sub>), and 1570±465 kg yr<sup>-1</sup> of total suspended solids (TSS). Phosphorus retention by the wetland varied with season (5-84%) with least amounts being retained during winter.

© CAB International/CABI Publishing

**330. Interactions between algae (*Selenastrum capricornutum*) and pesticides: Implications for managing constructed wetlands for pesticide removal.**

Friesen-Pankratz, B.; Doebel, C.; Farenhorst, A.; and Goldsborough, L. G.

*Journal of Environmental Science and Health, Part B: Pesticides, food contaminants and agricultural wastes* B38(2): 147-155. (Mar. 2003)

NAL Call #: TD172.J61; ISSN: 0360-1234

*Descriptors:* wetlands/ aquatic plants/ pollution control/ agricultural runoff/ pesticides/ runoff/ atrazine/ lindane/ algae/ agrochemicals/ sorption/ biodegradation/ water treatment/ artificial wetlands/ *Selenastrum capricornutum*/ constructed wetlands/ atrazine/ lindane/ prevention and control/ pollution/ freshwater pollution/ water pollution: monitoring, control & remediation

*Abstract:* This laboratory study examined the interactions between an algal species found in wetlands (*Selenastrum capricornutum*) and two agricultural pesticides (atrazine and lindane). Pesticide additions had a positive effect on the chlorophyll a concentrations of the treatments. The presence of algae decreased the aqueous persistence of both pesticides. It is speculated that the algae either provided sites for pesticide sorption or facilitated pesticide degradation.

© CSA

**331. Investigating dairy lagoon effluent treatability in a laboratory-scale constructed wetlands system.**

Benham, B. L. and Mote, C. R.

*Transactions of the ASAE* 42(2): 495-502. (1999)

NAL Call #: 290.9 AM32T; ISSN: 0001-2351

*Descriptors:* water quality/ wastewater treatment/ design/ water pollution/ pollution control/ constructed wetlands

*Abstract:* Dairy lagoon supernatant treatability was evaluated using 10 laboratory-scale (1.5 m X 0.45 m)

constructed wetlands. Selected design and operational variables were examined. Tested treatments were combinations of three organic loading rates (high, medium, and low) and three types of microbial attachment sites (vegetated, inert, and none). Five combinations (two replications each) of organic loading rate and microbial attachment sites were tested. Removal efficiencies were based on analysis of influent/effluent waste constituent levels. Dominant nitrogen removal mechanisms were determined from an examination of influent/effluent nitrogen specialization. In addition, an analysis of waste degradation kinetics provided insight with respect to the applicability of a widely used design model. Results showed consistently high nitrogen-removal efficiencies (65 to 81%) for all treatments. Nitrogen specialization results indicate that nitrification/denitrification was the dominant nitrogen removal mechanism. Carbon removal was less efficient (6 to 39%), and varied with influent strength. Waste utilization kinetic rate-constants from the five treatments were not statistically different ( $\alpha = 0.05$ ). The design model uses microbial attachment site parameters, such as specific surface area, to modify a base reaction rate-constant (i.e., a rate-constant for a system with no microbial attachment sites). In this case, the rate-constant for the control (treatments with no microbial attachment sites) was not statistically different from either the vegetated or the inert treatments.

This citation is from AGRICOLA.

**332. Landscape planning to reduce coastal eutrophication: Agricultural practices and constructed wetlands.**

Arheimer, B.; Torstensson, G.; and Wittgren, H. B.

*Landscape and Urban Planning* 67(1-4):

205-215. (Mar. 2004)

NAL Call #: QH75.A1L32; ISSN: 0169-2046

*Descriptors:* nitrogen/ eutrophication/ agriculture/ leaching/ mathematical models/ economics/ rivers/ catchments/ artificial wetlands/ models/ agricultural practices/ coastal zone/ water management/ fertilization/ wastewater treatment/ catchment area/ agricultural runoff/ ecosystem disturbance/ pollution control/ environment management/ river basin management/ soils/ catchment areas/ pollution load/ coastal waters/ economic impact/ Sweden/ marine pollution/ water pollution: monitoring, control & remediation/ planning/ development/ water/ protective measures and control/ water quality control

*Abstract:* Southern Sweden suffers from coastal eutrophication and one reason is the high nitrogen load through rivers. The major part of this load originates from diffuse land-based sources, e.g. arable soil leaching. Effective reduction of load from such sources demand careful landscape analysis, combined with changed behaviour of the stakeholders. This study describes a chain of methods to achieve trustworthy management plans that are based on numerical modelling and stakeholders participation and acceptance. The effect of some measures was unexpected when modelling their impact on the catchment scale. Management scenarios to reduce riverine nitrogen load were constructed in an actor game (i.e. role-play) for the Genevadsaan catchment in southern Sweden. The game included stakeholders for implementation of a loading standard for maximum nitrogen transport at the river mouth. Scenarios were defined after negotiation among involved actors and included changes in agricultural

practices, improved wastewater treatment, and establishment of wetlands. Numerical models were used to calculate the nitrogen reduction for different measures in each scenario. An index model (STANK) calculated the root zone leaching of nitrogen from crops at four type farms. This generated input to a catchment scale model (HBV-N) and farm economics. The economic impact of different sets of remedial measures was evaluated for each type farm and then extrapolated to the catchment. The results from scenario modelling show that possible changes in agricultural practices (such as tuning, timing of fertilisation and ploughing, changed crop cultivation) could reduce the nitrogen load to the sea by some 30%, while wetland construction only reduced the original load by some 5%. In the most cost-effective scenario agricultural practices could reduce the riverine load by 86 t per year at a cost of 1.0 million SEK, while constructed wetlands only reduced the load by 14 t per year at a cost of 1.7 million SEK. Thus, changed agricultural practices can be the most effective and less expensive way to reduce nitrogen transport from land to the sea, while constructed wetlands with realistic allocations and sizes may only have small impact on riverine nitrogen transport from land to sea. The overall experience is that actor games and numerical modelling are useful tools in landscape planning for analysing stakeholders' behaviour and the impact of measures to reduce coastal eutrophication.

© CSA

**333. Macrofungi from six habitats over five years in Clayoquot Sound, Vancouver Island.**

Roberts, Christine; Ceska, Oluna; Kroeger, Paul; and Kendrick, Bryce

*Canadian Journal of Botany* 82(10): 1518-1538. (2004)

NAL Call #: 470 C16C; ISSN: 0008-4026

*Descriptors:* wetlands/ habitat/ fungi/ dunes/ estuaries/ forests/ community composition/ ecological distribution/ rare species/ hygrophorus/ *Tricholoma apium*/ *Craterellus*/ *Craterellus tubaeformis*/ Canada, British Columbia, Vancouver I., Clayoquot Sound/ comparative studies/ bogs/ temperate rainforests/ geographical distribution

*Abstract:* Over 5 years, macrofungi from six habitats in Clayoquot Sound, Vancouver Island, British Columbia, were documented. Habitats were categorized as dune, spruce fringe, old-growth rainforest, second-growth forest, bog, or estuarine. All but the second-growth forest are natural ecosystems. A total of 551 taxa of macrofungi were recorded. Between 17% and 36% of the species in any one habitat were found only in that habitat. The most frequently encountered and ubiquitous species was *Craterellus tubaeformis* (Fr.) Quel., found in all years, habitats, and sites. Of the 551 taxa, only 28 were found every year, and 308 were found in only 1 year. Rare species that were recorded include *Cordyceps ravenelii* Berkeley & Curtis, *Hygrophorus inocybiformis* Smith, and *Tricholoma apium* Schaeffer in the dunes and *Stereopsis humphreyi* (Burt) Redhead in the spruce fringe. Similarities between habitats based on taxa in common showed that bog and estuarine habitats had only 9%-17% in common with each other and the other habitats, whereas dune, spruce fringe, and the two forest types shared 21%-31% of their species. Old-growth rainforest yielded approximately 4 times as many species as bog and estuarine habitats, and approximately 1.5 times as many as the other three habitats.

© CSA

**334. Management optimization and sustainable technologies for the treatment and disposal/reuse of fish farm effluent with emphasis on constructed wetlands.**

Negrone, G.

*World Aquaculture* 31(3): 16-19. (Sept. 2000)

NAL Call #: SH1.W62; ISSN: 1041-5602

*Descriptors:* wetlands/ aquaculture effluents/ technology/ effluent treatment/ wastewater treatment/ economics/ environmental impact/ recycling/ fish culture/ organic wastes/ pollution control/ water pollution control/ aquaculture/ fish farming/ effluents/ water reuse/ wastewater management/ wastewater disposal/ fish farming/ effluent/ reuse/ Pisces/ sewage & wastewater treatment/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ protective measures and control/ wastewater treatment processes/ industrial effluents

*Abstract:* Disposal of fish farm effluent is not only a technical, but also a management problem. Many technologies are available to process and recycle the fish farm waste to meet the effluent standards of different countries, but costs are a limiting factor. In accordance with the available natural resources, constructed wetlands (CW) could be an attractive option. CW could greatly help to obtain certified "natural" fish production for concerned niche clients. The waste water treatment plant (WWTP) could be a center of production to complete the cycle that begins with feed, goes through fish, and then returns to agriculture. Aquaculture effluent is generally very diluted and expensive to treat. Where no control is needed, the water from fish ponds is simply discharged back to the original source or to another body of water. Many countries are concerned with the potential pollution effects, and strict regulations make it mandatory to treat the fish farm effluent. The effluent is a resource and should not be wasted but recycled. In this article, some "innovative" technologies and farm management practices are proposed whereby the efficiency of WWTP of the fish farms can be improved by recycling purposes. The problem of fish farm waste confronting intensive farms and, to some extent, semi-intensive fish farms is addressed.

© CSA

**335. A method for coring inland, freshwater wetland soils.**

Reinhardt, Carrie H.; Cole, Charles Andrew; and Stover, Lee R.

*Wetlands* 20(2): 422-426. (2000)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

*Descriptors:* methods and techniques/ soil science/ aluminum irrigation pipe corer/ field equipment/ hand operated soil corer/ incremental analysis/ analytical method/ radiochronologic dating/ dating method/ soil coring method/ field method/ bulk density measurement/ disturbance/ inland freshwater wetland soil/ seed bank/ soil contamination analysis: stratigraphic integrity/ wetland substrate type

*Abstract:* Currently, no method exists to core large volumes of inland freshwater wetland soils that maintains stratigraphic integrity, minimizes unnecessary disturbance, and cores up to a depth of 50 cm. Our objective was to create a large-volume soil coring device that could be applied with consistency to a variety of wetland substrates. The result is a hand-operated soil corer that resembles the

aluminum irrigation pipe corer that DeLaune et al. (1978) used to core soft marshy substrates. Instead of aluminum pipe, we used regular steel stovepipe and a variety of tools for insertion. After the sample is extracted from the sediment, the handle can be quickly removed for ease of transportation and storage of a core. The stovepipe can be cut open to expose the soil sample so that it can easily be sectioned for incremental analysis. The corer was used to take 130 samples in 18 different sites, spanning many different wetland substrate types. Our method has many applications, including radiochronologic dating, seed bank analysis, bulk density measurement, and soil contaminants analysis.

© The Thomson Corporation

**336. Microbiological management of wetland rice fields.**

Roger, P. A.; Zimmerman, W. J.; and Lumpkin, T. A.

In: *Soil Microbial Ecology: Applications in Agricultural and Environmental Management*/ Metting, F. B.

New York: Marcel Dekker, 1993; pp. 417-455.

*Notes:* ISBN: 0824787374

NAL Call #: QR111.S664 1992

*Abstract:* Presents a summary of the major environments of the wetland rice field ecosystem and the major microbial activities they host, and an overview of research on microbiological management of rice fields. The next sections discuss in detail potential and adopted practices, including 1) the utilization of symbiotic and free-living N<sub>2</sub>-fixing blue-green algae as biofertilisers; 2) inoculation of rice with heterotrophic bacteria and the potential for rhizosphere microflora management; and 3) the utilization of bacterial and algal inhibitors to decrease N fertilizer losses. -from Authors

© 2006 Elsevier B.V. All rights reserved.

**337. Mitigation of chlorpyrifos runoff using constructed wetlands.**

Moore, M. T.; Schulz, R.; Cooper, C. M.; Smith, S.; and Rodgers, J. H.

*Chemosphere* 46(6): 827-835. (2002)

NAL Call #: TD172.C54; ISSN: 0045-6535

*Descriptors:* pesticides/ agricultural runoff/ stormwater runoff/ artificial wetlands/ chlorpyrifos/ water pollution control/ nonpoint pollution sources/ best management practices/ sorption/ accumulation/ performance evaluation/ pollution (nonpoint sources)/ runoff (agricultural)/ pesticides/ sorption/ pollution control/ agricultural pollution/ wastewater treatment/ water pollution treatment/ plant populations/ bioaccumulation/ sediments/ South Africa, Cape Town/ South Africa, Lourens R./ chlorpyrifos

*Abstract:* Constructed wetlands have been proposed as a potential best management practice (BMP) to mitigate effects of pesticide-associated agricultural runoff. Wetland mesocosms (14 m x 59-73 m) were amended with chlorpyrifos to simulate a storm runoff event at concentrations of 73, 147 and 733 µg/l. Water, sediment and plant samples collected weekly for 12 weeks indicated that chlorpyrifos rapidly sorbed to sediment and plant material, with approximately 47-65% of measured chlorpyrifos mass retained within the first 30-36 m of wetland mesocosms. Of the measured mass, approximately 55% and 25% were retained by sediments and plants, respectively. A field-scale evaluation of a constructed wetland's mitigation capability was performed in the Lourens River watershed of Cape Town, South

Africa. Results indicate that the wetland was able to retain and considerably decrease the concentration (and hence toxicity) of chlorpyrifos and suspended sediment entering the receiving waterbody (Lourens River). This research provides fundamental answers concerning constructed wetland capabilities that are necessary for constructing field-scale systems within agricultural watersheds.

© CSA

**338. Modelling nitrogen transformations in freshwater wetlands: Estimating nitrogen retention and removal in natural wetlands in relation to their hydrology and nutrient loadings.**

Dorge, Jesper

*Ecological Modelling* 75-76(0): 409-420. (1994)

NAL Call #: QH541.15.M3E25; ISSN: 0304-3800

*Descriptors:* agronomy: agriculture/ conservation/ ecology: environmental sciences/ freshwater ecology: ecology, environmental sciences/ mathematical biology: computational biology/ metabolism/ models and simulations: computational biology/ nutrition/ pollution assessment control and management/ toxicology/ agriculture/ eutrophication/ groundwater/ mathematical model/ nitrates

*Abstract:* The agricultural utilization of the transition zone between the terrestrial and the aquatic system has strongly reduced these important buffer zones in the last 30 years. The reestablishment of wetlands in relation to the aquatic environment is getting more and more in focus in the debate on eutrophication. A general simulation model has been developed for freshwater wetlands to determine the retention and removal of nitrogen in wetlands as water flows from intensively cultivated farm land through wetlands and into the aquatic system. The model consists of a simple hydrological submodel and a more complex biological submodel including heterotrophic nitrogen dynamics and plant uptake. The whole biogeochemical pathway from mineralization of organic matter to ammonia and further to nitrate in the oxic microzone by nitrifiers. before denitrification, is explicitly modelled. The model has been calibrated with field data from three wetlands with different levels of NO<sub>3</sub>-loading (587-1502 kg NO<sub>3</sub>-N/ha cndtdot y) and vegetation. The calculated N-retention varies from 0 to 107 kg N/ha cndtdot y) and denitrification from 199 to 743 kg NO<sub>3</sub>-N/ha cndtdot y with the lowest value in a Sphagnum-dominated wetland and the highest in a reed swamp. The wetland model can be applied to a model system describing the nitrogen turnover and transport from agricultural fertilization through soil and groundwater processes to the final washout into the aquatic environment. Moreover, the model can be used as a prognostic tool for an assessment of the potential effects on the aquatic ecosystem if relevant wetlands were reestablished.

© The Thomson Corporation

**339. Multiobjective approach to water management system for wetlands in Biebrza River valley: Case study.**

Okruszko, H.; Szuniewicz, J.; and Okruszko, T.

In: Proceedings of the International Symposium on the Hydrology of Wetlands in Temperate and Cold Regions. (Held 6 Jun 1988-8 Jun 1988 at Joensuu, Finland.); Vol. 1. Helsinki, Finland: Academy of Finland; pp. 10-15; 1988.

*Descriptors:* wetlands/ multiobjective planning/ peat bogs/ marsh management/ Poland/ river basins/ land use/

reclamation/ preservation/ case studies/ mires/ drainage effects/ computer models/ irrigation requirements/ water demand/ water management/ grasslands/ forest management/ lakes/ control of water on the surface

*Abstract:* A preliminary attempt has been made to develop a water management program for the Biebrza River Valley of Poland. This wetland territory is not reclaimed but partly drained due to some changes in natural hydrographic networks caused by the building of several canals in the 19th century. The areas in the valley of the middle Biebrza river have been divided into five types of sites: (1) the Red Bog reservation, a complex mire of transition and high moor, (2) areas surrounding the birch forests, (3) large consolidated complexes of birch forests, (4) grassland for agricultural use requiring irrigation, and (5) grassland for agricultural use without irrigation. In two of the five selected areas of the river valley, the water conditions are appropriate to levels of utilization. In three other areas, water conditions must be adjusted to the requirements associated with the methods of their planned management. The areas surrounding the Red Bog have been partially drained and designed for protection as wetlands. They must undergo renaturalization by increasing water inflow into these areas and by raising the groundwater level. This can be accomplished by raising the level of water and decreasing its outflow in the rivers Elk and Jegrznia and the canal joining them. Birch forests may also require water regulation due to evapotranspiration under the forest ecosystem. Grasslands will also require water management and a water balance involving probable deficiency of water from precipitation has been made on the basis of the meteorological conditions. An analysis of the water reserves and requirements in the Biebrza River Valley has shown that by utilizing water from the winter season all water demands can be met. Mathematical models have been used to regulate the water relations in the valley according to the needs of different ecosystems. Systematic observations of meteorological and hydrological conditions are required to make further calculations for water management in the Biebrza River Valley.

© CSA

**340. Nitrogen cycling in wetland systems.**

Hunt, P. G.; Poach, M. E.; and Liehr, S. K.

In: Nutrient management in agricultural watersheds: A wetlands solution/ Dunne, E. J.; Reddy, K. R.; and Carton, O. T.

Wageningen, Netherlands: Wageningen Academic Publishers, 2005; pp. 93-104.

*Notes:* International symposium on Nutrient Management in Agricultural Watersheds: A Wetlands Solution, Wexford, Ireland

*Descriptors:* wetlands/ aerobic treatment/ agriculture/ air quality/ ammonia/ anaerobic treatment/ artificial wetlands/ biodegradation/ biological treatment/ cycling/ dairy effluent/ denitrification/ ditches/ drainage/ ecological balance/ environmental protection/ microbial activities/ nitrification/ nitrogen/ nitrogen cycle/ oxidation/ oxygen/ piggery effluent/ riparian vegetation/ streams/ vegetated strips/ waste water/ waste water treatment/ water quality/ watersheds

*Abstract:* When considering the management of N on an agricultural watershed, the cycling of N is paramount because N exists in many different oxidative and physical states. The cycle is active in the biology of both aerobic and anaerobic processes. Furthermore, the cycling of N in both

natural and constructed wetlands is particularly dynamic and exceedingly valuable to N management for both productive agriculture and environmental quality. Nitrogen cycling is illustrated in the context of three types of wetlands - constructed, riparian, and in-stream. We present the higher than expected rates of denitrification in constructed wetland used for animal waste water treatment as an example of denitrification via new pathways such as ANAMMOX that require less oxygen in the precursor oxidation of ammonia. We show the effectiveness of different riparian zones for stream buffering and denitrification, particularly noting that they appear to provide a reasonable balance for protecting both water and air quality. We emphasize the importance of in-stream wetlands for assimilations and transformations of N that escapes agricultural watersheds.

© CAB International/CABI Publishing

**341. Nitrogen removal and cycling in restored wetlands used as filters of nutrients for agricultural runoff.**

Comin, F. A.; Romero, J. A.; Astorga, V.; and Garcia, C. *Water Science and Technology* (1997)

NAL Call #: TD420.A1P7; ISSN: 0273-1223.

Notes: Conference: 5. Int. Conf. on Wetland Systems for Water Pollution, Vienna (Austria), 15-19 Sep 1996; Issue editors: Haberl, R.; Perfler, R.; Laber, J.; and Cooper, P.

Descriptors: wetlands/ nitrogen removal/ nitrogen cycle/ nutrients/ filters/ agricultural runoff/ aquatic plants/ rice/ denitrification/ rehabilitation/ water pollution control/ pollution control/ habitat improvement (biological)/ *Phragmites australis*/ *Typha latifolia*/ *Scirpus lacustris*/ Spain, Ebro R./ *Phragmites australis*/ *Typha latifolia*/ *Scirpus lacustris*/ pollution control/ habitat improvement (biological)/ Med, Spain, Tarragona, Ebro delta/ rice/ rehabilitation/ nitrogen removal/ nutrients/ water pollution control/ water quality control/ freshwater pollution/ prevention and control

Abstract: Four restored wetlands dominated by *Phragmites australis*, *Typha latifolia* and *Scirpus lacustris* were used to improve the quality of agricultural runoff in the Delta of the Ebro River (NE Spain) in 1993. The wetlands were continuously flooded with water from a ricefield irrigation network during the growing season and received water with between 0-270 mg m<sup>-2</sup> d<sup>-1</sup> of total nitrogen, 29-105 mg m<sup>-2</sup> d<sup>-1</sup> of dissolved inorganic nitrogen and 0-27 mg m<sup>-2</sup> d<sup>-1</sup> of dissolved organic nitrogen. Surface outflows contained between 0-80 mg m<sup>-2</sup> d<sup>-1</sup> of total nitrogen, 0-12 mg m<sup>-2</sup> d<sup>-1</sup> of dissolved inorganic nitrogen and 1-19 mg m<sup>-2</sup> d<sup>-1</sup> of dissolved organic nitrogen. The nitrogen retention efficiency was close to 100% of the input, except for dissolved organic nitrogen at the end of the growing season. The denitrification rates measured by the acetylene reduction in the sediment ranged between 0 and 3.46 mg N m<sup>-2</sup> d<sup>-1</sup> and represented between 0 and 12% of the inflowing dissolved inorganic nitrogen. Emergent macrophytes accumulated between 20 and 100 mg N m<sup>-2</sup> d<sup>-1</sup>, which accounts for between 66 and 100% of the inflowing dissolved inorganic nitrogen. The wetland sediment accumulated between 111 and 250 mg N m<sup>-2</sup> d<sup>-1</sup> during the six month growing season. The removal rate constants calculated according to a first - order plug - flow kinetics, were between 0.01-0.075 m d<sup>-1</sup> for total nitrogen and 0.01-0.3 m d<sup>-1</sup> for dissolved inorganic nitrogen.

Plant uptake, detritus accumulation and decomposition, and nitrogen recycling in the sediment are major processes for nitrogen retention and recycling in the wetlands. This type of wetlands, restored from ricefields, act as highly efficient water polishing filters for agricultural runoff and, at the same time, can contribute to increase the habitat biodiversity of large areas where rice is cultivated extensively.

© CSA

**342. Nitrogen spiraling in subsurface-flow constructed wetlands: Implications for treatment response.**

Kadlec, R. H.; Tanner, C. C.; Hally, V. M.; and Gibbs, M. M. *Ecological Engineering* 25(4): 365-381. (2005)

NAL Call #: TD1.E26; ISSN: 0925-8574

Descriptors: 15N/ ammonia/ nitrogen/ spiralling/ stable isotope/ subsurface wetlands

Abstract: Nitrogen processing in treatment wetlands was investigated by use of the stable isotope 15N introduced as ammonium. Two small field-scale, gravel-bed wetlands with horizontal subsurface-flow (SSF) received primary meat processing water. Four SSF cascade mesocosms, each comprising five tanks in series, received primary meat processing water, primary dairy water, secondary dairy water or aerated secondary dairy water. The mesocosms and one of the field-scale wetland contained well-established bulrushes (*Schoenoplectus tabernaemontani*), and the other field-scale wetland remained unvegetated. The systems were operated at steady inflows, with a nominal detention times of 4-5 days. The incoming ammonium nitrogen ranged from 18.5 to 177 g m<sup>-3</sup>, and removals ranged from 15 to 90% for the various feed waters. Each system was dosed with a single pulse of 15N ammonium mixed into the feed wastewater, and the fate and transport of the isotopic nitrogen were determined. The 15N pulses took 120 days to clear the heavily loaded field-scale wetlands. During this period small reductions in 15N were attributable to nitrification/denitrification, and a larger reduction due to plant uptake. Mesocosm tests ran for 24 days, during which only 1-16% of the tracer exited with water, increasing with N loading. Very little tracer gas emission was found (?1%). The majority of the tracer was found in plants (6-48%) and sediments (28-37%). These results indicated a rapid absorption of ammonium into a large sediment storage pool, of which only a small proportion was denitrified during the period of the experiment. Plant uptake claimed a fraction of the ammonium, determined mainly by the plants requirement for growth rather than the magnitude of the nitrogen supply. A rapid return of ammonium to the water was also found, so that movement of 15N through the wetland mesocosms was comprised of a spiral of uptake and release along the flow path. A two compartment model was found to reasonably represent the isotope progress through the wetlands. First order exchanges and removals were employed in dynamic mass balances on water and solids. It is concluded that interpretation of nitrogen dynamics in wetlands must include the nitrogen spiral through the wetland, as well as plant uptake. This greatly increases the N residence time in treatment wetlands relative to the hydraulic detention time, resulting in long delays of treatment system response to changes in N loading and attenuation of short-term fluctuations in loading.

© 2006 Elsevier B.V. All rights reserved.

**343. Non-point source pesticide removal by a mountainous wetland.**

Kao, C. M.; Wang, J. Y.; Chen, K. F.; Lee, H. Y.; and Wu, M. J.

*Water science and Technology* 46(6-7): 199-206. (2002)  
NAL Call #: TD420.A1P7; ISSN: 0273-1223.

*Notes:* Conference: 2nd World Water Congress of the International Water Association: Integrated Water Resources Management, Berlin [Germany], 15-19 Oct 2001

*Descriptors:* wetlands/ nonpoint pollution sources/ fate of pollutants/ agricultural runoff/ pesticides/ atrazine/ biodegradation/ microbial degradation/ field tests/ data collections/ storm runoff/ pollution (nonpoint sources)/ runoff (agricultural)/ biodegradation/ field studies/ runoff sources and fate of pollution/ water treatment/ water pollution: monitoring, control & remediation

*Abstract:* Non-point source (NPS) pollution is believed to be one of the major causes of impairment of water bodies. Among NPS pollution, agricultural NPS pollution is considered to be the largest single category resulting in water quality deterioration. Pesticides are some of the most ubiquitous of these agricultural NPS pollutants. In this study, a mountainous wetland was selected to investigate the effects of the natural wetland system on the NPS pesticide (atrazine) removal to maintain the surface water quality. The selected wetland receives water from two unnamed creeks, which drain primarily upgradient agricultural lands. Wetland investigation and monitoring were conducted from November 1999 to March 2001. Major storm events and baseline water quality samples were analyzed. Field results indicate that the wetland was able to remove NPS atrazine flushed from the upgradient agricultural lands after the occurrence of storm events. Laboratory aerobic and anaerobic bioreactor experiments were conducted to evaluate the biodegradation of atrazine under the intrinsic conditions of the wetland system. Microbial enumeration was conducted for a quick screen of bacterial activity in the studied wetland. Results from the study suggest that the methanogenesis process was possibly the dominant biodegradation pattern, and atrazine can be degraded under reductive dechlorinating conditions when sufficient intrinsic organic matter was provided. Results from this study can provide us with further knowledge on pesticide removal mechanisms in natural wetlands and evaluate the role of wetlands in controlling pesticide pollutants from stormwater runoff.

© CSA

**344. Nutrient removal by a constructed wetland treating subsurface drainage from grazed dairy pasture.**

Tanner, C. C.; Nguyen, M. L.; and Sukias, J. P. S.

*Agriculture Ecosystems and Environment* 105(1-2): 145-162. (2005)

NAL Call #: S601.A34; ISSN: 0167-8809

*Descriptors:* flow proportional sampling: applied and field techniques/ grazed dairy pasture

*Abstract:* Nitrogen and phosphorus budgets over two annual periods are presented for an establishing surface-flow constructed wetland treating subsurface drainage from rain-fed, dairy cattle grazed pasture in the North Island of New Zealand. Drainage flows to the wetland (occupying approx 1% of the catchment area) were highly pulsed, associated with rainfall and soil water status, and differed between years (305 and 197 mm drainage). Flow-proportional sampling of inflow and outflow concentrations

were combined with continuous flow records to calculate mass balances for the wetlands. Influent nitrate concentrations were high (median 11 g m<sup>-3</sup>) in both years, but transient loads of organic N were also an important form of N in the first year. Mass removal of total nitrogen (TN) and its main constituent forms nitrate/nitrite and organic N was recorded for all seasons over both annual periods studied. TN mass removal efficiency of 79% (841 g m<sup>-2</sup> per year) in the first year, declined to 21% (40 g m<sup>-2</sup> per year) in the second year, associated with changes in the magnitude, speciation and seasonal pattern of N export from the catchment. Ammoniacal N (NH<sub>4</sub>-N), which comprised <0.5% of TN loadings to the wetland, was generated in small amounts during passage through the wetland in both years. Total phosphorus (TP) in the drainage waters occurred at median concentrations of 0.1-0.2 g m<sup>-3</sup>, mainly in dissolved reactive forms (DRP 92% by mass). TP export rose by 101% (5.0 g m<sup>-2</sup> per year) after passage through the wetland in the first year, but decreased by 12% (0.2 g m<sup>-2</sup> per year) in the second year. The results show that constructed wetlands comprising approx 1% of catchment area can markedly reduce N export via pastoral drainage, but may be net sources of NH<sub>4</sub>-N, DRP and TP during establishment. Performance of the wetland appeared to be affected by both establishment/maturation factors and year-to-year climatic variations. Longer-term studies, supplemented by process-based laboratory and mesocosm investigations, are required to evaluate sustainable nutrient removal rates over a range of climatic conditions, and identify the key factors regulating performance. Copyright 2004 Elsevier B.V. All rights reserved.

© The Thomson Corporation

**345. Nutrient removal from aquaculture wastewater using a constructed wetlands system.**

Lin, Y.; Jing, S.; Lee, D.; and Wang, T.

*Aquaculture* 209(1-4): 169-184. (June 2002)

NAL Call #: SH1 .A6; ISSN: 0044-8486

*Descriptors:* fish culture/ wastewater treatment/ nutrients (mineral)/ nitrogen/ phosphorus/ aquaculture effluents/ water purification/ uptake/ water quality control/ water reuse/ eutrophication/ nutrient removal/ artificial wetlands/ aquaculture/ hydraulic loading/ nitrogen removal/ phosphorus removal/ ammonium/ phosphates/ vegetation/ free water/ storm seepage/ pilot plants/ tin/ receiving waters/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ protective measures and control/ sewage & wastewater treatment/ wastewater treatment processes/ water & wastewater treatment

*Abstract:* Nutrient removal is essential for aquaculture wastewater treatment to protect receiving waters from eutrophication and for potential reuse of the treated water. A pilot-scale wastewater treatment system consisting of a free water surface (FWS) and a subsurface flow (SSF) constructed wetlands arranged in series was operated for around 8 months. The study was conducted to examine system start-up phenomena and to evaluate system performance in removing inorganic nitrogen and phosphate from aquaculture wastewater under various hydraulic loading rates (1.8 to 13.5 cm day<sup>-1</sup>). The wetlands system showed rapid start-up behaviors in which process stabilities were achieved in the following sequence: phosphate removal in the SSF without an adaptation period, nitrogen removal in the SSF after 1 month, nitrogen removal in the

FWS after 2 to 3 months, phosphate removal in the FWS after 3 months, and vegetation cover in both wetlands after 7 months of operation. Nitrogen removals were excellent, with efficiencies of 86% to 98% for ammonium nitrogen (NH<sub>4</sub>-N) and 95% to 98% for total inorganic nitrogen (TIN). Removal efficiencies were affected little by the hydraulic loading trials. Phosphate removal of 32% to 71% occurred, with the efficiencies being inversely related to hydraulic loading. The FWS wetland removed most inorganic nitrogen, whereas the SSF wetland removed phosphate at a rate equal to or even greater than the FWS. Removal of ammonium and nitrite (effluent concentrations 0.3 mg NH<sub>4</sub>-N l<sup>-1</sup> and 0.01 mg NO<sub>2</sub>-N l<sup>-1</sup>) were sufficient for recycle in the aquaculture system without danger of harming the fish.  
© CSA

**346. Nutrient removal from piggery effluent using vertical flow constructed wetlands in southern Brazil.**

Sezerino, P. H.; Reginatto, V.; Santos, M. A.; Kayser, K.; Kunst, S.; Philippi, L. S.; and Soares, H. M.  
*Water Science and Technology* 48(2): 129-135. (2003)  
NAL Call #: TD420.A1P7; ISSN: 0273-1223.  
*Notes:* Conference: 5th International Conference on Waste Stabilisation Ponds: Pond technology for the new millennium, Auckland, New Zealand, 2-5 Apr 2002; Issue editors: Shilton, A. N.; Craggs, R. J.; and Walmsley, N.  
*Descriptors:* biological wastewater treatment/ artificial wetlands/ nutrient removal/ barn wastewater/ pilot plants/ experimental data/ performance evaluation/ piggeries waste waters/ wastewater treatment (biological)/ nutrients/ farm buildings/ agricultural wastewaters/ Brazil, Santa Catarina/ wastewater treatment processes/ industrial effluents/ water & wastewater treatment

*Abstract:* Santa Catarina State, southern Brazil, has the greatest swine breeding activities of Latin America. Generally, the piggery wastewater is treated in pond systems that are able to remove organic material according to local environmental legislation. However, these systems do not remove nitrogen and phosphorus efficiently. This work deals with a post-treatment system, using vertical flow constructed wetlands. The experiment was conducted in a swine production farm which has 45,000 animals. Although the pond system was able to partially remove the content of nutrients, their concentration in the effluent was high for environmental disposal. A four-bed vertical flow constructed wetland pilot plant, using *Typha* spp., was built. The pilot plant operated for 280 days for beds 2-4 (sand 2). However, the experiments with beds 1-3 (sand 1) were stopped after 111 days of operation, when a reduction in the wastewater drainage was observed. The beds with sand 2 showed a 33% COD removal, and about 49% of nitrification was observed from 111 days until the end of the operation. PO sub(4)-P removal was 45% with a loading rate of around 1.36 g m super(-2) d super(-1).  
© CSA

**347. Organic matter accumulation during maturation of gravel-bed constructed wetlands treating farm dairy wastewaters.**

Tanner, C. C.; Sukias, J. P. S.; and Upsdell, M. P.  
*Water Research* 32(10): 3046-3054. (Oct. 1998)  
NAL Call #: TD420.W3; ISSN: 0043-1354  
*Descriptors:* artificial wetlands/ accumulation/ retention/ hydraulic loading/ dairy wastes/ density/ plant growth/ gravel/ organic matter/ cores/ agricultural runoff/

wastewater treatment/ artificial lakes/ hydrology/ dairies/ agricultural wastes/ wastewater treatment processes/ prevention and control/ sewage & wastewater treatment  
*Abstract:* The accumulation of organic matter (OM) was investigated after two and five years in a series of four gravel-bed constructed wetlands supplied with different hydraulic loading rates (21, 26, 46 and 72 mm d super(-1)) of farm dairy wastewaters. At these hydraulic loadings, mean wastewater loadings of particulate OM (determined as volatile suspended solids) to the wetlands ranged between similar to 1.7 and 5.8 g m super(-2) d super(-1). Vertical and horizontal gradients of OM accumulation, measured by "loss on ignition", were sampled by stratified coring at 18 sites in each wetland, and their impact on wastewater residence times investigated in three of the wetlands using bromide as a conservative tracer. Mean accumulations of OM in the wetlands after five years operation ranged between 6.8 and 14.9 kg m super(-2), increasing with wastewater loading rate. The annual rates of accumulation during the first two years were 1.2 to 2-fold higher than those in the subsequent three years. Around 50-60% of the OM occurred within the gravel substratum, the remainder forming surface sludges, commonly exceeding 50 mm depth over much of the wetland substratum. OM accumulation in the wetlands considerably exceeded that contributed from applied wastewaters, with wetland plant derived detritus supplying substantial additional quantities of OM. The effective void space of the wetland substrata was markedly reduced in the highest loaded wetland, with mean wastewater retention time reduced to similar to 50% of its theoretical value (corrected for evapotranspiration losses). In contrast, the lowest-loaded wetland exhibited retention times close to theoretical values. There was, however, no direct relationship between OM accumulation and the effective retention times of the wetlands, suggesting other factors, such as differences in OM bulk density, spatial patterns of accumulation and plant root growth, and inorganic accumulations, were also influencing their hydrology.  
© CSA

**348. Organic matter composition, microbial biomass and microbial activity in gravel-bed constructed wetlands treating farm dairy wastewaters.**

Nguyen, L. M.  
*Ecological Engineering* 16(2): 199-221. (Nov. 2000)  
NAL Call #: TD1.E26; ISSN: 0925-8574  
*Descriptors:* wetlands/ biomass/ farms/ dairies/ waste water/ wastewater treatment/ dairy industry/ microorganisms/ organic matter/ sediments/ respiration/ agricultural wastes/ microbial activity/ humic acids/ *Schoenoplectus tabernaemontani*/ *schoenoplectus tabernaemontani*/ environmental degradation/ non-patents/ sewage & wastewater treatment  
*Abstract:* Organic matter (OM) composition, microbial biomass and microbial activity in a planted (*Schoenoplectus tabernaemontani*), gravel-bed wetland receiving cumulative OM (determined as volatile suspended solids) loadings over 5 years from farm dairy wastewater (8.2 kg OM m super(-2)) and in situ plant residues (8.4 kg OM m super(-2)) were investigated. Organic deposits above and within the gravel stratum (0-100- and 100-400 mm depths) were collected from six sites (with three transverse points per site) along the wetland channel. They were sequentially extracted for labile and stable OM fractions and determined

for total carbon (C), total nitrogen (N), biomass C, biomass N, and microbial activity (respiration rate). Over 90% of the OM accumulated in the wetland was present as stable OM fractions. Humic acid, fulvic acid and humin were the predominant stable OM fractions, accounting for similar to 63-96% of total C in surface deposits and the gravel substratum. The predominance of stable OM fractions in the wetland was attributed to the refractory nature of OM inputs (lignocellulose and humic compounds) from wetland plant litter and the applied dairy wastewater. Clogging of the gravel pore spaces over a 5-year wetland operation was therefore a result of the accumulation of refractory organic solids, originating from plant litter and applied dairy wastewater. Mineral aluminium (Al) and iron (Fe) compounds did not play a major role in OM stabilisation and accumulation in the wetland since organic C associated with Al and Fe accounted for <2% of the total C in surface deposits and the gravel substratum. Humic compounds were at least 2-fold higher in surface deposits and the top 100 mm of the gravel-bed than the lower gravel substratum, suggesting that pore clogging by these compounds was more prominent in the top layer of the gravel-bed. Microbial respiration rate and microbial biomass were significantly ( $P$  less than or equal to 0.001) correlated with sediment OM fractions, suggesting that these microbial parameters may be used to predict changes in the labile and stable fractions of OM accumulation in the wetland. Both quantitative assessment of OM content and qualitative determination of labile and stable OM fractions in surface deposits and the gravel substratum are equally important in the understanding of OM accumulation-decomposition and pore clogging in gravel-bed wetlands.

© CSA

**349. Oxidation of the root zone by aquatic plants growing in gravel-nutrient solution culture.**

Steinberg, S. L. and Coonrod, H. S.  
*Journal of Environmental Quality* 23(5): 907-913. (1994)  
 NAL Call #: QH540.J6; ISSN: 0047-2425.  
*Notes:* Conference: Symposium on Wetland Processes and Water Quality, Minneapolis, MN (USA), 3-4 Nov 1992  
*Descriptors:* wetlands/ aquatic plants/ nutrients/ chemical reactions/ oxygen/ oxidation/ wastewater treatment/ roots/ redox reactions/ waste disposal sites/ redox potential/ wastewater aquaculture/ *Juncus alpinus*/ *Phalaris arundinacea*/ *Typha latifolia*/ redox potential/ waste disposal sites/ wastewater aquaculture/ root zone/ roots/ redox reactions/ nutrients/ chemical processes/ freshwater pollution/ methods and instruments/ plant culture  
*Abstract:* The root zone oxidation state was monitored over a period of 87 d for alpine rush (*Juncus alpinus* Vill.), canarygrass (*Phalaris arundinacea* L.), and cattail (*Typha latifolia* L.) growing in gravel-nutrient solution culture. The dissolved oxygen concentration in the root zone of cattail and canarygrass was less than or equal to 1 mg/L, whereas in alpine rush it ranged from 0 to 2 mg/L. All planted treatments consistently had a dissolved oxygen concentration 1 to 2 mg/L lower than gravel without plants. Redox potentials in the root zone of alpine rush were normally between 400 and 700 mV, indicating an aerobic root zone. The root zone of cattail also tended to be aerobic, although redox potentials of < 400 mV were obtained 40% of the time. Canarygrass had the most reduced root zone with 85% of the redox potential measurements < 400 mV. Dissolved oxygen concentrations

and redox potentials in the root zone did not change significantly on a diurnal basis for any of the plant species. The results show that there was a plant species effect on the oxidation state of the root zone as measured by dissolved oxygen and redox potential.

© CSA

**350. Performance of a constructed wetland treating intensive shrimp aquaculture wastewater under high hydraulic loading rate.**

Lin, Y. F.; Jing, S. R.; Lee, D. Y.; Chang, Y. F.; Chen, Y. M.; and Shih, K. C.  
*Environmental Pollution* 134(3): 411-421. (Apr. 2005)  
 NAL Call #: QH545.A1E52; ISSN: 0269-7491  
*Descriptors:* artificial wetlands/ economics/ feasibility studies/ water quality control/ aquaculture effluents/ wastewater treatment/ hydraulics/ biochemical oxygen demand/ ammonia/ nitrites/ prawn culture/ intensive culture/ water management/ environmental impact/ suspended particulate matter/ recirculating systems/ water pollution treatment/ nitrogen compounds/ aquaculture economics/ feasibility/ culture effects/ Crustacea/ sewage & wastewater treatment/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ protective measures and control/ water & wastewater treatment  
*Abstract:* A water treatment unit, mainly consisting of free water surface (FWS) and subsurface flow (SF) constructed wetland cells, was integrated into a commercial-scale recirculating aquaculture system for intensive shrimp culture. This study investigated performance of the treatment wetlands for controlling water quality. The results showed that the FWS-SF cells effectively removed total suspended solids (55-66%), 5-day biochemical oxygen demand (37-54%), total ammonia (64-66%) and nitrite (83-94%) from the recirculating water under high hydraulic loading rates (1.57-1.95 m/day). This led to a water quality that was suitable for shrimp culture and effluent that always satisfied the discharge standards. The area ratios of wetlands to culture tank being demonstrated (0.43) and calculated (0.096) in this study were both significantly lower than the reported values. Accordingly, a constructed wetland was technically and economically feasible for managing water quality of an intensive aquaculture system.  
 © CSA

**351. Phosphorus adsorption characteristics of a constructed wetland soil receiving dairy farm wastewater.**

Jamieson, T. S.; Stratton, G. W.; Gordon, R.; and Madani, A.  
*Canadian Journal of Soil Science* 82(1): 97-104. (2002)  
 NAL Call #: 56.8 C162; ISSN: 0008-4271.  
*Notes:* Original Title: Adsorption du phosphore par une terre humide artificielle recevant les eaux usées d'une exploitation laitière  
*Descriptors:* wetlands/ phosphorus removal/ adsorption/ dairy wastes/ wastewater disposal/ regression analysis/ farm wastes/ dairies/ agricultural wastes/ Canada, Nova Scotia/ wastewater treatment processes/ land pollution/ water & wastewater treatment  
*Abstract:* Adsorption to soil has been identified as a key wastewater P removal mechanism in treatment wetlands. Batch incubation experiments were performed to measure the capacity of a constructed dairy farm wetland in Pictou County, Nova Scotia, to remove P from solution. The

constructed wetland had been receiving wastewater since 1996. Non-linear regression analysis was performed using the Langmuir adsorption model to describe the P adsorption characteristics for the wetland soil under study. The Langmuir model was adequate in describing the P adsorption characteristics of the system studied. The P adsorption maxima found were approximately 925, 924, and 1600 mg P kg<sup>-1</sup> soil, for the deep zone soil, shallow zone soil, and a background soil (not receiving wastewater), respectively. The P adsorption maxima for the deep zone and shallow zone soils were not significantly different ( $P > 0.05$ ) from one another, but were significantly lower ( $P < 0.05$ ) than the background soil. These data, together with information on wastewater inflow and P loading, were used to predict a lifespan of 8 yr for this wetland, relative to P removal.

© CSA

### 352. Phosphorus biogeochemistry of wetlands in agricultural watersheds.

Dunne, E. J. and Reddy, K. R.

In: Nutrient management in agricultural watersheds: A wetlands solution/ Dunne, E. J.; Reddy, K. R.; and Carton, O. T.

Wageningen, Netherlands: Wageningen Academic Publishers, 2005; pp. 105-119.

Notes: International symposium on Nutrient Management in Agricultural Watersheds: A Wetlands Solution, Wexford, Ireland; ISBN: 9076998612

Descriptors: wetlands/ absorption/ acid soils/ adsorption/ agriculture/ alkaline soils/ aluminium/ artificial wetlands/ bioavailability/ biogeochemistry/ calcium/ chemical precipitation/ desorption/ eutrophication/ inorganic phosphorus/ iron/ nutrient content/ nutrients/ phosphate/ phosphorus/ retention/ reviews/ river water/ sediment/ soil types/ soil water/ solubility/ sorption/ sorption isotherms/ streams/ transport processes/ water pollution/ water quality/ watersheds/ wetland soils

Abstract: Within agricultural watersheds, wetlands are located at the interface between terrestrial uplands and truly aquatic systems. Therefore, the processes occurring within wetland systems affect down stream water quality as water and associated nutrients such as phosphorus (P) are typically transported from upland areas to aquatic systems. This review will describe some of the common forms of P found in wetland soils/sediments and the processes responsible for P transformation and translocation. Phosphorus forms that enter a wetland are typically grouped into: (i) dissolved inorganic P; (ii) dissolved organic P; (iii) particulate inorganic P; and particulate organic P. Calcium (Ca) compounds determine the availability of inorganic P in alkaline soils while, in acidic soils iron (Fe) and aluminium (Al) controls P solubility. Inorganic P has four main fractions of decreasing bioavailability (viz., exchangeable P, Fe and Al bound P, Ca and Mg bound P, and residual P). Phosphorus sorption is one of the main processes involved in inorganic P biogeochemistry in wetland soils/sediments. Sorption is controlled by the concentration of phosphate in soil porewater and solid phases. Maximum sorption capacity of a soil can be determined using empirical models. Typically, soils only sorb P when added P in solution has a higher concentration than soil porewater. Phosphorus precipitation involves the reaction of phosphate ions with metallic cations forming solid precipitate. Inorganic P forms dominate the

bioavailable fractions, whereas organic P fractions typically dominate the total P content of wetland soils/sediments. Organic P compounds can also be fractionated in decreasing order of bioavailability. At the wetland ecosystem-scale processes involved in long term P retention include: sorption on wetland substrates and the accumulation and subsequent accretion of new soil/sediment material.

© CAB International/CABI Publishing

### 353. Phosphorus removal from trout farm effluents by constructed wetlands.

Comeau, Y.; Brisson, J.; Reville, J. P.; Forget, C.; and Drizo, A.

*Water Science and Technology* 44(11-12): 55-60. (2001)

NAL Call #: TD420.A1P7; ISSN: 0273-1223.

Notes: Conference: 7th International Conference on Wetland Systems for Water Pollution Control 2000, Lake Buena Vista, FL [USA], 11-16 Nov 2000; Issue editors: Kadlec, R. H. and Reddy, K. R.; ISBN: 1843394073

Descriptors: wastewater treatment/ fish farming/ stage treatment/ filtration/ screens/ artificial wetlands/ suspended solids/ phosphorus removal/ performance evaluation/ feasibility studies/ phosphorus/ aquaculture effluents/ pollution control/ water quality control/ fish culture/ fish farming/ screens and screening/ freshwater fish/ limestone/ effluent treatment/ macrophytes/ Salmonidae/ Phragmites australis/ salmonids/ wastewater treatment processes/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ prevention and control/ underground services and water use/ sewage & wastewater treatment/ water & wastewater treatment

Abstract: Freshwater trout farms need a high and continuous clean water flow to keep fish exposed to a non-toxic ammonium concentration. As a result, the concentration of effluents from these farms are even below standard effluent criteria for municipal wastewater effluent for solids, nitrogen and phosphorus. Nevertheless, the mass of pollutants discharged, originating mostly from excreta and undigested fish food, must be reduced by simple and economical treatment processes. We designed and operated a three-stage system aimed at retaining solids by a 60 µm nylon rotating microscreen followed by treatment with a phosphorus-retaining constructed wetland system. Washwater from the microscreen was pumped to a series of two horizontal flow beds of 100 m<sup>2</sup> super(3) each (0.6 m deep). Coarse (2 mm) and finer (< 2 mm) crushed limestone were used in each bed, respectively, with the first one being planted with reeds (*Phragmites australis*) and the second one designed to remove even more phosphorus by adsorption and precipitation. Preliminary results indicated that the microscreen captured about 60% of the suspended solids and that greater than 95% of the suspended solids and greater than 80% of the total phosphorus mass loads were retained by the beds. The potential of constructed wetlands as an ecologically attractive and economical method for treating fish farm effluents to reduce solids and phosphorus discharge appears promising.

© CSA

**354. Phosphorus removal in emergent free surface wetlands.**

Kadlec, R. H.

*Journal of Environmental Science and Health, Part A Toxic/Hazardous Substances and Environmental Engineering* 40(6-7): 1293-1306. (2005)

NAL Call #: TD172.J6; ISSN: 1093-4529

*Descriptors:* wetlands/ agricultural runoff/ phosphorus/ surface flow/ treatment/ wastewater

*Abstract:* Constructed and natural wetlands are capable of absorbing new phosphorus loadings, and, in appropriate circumstances, can provide a low-cost alternative to chemical and biological treatment. Phosphorus interacts strongly with wetland soils and biota, which provide both short-term and sustainable long-term storage of this nutrient. Soil sorption may provide initial removal, but this partly reversible storage eventually becomes saturated. Uptake by biota, including bacteria, algae, and duckweed, as well as macrophytes, forms an initial removal mechanism. Cycling through growth, death, and decomposition returns most of the biotic uptake, but an important residual contributes to long term accretion in newly formed sediments and soils. Despite the apparent complexity of these several removal mechanisms, data analysis shows that relatively simple equations can describe the sustainable processes. Previous global first order removal rates characterize the sustainable removal, but do not incorporate any biotic features. This article reviews the relevant processes and summarizes quantitative data on wetland phosphorus removal. Copyright © Taylor & Francis Inc.

© 2006 Elsevier B.V. All rights reserved.

**355. Phytoremediation of toxic trace elements in soil and water.**

LeDuc, D. L. and Terry, N.

*Journal of Industrial Microbiology and Biotechnology* 32(11-12): 514-520. (2005)

NAL Call #: QR53 .J68; ISSN: 1367-5435

*Descriptors:* constructed wetlands/ hyperaccumulators/ phytoremediation/ phytovolatilization/ selenium

*Abstract:* Toxic heavy metals and metalloids, such as cadmium, lead, mercury, arsenic, and selenium, are constantly released into the environment. There is an urgent need to develop low-cost, effective, and sustainable methods for their removal or detoxification. Plant-based approaches, such as phytoremediation, are relatively inexpensive since they are performed in situ and are solar-driven. In this review, we discuss specific advances in plant-based approaches for the remediation of contaminated water and soil. Dilute concentrations of trace element contaminants can be removed from large volumes of wastewater by constructed wetlands. We discuss the potential of constructed wetlands for use in remediating agricultural drainage water and industrial effluent, as well as concerns over their potential ecotoxicity. In upland ecosystems, plants may be used to accumulate metals/metalloids in their harvestable biomass (phytoextraction). Plants can also convert and release certain metals/metalloids in a volatile form (phytovolatilization). We discuss how genetic engineering has been used to develop plants with enhanced efficiencies for phytoextraction and phytovolatilization. For example, metal-hyperaccumulating plants and microbes with unique abilities to tolerate, accumulate, and detoxify metals and

metalloids represent an important reservoir of unique genes that could be transferred to fast-growing plant species for enhanced phytoremediation. There is also a need to develop new strategies to improve the acceptability of using genetically engineered plants for phytoremediation. © Society for Industrial Microbiology 2005. © 2006 Elsevier B.V. All rights reserved.

**356. Plant community succession in a coastal wetland after abandonment of cultivation: The example of the Rhone Delta.**

Mesleard, F.; Grillas, P.; and Lepart, J.

*Vegetatio* 94(1): 35-45. (1991)

NAL Call #: 450 V52; ISSN: 0042-3106

*Descriptors:* wetlands/ species richness/ environmental factors/ old fields/ coastal environments/ agriculture/ salinity effects/ ecological succession/ plant populations/ France, Camargue/ succession/ ecological succession/ plant populations/ Med, France, Camargue/ species richness/ old fields/ coastal environments/ coastal ecosystems/ habitat community studies

*Abstract:* A synchronous study was carried out of plant succession in land abandoned after cultivation in the Camargue (southern France) in relation to the main biotic and abiotic environmental factors. Correlations between environmental factors and species abundance were established using Canonical correspondence analysis. The most strongly correlated variables were those of the water regime. Abandonment of cultivation does not always imply abandonment of management, but a change in land use. Water level management (flooding in winter, or in summer, irrigation) creates and maintains communities suitable for grazing. In the absence of water level management, the soils become saline and stable plant communities similar to those present under natural conditions quickly develop. The salt generally limits the installation of woody plants; only *Phillyrea angustifolia* can develop and then only when the water table is quite deep. It appears that the forest stage can only be reached in the proximity of riverine gallery forest and irrigation canals where *Populus alba* is dominant. © CSA

**357. Plant succession and greentree reservoir management: Implications for management and restoration of bottomland hardwood wetlands.**

King, S. L. and Allen, J. A.

*Wetlands* 16(4): 503-511. (1996)

*Descriptors:* wetlands/ ecological succession/ resource management/ reclamation/ flood plains/ habitat improvement/ flooding/ forests/ water management/ environmental restoration/ hydrological regime/ hardwood/ waterfowl/ habitats/ USA/ bottomland hardwood forests/ environmental restoration/ hydrological regime/ hardwood/ waterfowl/ habitats/ ecological succession/ reclamation/ habitat improvement/ resource management

*Abstract:* Bottomland hardwood forests are distributed along rivers and streams throughout the central and eastern United States, with the greatest concentration in the Southeast. Past and projected losses of bottomland hardwoods and degradation of remaining stands suggest that habitat management and/or restoration strategies that target multiple species and multiple uses will be necessary to maintain, enhance, and restore flora and fauna within bottomland hardwood wetlands. A greentree reservoir is a current management strategy that entails manipulating

water regimes to provide habitat for wintering waterfowl. We conducted a literature review and synthesis to determine the potential impacts of greentree reservoir management on plant succession within bottomland hardwood wetlands. Greentree reservoirs can impact vegetation establishment through several processes. Despite shortcomings of greentree reservoirs, designs similar to them could be very beneficial in restoring bottomland hardwood plant and animal communities from degraded forests provided water-level control and maintenance are substantially improved. Emulation of natural hydrologic regimes, including natural variability, could produce diverse bottomland hardwood plant communities and provide habitat for a variety of wildlife species.  
© CSA

**358. The potential use of constructed wetlands in a recirculating aquaculture system for shrimp culture.**

Lin, Y. F.; Jing, S. R.; and Lee, D. Y.

*Environmental Pollution* 123(1): 107-113. (2003)

*Descriptors:* aquaculture effluents/ effluent treatment/ wastewater treatment/ water quality/ physicochemical properties/ fisheries/ artificial wetlands/ shrimp culture/ aquaculture systems/ recirculating systems/ water quality control/ culture media/ aquaculture techniques/ *Litopenaeus vannamei*/ Taiwan/ whiteleg shrimp/ constructed wetlands/ sewage & wastewater treatment/ methods and instruments/ aquaculture/ shellfish culture/ shellfish culture/ water & wastewater treatment

*Abstract:* A pilot-scale constructed wetland unit, consisting of free water surface (FWS) and subsurface flow (SF) constructed wetlands arranged in series, was integrated into an outdoor recirculating aquaculture system (RAS) for culturing Pacific white shrimp (*Litopenaeus vannamei*). This study evaluated the performance of the wetland unit in treating the recirculating wastewater and examined the effect of improvement in water quality of the culture tank on the growth and survival of shrimp postlarvae. During an 80-day culture period, the wetland unit operated at a mean hydraulic loading rate of 0.3 m/day and effectively reduced the influent concentrations of 5-day biochemical oxygen demand (BOD sub(5), 24%), suspended solids (SS, 71%), chlorophyll a (chl-a, 88%), total ammonium (TAN, 57%), nitrite nitrogen (NO sub(2)-N, 90%) and nitrate nitrogen (NO sub(3)-N, 68%). Phosphate (PO sub(4)-P) reduction was the least efficient (5.4%). The concentrations of SS, Chl-a, turbidity and NO sub(3)-N in the culture tank water in RAS were significantly ( $P \leq 0.05$ ) lower than those in a control aquaculture system (CAS) that simulated static pond culture without wetland treatment. However, no significant difference ( $P \leq 0.05$ ) in BOD sub(5), TAN and NO sub(2)-N was found between the two systems. At the end of the study, the harvest results showed that shrimp weight and survival rate in the RAS (3.8±1.8 g/shrimp and 90%) significantly ( $P \leq 0.01$ ) exceeded those in the CAS (2.3±1.5 g/shrimp and 71%). This study concludes that constructed wetlands can improve the water quality and provide a good culture environment, consequently increasing the shrimp growth and survival without water exchange, in a recirculating system. Constructed wetlands improved water qualities and consequently increased the shrimp growth and survival in a recirculating system.

© CSA

**359. A proposed methodology for measuring incremental environmental benefits from using constructed wetlands to control agricultural non-point-source pollution.**

Macdonald, H. F.; Bergstrom, J. C.; and Houston, J. E. *Journal of Environmental Management* 54(4): 259-267. (Dec. 1998)

NAL Call #: HC75.E5J6; ISSN: 0301-4797

*Descriptors:* water quality control/ pollution control/ wastewater treatment/ agricultural pollution/ agricultural runoff/ environment management/ water pollution treatment/ nonpoint pollution sources/ water pollution prevention/ environmental quality/ artificial wetlands/ benefits/ cultivated lands/ prevention and control/ water quality control

*Abstract:* A binary response estimation procedure using contingent valuation data is proposed for estimating the incremental environmental benefits associated with the use of constructed wetlands to control agricultural waste-water runoff. The model uses two binary responses per individual while circumventing the non-independence problems associated with follow-up valuation questions. Case study results suggest that the methodology provides a potentially effective means for measuring the non-market benefits of constructed wetlands in addition to water-quality maintenance.

© CSA

**360. Quantification of P-flux through shallow, agricultural and natural waters as found in wetlands of the Camargue (S. France).**

Golterman, H. L.

*Hydrobiologia* 392(1): 29-39. (1999)

NAL Call #: 410 H992; ISSN: 0018-8158.

*Notes:* Special Issue: "Sediment-Water Interaction 9".

*Descriptors:* wetlands/ phosphates/ pollution dispersion/ agricultural pollution/ hydrology/ path of pollutants/ agricultural runoff/ chemical reactions/ rice fields/ agriculture/ fertilizers/ marshes/ irrigation/ aquatic environment/ France, Camargue/ France, Etang de Vaccares/ France/ characteristics, behavior and fate/ sources and fate of pollution/ freshwater pollution

*Abstract:* The flux of phosphate in the aquatic ecosystems of the Camargue was modelled. The model developed for the hydrological unit, the water basin of the Aube de Bouic, is based on the hydrology of the system, the reaction equations of the adsorption of phosphate onto Fe(OOH) and the solubility product of apatite. The water basin consists of an inlet canal, the Aube de Bouic, ricefields and natural marshes, plus a drainage canal through which the excess water is pumped into the Etang de Vaccares. Phosphate is introduced into ricefields either with the irrigation water, taken from the Rhone, or as fertiliser. Most of the phosphate will be fixed on the ricefield soils either as iron-bound or as calcium-bound phosphate, depending on the pH. The o-phosphate concentration will slowly increase to an extent depending on the pH. From the ricefields water will flow towards the Etang de Vaccares; the amount of phosphate reaching the Etang de Vaccares depends on the pH of the system and the depth of the water outlet of the ricefields. In six different scenarios the amount of phosphate reaching the Etang de Vaccares is calculated depending on the quantity of fertiliser, the depth of the water outlet and the pH. For the Etang de Vaccares the model predicts the present concentration of o-P relatively

well and shows that the loading is considerable. This should cause concern; the danger of serious eutrophication is real. Part of the irrigation water is used to refill or keep under water the natural marshes in this hydrological unit, which without irrigation would dry out during summer. Again high P-concentrations are found in the marshes, but mostly in the form of Fe(OOH) approximately P or CaCO<sub>3</sub> approximately P, the ratio of which depends again on the pH of the sediments. The o-P concentration has remained low up to now.  
© CSA

**361. Removal of dimethyl disulfide and p-cresol from swine facility wastewater using constructed subsurface-flow wetlands.**

Wood, S. L.; Wheeler, E. F.; and Berghage, R. D. *Transactions of the ASAE* 43(4): 973-979. (2000)  
NAL Call #: 290.9 Am32T; ISSN: 0001-2351  
*Descriptors:* odor control/ wastewater treatment/ pollution control/ pig manure/ constructed wetlands  
*Abstract:* Anecdotal evidence suggests that constructed wetlands can remove odors from veal, dairy, and swine wastes (Murphy and George, 1997; McCaskey, 1995). However, the use of constructed wetlands as an odor control treatment will be more successful after malodor reduction in wetland systems has been quantified. This study quantified odor removal from swine facility wastewater (feces, urine, and flushwater) in constructed subsurface-flow wetlands. Four wetlands planted with wetland grasses and four unplanted wetlands received swine facility waste. The relationship between wetland treatments (planted vs unplanted) and reductions of malodorous dimethyl disulfide and p-cresol in wastewater were examined. Reductions in odor intensity and offensiveness as perceived by a human sensory panel were also studied. Gas chromatography analysis indicated that planted wetlands removed 80 and 83% of dimethyl disulfide (DMDS) and p-cresol, respectively. Unplanted wetlands removed 52 and 64% of dimethyl disulfide and p-cresol, respectively. The reductions in DMDS and p-cresol did not differ significantly ( $p > 0.05$ ) between the two treatments. A human sensory panel, using the cloth swatch technique, assigned a median odor intensity and offensiveness rating of 4 (identifiable odor-offensive, but tolerable) to untreated swine facility wastewater. Median odor ratings for both planted and unplanted effluent were 1 (faint odor-nonidentifiable, not offensive). These median odor ratings were significantly ( $p < 0.05$ ) lower than the median odor rating for untreated wastewater, indicating that constructed wetlands were effective in removing malodor from swine facility wastewater.  
This citation is from AGRICOLA.

**362. Removal of enteric bacteria in constructed treatment wetlands with emergent macrophytes: A review.**

Vymazal, J.  
*Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering* 40(6-7): 1355-1367. (2005)  
NAL Call #: TD172.J6; ISSN: 1093-4529  
*Descriptors:* wastewater/ bacterial/ artificial wetlands/ macrophytes/ fecal coliforms/ hydraulics/ vegetation/ public health/ reviews/ environmental health/ environmental engineering/ biofiltration/ wastewater treatment/

microorganisms/ waste water/ colony-forming cells/ pollution/ sewage/ biofilters/ coliforms/ hydraulic loading/ pathogenic organism/ indicators/ enteric bacteria/ risk/ Escherichia coli/ water pollution sources/ catchment areas/ surveys/ domestic wastes/ sewage and wastewater treatment/ other water systems/ wastewater treatment processes/ sewage/ water and wastewater treatment  
*Abstract:* Domestic and municipal sewage contains various pathogenic or potentially pathogenic microorganisms which, depending on species concentration, pose a potential risk to human health and whose presence must therefore be reduced in the course of wastewater treatment. The removal of microbiological pollution is seldom a primary target for constructed treatment wetlands (CWs). However, wetlands are known to act as excellent biofilters through a complex of physical, chemical and biological factors which all participate in the reduction of the number of bacteria. Measurement of human pathogenic organisms in untreated and treated wastewater is expensive and technically challenging. Consequently, environmental engineers have sought indicator organisms that are (1) easy to monitor and (2) correlate with population of pathogenic organisms. The most frequently used indicators are total coliforms, fecal coliforms, fecal streptococci and Escherichia coli. The literature survey of 60 constructed wetlands with emergent vegetation around the world revealed that removal of total and fecal coliforms in constructed wetlands with emergent macrophytes is high, usually 95 to >99% while removal of fecal streptococci is lower, usually 80-95%. Because bacterial removal efficiency is a function of inflow bacteria number, the high removal effects are achieved for untreated or mechanically pretreated wastewater. Therefore, the outflow numbers of bacteria are more important. For TC and FC the outflow concentrations are usually in the range of 10 super(2) to 10 super(5) CFU/ 100 ml while for FS the range is between 10 super(2) and 10 super(4) CFU/ 100 ml. Results from operating systems suggest that enteric microbe removal efficiency in CWs with emergent macrophytes is primarily influenced by hydraulic loading rate (HLR) and the resultant hydraulic residence time (HRT) and the presence of vegetation. Removal of enteric bacteria follows approximately a first-order relationship.  
© CSA

**363. Removal of solids and oxygen demand from aquaculture wastewater with a constructed wetland system in the start-up phase.**

Lin, Y. F.; Jing, S. R.; and Lee, D. Y.  
*Water Environment Research* 74(2)(Mar. 2002-Apr. 2002)  
NAL Call #: TD419.R47; ISSN: 1061-4303  
*Descriptors:* wastewater treatment/ aquaculture/ artificial wetlands/ performance evaluation/ suspended solids/ algae/ chemical oxygen demand/ hydraulic loading/ water pollution treatment/ aquaculture effluents/ suspended particulate matter/ ground water/ surface water/ aquatic plants/ pollution control/ hydrology/ biodegradation/ performance assessment/ wastewater treatment processes/ protective measures and control/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ industrial effluents/ sewage & wastewater treatment/ water & wastewater treatment  
*Abstract:* A pilot-scale, constructed wetland system consisting of a free water surface (FWS) and a subsurface flow (SF) wetland operated in series was set up for treating

aquaculture farm wastewater. This study examined the system start-up phenomena and evaluated its performance in removing suspended solids, algae, and chemical oxygen demand (COD) under various hydraulic loading rates (1.8 to 13.5 cm/d). The SF wetland achieved stable effluent qualities without an adaptation period, while the FWS wetland required approximately 5 months to reach consistent removal levels for suspended solids and algae. Macrophyte density was a critical factor affecting the reduction of suspended solids and chlorophyll for the FWS wetland, but not for the SF wetland. Suspended solids removals in both of the wetlands and the combined system (47 to 86%) decreased significantly as the hydraulic loading rate increased, strongly following the first-order mass-decrease equation. Phytoplankton solids (biomass and detritus) were a primary source of suspended solids in the aquaculture wastewater. Both chlorophyll reduction (76 to 95%) and COD removal (25 to 55%) in the constructed wetland system were apparently not affected by hydraulic loading. While algae died out because of limited sunlight in both wetlands, algae detritus probably still contributed fine particles that were difficult to remove from the water by either filtering or settling out. Removed suspended solids did not result in the increase of COD and nutrients, indicating that further solids stabilization occurred in the wetland system.

© CSA

**364. Restoration experiments in middle European wet terrestrial ecosystems: An overview.**

Pfadenhauer, J. and Kloetzli, F.

*Plant Ecology* 126(1-4): 101-115. (Sept. 1996)

NAL Call #: QK900.P63; ISSN: 0042-3106.

Notes: Conference: 6th International Congress of Ecology, Manchester (UK), Aug 1994

Descriptors: wetlands/ peat/ agriculture/ man-induced effects/ ecosystem management/ nature conservation/ restoration/ environmental effects/ flooding/ drainage/ Europe/ fens/ water retention/ environmental/ drainage/ man-induced effects/ ecosystem management/ nature conservation/ restoration/ habitat community studies/ protective measures and control/ reclamation/ effects on water of human nonwater activities

Abstract: Most wetlands in the central European lowlands have been severely altered by cultivation. As a consequence they no longer fulfil their function as habitats for specialised species and communities, nor as retention areas for water and solid materials. Therefore, a number of renaturation experiments are in progress, which intend to develop and test strategies and measures to improve this defect in landscape diversity. For this purpose experiments on re-wetting, nutrient depletion of eutrophicated areas and re-establishment of typical wetland plant species and phytocoenoses have been performed. An ecological development concept defining the aims and describing their feasibility precedes such experiments. Preliminary results indicate that the reconstruction of the former state (regeneration) is impossible within reasonable time spans. In drained raised bogs overgrown with heather, as well as in those which have been industrially exploited, the primary aim must always be to restore efficient peat formation as far as possible; as a rule one succeeds only with well-growing and nutrient-demanding fen and transitional bog species. In cultivated fens the aim is to reduce peat loss. As a first step this is accomplished by converting arable fields and sown

meadows into permanent grassland, if possible with reduced fertilization and low mowing or grazing frequencies, and accompanied by rewetting during winter. Many experiments have sought to impoverish eutrophicated fen soils and introduce typical fen species by sowing or planting, so well tested techniques are available. However, the total prevention of peat loss is only possible by permanent rewetting throughout the year, so that peat accumulation can start again. Only in this way could fens regain their former function as sinks in landscape processes.

© CSA

**365. Restoration of a Canadian prairie wetland with agricultural and municipal wastewater.**

White, J. S.

*Environmental Management* 24(1): 25-37. (1999)

NAL Call #: HC79.E5E5; ISSN: 0364-152X

Descriptors: wetlands/ environmental restoration/ prairies/ habitat/ species richness/ waste water/ municipal wastewater/ food processing industry/ land application/ land management/ land reclamation/ land disposal/ wildlife management/ birds/ water management/ habitat improvement/ waste utilization/ aquatic birds/ vegetation cover/ ecosystem management/ wildlife conservation/ marshes/ wastewater treatment/ Canada, Alberta

Abstract: A rapid development and approval process was employed by Ducks Unlimited Canada and other stakeholders to restore a 1246-ha (3079-acre) northern prairie wetland in southern Alberta, Canada, with 3640 m super(3)/day (800,000 US gallons) of municipal wastewater and beef processing wastewater. A large nongovernmental organization hastened restoration with a development process that outlined restoration goals and management objectives to satisfy a dual mandate of wastewater treatment and wildlife habitat creation. In 1995, after five years of wastewater additions, the basins had been refilled and the surrounding uplands had been acquired and restored. The Frank Lake Conservation Area currently provides high-quality habitat for a variety of wildlife in a region where many of the native plants and animals species have been lost due to habitat loss and fragmentation. The success of upland and water management strategies is reflected in the increase of target species' abundance and richness: 50 shorebird species, 44 waterfowl species, 15 raptor species, and 28 other new bird species have returned to the marsh since restoration. As well, significant N and P reduction occurs as waters flow through the first basin of the marsh. The management strategies of this project that satisfied a dual mandate serve as a model to guide managers of other large-scale wetland restoration projects.

© CSA

**366. Restoration of Botshol (The Netherlands) by reduction of external load: Problem analyses and restoration methods.**

Van Iersel, P. B. W. and Rip, W. J.

*Hydrobiological Bulletin* 25(3): 265-273. (1992)

NAL Call #: QH90.A1H9; ISSN: 0165-1404

Descriptors: wetlands/ botshol/ eutrophication/ lake restoration/ nutrient removal/ The Netherlands/ water pollution control/ water quality management/ agricultural drainage/ algal growth/ nutrients/ phosphorus

Abstract: Since 1960 the water quality of the Botshol

nature reserve in The Netherlands has been deteriorating due to an increase in the nutrient load that has caused increases in algal growth. The source of the nutrients is believed to be nutrient-rich agricultural water that flows into the area and the Nellestein polder which contains meadows, marshland, reedland, hayfields and roughlands, and open water. Interdisciplinary research has been conducted from 1980 to 1985 in order to analyze the causes of the changes. An integrated restoration plan was developed to reduce the eutrophication. In 1989 the plan was implemented: (1) agricultural areas were isolated from the reserve area; and (2) the inlet water was dephosphorized. These restoration measures resulted in a reduction of the external load from 0.6 to 0.1 g P/sq m/y. (Author's abstract)

© CSA

**367. Restored wetlands as filters to remove nitrogen.**

Romero, J. A.; Comin, F. A.; and Garcia, C.

*Chemosphere* 39(2): 323-332. (1999)

NAL Call #: TD172.C54; ISSN: 0045-6535.

Notes: Conference: XIII International Symposium on Environmental Biogeochemistry -- Matter and energy fluxes in the anthropocentric environment, Monopoli (Italy), 21-26 Sep 1997; Issue editors: Sensesi, N.; Rice, J. A.; and Miano, T. M.

Descriptors: wetlands/ filtration/ agricultural runoff/ nitrogen removal/ Spain, Ebro Delta/ water quality/ retention/ macrophytes/ bioaccumulation/ kinetics/ recycling/ rice/ filters/ water quality control/ biofilters/ nitrogen/ aquatic plants/ agricultural pollution/ land use/ rice fields/ sediment chemistry/ restoration/ nitrogen cycle/ *Typha latifolia*/ *Scirpus lacustris*/ *Phragmites australis*/ Spain, Cataluna, Tarragona, Ebro Delta/ nitrogen removal/ freshwater pollution/ water quality control/ protective measures and control

Abstract: Four wetlands established in abandoned ricefields and dominated by *Phragmites australis*, *Typha latifolia* and *Scirpus lacustris* were used to improve the quality of agricultural runoff in the Ebro Delta (NE Spain) in 1993, 1994 and 1995. The wetlands were continuously flooded with water from a ricefield irrigation network during the growing season and received water with between 5 and 200 mg N m<sup>super(-2)</sup> d<sup>super(-1)</sup> in the form of dissolved inorganic nitrogen (DIN), between 0 and 67 mg N m<sup>super(-2)</sup> d<sup>super(-1)</sup> in the form of dissolved organic nitrogen (DON) and between 1.2 and 225 µg m<sup>super(-2)</sup> d<sup>super(-1)</sup> in the form of particulate nitrogen (PN). Surface N outflows contained between 0 and 12 mg N m<sup>super(-2)</sup> d<sup>super(-1)</sup> of DIN, between 1 and 86 mg N m<sup>super(-2)</sup> d<sup>super(-1)</sup> of DON and between 1 and 40 µg m<sup>super(-2)</sup> d<sup>super(-1)</sup> of PN. The nitrogen retention efficiency was always positive 100% of the input, except for DON and PN at low inlet loadings. The emergent macrophytes accumulated between 20 and 100 mg N m<sup>super(-2)</sup> d<sup>super(-1)</sup>, which accounted for between 66 and 100% of the inflowing DIN. The removal rate constants calculated according to first-order plug-flow kinetics, were between 0.003-0.09 m day<sup>super(-1)</sup> for total nitrogen, and 0.005-0.3 m day<sup>super(-1)</sup> for DIN. Plant uptake, detritus accumulation and decomposition, and nitrogen recycling in the sediment are the major processes which could explain nitrogen retention in the wetlands. Wetlands restored from ricefields act as highly efficient water polishing filters for

agricultural runoff and, at the same time, can contribute to the habitat biodiversity of large areas where rice is cultivated extensively.

© CSA

**368. Rice fields as temporary wetlands: A review.**

Lawler, S. P.

*Israel Journal of Zoology* 47(4): 513-528. (2001)

NAL Call #: 410 IS7; ISSN: 0021-2210

Descriptors: wetlands/ animal ecology/ aquatic communities/ biodiversity/ biological control/ chemical control/ freshwater ecology/ habitats/ irrigation/ pest control/ pesticides/ plant pests/ ponds/ population dynamics/ predators/ rice/ species diversity/ species richness/ water management

Abstract: Rice fields are temporary wetlands that harbor many of the same species that breed in natural temporary ponds. Therefore the rice agroecosystem has the potential to help sustain the regional biodiversity of many invertebrates and vertebrates. Like natural areas of wetlands, rice cultivation provides a habitat mosaic of temporary and more permanent waters. Because of their low floral diversity and because their species composition will rarely overlap completely with that of natural ponds, rice fields are not substitutes for natural temporary ponds. However, they are important in sustaining populations of several species, including wading birds and frogs. Farming methods vary widely, and different practices can alter the suitability of rice fields as habitats. Farmers use water management, pesticides, and sometimes fish to control crop pests and mosquitoes, and other taxa may be affected as well. Farmers may irrigate rice intermittently to control pests, and intermittent habitat holds fewer species than areas that are flooded for longer periods. Broad-spectrum pesticides may harm invertebrates and other wildlife, and may even cause pest resurgences if they have greater effects on predator populations than on the pests. Fish often decrease the abundance of invertebrate predators, but fish farming in rice fields often discourages the use of harmful pesticides. Because farming practices can affect the conservation value of rice fields, ecologists are encouraged to work with farmers and study the role of rice fields in the population dynamics of temporary pond species, and how changing farming methods alter this role. © CAB International/CABI Publishing

**369. Sediment and nutrient retention by freshwater wetlands: Effects on surface water quality.**

Johnston, C. A.

*Critical Reviews in Environmental Control* 21(5-6):

491-565. (1991)

NAL Call #: QH545.A1C7; ISSN: 1040-838X

Abstract: Freshwater wetlands alter surface water quality in ways which benefit downstream use. This review summarizes the mechanisms of freshwater wetland interaction with sediment and nutrients that affect surface water quality. The mechanisms vary in magnitude and reversibility, and differ among wetland types. They include sedimentation, plant uptake, litter decomposition, retention in the soil, and microbial processes. Sedimentation is a relatively permanent retention mechanism whereby particulates and associated contaminants are physically deposited on the wetland soil surface. Plant uptake and litter decomposition provide short- to long-term retention of nutrients, depending on rates of leaching, translocation to

and from storage structures, and the longevity of plant tissues. Plant litter can also provide a substrate for microbial processing of nutrients. Wetland soils sorb nutrients, and provide the environment for aerobic and anaerobic microorganisms that process nutrients. Wetland storage compartments, fluxes, and net retention rates are discussed for nitrogen and phosphorus.  
© 2006 Elsevier B.V. All rights reserved.

### 370. Shrimp pond effluent: Pollution problems and treatment by constructed wetlands.

Sansanayuth, P.; Phadungchep, A.; Ngammontha, S.; Ngdngam, S.; Sukasem, P.; Hoshino, H.; and Tabucanon, M. S.

*Water Science and Technology*(1996)

NAL Call #: TD420.A1P7; ISSN: 0273-1223.

Notes: Conference: 18th Biennial Conf. of the International Association on Water Quality, (Singapore), 23-28 Jun 1996; Issue editors: Bally, D.; Asano, T.; Bhamidimarri, R.; Chin, K. K.; Grabow, W. O. K.; Hall, E. R.; Ohgaki, S.; Orhon, D.; Milburn, A.; Purdon, C. D.; and Nagle, P. T.

Descriptors: shrimp/ nutrient removal/ comparison studies/ gravel/ shellfish farming/ littoral environment/ effluents/ wastewater treatment/ aquaculture effluents/ shrimp culture/ intensive culture/ environmental impact/ Thailand/ constructed wetlands/ water pollution effects/ shrimp culture/ aquaculture effluents/ intensive culture/ environmental impact/ shrimp/ nutrient removal/ comparison studies/ shellfish farming/ littoral environment/ gravel/ wastewater treatment processes/ shellfish culture/ shellfish culture/ prevention and control/ sewage & wastewater treatment

Abstract: An intensive shrimp culture in Thailand has rapidly expanded especially along the coast during the last decade. Excessive feed basically given during the culture causes water and sediment in the pond to contain organic matter and nutrients in high concentration. After harvesting, discharging sediment is prohibited; however, pond water is mostly discharged directly to natural water resources without any effective treatment. The nutrient load discharged from shrimp ponds can form significant source of nutrients causing pollution and eutrophication in littoral areas of Thailand. The possibility of a subsurface-flow constructed wetlands application for treating shrimp pond effluent containing high salinity was studied. An experimental-scaled model planted with *Acrostichum aureum* (mangrove fern) in gravel was studied by comparison with one containing only gravel. The results showed that models can reduce suspended solids, biochemical oxygen demands, total organic carbon, total nitrogen (T-N) and total phosphorous (T-P) up to 84%, 91%, 46%, 48% and 31%, respectively. Higher removal efficiencies for TOC, T-N and T-P of the planted model compared with the gravel model were clearly found.

© CSA

### 371. Soil infiltration and wetland microcosm treatment of liquid swine manure.

Prantner, S. R.; Kanwar, R. S.; Lorimor, J. C.; and Pederson, C. H.

*Applied Engineering in Agriculture* 17(4): 483-488. (2001)

NAL Call #: S671.A66; ISSN: 0883-8542

Descriptors: wetlands/ pig manure/ waste treatment/ topsoil/ loam soils/ Typha/ ammonium nitrogen/ nitrate nitrogen/ phosphorus/ ammonia

Abstract: Management systems are needed to minimize water quality concerns associated with liquid swine manure from large swine production facilities. Experiments were conducted to investigate the removal of ammonium-N, nitrate-N, and total phosphorus from liquid swine manure through the use of a soil infiltration and wetland system. Experimental treatments applied directly to the soil infiltration areas included a full-rate application of liquid swine manure, a mixture of 3/4 manure and 1/4 water, and a control application of water only. For three months during both summers of 1998 and 1999, nutrient concentrations were determined in the infiltration area influent, the infiltration area effluent, and the wetland effluent on a weekly basis. Approximately 93% of the ammoniacal nitrogen (NH<sub>3</sub>-N and NH<sub>4</sub>-N) from the applied swine manure was removed by the soil infiltration areas with a corresponding 99% increase in the nitrate nitrogen (NO<sub>3</sub>-N) concentrations were found. The wetland systems removed 94% of the remaining NH<sub>3</sub>-N and NH<sub>4</sub>-N and 95% of the NO<sub>3</sub>-N. The total P levels were decreased in the soil infiltration areas and wetlands by 89 and 84%, respectively. This citation is from AGRICOLA.

### 372. Test of the first-order removal model for metal retention in a young constructed wetland.

Goulet, R. R.; Pick, F. R.; and Droste, R. L.

*Ecological Engineering* 17(4): 357-371. (Aug. 2001)

NAL Call #: TD1.E26; ISSN: 0925-8574

Descriptors: wetlands/ agricultural runoff/ heavy metals/ hydrology/ iron/ manganese/ zinc/ wastewater treatment/ environmental engineering/ water pollution control/ artificial wetlands/ urban runoff/ metals/ design criteria/ performance evaluation/ model studies/ model testing/ seasonal variations/ biotic factors/ temperature effects/ pollution control/ artificial wetlands/ sewage & wastewater treatment/ water quality control/ protective measures and control/ water & wastewater treatment

Abstract: The first-order removal model is widely used in constructed wetland design. The suitability of this model was tested to predict metal retention in a young constructed wetland receiving agricultural and urban runoff. During two years, water samples for total and dissolved metal analyses were collected every third day at both the inlet and the outlet. The wetland retained metals best during summer and fall whereas during winter the retention of metals was significantly lower. The first-order removal model predicted Fe and Mn retention in the spring and dissolved Zn retention from spring to fall in both years. During those periods, hydraulic retention times (HRTs) greater than 7 days provided maximum retention for Fe, Mn, and dissolved Zn. However, first-order removal models failed to fit summer, fall and winter data for almost every metal under investigation (Fe, Mn, dissolved Cu, dissolved As) suggesting that HRTs (< 1 - 25 days) did not affect metal retention during these seasons. The metal loading to the wetland was low and the input of metals through internal loading may be more significant consequently decreasing the metal retention. Therefore, the first-order removal model is inadequate to predict metal retention on a seasonal basis. Models used to design constructed wetlands under cold climates must consider seasonal changes that affect biological as well as hydrological variables.

© CSA

**373. Treatment of agricultural wastewater in a pilot-scale tidal flow reed bed system.**

Sun, G.; Gray, K. R.; and Biddlestone, A. J.

*Environmental Technology* 20(2): 233-237. (Feb. 1999)

NAL Call #: TD1.E59; ISSN: 0959-3330

*Descriptors:* wetlands/ tides/ agricultural wastes/ slurries/ wastewater treatment/ reed beds/ agriculture/ animal wastes/ aeration/ biological treatment/ biochemical oxygen demand/ organic wastes/ water pollution treatment/ agricultural pollution/ oxygenation/ nitrification/ water motion/ pollution control/ agricultural runoff/ tidal flow reed beds/ "tidal" flow reed bed/ environmental applications/ impact/ sewage & wastewater treatment/ prevention and control

*Abstract:* Tidal flow reed bed treatment is a process consisting of alternately filling and draining the bed matrix with wastewater. During the draining process, air is positively drawn from the atmosphere into the bed so the aeration of the system is significantly improved. A pilot-scale tidal flow reed bed system was studied for the treatment of agricultural wastewater, which was prepared by diluting pig slurry. At an average influent BOD sub(5) of 649 mg l super(-1) and ammoniacal-nitrogen of 333 mg l super(-1), the BOD sub(5), COD, SS and PO sub(4)-P levels were reduced by 71.0, 58.3, 65.2 and 38.7%, respectively. The removals of BOD sub(5), COD, SS and PO sub(4)-P increased with their influent strengths in straight line correlations. The NH sub(4)-N was reduced by only 13.3% through the system; 69.0% of this removal resulted from nitrification into NO sub(2)-N and NO sub(3)-N, whereas 31% of the removal was due to other processes. The average oxygen consumption rate in this tidal flow system reached 203 gO sub(2) m super(-2) d super(-1), significantly higher than the rates obtainable in horizontal flow and downflow reed beds. The rhythmical air and water movement in the tidal flow system enhances the oxygenation ability of the beds and improves the efficacy of utilisation of the available bed volume. Accordingly, tidal flow reed beds appear to have much potential as initial treatment stages for small amounts of strong waste effluents where the bulk of the BOD sub(5) removal can take place.

© CSA

**374. Treatment of freshwater fish farm effluent using constructed wetlands: The role of plants and substrate.**

Naylor, S.; Brisson, J.; Labelle, M. A.; Drizo, A.; and Comeau, Y.

*Water Science and Technology* 48(5): 215-222. (2003)

NAL Call #: TD420.A1P7; ISSN: 0273-1223

*Descriptors:* biological wastewater treatment/ fish farming/ artificial wetlands/ experimental data/ aquatic plants/ macrophytes/ substrates/ performance evaluation/ optimization/ feasibility studies/ aquatic macrophytes/ aquaculture effluents/ fish culture/ wastewater treatment/ phosphorus/ nitrogen/ organic matter/ substrata/ water pollution treatment/ *Phragmites communis*/ *Typha latifolia*/ wastewater treatment processes/ industrial effluents/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ protective measures and control/ water & wastewater treatment

*Abstract:* Freshwater fish farm effluents have low nutrient concentrations but high flow rates, resulting in a pollutant load, especially phosphorus (P), causing eutrophication. The feasibility was tested of a treatment combining, within a

single constructed wetland, the contribution of macrophytes for reducing organic matter and nitrogen (N), with the high efficiency of steel slag and limestone for P removal. Twenty subsurface flow (SSF) basins of 280 L with different combinations of plants (*Phragmites communis* or *Typha latifolia*) and substrates (steel slag, limestone, gravel, peat) were fed with a reconstituted fish farm effluent in a greenhouse experiment. Pollutant removal was generally very good under all treatments. N and organic matter removal were correlated with plant biomass while P removal was better in substrates with steel slag and limestone. However, the high pH of the P-adsorbing substrate was detrimental to plant growth so that no combination of plants and substrates could maximise in one step the simultaneous removal of all evaluated pollutants. Therefore, the use of two sequential units is recommended, a first one consisting of a macrophyte planted basin using a neutral substrate to remove organic matter and N, followed by a second unplanted basin containing only a P-adsorbing substrate.

© CSA

**375. Treatment of rainbow trout farm effluents in constructed wetland with emergent plants and subsurface horizontal water flow.**

Schulz, C.; Gelbrecht, J.; and Rennert, B.

*Aquaculture* 217(1-4): 207-221. (Mar. 2003)

NAL Call #: SH1 .A6; ISSN: 0044-8486

*Descriptors:* wetlands/ pollution control/ aquaculture effluents/ fish culture/ aquaculture facilities/ nutrients (mineral)/ aquatic plants/ effluent treatment/ chemical oxygen demand/ nitrogen/ phosphorus/ artificial wetlands/ nutrient removal/ *Oncorhynchus mykiss*/ rainbow trout/ effects of aquaculture on the environment/ effects of aquaculture on the environment/ pollution - control and prevention/ sewage & wastewater treatment/ water & wastewater treatment

*Abstract:* The objective of this research was to investigate treatment of aquaculture effluents of flow-through systems in created wetlands. The constructed wetlands types used in this study were subsurface root zone systems with emergent plants and horizontal effluent soil percolation. Three 1.401.000.70 m (LWH) root zone systems were filled with sands of 1-2 mm particle size and planted with 20 rooted shoots of reed per square meter (*Phragmites australis*). Nutrient removal of rainbow trout (*Oncorhynchus mykiss*) effluents flowing through the wetland was determined for hydraulic loading rates of 1, 3 and 5 l/min corresponding to very short hydraulic residence times (HRTs) of 7.5, 2.5 and 1.5 h, respectively. Inflowing nutrients were removed within every continuously flooded wetland. Total suspended solids (TSS) and chemical oxygen demand (COD) were reduced by 95.8-97.3% and 64.1-73.8%, respectively, and demonstrated no influence of HRT. Total phosphorus (TP) and total nitrogen (TN) removal rates varied from 49.0% to 68.5% and 20.6% to 41.8%, respectively, and were negatively correlated with HRTs. Effluent purification was best at HRT of 7.5 h, but sufficient removal rates were achieved for shorter HRTs.

© CSA

**376. Use of constructed wetlands to process agricultural wastewater.**

Peterson, H. G.

*Canadian Journal of Plant Science* 78(2): 199-210. (Apr. 1998)

NAL Call #: 450 C16; ISSN: 0008-4220

*Descriptors:* wastewater treatment/ artificial wetlands/ nutrient removal/ agriculture/ waste management/ land use/ water quality/ nutrients (mineral)/ agricultural runoff/ construction/ food processing industry wastes/ pollutant removal/ technology/ constructed wetlands/ wastewater treatment processes/ methods and instruments/ sewage & wastewater treatment

*Abstract:* Constructed wetlands are emerging as a serious challenge to conventional wastewater treatment because of lower construction and operating costs, less requirement for trained personnel, more flexibility, and lower susceptibility to variations in waste loading rates. Water quality improvements can be achieved by removal of plant nutrients, such as N and P, organics (natural and man-made) as well as inorganic contaminants. Wetland treatment is now advocated by regulatory agencies and has been determined as the technology of choice by municipalities and industries required to meet stringent discharge regulations. These same regulations have not usually been imposed on the agricultural community, but deteriorating water sources will likely change this regulatory anomaly. Use of this technology in treating agricultural wastewater is still in its infancy with few, although rapidly expanding, applications. This paper aims to highlight different aspects of wetland treatment by exploring its use for the treatment of agricultural run-off as well as wastewater from the agri-food industry. It is concluded that natural wetlands will be quite limited in absorbing agricultural wastewater while constructed wetlands can be designed for optimum pollutant removal.

© CSA

**377. The use of constructed wetlands to treat aquacultural effluents.**

Schwartz, M. F. and Boyd, C. E.

*World Aquaculture* 26(11): 42-44. (1995)

NAL Call #: SH1.W62; ISSN: 1041-5602

*Descriptors:* wetlands/ pollution control/ wastewater treatment/ water pollution treatment/ aquaculture effluents/ biofilters/ water quality control/ aquaculture/ effluents/ construction/ pollution control/ aquaculture effluents/ aquaculture: general/ prevention and control/ wastewater treatment processes

*Abstract:* Wetlands act as biological filters to remove pollutants from water, and natural and constructed wetlands sometimes are used for treatment of agricultural, municipal, and industrial waste-waters. There are several advantages to wetland wastewater treatment: wetlands are inexpensive to build and operate, chemical treatment of wastewater is eliminated, wetlands contribute stability to local hydrologic processes, and plant communities in wetlands are excellent wildlife habitat. However, there is concern over the feasibility of wetlands for treating aquaculture effluents, because large areas of land may be necessary.

© CSA

**378. Using constructed wetland-pond systems to treat agricultural runoff: A watershed perspective.**

Bouchard, R.; Higgins, M.; and Rock, C.

*Lake and Reservoir Management* 11(1): 29-36. (1995)

NAL Call #: TC401.L3; ISSN: 0743-8141

*Descriptors:* eutrophication/ lakes/ artificial wetlands/ agricultural runoff/ watersheds/ nonpoint pollution sources/ phosphorus/ phosphorus removal/ water quality control/ eutrophic lakes/ nonpoint pollution/ algal blooms/ USA, Maine, St. John Valley/ nonpoint pollution/ algal blooms/ artificial wetlands/ wastewater treatment processes/ freshwater pollution/ characteristics, behavior and fate

*Abstract:* Long and Cross Lakes in the St. John Valley watershed of northern Maine have exhibited chronic algae blooms in past years. Survey data and modeling determined agricultural runoff to be the main source of phosphorus and sediments in both watersheds. "Nutrient/Sediment Control Systems" (NSCS) are being used to treat runoff from target subwatersheds. The systems consist of a sedimentation basin, grass filter strip, wetland, and detention pond in series. Annual removal efficiencies for one system were 85-88% for total phosphorus and 96-97% for total suspended solids. Seasonal removals varied considerably, with spring flows exporting more phosphorus and sediment from the system than was imported. Phosphorus loadings to Long Lake will be reduced between 10-33% with 20 NSCS and diversion of municipal wastewater effluent to a nearby river.

© CSA

**379. Waterbird communities and associated wetlands of the Colorado River Delta, Mexico.**

Hinojosa Huerta, Osvel; Destefano, Stephen; Carrillo Guerrero, Yamilet; Shaw, William W.; and Valdes Casillas, Carlos

*Studies in Avian Biology*(27): 52-60. (2004)

NAL Call #: QL671.S8; ISSN: 0197-9922

*Descriptors:* biodiversity/ biogeography: population studies/ marine ecology: ecology, environmental sciences/ agricultural drain/ flood control measures/ guild composition/ species abundance/ species richness/ waterbird communities/ wetland habitat/ wetland management program

*Abstract:* Despite extensive losses of wetlands caused by water diversions upstream, the Colorado River Delta in northwestern Mexico remains an important wetland system in the Sonoran Desert. The purpose of our study was to describe waterbird communities across a variety of wetland habitat types and zones that exist in the Delta. We measured species richness and abundance of waterbirds from September 1999 to August 2000. We observed a total of 11,918 individuals of 71 species at sites within seven wetland areas. The waterbird communities differed with respect to guild composition and species abundances among the wetland zones. Wetlands along the eastern portion of the Delta (Cienega and Indio), which are supported by agricultural drains and managed under conservation initiatives, exhibited the highest species richness in our summer and winter censuses, and highest abundance in summer. Shorebirds were the dominant guild in the summer period, while waterfowl were dominant during winter. Breeding marshbirds were also abundant, with the Yuma Clapper Rail (*Rallus longirostris yumanensis*) being most notable. Wetlands along the western Delta (Hardy and Cucapa) were also supported by

agricultural drains, but were not managed specifically for wildlife. The Double-crested Cormorant (*Phalacrocorax auritus*) and American Coot (*Fulica americana*) were dominant during winter, while long-legged waders (*Ardeidae*) were dominant in summer. The composition of waterbird communities along the mainstem of the Colorado River was similar to that of wetlands along the western portion of the Delta. The shallow and ephemeral Laguna Salada, along the western boundary of the Delta, exhibited the highest waterbird abundance among our winter censuses when it was flooded in 2000. The results of our study suggest that even minimal levels of instream flows would lead to habitat improvements for waterbirds in the Delta floodplain. A bi-national wetland management program for the Delta should consider the impacts of flood control measures and diversions for agricultural and urban uses to the health of wetland habitats on both sides of the international border.

© The Thomson Corporation

**380. The wetland constructed as a biological treatment system in an experimental recirculating aquaculture system in a tropical environment.**

Sedeno-Diaz, J. E.; Lopez, E.; and Sedeno-Alvarez, D. E. In: Proceedings of the 4th International Conference on Recirculating Aquaculture. (Held 18 Jul 2002-21 Jul 2002 at Roanoke, VA (USA).); Vol. VSGCP-C-00-001.; 2002.

*Descriptors:* freshwater aquaculture/ fish culture/ experimental culture/ recirculating systems/ water quality control/ bioremediation/ aquatic plants/ uptake/ nitrogen/ phosphorus/ removal/ efficiency/ rearing/ culture tanks/ Poeciliidae/ constructed wetlands/ livebearers/ fish culture

*Abstract:* An experimental system of fish farming was designed utilizing recirculation and a constructed wetland. The efficiencies of N and P removal of the wetland were tested using three different species of macrophytes and utilizing the system for 2 different fish cultivation densities of the family Poeciliidae. The system functioned adequately, filtering the waste generated by the fish, the food not consumed and the metabolic wastes of the primary productivity that was generated in the tanks. Water quality variables were monitored including the nutrients, OD, pH, conductivity, TDS, TSS, sulfates, hardness, COD and turbidity. To measure the removal of nutrients by the macrophytes, they were weighed prior to being added to the constructed wetland and again at the end of the experiment with the purpose of determining the profit in biomass. The N and P concentrations were determined in vegetable tissue before and after the experiment. There were observed differences in absorption of N and P of the three species of macrophytes utilized.

© CSA

**381. Xenobiotics removal from polluted water by a multifunctional constructed wetland.**

Cheng, S.; Vidakovic-Cifrek, Z.; Grosse, W.; and Karrenbrock, F.

*Chemosphere* 48(4): 415-418. (July 2002)

*NAL Call #:* TD172.C54; *ISSN:* 0045-6535

*Descriptors:* water pollution treatment/ artificial wetlands/ pesticides/ herbicides/ performance evaluation/ chemical analysis/ toxicity/ bioassay/ water reuse/ irrigation water/ wastewater treatment/ biodegradation/ water quality/ endocrine disruptors/ water quality control/ water treatment/ protective measures and control/ water & wastewater treatment

*Abstract:* Removal efficiencies on xenobiotics from polluted water in a twin-shaped constructed wetland consisting of a vertical flow chamber with the crop plant *Colocasia esculenta* L. Schott and a reverse vertical flow one with *Ischaemum aristatum* var. *glaucum* Honda, were assessed by chemical analysis and bioassays. After a four-month period of application, removal efficiencies of the applied pesticides parathion and omethoate were 100% with no detectable parathion and omethoate in the effluent. For the applied herbicides, the decontamination was less efficient with removal efficiencies of 36% and 0% for 4-chloro-2-methyl-phenoxyacetic acid and dicamba, respectively. As shown by toxicity assay with duckweed *Lemna minor* L., growth retardation may occur if the water treated for herbicide removal is used in irrigation of sensitive cultivars in agriculture or horticulture. In contrast to *I. aristatum* var. *glaucum* Honda, the crop *C. esculenta* L. Schott has a high yield in biomass production as a valuable source of renewable energy.

© CSA

