

Laboratory

Web Resources

Bakken M, Vangen O, Rauw WM (1998) **Biological limits to selection and animal welfare.** *Proceedings of the 6th World Congress on Production, Armidale, Australia, January 11-16, 1998. Volume 27: Reproduction; Fish Breeding; Genetics and the Environment; Genetics in Agricultural Systems; Disease Resistance; Animal Welfare; Computing and Information Technology; Tree Breeding.* World Congress on Genetics Applied to Livestock Production. Armidale, Australia. p.381-388

NAL Call No. SF105 W67 1998

This paper discusses the relationships between selection of livestock for improved production, the biological limits to selection and animal welfare. Consideration is given to (1) the definition of animal welfare, (2) the application of resource allocation theory to study the relationships between animal welfare and artificial selection, (3) experiments on selection limits in laboratory animals, and (4) undesirable correlated responses resulting from selection for performance in poultry and farm animals.

Descriptors: selection, animal welfare, livestock

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Blackshaw JK, Allan DJ, Martin AA, Tyler MJ (1987) *Principles of Laboratory Animal Management. 3rd ed.* N.S.W., Australia: Australian Society for the Study of Animal Behaviour 103 p.

NAL Call No. SF406.B5 1987

Descriptors: laboratory animals, animal welfare

Bourdon RM, Enns RM (1998) **Physiological breeding values: rethinking the way we express genetic values for improving production systems.** *Proceedings of the 6th World Congress on Genetics Applied to Livestock Production, Armidale, Australia, January 11-16, 1998. Volume 27: Reproduction; Fish Breeding; Genetics and the Environment; Genetics in Agricultural Systems; Disease Resistance; Animal Welfare; Computing and Information Technology; Tree Breeding.* World Congress on Genetics Applied to Livestock Production. Armidale, Australia. 227-234

NAL Call No. SF105 W67 1998

This paper is concerned with the determination of breeding objectives for different combinations of management systems and biotypes in order to arrive at the optimal combination of management system and breeding objectives. Bioeconomic simulation is suggested as a technique for

evaluating production systems. The genetic inputs to a bioeconomic simulation model should satisfy 2 criteria: (1) they must indicate the underlying genetic potential, i.e. genetic potential that is not compromised by the constraints commonly found in field data; (2) they must measure traits that are logical inputs for mechanical modelling. Physiological breeding values (PBV) are such inputs. PBV are similar to conventional breeding values, except that the definition of genetic potential is different. PBV are independent of population and environment but dependent on the model used. The problems associated with estimating PBV from conventional breeding values are discussed in relation to body weight and milk yield in cattle.

Descriptors: breeding value, production, systems, models, livestock, fishes

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Casebolt DB, Speare DJ, Horney BS (1998) **Care and use of fish as laboratory animals: current state of knowledge.** *Laboratory Animal Science (United States)*. 48(2):124-36
NAL Call No. 410.9 P94

Descriptors: animal welfare, animals, laboratory, fishes, genetically modified, genetic engineering, veterinary

Chen TT, Lu JK, Dunham RA, Powers DA (1994) **Transgenic fish: Ideal models for basic research and biotechnological application.** *3rd International Marine Biotechnology Conference: Program, Abstracts and List of Participants., Tromsø University, Tromsø (Norway)*, p. 70.

A wide range of transgenic animal species including fish have been produced by microinjecting or electroporating transgenes into developing embryos. This technology offers excellent opportunities for creating model animals for basic research as well as biotechnological applications. In basic research, transgenic animals provide excellent experimental models for studying molecular genetics of early vertebrate development, actions of oncogenes, and the biological actions of hormones at different stages of development. In applied biotechnology, transgenic technology offers unique opportunities for producing animal models for research in biomedical problems and environmental toxicology, improving the genetic background of broodstock for animal husbandry or aquaculture, and designing bioreactors for producing valuable proteins for pharmaceutical or industrial purposes. We have been studying the biological actions of growth hormone and insulin-like growth factor as well as concept of molecular toxicology, using transgenic common carp, channel catfish and medaka as experimental animals. In this paper we will use results from our own studies as well as these from others to demonstrate the potential application of transgenic fish technology.

Descriptors: transgenic animals, Pisces, research programs, biotechnology, models, genetics, genomes, aquaculture techniques

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DeTolla LJ, Srinivas S, Whitaker BR, Andrews C, Hecker B, Kane AS, Reimschuessel R

(1995) **Guidelines for the care and use of fish in research.** *ILAR Journal* 37(4):159-173.
 NAL Call No. QL55.A1I43

Descriptors: fishes, laboratory animals, animal experiments, animal husbandry, animal welfare, medical research, anesthesia, anesthetics, euthanasia, zoonoses, guidelines, regulations

Goolish EM, Evans R, Okutake K, Max R (1998) **Chamber volume requirements for reproduction of the zebrafish *Danio rerio*.** *Progressive Fish Culturist.* 60(2):127-132
 NAL Call No. 157.5 P94

The zebrafish or zebra danio *Danio* (= *Brachydanio*) *rerio* has recently become a major vertebrate model for the study of developmental biology, neurobiology, and molecular genetics. As a result, most research universities have now invested considerable resources in the construction of large zebrafish facilities. A key element in the design of these facilities is maximizing the efficiency of available space. Here we report on the effects of aquarium chamber volume on the reproduction of zebrafish, with the objective of identifying the minimal volume required for normal egg production. Six adults (two males and four females) were tested in chamber volumes of 500, 400, 300, 200, and 100 mL. Results were compared with those from a control volume of 3.5 L. Eggs were removed from the test chambers after spawning and incubated in petri dishes at 28°C. Total egg production, percent of eggs hatching, and larval length at 96 h postfertilization were used to evaluate breeding success. Compared with the control, egg production was not significantly affected by reduced aquaria volumes of 500, 400, and 300 mL. However, mean egg production from a test volume of 200 mL was only 48% of the control egg production ($P < 0.05$), and at a test volume of 100 mL, egg production was reduced to 26% of the control value ($P < 0.005$). Percent egg hatch and 96-h larval length were not affected at any test volume.

Descriptors: laboratory culture, test organisms, aquaculture facilities, stocking density, *Danio rerio*, Zebra danio

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Grunwald DJ, Eisen JS (2002) **Headwaters of the zebrafish - emergence of a new model vertebrate.** *Nature Reviews: Genetics.* 3(9):717-724 ISSN: 1471-0056

The understanding of vertebrate development has advanced considerably in recent years, primarily due to the study of a few model organisms. The zebrafish, the newest of these models, has risen to prominence because both genetic and experimental embryological methods can be easily applied to this animal. The combination of approaches has proven powerful, yielding insights into the formation and function of individual tissues, organ systems and neural networks, and into human disease mechanisms. Here, we provide a personal perspective on the history of zebrafish research, from the assembly of the first genetic and embryological tools through to sequencing of the genome.

Descriptors: reviews, animal models, embryogenesis, models, genetics, embryology, research, historical account, *Danio rerio*, Zebra danio

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Ivetac I, Becanovic J, Krishnapillai V (2000) **Zebrafish: Genetic tools and genomics.**

Asia Pacific Journal of Molecular Biology and Biotechnology. 8(1):1-11 ISSN: 0128-7451

The emergence of zebrafish (*Danio rerio*) as a model organism with applications in vertebrate developmental genetics, modeling and study of human genetic diseases, study of vertebrate genome evolution and improved aquaculture of transgenic fish, has been accompanied by the development of a vast array of zebrafish-specific genetic tools and genomic resources. Owing to its amenability to both phenotypic analysis and mutational screening and availability of a multitude of molecular genetic techniques, numerous zebrafish mutations have been assayed, extensive genetic maps created and many genes cloned. Comparative genomics using mammalian genomes is important to the provision of candidate genes for positional cloning strategies and gaining further insights into vertebrate genome evolution. With the likely sequencing of the entire zebrafish genome in the foreseeable future and further identification and cloning of zebrafish gene loci, the assignment of functions to uncharacterised human genes, known only by sequence from the Human Genome Project, is likely to become a reality.

Descriptors: reviews, genetic mapping, genomics, test organisms, genetics, laboratory culture, genomes, biological development, morphogenesis, organogenesis, *Danio rerio*, Zebra danio, genetic mapping

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Khudoley VV (1984) **Use of aquarium fish, *Danio rerio* and *Poecilia reticulata*, as test species for evaluation of nitrosamine carcinogenicity.** *Use of Small Fish Species in Carcinogenicity Testing., Monograph Series.* National Cancer Institute. 65:65-70

The carcinogenic effects of various doses of dimethylnitrosamine (DMNA), diethylnitrosamine (DNA), and nitrosomorpholine (NM), as well as the results of varying temperature and length of exposure to these carcinogens, were studied in short-term (20-21 wk) experiments in aquarium fish (820 *Danio rerio* and 944 *Poecilia reticulata*). All nitroso compounds induced liver tumors and esophageal papillomas. Exposure to NM also induced intestinal adenocarcinomas in *D. rerio*. When exposure time was shortened to 2 weeks, the dosage was decreased, or if the temperature was reduced to $17^{\circ} \pm 1^{\circ}$ C, the tumor incidence dropped and the latency increased. An increase in temperature to $27^{\circ} \pm 1^{\circ}$ C resulted in a 72-89% tumor incidence and shortened the latency to 11.3-14.1 weeks.

Descriptors: test organisms, nitrosamines, carcinogenesis, carcinogenicity testing, N-nitrosodiethylamine, N-nitrosodimethylamine, N-nitrosomorpholine, laboratory testing, carcinogenesis, *Danio rerio*, *Poecilia reticulata*, aquatic organisms

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Klontz, GW (1995) **Care of fish in biological research.** *Journal of Animal Science.* 73 (11): 3485-3492.

NAL Call No. 49 J82

Fish live in a very complex, dynamic environment. Their use as biological research subjects during the past three decades has increased almost exponentially because of the demand for an increased knowledge base in response to the need for better aquaculture technology. To use fish as biological research subjects requires the investigator to take into account approximately 40 interactive environmental variables, if the research data are to be free of unwanted biases. These environmental factors are classified into five major groups, all important to the well-being of fish. These five include intrinsic factors (fish associated) and extrinsic factors (water, container, nutrition, and management associated). The stress response is the primary intrinsic factor of concern, and associated pathological changes should be used to monitor animal well-being and prevent secondary infectious disease problems. The water-associated factors are the primary extrinsic factors affecting the well-being of fish. Thus, the investigator must design research protocols that maintain fish within documented environmental limits for the species.

Descriptors: fishes, fish culture, environmental control, water quality, animal welfare, fish feeding

Lin S, Yang S, Hopkins N (1994) **LacZ expression in germline transgenic zebrafish can be detected in living embryos.** *Developmental Biology.* 161(1):77-83

NAL Call No. 442.8 D49

Use of transgenic technology in zebrafish (*Brachydanio rerio*) has been limited by the inability to efficiently express transgenes in early embryos of F1 and subsequent generations and to rapidly detect transgenic fish. We generated transgenic fish by injecting fertilized eggs with the *Escherichia coli* lacZ gene under the control of the *Xenopus* elongation factor 16a transcriptional regulatory element. Four of five lines of transgenic fish we obtained express the lacZ gene in early embryos. The pattern of expression was distinct for each line, with two lines showing extensive expression beginning at approximately the midblastula transition, one showing patchy expression and one showing expression almost exclusively in motor neurons. Expression patterns were stable through the F2 generation in the three lines studied to date. The availability of these lines facilitated the development of a reliable and rapid method for live-staining lacZ-expressing embryos using the substrate fluorescein-di- beta -D-galactopyranoside (FDG). Positive embryos of the two most highly lacZ-expressing lines could be identified after 2-3 min of staining in FDG and then picked out and raised. These observations should prove useful for a variety of studies in zebrafish.

Descriptors: transgenic animals, *Danio rerio*, production, use, lacZ gene, germ cells, gene expression, embryos, genes, experimental research, genetics, biotechnology, *Brachydanio rerio*, transgenic zebrafish

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McHugh Law J (2001) **Mechanistic considerations in small fish carcinogenicity testing.**

ILAR Journal 42(4): *Fish Models in Biomedical Research.*

NAL Call No. QL55 A1I43

URL: http://dels.nas.edu/ilar/jour_online/42_4/mechanistic.asp

Historically, small fish species have proven useful both as environmental sentinels and as versatile test animals in toxicity and carcinogenicity bioassays. They can be bred in large numbers, have low maintenance and bioassay costs, and have a low background incidence of tumors. However, more mechanistic information is needed to help validate the information garnered from these models and to keep pace with other more fully developed animal models. This paper focuses on mechanistic considerations when using small fish models for carcinogenicity testing. Several small aquarium fish species have proven useful. The Japanese medaka is perhaps the best characterized small fish model for carcinogenicity testing; however, the zebrafish is emerging as an important model because it is well characterized genetically. Both route and methodology of exposure may affect the outcome of the study. Most studies have been conducted by introducing the test compound into the ambient water, but dietary exposures and embryo microinjection have also been used. Other considerations in study design include use of an initiating carcinogen, such as diethylnitrosamine, and differences in xenobiotic metabolism, such as the fact that fish CYP2B is refractory to Phenobarbital induction. The small size of these models has perhaps limited some types of mechanistic studies, such as formation and repair of DNA adducts in response to carcinogen exposure. However, improved analytical methods are allowing greater resolution and should be applied to small fish species. Slide-based methods such as immunohistochemistry are an important adjunct to routine histopathology and should be included in study design. However, there is a need for development of more species-specific antibodies for fish research. There is also a need for more fish-specific data on cytokines, serum biochemistry, and oncogenes to strengthen the use of these important test models.

Descriptors: fish models, human disease, biomedical research, carcinogenicity, cytochrome P450, diethylnitrosamine, DNA adduct, hepatocarcinogenesis, medaka, small fish models, zebrafish

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Midtlyng PJ (1997) **Novel vaccines and new vaccination strategies for fish.** *Bulletin of the European Association of Fish Pathologists.* 17(6):239-244 ISSN: 0108-0288

Sixty years after the first attempts to vaccinate fish, immunoprophylaxis has become the dominant strategy for disease control in commercial fish farming. Successful immunisation programmes against bacterial diseases of salmon leave little need for chemotherapy, thus providing pioneer evidence how the use of antimicrobials in industrial animal production can be curbed. The population of farmed fish now equals the numbers in other segments of world animal production, and aquaculture is rapidly moving into the focus of the

international agrochemical and pharmaceutical industry. At the same time, fish immunology and fish vaccinology from an academic discipline of pioneers to a commercially driven biotechnology and biomedical science. The present paper attempts to summarise the scientific contributions of the IABS symposium on Fish Vaccinology, which took place in Oslo, Norway June 5-7 1996, and from which the proceedings volume containing 45 review articles recently have been published. Among the subjects covered are recent achievements in research on fish immune mechanisms; development of vaccines against bacterial, viral and parasitic diseases of fish; issues relative to the production, evaluation and licensing of fish vaccines; safety and environmental issues; and recommended vaccination strategies for various aquacultured species and productions.

Descriptors: vaccination, fish culture, disease control

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Midtlyng PJ (2001) **Vaccination of fish - achievements and challenges.** *NATO Science Series: Series A: Life Sciences. Modern Aquaculture in the Coastal Zone-Lessons and Opportunities.* 314:197-211. ISSN: 1387-6686

The first written scientific communications of fish vaccination are now more than 60 years old, and immunoprophylaxis has become the dominant strategy for disease control in commercial fish farming. Successful immunization programmes against bacterial diseases of salmon have dramatically diminished the need for chemotherapy, thus providing pioneer evidence how the use of antimicrobials in industrial animal production can be reduced. The population of farmed fish has now surpassed other segments of world animal production in numbers, and aquaculture is rapidly moving into the focus of the international agrochemical and pharmaceutical industry. At the same time, fish immunology and fish vaccinology has evolved from an academic discipline of pioneers to a commercially driven biotechnology and biomedical science. This paper presents an overview of immunoprophylaxis in current fish farming, giving some examples of current opportunities and practices of vaccination in European coastal aquaculture. Recent achievements in research on fish immune mechanisms; in the development of vaccines against bacterial, viral and parasitic diseases of fish; issues relative to the production, evaluation and licensing of fish vaccines; safety and environmental issues; and recommended vaccination strategies for various aquacultured species and productions are being outlined.

Descriptors: vaccines, vaccination, fish diseases, disease control, Pisces, salmonids

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Moorman SJ (2001) **Development of sensory systems in zebrafish (*Danio rerio*).** *ILAR Journal* 42(4): *Fish Models in Biomedical Research.*

NAL Call No. QL55 A1I43

URL: http://dels.nas.edu/ilar/jour_online/42_4/sensory.asp

Zebrafish possess all of the classic sensory modalities: taste, tactile, smell, balance, vision, and

hearing. For each sensory system, this article provides a brief overview of the system in the adult zebrafish followed by a more detailed overview of the development of the system. By far the majority of studies performed in each of the sensory systems of the zebrafish have involved some aspect of molecular biology or genetics. Although molecular biology and genetics are not major foci of the paper, brief discussions of some of the mutant strains of zebrafish that have developmental defects in each specific sensory system are included. The development of the sensory systems is only a small sampling of the work being done using zebrafish and provides a mere glimpse of the potential of this model for the study of vertebrate development, physiology, and human disease.

Descriptors: fish models, human disease, biomedical research, dorsal root ganglion, inner ear, lateral line, olfactory system, vestibular system, visual system

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Mottet NK, Landolt ML (1987) **Advantages of using aquatic animals for biomedical research on reproductive toxicology.** *Environmental Health Perspectives.* 71:69-75
NAL Call No. RA565 A1E54

Major advantages of the use of aquatic animals, such as trout (*Salmo gairdneri*), English sole (*Parophrys vetulus*), or sea urchins (*Strongylocentrotus purpuratus*), for studying the mechanisms of reproductive toxicology are discussed. The remarkable synchrony of differentiation of gametes in large quantities for detailed morphologic and biochemical measurements enables research not readily done on mammalian nonseasonal breeders. Structural differences such as the absence of a fibrous sheath in the more simple structure of fish and sea urchin sperm flagella facilitates comparative study of the mechanism of action of microtubules in flagella movement and the coupling of mitochondrial energy production to microtubules movement.

Descriptors: toxicology, reproduction, animal models, aquatic animals, toxicants, sexual reproduction, aquatic organisms, models, *Salmo gairdneri*, *Parophrys vetulus*, *Strongylocentrotus purpuratus*, mechanisms

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Ostrander GK (2000) *Laboratory Fish.* Academic Press, San Diego, CA. 678p

Descriptors: animals, laboratory; fishes; fish as laboratory animals.

Reimschuessel R (2001) **A fish model of renal regeneration and development.** *ILAR Journal* 42(4): *Fish Models in Biomedical Research.*

NAL Call No. QL55 A1I43

URL: http://dels.nas.edu/ilar/jour_online/42_4/fish_model.asp

The fish kidney provides a unique model for investigating renal injury, repair, and development.

Like mammalian kidneys, fish kidneys have the remarkable ability to repair injured nephrons, designated renal regeneration. This response is marked by a recovery from acute renal failure by replacing the injured cells with new epithelial cells, restoring tubule integrity. In addition, fish have the ability to respond to renal injury by de novo nephron neogenesis. This response occurs in multiple fish species including goldfish, zebrafish, catfish, trout, tilapia, and the aglomerular toadfish. New nephrons develop in the weeks after the initial injury. This nephrogenic response can be induced in adult fish, providing a more abundant source of developing renal tissue compared with fetal mammalian kidneys. Investigating the roles played by different parts of the nephron during development and repair can be facilitated using fish models with differing renal anatomy, such as aglomerular fish. The fish nephron neogenesis model may also help to identify novel genes involved in nephrogenesis, information that could eventually be used to develop alternative renal replacement therapies.

Descriptors: fish models, human disease, biomedical research, development, fish, kidney, model, nephron, regeneration, repair

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Smigielski AS (1975) **Hormone-induced spawnings of the summer flounder and rearing of the larvae in the laboratory.** *Progressive Fish Culturist*. 37(1):3-8

NAL Call No. 157.5 P94

Adult and immature summer flounder (*Paralichthys dentatus*) captured in Narragansett Bay and Block Island Sound were transported to the Northeast Fisheries Center, Narragansett Lab, Narragansett, Rhode Island, in 1970-71 and 1972. A photoperiod of 11 hr light 13 hr dark (11L:13D) was maintained by time clocks for 3 seasons, and water temps in the observation aquarium were allowed to fluctuate and coincide with bay temps during the seasons of 1970 and 1971. During the season of 1972, water temps in the observation aquarium and smaller fiberglass holding tank were maintained at $18^{\circ} \pm 1^{\circ}\text{C}$. The size and strength of the adult summer flounder necessitated the application of anaesthesia before administering hormone injections or spawning the fish. The anaesthetic Tricaine Methane Sulfonate (MS-222) at a conc of 1:20,000 was used without any harmful effects. Carp pituitary (freeze-dried powder) administered at the dosage levels of 0.5 mg and 5.0 mg/454 g fish caused hydration and subsequent ovulation at both dosage levels. The low fertilization percentages of eggs experienced in the lab resulted from an insufficient number of running ripe males readily available. It is hoped that in the future a major effort will be made to obtain and maintain larger numbers of ripe males in the lab. The eggs obtained from these hormonal induced spawnings appeared to be normal in all respects. They had an average diam of 1.02 mm and contained 1 large oil globule which averaged 0.25 mm. Incubation was carried out at 2 temps 15° and 18°C . Hatching occurred between 72 and 96 hr at a salinity of 32 ppt. Larvae obtained from hormone-induced spawnings appeared to be

normal in all respects and no abnormalities were noted. Their survival percentage was greater at water temps of 15°C and when reared in black-sided aquariums as opposed to clear-sided aquariums. Survival was also greater when a *Chlorella* sp like algae was introduced into their rearing aquariums regardless of the colour background. Appropriate sized zooplanktons, introduced at the proper time and amounts, are extremely important in rearing summer flounder larvae. It is hoped that in the future food density studies can be carried out to determine optimum food levels necessary for survival for this sp. As far as is known, these are the first successful hormone-induced spawnings reported with summer flounder and the subsequent rearing of their larvae through metamorphosis in the lab. The entire early life cycle of this flat fish can now be completed under controlled lab conditions.

Descriptors: induced breeding, hormones, rearing, fish larvae, *Paralichthys dentatus* ASFA; Copyright © 2003, FAO

Stoskopf MK (2002) **Biology and health of laboratory fishes**. Eds: Fox JG, Anderson LC, Loew FM, Quimby FW. *Laboratory Animal Medicine* (Ed 2) :886-907. Academic Press London, UK

NAL Call No. SF996.5 L33

Descriptors: animal health, animal welfare, bacterial diseases, biology, laboratory animals, fishes

Stoskopf M (2001) **Introduction**. *ILAR Journal* 42(4): *Fish Models in Biomedical Research*.

NAL Call No. QL55 A1I43

URL: http://dels.nas.edu/ilar/jour_online/42_4/introduction.asp

Descriptors: fish models, human disease, biomedical research

Vogl C, Grillitsch B*, Wytek R, Spieser OH, Scholz W (1999) **Qualification of spontaneous undirected locomotor behavior of fish for sublethal toxicity testing Part I. Variability of measurement parameters under general test conditions.**

Environmental Toxicology and Chemistry. 18(12):2736-2742

NAL Call No. QH545.A1E58

An automated, personal computer-based video-processing, object-recognition, and object-tracing system was used to record and analyze undirected spontaneous locomotor behavior of small groups of undisturbed semiadult zebra fish (*Brachydanio rerio*) in laboratory tanks. The primary data provided by the monitoring system were the individually assigned, time-stamped coordinates of the fish in two-dimensional projection. Secondary parameters (position, velocity of movement in the horizontal and the vertical direction, and temporal intraindividual and interindividual association) were calculated. The computed parameters offered a multidimensional description of spontaneous undirected swimming behavior of the fish and proved to be largely independent of water temperature, length, weight, and sex ratio of the zebra fish within the standardized range, but varied significantly with the feeding regime, time of day, number of fish per tank, and batch.

Statistical characteristics of the behavioral parameters confirmed them as being appropriate for parametric statistical analyses.

Descriptors: toxicity testing, behavior, aquatic organisms, computer applications, laboratory methods, Pisces, statistical analysis, monitoring systems, *Brachydanio rerio*, locomotor activity, swimming behavior, toxicity tests, bioaccumulation, pollution surveys, indicator species, swimming, sex ratio, toxicity, testing procedures, fish, bioindicators, water temperature, *Danio rerio*, statistical analysis, Zebra danio

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Walter RB, Kazianis S (2001) ***Xiphophorus* interspecies hybrids as genetic models of induced neoplasia.** *ILAR Journal* 42(4): *Fish Models in Biomedical Research.*

NAL Call No. QL55 A1I43

URL: http://dels.nas.edu/ilar/jour_online/42_4/hybrids.asp

Fishes of the genus *Xiphophorus* (platyfishes and swordtails) are small, internally fertilizing, livebearing, and derived from freshwater habitats in Mexico, Guatemala, Belize, and Honduras. Scientists have used these fishes in cancer research studies for more than 70 yr. The genus is presently composed of 22 species that are quite divergent in their external morphology. Most cancer studies using *Xiphophorus* use hybrids, which can be easily produced by artificial insemination. Phenotypic traits, such as macromelanophore pigment patterns, are often drastically altered as a result of lack of gene regulation within hybrid fishes. These fish can develop large exophytic melanomas as a result of upregulated expression of these pigment patterns. Because backcross hybrid fish are susceptible to the development of melanoma and other neoplasms, they can be subjected to potentially deleterious chemical and physical agents. It is thus possible to use gene mapping and cloning methodologies to identify and characterize oncogenes and tumor suppressors implicated in spontaneous or induced neoplasia. This article reviews the history of cancer research using *Xiphophorus* and recent developments regarding DNA repair capabilities, mapping, and cloning of candidate genes involved in neoplastic phenotypes. The particular genetic complexity of melanoma in these fishes is analyzed and reviewed.

Descriptors: fish models, human disease, biomedical research, CDKN2, melanoma, mnu, platyfish, swordtail, UV, Xmrk

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Westerfield, M. (2000). *The Zebrafish Book. A Guide for the Laboratory Use of Zebrafish (Danio Rerio)*. 4th ed., Univ. of Oregon Press, Eugene.

URL: http://zfin.org/zf_info/zfbook/zfbk.html

Descriptors: zebrafish, *Danio rerio*, developmental genetics, animal care, methodology, breeding, histology, homozygosity, pattern formation

Note: Hardcopies of the 4th edition of The Zebrafish Book can be obtained for a nominal fee from the [Zebrafish International Resource Center](http://www.zfish.org/), 5274 University of Oregon, Eugene, OR 97403 USA; fax: 541-346-6151.

Winn RN (2001) **Transgenic fish as models in environmental toxicology.** *ILAR Journal* 42(4): *Fish Models in Biomedical Research.*

NAL Call No. QL55 A1I43

URL: http://dels.nas.edu/ilar/jour_online/42_4/transg.asp

Historically, fish have played significant roles in assessing potential risks associated with exposure to chemical contamination in aquatic environments. Considering the contributions of transgenic rodent models to biomedicine, it is reasoned that the development of transgenic fish could enhance the role of fish in environmental toxicology. Application of transgenic fish in environmental studies remains at an early stage, but recent introduction of new models and methods demonstrates progress. Rapid advances are most evident in the area of in vivo mutagenesis using fish carrying transgenes that serve as recoverable mutational targets. These models highlight many advantages afforded by fish as models and illustrate important issues that apply broadly to transgenic fish in environmental toxicology. Development of fish models carrying identical transgenes to those found in rodents is beneficial and has revealed that numerous aspects of in vivo mutagenesis are similar between the two classes of vertebrates. Researchers have revealed that fish exhibit frequencies of spontaneous mutations similar to rodents and respond to mutagen exposure consistent with known mutagenic mechanisms. Results have demonstrated the feasibility of in vivo mutation analyses using transgenic fish and have illustrated their potential value as a comparative animal model. Challenges to development and application of transgenic fish relate to the needs for improved efficiencies in transgenic technology and in aspects of fish husbandry and use. By taking advantage of the valuable and unique attributes of fish as test organisms, it is anticipated that transgenic fish will make significant contributions to studies of environmentally induced diseases.

Descriptors: fish models, human disease, biomedical research, *Fundulus*, lambda, medaka, plasmid, transgenic

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Woolaston RR (1998) **Breeding livestock for reduced reliance on chemicals.**

Proceedings of the 6th World Congress on Genetics Applied to Livestock Production, Armidale, Australia, January 11-16, 1998. Volume 27: Reproduction; Fish Breeding; Genetics and the Environment; Genetics in Agricultural Systems; Disease Resistance; Animal Welfare; Computing and Information Technology; Tree Breeding. World Congress on Genetics Applied to Livestock Production. Armidale, Australia. 145-152

NAL Call No. SF105 W67 1998

This paper begins with a brief discussion of why chemicals are used in animal production and then considers the problems associated with their use, including residues in animal products, resistance of bacteria and parasites, environmental consequences and carcass damage. It is argued that many traits targeted by chemicals are heritable and, therefore, breeding can achieve similar ends, although it would be more practicable, in most cases, to use both methods to achieve improvement in productivity. Disease is an example of a trait where reliance on veterinary chemicals can be reduced by breeding for resistance. The optimal emphasis that should be placed on disease resistance in breeding programmes depends on a number of factors, some of which are difficult to measure. Genetic correlations between productivity and disease resistance appear to be unfavourable or neutral in a number of species.

Descriptors: breeding, disease resistance, livestock, diseases

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Web Resources:

Aquaria Fish Models of Human Disease

http://www.xiphophorus.org/100300s1/css/100300s1_1.htm

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419 Centennial ...

Aquatic Animal Models of Human Disease Conference. September 29-October 2, 2003. Manassas, VA.

<http://pasteur.atcc.org/aqua/AbstractSubmission.cfm>

Kent ML, Spitsbergen JM, Matthews JM, Fournie JW, Westerfield (2002) Diseases of zebrafish in research facilities.

http://zfin.org/zf_info/stckctr/dis_man/Fish_Diseases.html

Marine Biotechnology Volume 3 – Supplement (2001) SPECIAL ISSUE: Aquaria Fish Models of Human Disease

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How the Xiphophorus Problem Arrived in San Marcos, Texas

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Xiphophorus Genetic Linkage Map: Beginnings of Comparative Gene Mapping in Fishes

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Four Resource Centers for Fishes: Specifies, Stocks, and Services

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Use of the Japanese Pufferfish (*Fugu rubripes*) in Comparative Genomics

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Introduction: Aquaria Fish Models of Human Disease

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A Proposed Classification Scheme for Xiphophorus Melanomas Based on Histopathologic Analyses

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Lesser Known Aquarium Fish Tumor Models

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In Appreciation of Klaus D. Kallman

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Aquaria Fish Models Attendee Roster September 21-24, 2000

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Dioxin Toxicology and the Aryl Hydrocarbon Receptor: Insights from Fish and Other Non-traditional Models

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Relative Base Excision Repair in Xiphophorus Fish Tissue Extracts

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Aquaria Fish Models of Human Disease: Reports and Recommendations from the Working Groups

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Three Unique Experimental Fish Stories: Poecilia (the Past), Xiphophorus (the Present), and Medaka (the Future)

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Reporter Gene Expression in Fish Following Cutaneous Infection with Pantropic Retroviral Vectors

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Utility of Natural Populations for Microarray Analyses: Isolation of Genes Necessary for Functional Genomic Studies

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Model Organisms: Fish

<http://www.wellcome.ac.uk/en/genome/genesandbody/hg05b004.html>

Toxicological Pathology Atlas of Small Laboratory Fish

Part I - Normal Histology and Effects of Endocrine Disruptors in Zebrafish *Danio rerio*

http://arch.rivm.nl/milieu/rivmzfatlas/fishtoxpat/index_uk.html

UM MFBSC Marine Models

<http://www.rsmas.miami.edu/groups/niehs/science/models.jsp>

Marine Models of Human Disease. ... Importantly, fish and invertebrates represent a vast phylogenetic diversity that far exceeds that of mammals. ...

Westerfield, M. (2000). **The zebrafish book. A guide for the laboratory use of zebrafish (*Danio rerio*).**

4th ed., University of Oregon Press, Eugene.

http://zfin.org/zf_info/zfbook/zfbk.html

Hardcopies of the 4th edition of The Zebrafish Book can be obtained for a nominal fee from the [Zebrafish International Resource Center](#), 5274 University of Oregon, Eugene, OR 97403 USA; fax: 541-346-6151.

The Zebrafish Information Network

http://zfin.org/cgi-bin/webdriver?MIval=aa-ZDB_home.apg

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