

Health and Welfare

Web Resources

Alderton D (1988) **Small animals, birds, reptiles and ornamental fish.** *Proceedings. 14th International Conference. Animal Air Transportation Association, Inc. May 8-11, 1988, Amsterdam, The Netherlands.* Animal Air Transportation Association, Inc. Fort Washington, MD 20744, USA. p.131-140

NAL Call No. TL720.7 A5

Descriptors: trade in animals, aquarium fishes, legislation, transport of animals, animal welfare, small mammals

American Humane Association (1985) *Care of Fish.* American Humane Association. Denver, Colorado. 10 p.

NAL Call No. SF457.C3

Descriptors: fishes, animal welfare

Bjerkaas E, Wall AE, Prapas A (2000) **Screening of farmed sea bass (*Dicentrarchus labrax* L) and sea bream (*Sparus aurata* L) for cataract.** *Bulletin of the European Association of Fish Pathologists. Weymouth.* 2(5):180-185 ISSN: 0108-0288

Screening of sea bass and sea bream for lens changes was carried out on three modern fish farms in Greece at different localisations and farming conditions. The fish were randomly caught with a dip-net for examination and were of different ages and weights. Small cataract changes were diagnosed in 11.9% of the examined sea bream, while only four of 102 examined sea bass (2.9%) showed small cataract changes. Osmotic lens changes were observed in a considerable number of the small sea bass, as well as in some of the larger bass after anaesthesia, while the same effect was not found in the sea bream examined. In addition, ocular changes, including panophthalmitis, rupture of the globe and uveitis were diagnosed in a few fish in poor condition. The results of the study indicate that cataracts may develop in the two species studied, especially in the sea bream, and that the situation should be monitored as Mediterranean fish farming industry is intensified.

Descriptors: eyes, screening, vision, husbandry diseases, *Dicentrarchus labrax*, *Sparus aurata*, cataracts

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Brannas E, Alanara A, Magnhagen C (2001) **The social behaviour of fish.** Eds: Keeling LJ, Gonyou HW. *Social Behaviour in Farm Animals.* p.275-304. CABI Publishing, Wallingford, UK
ISBN: 0-85199-397-4

Descriptors: aggressive behaviour, animal behaviour, animal physiology, animal welfare, aquaculture, cannibalism, crowding, environmental factors, group interaction, group size, predator prey relationships, social behaviour, social structure, social systems, space requirements, fishes

Braunbeck T (1998) **Cytological alterations in fish hepatocytes following in vivo and in vitro sublethal exposure to xenobiotics--- structural biomarkers of environmental contamination.** (Eds:) Hinton DE, Streit B. *Fish Ecotoxicology.* Basel Switzerland Birkhaeuser Verl pp. 61-140

Cytopathological alterations in hepatocytes of fish following exposure to xenobiotic compounds represent a powerful tool to reveal sublethal effects of chemicals and to elucidate underlying modes of action. The present communication reviews the available information about ultrastructural changes in fish liver as well as isolated hepatocytes, whereas the discussion of in vivo effects is primarily focused on data from rainbow trout (*Oncorhynchus mykiss*) and zebrafish (*Danio rerio*), the presentation of in vitro data has been restricted to results from experiments with rainbow trout hepatocytes due to a lack of data from studies with hepatocytes from other species. Both in vivo and in vitro exposure to xenobiotics results in sensitive, selective, and, especially in in vitro experiments, extremely rapid responses of hepatocytes, which, however, may be confounded by internal parameters (species, sex, age, hormonal status) and external parameters (temperature, nutrition, duration of exposure). Thus, transfer of results and conclusions from one experiment to another is usually not possible. Likewise, in vitro results may not necessarily be extrapolated to the situation in intact fish, and effects by acute toxic exposure cannot be translated into sublethal effects. Hepatocellular reactions consist of both unspecific and substance specific effects, in any case, as a syndrome, the complex of all changes induced by a given xenobiotic, is specific. Especially in the lower exposure range, most, if not all, ultrastructural alterations appear to be fully reversible, upon cessation of exposure, restitution of hepatocellular integrity is usually accomplished within a few days. Most early reactions of hepatocytes apparently serve functions within the general adaptation syndrome, which is induced to compensate for the misbalance in organismic homeostasis. Most ultrastructural alterations after sublethal exposure have, therefore, to be classified as indicators of adaptive processes and may be contrasted to irreversible, i.e., degenerative and truly pathological phenomena. These adaptive processes should by definition, not have consequences at higher levels of biological organization, yet, as biomarkers, they are of ecotoxicological relevance. Thus, with regard to their (eco)toxicological significance, components of this nonspecific "general toxicant adaptation syndrome" may serve as early and sensitive warning signals of chemical exposure, whereas more specific changes may be of advanced diagnostic value and may serve as indices for the identification of xenobiotics. Integration of cytopathological alterations into routine aquatic toxicology requires quantification by means of stereological techniques, which make structural data accessible for statistical analysis and

comparable with quantitative techniques such as biochemistry and molecular biological methods. Implementation of cytopathological techniques into routine long term investigations with fish gives credit to the principles of animal welfare and protection, since more in depth analysis of internal mechanisms of sublethal chemical contamination in addition to the study of externally overt symptoms of intoxication adds to a refinement of fish experiments. One step further towards reduction of animal experiments may be achieved by translation of environmental cytopathology to primary hepatocyte cell cultures.

Descriptors: cell culture, sublethal effects, ultrastructure, liver, *Danio rerio*, *Oncorhynchus mykiss*

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Canfield PJ, Quartararo N, Griffin DL, Tsoukalas GN, Cocaro SE. (1994) **Haematological and biochemical reference values for captive Australian snapper, *Pagrus auratus*.**

Journal of Fish Biology. 44(5):849-856.

NAL Call No. QL614 J68

Reference values for common haematological and biochemical tests were established for 64 captive Australian snapper, *Pagrus auratus* (Bloch & Schneider). Fish were bled from caudal vertebral sinuses after benzocaine anaesthesia. Haematological results were extremely variable for total leucocytes and types of leucocytes. There was no correlation between leucocytes counts and leucocrit values ($R_{\text{super}(2)} = 0.37$). Thrombocytes were not determined by direct cell counting due to problem of aggregation. Polychromasia was common but did not correlate with reticulocyte counts ($R_{\text{super}(2)} = 0.08$). Biochemical results were extremely variable for creatine kinase and aspartate transaminase but this was considered a direct result of muscle damage during collection.

Descriptors: biochemical composition, hematology, baseline studies, *Pagrus auratus*

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Chiba A, Hamaguchi M, Kosaka M, Tokuno T, Asai T, Chichibu S (1990) **Energy metabolism in unrestrained fish with in vivo ^{31}P -NMR.** *Comparative Biochemistry and Physiology.* 96A(2): 253-255

NAL Call No. QP1.C6

We evaluated changes in high energy phosphate metabolism in unrestrained freshwater loaches by in vivo ^{31}P -NMR. When dissolved oxygen was deficient, both an increase in Pi and a decrease in PCr were observed as the loach struggled. After pretreating the fish with an anesthetic agent, we observed the dependence of high energy phosphate metabolism on changes in dissolved oxygen. Under anesthetic (Pi)/(Pi) + (PCr) ratio, an index of metabolic state, was lower than without anesthesia. Decrease in high energy phosphate metabolism in fish during oxygen deficiency was not caused by poor oxygen supply but resulted from struggle movement due to lack of oxygen.

Descriptors: *Cobitis biwae*, animal metabolism, phosphates, freshwater fish

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Claireaux G (1999) **Metabolic scope: An indicator of welfare in fish?**. *Copenhagen-Denmark ICES. International Council for the Exploration of the Sea Copenhagen (Denmark) Theme Sess. Health and Welfare of Cultivated Aquatic Animals. Council Meeting of the International Council for the Exploration of the Sea, Stockholm (Sweden), 27 Sep-6 Oct 1999*. 1 pp. Compact Disc

Even though environmental factors affecting the relationship between fish and their environment are relatively well identified, documented scientific arguments on their interactions and the dynamics of their effects are scarce. Consequently, to date there exist no unequivocal and easily implemented methods to assess the reactions of an animal to its natural or rearing environment. With regards to the fish-environment interactions, environmental factors are deciding because, (1) they determine the size of fish realised niche, (2) they dictate the general conditions governing the use of this environment, (3) they set the maximum power output that animals will have their disposal to support routine activities. Therefore it ensures, that in order to survive, a fish must continually maintain the appropriate balance between two requirements. The first one is obviously to attain the power output necessary to fulfil the energetic requirements associated with its habitat. The second one is to operate as low as possible from its topmost physiological limits. The maximisation of this functional safety margin between the realisable and the actual metabolic rate is indeed crucial, especially if one considers that the magnitude of that scope provides for natural contingencies, and in fine, sets productivity level (fish farm) and/or mortality risk (natural ecosystem). In this context, we formulated our working hypothesis as follow: a maximised metabolic scope is synonymous with reduced energy budgeting conflicts, increased welfare, and thus with maximised ecosystem/farm yield. As a contribution to the understanding of the fishmilieu interactions, the authors designed an experimental and modelling procedure to analyse the environmental impact on fish metabolic scope. Using this procedure, the authors then tested the hypothesis that fish do behaviourally optimise their aerobic metabolic capacity. Finally, the authors analysed particular situations in which energy budgeting conflict occurred. (DBO).
Descriptors: fish, animal welfare, metabolism, environmental factors, aquaculture
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Deutsche Veterinärmedizinische Gesellschaft (1978) **Tierschutzgerechte Halterung, Transport und Töten von Süßwasserfischen. Tagung der Fachgruppe Tierschutzrecht am 10-11 November 1977 in München [Humane keeping, transport and killing of freshwater fish. Meeting of the Animal Welfare group on 10 - 11th November 1977 in Munich]**. *Du und das Tier*. 8(1):8-37 (In German)

ISSN: 0341-5759

The 16 papers presented at this meeting are published in this number of the journal. They cover various aspects of animal welfare in relation to fisheries, the good health of fish, stress and the blood picture, pain in the fish, oxygen requirements, temperature and hydrogen, humane killing, and the use of tranquillizers during transport.

Descriptors: fish farming, animal welfare, fisheries, transport of animals
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Elliott DG, Pascho RJ, Manning PR, McKibben CL (1994) **Studies on the potential for transmission of *Renibacterium salmoninarum* to chinook salmon (*Oncorhynchus tshawytscha*) during code-wire tagging procedures.** *International Symposium on Aquatic Animal Health: Program and Abstracts., Univ. of California, School of Veterinary Medicine, Davis, CA (USA).* p. W-17.5

Binary coded-wire tags have been used extensively for more than 30 years for the identification and management of stocks of anadromous salmonid fishes. During a study of the use of brook stock segregation for the control of bacterial kidney disease (BKD) in hatchery-reared spring chinook salmon *Oncorhynchus tshawytscha*, we observed evidence suggesting that transmission of the causative agent of BKD, *Renibacterium salmoninarum*, might be enhanced by coded-wire tagging procedures. About 4 months after coded-wire tags were implanted in fish from two brood years, we examined histological sections of 14 tissues from each of 120 spring chinook salmon smolts in the study groups. Up to 36 of the *R. salmoninarum*-infected fish in some groups had focal infections detected only in the snout area near the site of tag implantation. The lesions associated with the infections often resulted in destruction of the olfactory epithelium and supporting tissues. No focal snout infections were observed in fish that were not marked with coded-wire tags. These data suggested that coded-wire tagging procedures can promote the transmission of *R. salmoninarum* among fish via contaminated tagging needles or by facilitating the entry of pathogens through the injection wound. Further field investigations focused on the occurrence of *R. salmoninarum* contamination on tagging needles, on coded-wire tags, and in the water of anesthetic baths used during the tagging spring chinook salmon.

Descriptors: *Oncorhynchus tshawytscha*, *Renibacterium salmoninarum*, tagging, fish diseases, bacterial diseases, histology, disease transmission, lesions

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Fiskeriforskning (2000) **Institutt for Fiskeri og Haveruksforskning [Annual Report 2000].** *Fiskeriforskning Norsk Institutt for Fiskeri og Haveruksforskning AS Norway.* 40 pp (In Norwegian)

This annual report summarizes information about Fiskeriforskning and excerpts from the scientific results in 2000 including: product and processing development for Norwegian seafood industry; seafood marketing and industrial economics; biotechnology in development of products from marine raw material; health and welfare of farmed fish; development of feed and technology for new farmed species; stock estimation and ecology of sea mammals, crustaceans, molluscs, coastal resources and flatfishes.

Descriptors: fishery institutions, aquaculture, seafood, biotechnology, research institutions, annual reports, Norway, fish health, fish welfare

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Hashimoto Y, Nishiuchi Y (1983) **Effects of herbicides on aquatic animals.** Eds: Miyamoto J, Kearney PC, Takahashi N, Yoshioka H, Misato T, Matsunaka S. *Pesticide*

Chemistry, Human Welfare and the Environment. Volume 2. Natural Products. Pergamon Press. Oxford, U.K. p.355-358

NAL Call No. SB951 I562 1982

LC-50 values of 35 herbicides are tabulated for carp, Daphnia, Physa and tadpoles. Trials demonstrating the acute toxicity of PCP and sub-acute toxicity of molinate to carp are discussed. In addition to the haemorrhagic anaemia induced in carp by molinate, vertebral deformities in certain kinds of fish caused by trifluralin or benthocarb are considered.

Descriptors: Molinate, toxicology, Trifluralin, THIOBENCARB, herbicides, fishes, thiocarbamate herbicides, carbamate pesticides, pesticides, aquatic animals

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Institut Natl. de la Recherche Agronomique, Paris; IFREMER, Issy-les-Moulineaux (1999)

Premieres journées de la pisciculture, Nantes, 2-4 novembre 1999: actes [First workshop of the pisciculture, Nantes, 2-4 November 1999: acts]. *Nantes France Ifremer.* 145 pp. (In French with English Summary)

This symposium has been organized by many research institutes and partners of the fish sector. The following topics were developed: research and development of this activity, economic analysis, administration, reglementation, quality of the products, the fishes welfare, pathology, environment and nutrition, importance of the professional, and the fish ponds.

Descriptors: conferences, fish culture, economics, legislation, research, experimental, research, quality assurance, biological stress, pathology, nutrition, pond culture, animal welfare

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Jencic V (2000) **Skrb za dobrobit rib[Concern for the fish welfare].** *Slovenski Veterinarski Zbornik.* 37(3):163-169 (In Polish)

NAL Call No. SF604 L52

Descriptors: fishes, animal welfare, behaviour; fish culture, aquaculture, fishing operations, stress, ethics, value, systems, aquaculture

Jones D (1998) **Free captive fish.** *Nature (United Kingdom).* 392(6673):234 ISSN: 0028-0836

NAL Call No. 472 N21

Descriptors: fishing, ecosystem, biochemical oxygen demand, fish, environmental protection, animal welfare, nonhuman, short survey

Kanshik SJ, Luquet P (eds.) (1993) **Fish nutrition in practice.** *The 4th International Symposium on Fish Nutrition and Feeding, Biarritz (France), 24-27 Jun 1991. Colloq. Inra Paris France Institut National De La Recherche Agronomique.* 61. 974 pp.

NAL Call No. S539.7 C6 no.61

In feed-based aquaculture, adequate nutrition practices are decisive in order to be economically

competitive as well as to ensure the welfare of the fish. This symposium was held under the auspices of the International Union of Nutrition Sciences. The following topics have been discussed: fish nutrition and reproductive performance; nutrition and health; metabolism and growth; environmental effects; larval and crustacean nutrition; aquaculture and tropical nutrition; and nutrition research and aquaculture development. More than one hundred presentations have stressed the role of nutrition on growth, reproduction and health of species raised in fish farms.

Descriptors: conferences, animal nutrition, feed efficiency, fish culture, aquaculture development, disease resistance, nutrient deficiency, growth, animal metabolism, aquaculture effluents, warm water aquaculture, fish larvae, brood stocks, marine crustaceans, nutritional requirements

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Mayes MA, Barron MG (1991) **Aquatic Toxicology and Risk Assessment: Fourteenth Volume.** *Proceedings from the 14th ASTM Symposium on Aquatic Toxicology and Risk Assessment, San Francisco, CA (USA), 22-24 Apr 1990.* ASTM Special Technical Publication. Philadelphia, PA USA American Society For Testing and Materials. 388 pp. NAL Call No. QH545 W3S95

The objective of the 14th ASTM Symposium on Aquatic Toxicology and Risk Assessment was to provide aquatic toxicologists a forum to share new ideas, to demonstrate the application of old ideas, and to challenge current dogma. To this end, we organized ten sessions that ranged from the specific (Organ System Toxicology and Biomarkers) to the more general (Risk Assessment and Complex Mixtures). The symposium was initiated with a panel discussion on "The Animal Welfare Act: Implications and Predictions in Lower Vertebrate Research." This timely subject was presented from the viewpoint of academia, industry, and governmental regulatory and funding agencies. All agreed that now is the time to become involved in this issue in order to influence future regulations. Traditional environmental effects testing have endpoints that assess real-time exposure-related effects or responses. The session on Biomarkers presented methods/examples that provide an indication of previous and/or current pollutant or stress or exposure. In the session of Organ System Toxicology the contributors explored the basic physiological processes of specific target organs and argue that an understanding of these processes are basic to understanding the mechanism of toxic action of specific chemicals. The use of fish to assess the potential carcinogenicity of xenobiotics was the focus of the Carcinogenesis session. Topics ranged from the complexities of carcinogenesis in the fish liver to the description and validation of fish carcinogenicity models. As regulatory agencies begin to include biological assessments in an effort to meet the objectives of several environmental laws, biomonitoring is becoming more prevalent. Several sessions addressed the methods and strategies for biomonitoring point sources as well as monitoring to assess the effectiveness of bioremediation strategies. The sessions on Toxicity Evaluation and Toxicant Reduction Strategies included topics that focused on the utility and limitations of current test methods, the use of a toxicity index for data extrapolation, the utility of specific species for aquatic testing, and factors that may effect interpretation of the results. The concern about the toxicity of contaminated sediments was addressed in a series of presentations in the session on Sediment Toxicity Assessment. Both bioaccumulation and toxicity

assessment strategies were presented along with considerations of intrinsic characteristics of the sediment that may influence the interpretation of test results.

Descriptors: aquatic environment, toxicology, conferences, hazard assessment, exposure tolerance, environmental monitoring, aquatic environments, risk assessment, fish, animal welfare

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Midtlyng PJ (1997) **Vaccinated fish welfare: protection versus side-effects.**

Developments in Biological Standardization (Switzerland). 90:371-379. National Centre for Veterinary Contract Research and Commercial Services, Ltd. (VESO AS), Oslo, Norway. NAL Call No. QR180.3 D4

ctive immunisation of fish involves a number of potentially harmful procedures like handling, anaesthesia or injection of more or less toxic substances. Adjuvanted vaccines may cause inflammation, granuloma and pigmentation at the site of injection. Intraperitoneal administration of oil-adjuvanted vaccines to Atlantic salmon pre-smolts has occasionally resulted in impaired growth and reduced carcass quality. The consequences of such vaccination for fish welfare may therefore be questioned. With respect to furunculosis caused by *Aeromonas salmonicida*, scientific data suggest, however, that only oil-adjuvanted vaccines are protective throughout the production cycle of farmed salmon. Data are presented to show that salmonids are highly at risk to epizootics if left unprotected against this or other endemic diseases. A panel of parameters partly adopted from experimental animal medicine is proposed to assess the impact of vaccine side-effects in farmed fish. In intensive salmon aquaculture systems, reduced disease risks are thought to justify the observed level of side-effects following current vaccination practices. For future fish vaccines, reduction of side-effects without compromising long-term protective immunity constitutes a challenging goal.

Descriptors: fishes, vaccination, adjuvants, immunologic, administration, dosage, adverse effects, animal welfare, fish diseases, prevention and control, fisheries, injections, safety, Salmonidae, vaccines

Ribelin WE, Migaki G (1975) *The Pathology of Fishes*, U of WI Press, Madison, Wisconsin. 1004 pp.

NAL Call No. SH171 P38

Descriptors: fishes, disease, medical, veterinary, pathology, medicine

Ollenschlager B (1978) **Der Einfluss von Temperatur und Wasserstoffionenkonzentration auf den Fisch [Influence of temperature and pH (of water) on fish]**. *Du und das Tier*. 8(1):24-25 (In German)

ISSN: 0341-5759

Descriptors: animal welfare, environmental temperature, pH, fishes

Poppe TT, Haastein T (1984) **Fisk og dyreverv [Fishes and animal welfare]**. *Norsk*

Veterinaertidsskrift, 96(3):179-181. (In Norwegian)

NAL Call No. 41.8 N81

Descriptors: fishes, animal welfare, fish culture, animal health, animals, aquaculture, aquatic animals, aquatic organisms, foods, vertebrates

Pough FH (1996) **Setting guidelines for the care of reptiles, amphibians and fishes.**

Scientists Center for Animal Welfare (SCAW) newsletter. 18(1):3-8. Arizona State University West, Phoenix, AZ.

NAL Call No. QL55.N48

Descriptors: reptiles, amphibia, fishes, animal husbandry, animal welfare, guidelines

Reichenbach-Klinke HH (1987) **Fisch und Naturschutz [Fish and natural protection].**

Tieraerztliche Praxis. 15(1): 99-106. (In German)

NAL Call No. SF603.V4

Descriptors: fishes, fishing operations, transport, stress, slaughtering, environmental effects, fish diseases, pathology, histology, animal welfare, animal health, animals, aquatic animals, aquatic organisms, diseases, disorders, dysregulation, functional disorders, harvesting, injurious factors, methods, processing, vertebrates

Reichenbach-Klinke HH (1987) **Die wesentlichen Parameter für das Erkennen einer Beeinträchtigung des Wohlbefindens des Fisches [Important values for the**

recognition of detrimental effects on the well being of fish]. *Du und das Tier.* 8(1): 12-14. (In German). ISSN: 0341-5759

Descriptors: stress, transport of animals, animal welfare, fish diseases, fishes

Reynnells RD, Eastwood BR (1998) **Animal welfare issues compendium.** *Poultry*

Science 77 (Supplement 1):151

NAL Call No. 47.8 Am33P

Descriptors: animal care, animal husbandry, fish, animal welfare issues, compendium, aquaculture, beef production, conservation, dairy production, hunting, veal production

Sagar Kumar, Shalini Chauhan, Chauhan RRS (1997) **Long-term effect of light on haematology of a fish *Clarias batrachus* (Linn.).** *Uttar Pradesh Journal of Zoology.* 17

(1):50-52

ISSN: 0256-971X

The exposure of *Clarias batrachus* to constant light for 24 h resulted in a general elevation in red blood cell count, blood urea, haemoglobin percentage (haematocrit?), blood sugar, bilirubin, alkaline phosphatase and serum transaminase. Levels of cholesterol and serum protein concentration were depleted. All parameters, except for blood urea, returned to pre-exposure levels 5 days later.

Descriptors: light, haematology, blood chemistry, animal welfare, cholesterol, blood sugar,

urea, blood proteins, alkaline phosphatase, *Clarius batrachus*

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Sauer N, Manz D (1994) **Tierschutzatbestaende bei Fischen [The welfare of fish].**

Tieraerztliche Umschau. 49(10):653-658 (In German)

NAL Call No. 41.8 T445

Welfare legislation applies to fish just as they do to other species. Compared to other pets and domestic animals, fish present a number of differences that present a problem in determining whether the regulations are being observed. These problems are compounded by the diverse uses and management, e.g. breeding, storage and transportation, commercial uses, scientific study and game fishing, to which they are subjected. There is general agreement that fish are capable of suffering and it is therefore immaterial that it has never been established that fish sense pain. In commercial enterprises, causes of suffering can be found as a result of feeding, breeding, over fishing, sorting, mixing of species, transportation and slaughter. Water quality is another source of suffering due to contamination. The major causes for aquarium fish are related to capture, breeding and trade, as well as from errors in the management and care by aquarists. Game fishing has gained considerable attention with respect to welfare. Examples are presented for all of these diverse activities.

Descriptors: fishes, fishing operations, fish culture, fish feeding, fish ponds, pain, animal welfare, transport of animals, animal health, ornamental fishes, aquaculture, neurophysiology, legal aspects, fish handling, biological stress, sport fishing, hygiene, Teleostei, fish welfare
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Sauer N (1993) **Tierschutz bei Fischen [Animal protection with fishes].** *Fachbereich*

Veterinaermedizin. Justus-Liebig-Univ., Giessen (FRG). 290 pp. (In German)

In the present dissertation the influence and effects of the human being regarding fishes are analyzed under animal welfare aspects. Respectively a division of the subranges fish cultivating in ponds, cultivation of flowing waters, influences on natural biotopes, angling ornamental fish keeping and fishes as test animals is effected. The foundation are, besides of a multifarious and wide-branching literature, the relevant laws and other regulations, relevant degrees and own experiences of many years.

Descriptors: ornamental fish, fishery protection, ecological balance, legal aspects, spawning, food availability, biological stress, disease control, sport fishing
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Schulz D (1978) **Sauerstoff und Fisch. [Oxygen and fish.].** *Du und das Tier.* 8(1):21-23

(In German)

ISSN: 0341-5759

Descriptors: animal welfare, gases, water, oxygen, fishes

Simpson SJ, Raubenheimer D (2001) **A framework for the study of macronutrient**

intake in fish. *Aquaculture Research*. 32(6):421-432

NAL Call No. SH1.F8

A good understanding of the capabilities of commercially reared fish species to regulate intake of specific macronutrients has potential economic, welfare and environmental benefits. We present a conceptual and experimental framework for studying macronutrient intake in fish. This 'geometric' approach addresses the multidimensional and interactive nature of nutrition. It was developed from work on insect herbivores and has successfully been applied to mammals and birds. The various components of the framework are introduced in simple outlines, and key experimental designs are described for assessing whether or not fish specifically regulate their intake of macronutrients, how they balance over-ingesting some nutrients against under-eating others when provided with suboptimal diets, and how they regulate growth post-ingestively. Descriptors: fishes, experimental design, selectivity, feeding behavior, fish feeding, nutrient uptake, nutrition physiology, growth, literature, fish culture, nutritional requirements, feed efficiency, diets, bioenergetics

Toovey JPG, Lyndon AR, Duffus JH (1999) **Ivermectin inhibits respiration in isolated rainbow trout (*Oncorhynchus mykiss* Walbaum) gill tissue.** *Bulletin of the European Association of Fish Pathology*. 19(4):149-152.

The effect of the anti parasitic compound ivermectin on respiration of isolated rainbow trout gills was investigated. Control (saline only) gills had similar oxygen consumption rates to previous reports for perfused preparations. Ivermectin caused a significant, dose dependent depression of gill oxygen consumption at concentrations of 1.21 µg/ml and above, with an EC₅₀ of 2.15 µg/ml. The carrier solvent (propylene glycol) exhibited dose independent inhibition of branchial respiration by 12%. Assuming that these inhibitory effects were cumulative, ivermectin reduced gill respiration by up to 72% at a concentration of 11.2 µg/ml. In comparison, excess (10 mM) ouabain resulted in a 40% drop in oxygen consumption. It is concluded that further characterisation of ivermectin's impact on fish health, and therefore welfare, is essential if its use for chemotherapeutic purposes in fish is to be licensed.

Descriptors: antiparasitic agents, respiration, oxygen consumption, drugs, disease control, *Oncorhynchus mykiss*

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Treasurer J (2002) **Welfare of wrasse.** *Fish Farmer*. 25(6):38-39

NAL Call No. SH151.F574

Although biological control of sea lice by stocking wrasses have environmental benefits, reports from environmental groups have suggested that wrasses were unsuitable because welfare measures are required of them. This article briefly discusses some of the measures to improve the overwintering survival of wrasses.

Descriptors: animal welfare, overwintering, survival, Labridae, Perciformes, Osteichthyes, fishes, vertebrates, Chordata, aquatic organisms, aquatic animals

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Wahli T (2002) **Approaches to investigate environmental impacts on fish health.**

Bulletin of the European Association of Fish Pathologists. 22 (2):126-132

ISSN: 0108-0288

Descriptors: animal health, animal welfare, environmental impact, toxic substances, water pollution, water temperature, brown trout, fishes, *Salmo trutta*, Salmo, Salmonidae, Salmoniformes, aquatic animals

WHO (1990) **Aktuelle Probleme des Tierschutzes. Fortbildungsveranstaltung am 12./13. Oktober 1989 [Current problems of animal welfare. Refresher course held at Hannover on 12-13 October 1989].** *Deutsche Tierärztliche Wochenschrift* 97(4):139-180 (In German with an English summary)

NAL Call No. 41.8 D482

Individual papers outlined the animal welfare situation in Europe, and welfare problems of pigs, Muscovy ducks, pets, fish, furbearing animals and fallow deer.

Descriptors: animal welfare, fish

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Witter DJ (1977) **Attitudes Toward Animals and Their Uses: Literature Citations and Animal Welfare Organization Data (Monograph).** *Arizona University, Tucson.*

Department of Agricultural Economics. Report Number: AGERS-45, 45 p. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)321-8547; and email at orders@ntis.fedworld.gov

NAL Call No. HD1775 A6A6

The report contains 486 citations of work about man's feelings toward animals and their uses, and 80 citations of related social scientific works. The citations are grouped alphabetically by author in four categories: (1) general coverage; (2) animals as recreational and esthetic resources; (3) animals as industrial resources and in biological research; and (4) related social scientific literature. Additionally, the address, foundation date, membership and staff size, purpose, and periodicals of 141 national organizations concerned with animal welfare are listed.

Descriptors: attitudes, animals, ethics, social psychology, laboratory animals, resources, animal ecology, human behavior, birds, utilization, recreation, sociology, tables (data), statistical data, wildlife, domestic animals, conservation, bibliographies, fishes

Web Resources:

Aspects of Animal Welfare and Aquaculture - A Compendium of Selected Literature by Richard D. Moccia and Kristopher P. Chandroo; Aquaculture Centre, University of Guelph, Guelph, Ontario, Canada

<http://www.aps.uoguelph.ca/~aquacentre/aec/publications/welfare-bib.html>

Canadian Council on Animal Care (CCAC)

<http://www.ccac.ca>

The Canadian Council on Animal Care (CCAC) has posted its second draft of CCAC guidelines on: the care and use of fish in research, testing, and teaching. The draft guidelines

and future final guidelines are available at the CCAC webpage (<http://www.ccac.ca> and <http://www.ccac.ca/english/new/newframe.htm>).

Fish Products Standards and Methods Manual

Bulletin No. 9 24/03/03

Approved Therapeutants for Aquaculture Use

(This bulletin supersedes and replaces Bulletin no. 8.) The purpose of this bulletin is to inform manual holders of the authorized use of drugs and pesticides in the aquaculture of fish

and crustaceans.

<http://www.inspection.gc.ca/english/anima/fispoi/manman/samnem/snmalle.pdf>

Netvet: Fish Resources

<http://netvet.wustl.edu/fish.htm>

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