WATERLINES

NEWSLETTER OF THE WESTERN REGIONAL AQUACULTURE CENTER

Alaska • Arizona • California • Colorado • Idaho • Montana • Nevada • New Mexico • Oregon • Utah • Washington • Wyoming

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Serge Doroshov & Sturgeon Aquaculture

Ken Chew, WRAC Director, School of Aquatic & Fishery Sciences, University of Washington

Serge I. Doroshov is a distinguished scientist in the field of aquatic animal reproduction and fish culture, and a pioneer in sturgeon aquaculture in the United States. In recognition of his ongoing research efforts, Dr. Doroshov was awarded the Honorary Lifetime Membership Award by the World Aquaculture Society in 2000.

Training begins

Dr. Doroshov was born in western Siberia, Russia in 1937. His family moved to Moscow in 1943 where he lived until 1975. He married Julie in 1958 while they were both studying at the University of Moscow, and in 1959, they graduated with BS and MS degrees in zoology-ichthyology.

His early research focused on the feeding ecology of Chinese white bream. In 1967, Doroshov earned a PhD in biology, and in 1968, he became director of the ZNIRO (now the Russian Research Institute of Marine Fisheries and Oceanography) Laboratory of Marine Aquaculture. While there, he worked with striped bass (which had been introduced from South Carolina), the local black sea urchin, white sea cod, and polar flounder, and he supervised research programs on hybrid sturgeon development and salmonid and oyster culture.

Even though he was not a member of the Communist Party, Dr. Doroshov was allowed to travel to many countries, such as Japan, France, Britain, and Canada. In 1976–77, he worked for the FAO in Cuba as an aquaculture expert on marine fish breeding. His wife and their two children (daughter Tanya and son Paul) were allowed to accompany him. On their way back, they made the decision not to return to the USSR. With the help of friends such as the late Dr. Donald Bevan and his wife Tanya, he came to Seattle, Washington. Shortly thereafter, in 1978, Dr. Doroshov accepted a faculty position in the Department of Animal Science at the University of California-Davis.

UC-Davis tenure

Initially, Dr. Doroshov studied larval swim bladders of tilapia and striped bass, and the reproductive biology of cultured catfish and trout. Around 1985, the focus

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Ken Chew

Serge Doroshov

Funding provided by the US Department of Agriculture, Cooperative State Research, Education & Extension Service

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of his research shifted almost entirely to the reproductive physiology and broodstock development of white sturgeon.

He has collaborated with commercial aquaculturists and scientists in California, Washington, Idaho, Oregon, and Montana. He has also maintained an active teaching schedule and has mentored many graduate students. Dr. Doroshov currently teaches two animal science courses—*Fish Production in Aquaculture* and *Reproduction and Development of Aquatic Animals*, and he participates in teaching graduate courses in Physiological Ecology and Comparative Physiology.

He has written numerous publications on the reproductive development of sturgeon. His research continues on the reproductive biology of white and green sturgeon and on the development of breeding and culture of the endangered species, Delta smelt.

Dr. Doroshov is a person of commitment. I recently had the opportunity to hear his presentation, "Captive Breeding and Domestication of Sturgeon," and to speak to him about the future of aquaculture as he sees it.

What was the most challenging part of getting sturgeon culture started?

It was the uncertainty of sturgeon maturation in captivity. Wild female white sturgeon mature at a median age of 24 years—entirely unrealistic for breeding or roe production in any culture. We hoped that maturation would change with accelerated growth in captivity; however, it took at least five to seven years to understand this. Today, we know that artificial feeding and rearing temperature affect development and growth of sturgeon. Female and male sturgeon, cultured in California, mature at age 8 and 4 years, respectively. It is still a long time for breeding, but it made meat and caviar production realistic.

What is your prediction for growing sturgeon for food?

Currently, sturgeon farms in the Western Region produce approximately 2–3 million pounds of food fish, including 15–20 pound fish for the restaurant market and younger, 6–10 pound fish for live fish markets (primarily ethnic market in California). Young, 2-year-old, 6–10 pound white sturgeon yield excellent quality and large-size boneless fillets. Economic analysis indicates feasibility of this culture. However, it will require development of product processing and packaging. The quality of meat in young sturgeon is very good, and such a product will compete favorably in supermarkets.

I know three farms in California and two in Idaho producing food fish for the restaurant and ethnic markets. The production of caviar is limited to two farms in California. The total number of sturgeon farms in the US is probably around ten. Regulations related to endangered species greatly affect the growth of sturgeon farms.

Do you expect caviar prices will remain high with increasing production?

It will depend on product quality, further improvement of sturgeon stocks, and competition among farms. Current production of "farmed" caviar is a rather costly and complex process. For targeting specialized markets, farmers will be required to supply a product similar in taste and appearance to traditional caviar from the Caspian Sea. With this high-priced product, caviar production from farmed sturgeon is economically feasible and is likely to stay within the historic level of production from capture fisheries. The potential improvement of cultured sturgeon stocks (e.g., maturation at younger age, higher yield of eggs) by optimizing nutrition, husbandry, breeding, and health management, as well as the development of new caviar processing technology may change this picture, increase production and competition, and lead to decline in price. However, I don't see this happening in the near future.

Total caviar production from world sturgeon farms (primarily the US and France) is about 10 metric tons (mt), versus an estimated 20–50 mt from the Caspian Sea fisheries. (Statistics there are very unreliable.) Medium- to large-size sturgeon farms, which had initiated domestic breeding at least ten years ago and keep the continual year-class inventory of female sturgeon, have a capacity to double current production within a few years... if they maintain high product quality.

In conclusion, if Dr. Doroshov had not come along to continue his physiological and culture research work on sturgeon at UC Davis, the aquaculture industry would not have experienced the level of development it has in the Western Region. In addition, some of his former students are involved with current research while others have gone on to commercial ventures in sturgeon culture. As a researcher and educator, he has well served the needs of finfish aquaculture in general and the budding sturgeon industry in particular. ≈

Is Your Fish Like a Volkswagen or a Porsche?

Adapted from an article by Ron Hardy and Gary Fornshell, Fish Farming News, November/December 2001

Would you rather drive a Volkswagen or a high-performance Porsche? Most people who could afford it would choose a Porsche because they know it is a better machine that delivers value for its lofty price.

What about high performance in aquaculture? Would you know if your fish perform like Porsches or Volkswagens? Answering this question was one of the goals of a four-year feed comparison study recently completed by the Western Regional Aquaculture Center.

We all want high-performance fish—fish that grow faster, eat less, convert feed more efficiently, and possess superior product quality. But, are we willing to provide the necessary input to allow our fish to reach their potential and become high-performance fish?

Who would fill-up a Porsche with low-octane gasoline? Low-octane fuel may cost less per tankful, but your Porsche will travel fewer miles per tank. The apparent saving is really an increased cost in terms of fewer miles per gallon and lower performance.

Similarly, low-performance feeds cost less per ton than high-performance feeds, but they also produce less weight gain. The true economic cost of feeds—cost per unit gain—is typically higher for a low-performance feed than a high-performance one.

The typical fish grower pays 50–60 cents for feed on every dollar spent on fish production. The type and quality of feed and the quality of the grower's feed management significantly impact fish performance and cost of production.

Courtesy of G. Fornshell

Ken Chew

left: Gary Fornshell; right: Ron Hardy

Objectives & goals

The WRAC-funded feed and nutrition project was multi-faceted and addressed many topics including the regular vs. premium question for rainbow trout. The objectives for the high-performance feeds study were to:

- Evaluate the effects of feeding high-energy diets (25–30% lipid content) during the grower and finishing phase of production on fish growth performance, feed efficiency ratios, nutrient retention, and product quality.
- Evaluate the potential of modified fish meals, other alternate protein, and alternate dietary oil as protein and energy sources in salmonid diets during the grower and finishing phase of production.
- Compare the effects of feed-manufacturing technology on nutrient-dense diets and in standard production diets, on fish growth performance, feed efficiency ratios, nutrient retention, and product quality.
- Continue to develop and validate the *in vitro* digestibility assay, which is intended to predict nutritional value of a feed ingredient or diet.
- Determine the optimum feed ingredient particle size for trout feed with respect to apparent digestibility and proportion of settable solids and soluble material in fecal wastes.

The goals of the multi-year project were twofold:

- To use information generated in studies during the first years to develop multiple strategies related to feed formulation and manufacture, feeding practices, and the development of practical *in vitro* digestibility tests to reduce pollution in hatchery effluents, especially during the growout period.
- To provide information to properly formulate high-performance feeds.

These goals were tested in the third and fourth years of research. This article's focus is on the first objective —evaluating the effects of high-energy diets on fish performance and product quality.

How fat is fat?

In the United States, the lipid content of trout feeds has increased considerably over the past decade, from 15–17% to 20–24%. With this increase, concerns have surfaced about the effects of high-lipid feeds on product quality and shelf life. There are also reported benefits of high-energy feeds, including faster growth, increased feed conversion efficiencies, and reduced pollutant loading.

In the WRAC-supported study, five fish meal diets formulated to contain 10%, 15%, 20%, 25%, and 30% lipid content were fed to rainbow trout with a starting weight of 100 grams for 24 weeks. Four replicate tanks were fed each of the five diets until the fish reached a

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final weight of about 500 grams. The feed trial was run at the Ennis National Fish Hatchery in Montana.

Results

At the end of the trial, rainbow trout fed the 30% lipid diet had significantly higher average body weight, weight gain, feed intake, and specific growth rate—all signs of high performance. They had significantly lower feed conversion ratios (FCR), meaning that it took less feed per unit gain. A trend of lower FCR as lipid content increased was also observed.

Other studies have shown that increasing dietary lipids tends to result in more fat in the gut (and less yield). But there was no apparent trend in viscera somatic index (VSI) with dietary lipid content. VSI was measured by weighing the whole fish, then eviscerating the fish and weighing the viscera. Viscera included all the internal organs, including gonads, but not the gills.

Surprisingly, there were no significant differences in protein efficiency ratios (PER) among the dietary treatments. There was a trend for higher PER and percent apparent net protein utilization values with increased dietary lipid content, suggesting that protein utilization was more efficient with increased levels of dietary lipid. This protein-sparing effect results from the fish using dietary lipid to supply metabolic energy needs, leaving more protein for growth.

There were also no significant differences in whole body concentrations of moisture, protein, and ash, but fish fed the 30% diet contained significantly higher lipid concentrations than fish fed the 10% diet.

The proximate composition of the fillets showed a similar pattern. Fillets from fish fed the 30% lipid diet had significantly higher lipid concentrations than fillets from fish fed the 10 or 15% diets. The percent lipid content of the viscera also progressively increased with increasing dietary lipid concentration.

Taste differences

Taste panel results revealed some differences among diet groups. Fillets from fish fed the 30% lipid diet were significantly "more fishy" than fillets from fish fed the 15% diet, as judged by paired comparison tests.

The storage life of frozen fillets, determined by measuring levels of thiobarbituric acid reactive substances (TBARS) in fillets over time, was not affected by increasing lipid concentration. However, there were measurable differences in TBARS content: fillets from fish fed the 30% lipid diet were the highest. Although these differences were not statistically significant, they may have affected overall aroma and flavor intensity.

Consumers are very aware of "fishy" aroma and flavor, and high levels are undesirable. Thus, products must be stored and handled to minimize these properties, and fillets from fish fed high-lipid diets may require special consideration.

Other studies on the effects of high-energy feeds on product quality with Atlantic salmon rainbow trout have yielded mixed results. Some have reported higher fillet lipid levels when high-energy feeds are fed, whereas others report a minor effect. Study duration, water temperature, diet formulation, and fish size are likely responsible for different results in different studies.

High lipid = high octane

As evidenced by weight gain, specific growth rate, and feed conversion ratios, fish grew faster and more efficiently with increasing dietary lipid levels. Feed intake increased with increasing dietary lipid levels as FCR decreased, indicating, as other studies have shown, that high-energy diets reduce the nutrient load in effluents through greater use and retention of nutrients by fish.

The more efficient a feed, the less waste is produced. Although an economic analysis comparing the cost per gain for the five diets was not done in this study, the results demonstrate that fish fed high-energy feeds outperform fish fed low-energy feeds.

Individual operators are ultimately responsible for deciding which type of feed to use, and this, of course, includes an awareness of acceptable feed costs per unit gain in a given market environment. ≈

PROJECT PARTICIPANTS

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Jamir Hired as Executive Director of NRAC

Lorelei Stevens and Susan Jones, Fish Farming News, September/October 2001

Courtesy of T. Jamir

Dr. Tomas "Tom" Vergel C. Jamir, executive director of the Northwest Regional Aquaculture Center (NRAC)

The Northeastern Regional Aquaculture Center (NRAC), which is housed at the University of Massachusetts Dartmouth, has a new executive director. Dr. Tomas Vergel C. Jamir hopes to bring a distinctively pro-industry, problem-solving philosophy to the position.

Jamir identified the three industry segments as:

- "Mom & Pop" operations—the majority of growers
- "Intermediate" growers
- "Big commercial" companies—there are only a few.

Jamir brings much-needed administrative leadership to NRAC, according to Mike Hastings, who serves on the NRAC board of directors and is executive director of the Maine Aquaculture Innovation Center.

Since former director Dr. Kim Harrison left the post over a year ago, members of the board have worked with the two-member NRAC staff to help keep the center operating on track. "Without an executive director, board members and staff had to do extra duty. But it is hard to operate without the top leader." said Hastings.

Project proposals

NRAC uses a competitive request-for-proposals (RFP) process to determine the projects it wants to sponsor. While the RFP process is seen as most equitable given the diversity of the region's aquaculture industry, it can result in the approval of many projects. Because they all need CSREES review, project applicants may wait for as long as a year for their money.

Other RACs use a "working group" approach to develop their annual project work list. These proposals tend to be larger and require a greater share of a center's budget, so fewer are submitted for CSREES vetting. That can mean a faster turnaround time.

Jamir wants to officially recognize the three industry segments and streamline the RFP process. He said that working groups, one for each segment, would look at "What's been done, what needs to be done, and what NRAC can do." And, once the task is done, the working groups would be disbanded to avoid a perception of the center as being dominated by "an old-boy network."

Applied research

Matching project to the regional industry's needs is important in the Northeast because USDA grants are the leading source of funding for applied research. "We need to focus more on what is needed by industry," Jamir said. "My perspective is that there are two basic criteria for proposal review: its financial contribution and its probability of success."

Outlook

Jamir is enthusiastic about the prospects for aquaculture in the Northeast. The challenge, he said, is technology transfer. "I think the main problem is not technology. It's a matter of distinguishing what technology is needed by industry and getting it to the farm," he said. Unabashedly acknowledging his "industry bias," Jamir continued, "Aquaculture is an industry, not a technical research project for universities."

Before taking the NRAC job, Jamir was the program director of the Gulf and South Atlantic Fisheries Foundation, a private nonprofit corporation serving the research, education, and conservation needs of the southeastern US commercial fishing industry. He has also held positions as: center director, School of Field Studies and the Boston University-affiliated Center for Marine Resource Studies; instructor, Oregon State University and the University of the Philippines; fisheries biology aide, Oregon's Department of Fish & Wildlife; marine extension agent, Fishery Resource Management Program, Development Academy of the Philippines; and operations and marketing manager, AQUATECH Fishery Consultants and Contractors.

Jamir can be reached at (508) 999-8157 or by email at *tjamir@umassd.edu*. ≈

Report: US Aquaculture Yields Promise, Raises Concerns

Gary Jensen, CSREES News Release, August 1, 2001

As the American consumer's demand for seafood continues to rise, so too does the likelihood that the fish, shrimp, or shellfish purchased at the market or restaurant has been farm raised. Aquaculture—the farming of finfish, shellfish, or aquatic plants—continues to grow rapidly worldwide, with production doubling by weight and value from 1989 to 1998. In the United States, aquaculture facilities now exist in every state and certain regions are seeing rapid growth.

A new report presented to the Pew Oceans Commission examines the role of the emerging US aquaculture industry in meeting the nation's demand for seafood and its current and potential impacts on the marine environment. The report recommends steps to ensure that domestic aquaculture grows in a sustainable fashion, and calls upon the US to take a global leadership role in adopting best practices.

"The reality today is that aquaculture is supplying a significant source of protein to consumers as wild ocean fisheries are depleted or reach their limit," said Leon E. Panetta, chair of the independent Pew Oceans Commission, which is conducting the first review of national ocean policies in over 30 years. "There are a number of issues related to this growing industry that can affect the quality of our oceans. This report looks at those concerns and presents recommendations for balancing the expected growth in aquaculture production with protection of those natural species and habitats that are essential to the future of our oceans."

Ken Chew

Red Tilapia being raised at Fish Breeders of Idaho

The report's authors are Dr. Rebecca Goldburg and Matthew Elliott of Environmental Defense and R. Rosamond Naylor of Stanford University. They find that farmed fish and shellfish supply one-third of the world's seafood, and that in the United States, aquaculture (including imports) provides almost all of the catfish and trout and nearly half of the shrimp and salmon currently consumed.

Although American aquaculture represents just over 1% of the world's production, about 4,000 aquaculture facilities exist in the United States, ranging from enclosed tanks on land to netpens and shellfish beds in bays and estuaries. Collectively, they raise over 100 different species of aquatic animals and plants, and provide new sources of seafood for consumers.

"With supplies of wild seafood limited and demand rising, aquaculture will likely continue to expand in the United States," says Dr. Goldburg, "Aquaculture is here to stay. The challenge is to ensure that this young industry grows in a sustainable manner and does not cause serious ecological damage."

The authors find that the present harmful effects of US aquaculture on the marine environment are minor compared to overfishing, coastal development, or global warming. They also point out that the aquaculture industry is diverse in its methods and practices and that some segments of the industry, such as shellfish growing, can have ecological benefits. Nevertheless, they recommend immediate motion concerning several problem areas:

Eliminate or drastically reduce the accidental release of farmed fish into the wild

The accidental release of farmed fish may harm wild fish populations through interbreeding and competition for habitat and food. In addition, escaped fish may spread diseases and parasites throughout an ecosystem. Supporting federal activities under the Endangered Species Act to protect wild salmon populations is a key element of protecting native fish.

Reduce the use of wild fish for fish feed

Some types of aquaculture, particularly salmon aquaculture, use large quantities of wild-caught fish as feed ingredients. Increased catches of small fish for use in feed would reduce the amount of food available for wild

predators such as large fish, marine mammals, and seabirds. The authors call for greater federal research to identify alternatives to the use of wild fish for fish feeds, and the cultivation and promotion of noncarnivorous aquaculture species.

In addition to these recommendations, the authors also propose several additional steps to limit the current impacts of aquaculture:

Develop strong effluent guidelines for aquaculture under the Clean Water Act, particularly for larger-scale aquaculture pens that discharge wastes directly into coastal waters.

Put in place an environmental protective federal permitting program for offshore aquaculture before this developing segment of the industry becomes established.

Champion research and development investments and cost-share incentives for sustainable aquaculture practices, such as recirculating on-land systems.

Seek greater environmental sustainability through the World Trade Organization, with the goal of allowing environmental considerations in the production of traded-food commodities to play a far larger role in trade decisions.

The Pew Oceans Commission is an independent group led by former White House chief of staff Leon Panetta, which is conducting a national review of the policies needed to restore and protect the oceans' living resources. The commission includes leaders from ocean research, fishing, conservation, industry, and government.

The marine aquaculture report is the second in a series of scientific reports that will assist the independent commission with its review. In addition to aquaculture, the commission is reviewing coastal development, marine pollution, fishing, invasive species, ocean governance, and marine protected areas. The commission will issue its formal recommendations to the President and the Congress in 2002.

Copies of the report, *Marine Aquaculture in the United States: Environmental Impacts and Policy Options,* are available online at *www.pewoceans.org* or by calling 703-516-0624. To receive a pdf version via email, contact Justin Kenney at *Kenneyj@pewoceans.org.* ≈

Ken Chew

Meal hosted by Alaska shellfish growers for WRAC board of directors

US Seafood Consumption Climbs

WorldCatch News Network, 2001

Seafood consumption in the United States increased 2.3%, with Americans consuming 4.3 billion pounds of domestic and imported seafood in 2000—or 15.6 pounds per person.

The National Marine Fisheries Service said the per person consumption represents an increase of 0.2 pounds from the revised 1999 level. Of the 15.6 pounds, 10.5 were fresh or frozen fish or shellfish, 4.8 were canned seafood, and 0.3 were cured. That represents a 0.1 pound increase in both fresh/frozen and canned products compared to 1999 figures. Shrimp consumption (all preparations) achieved a record 3.2 pounds per person consumed in 2000.

Total US supply of edible fishery products on a "round weight" basis was down 1.9 % in 2000. While US landings for human consumption increased by 1.2%, imported fish and shellfish increased 2.6% in 2000, comprising 68% of the seafood consumed in the United States. US exports increased by 11.4%. Inventories of frozen seafood in cold storage dropped slightly, declining less than 1% from the 1999 level.

The calculation of per capita consumption is based on a "disappearance" model. The total US supply of imports and landings is converted to edible weight and decreases in supply such as exports and inventories are subtracted out. The remaining total is divided by a population value to estimate per capita consumption.

Data for the model are derived primarily from secondary sources and are subject to incomplete reporting; changes in source data or invalid model assumptions may each have a significant effect on the resulting calculation. ≈

2001 Fellows of the Institute of Food Technologists

Adapted from an article by Sara Langen, Assistant Editor, Food Technology, August 2001

UW Health Sciences Photography

Faye M. Dong
Professor
Aquatic & Fishery Sciences
University of Washington
PhD in Nutrition, University of California, Davis

Courtesy of N. Haard

Norman F. Haard
Professor
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Faye M. Dong was recognized for her meritorious and outstanding contributions and her leadership in advancing the quality of food science education at universities, community colleges, and elementary and secondary schools. Her efforts have helped make teaching and learning food science more public, more scrutinized by critical review and evaluation, and more accessible to others in the Institute of Food Technologists (IFT).

In a WRAC-funded study (see page 3), Professor Dong and her colleagues are developing environmentally compatible feeds for hatchery-raised rainbow trout and salmon that minimize phosphorus and nitrogen in the effluent. In another study, she is working to define effective treatments for killing *Anisakis* simplex nematodes in arrowtooth flounder by microwave processing, freeze treatment, and high-hydrostatic-pressure processing.

She teaches courses in human nutrition, seafood science, and fish nutrition, and is involved in K–12 outreach activities, including teaching a food chemistry course to fourth-grade teachers. Faye has also mentored many graduate and undergraduate students.

Faye has served as chair of the IFT Steering Committee to start the Education Division, as well as division interim chair (1995–96) and chair (1996–97). During the creation of this division, she was the leader in organizing, encouraging, and supporting the presentation of symposia, forums, and technical sessions on teaching and learning. Her tireless efforts helped create a place where food scientists in academia, industry, and regulatory agencies are able to interact with experts in the field of education.

As a member of the Career Guidance Committee, she was instrumental in starting a Mini-Grant Program for university food science programs to host workshops for high school teachers. She has served on IFT program, annual planning, nominations and elections, awards, and sections and division committees. She also served as chair of the Task Force on Excellence in Food Science Education. ≈

Norman F. Haard was recognized for his leadership in advancing research in fisheries and fruits and vegetables, as well as food science education in the United States and throughout the world. He has been involved in WRAC studies in high performance fish feeds (see article, page 3).

Norm received his education in food science from Rutgers University (BS 1963) and University of Massachusetts (PhD 1966). After a National Institute of Health post-doctoral position at the Enzyme Institute, University of Wisconsin, he was a faculty member in the Food Science Department at Rutgers University from 1968 to 1976. He then joined the Department of Biochemistry at the Memorial University of Newfoundland, where he helped introduce undergraduate and graduate programs of study in Food Science and Nutrition. In 1986, he came to his present position at the Institute of Marine Resources at UC, Davis.

Professor Haard has been very active internationally in developing food science and technology programs in academic institutions in China, Mexico, Pakistan, and Thailand.

He has served on numerous editorial boards and is currently editor of the *Journal of Food Biochemistry*.

Norm's research has focused on the post-harvest biochemistry of edible plants and aquatic organisms, and he has been recognized with IFT's Samuel Cate Prescott Award (1973), Atlantic Provinces Intercollegiate Committee's Fraser Award (1980), and Atlantic Fisheries Technologists' E. P. McFee Award (1997).

An active member of IFT, he has served on a number of committees and award juries, including the Annual Meeting Program Committee and the Prescott Award Jury. ≈

Utah Begins Triploid Rainbow Trout Production

The Ichthyogram, May 2001, Reported in Idaho Aquaculture Association Newsletter, July 2001

triploid rainbow trout

Sterility is beneficial in preventing hybridization with native cutthroat trout

Research biologists at the Fisheries Experiment Station in Utah have announced the apparent success of the first production-scale, heat-shocking process for production of all-female, triploid rainbow trout.

Triploids possess three sets of chromosomes instead of the normal two, rendering them sterile. Because of the possible impact of sterile rainbow trout males on native cutthroat trout, production of all female triploids is of interest. Triploid males still produce sperm, but the sperm duct is blocked, preventing fertilization. However, these fish still behave as fertile males, possibly displacing fertile males during courtship. For reasons unknown, female triploids do not produce gametes. Therefore, it is desirable to rear all female rainbow trout for areas in which they may compete with spawning cutthroat trout.

This may be achieved by altering the hormonal balance in hatchery feed during the first 60 days. Half of these fish develop as true males, but the other half are sex-reversed and become phenotypic males, but genotypic females (i.e., they look and produce sperm like males, but genetically are female). These are the fish used for spawning to produce all female progeny. They are selected from the true-male group by attempting to strip milt when they reach 2 years of age. If milt is expressed, it is considered a normal male and discarded. If milt is not expressed, it is considered a sex-reversed fish and the gonads are surgically removed for use.

Sex-reversed broodstock have been produced at the Fisheries Experiment Station and 2-year classes have been transferred to the J. Perry Egan State Fish Hatchery. Work in Fall 2000 was the first attempt at using this triploid production. Generally, these fish are sacrificed for the gonads, creating a yearly need for males. An attempt was made to surgically harvest only one gonad and recover the fish for reuse the following year. Although the surgical process was successful and the fish recovered, later complications from suture dehiscence necessitated the euthanasia of the fish. Plans are being formulated to retry the procedure with different suture material.

The triploidy process involved heat shocking of eggs at 26–27°C for 20 minutes at 20 minutes after fertilization. Based on previous testing, this regime worked well for achieving high percentages of triploids without the major egg losses observed at higher temperatures. The heat shocks were conducted in a hatchery trough at the Egan Hatchery using recirculating heater pumps to maintain the temperature.

A total of 1.6 million eggs of both the Sand Creek and Ten Sleepstrains were treated. Egg survival was relatively high, so there were many excess eggs that were discarded.

Some combining of lots was done for shipping, resulting in five lots that were reared at the state hatcheries in Springville—Loa, Kamas, and the Fisheries Experiment Station. All but the Kamas lot were progeny from the XX males and should all be female. The five lots were sampled recently by diluting blood from 60 fish per lot in Alsere's anticoagulant solution. These were kept cold and shipped to Washington State University where Paul Wheeler analyzed the samples using flow cytometry. Overall the average triploidy rate was 99.7%.

The results indicate that the first year of production was a great success. Sterility is beneficial in preventing hybridization with native cutthroat trout. It can also produce bigger fish, because the energy normally put into gonads is put into growth. These differences become more noticeable as the fish mature in the age 3 year class and older, so put-and-take programs would not see much growth benefit. Most of this year's production will be stocked into Strawberry Reservoir. Further production is planned. DWR Sport Fish Managers are considering the sterilization of the majority of rainbow trout production in the state for future stocking. ≈

The Aquaculture Business is for the Birds

Bob Robinson, Communications Committee Chair, National Aquaculture Association, AFS Newsletter, October 2001

Many species of birds are drawn to the pen water and large concentrations of fish and shellfish on aquaculture facilities. The result is significant predation on aquacultured products. Birds are highly mobile, adaptable, and able to rapidly exploit food abundance.

The severity of the predation problem varies by species of bird, number of birds present, size of available fish, and whether the birds reside seasonally or throughout the year. In recent years, populations of normally migratory birds have remained near fish production facilities year-round.

Think about it from a "bird's-eye view:" If you were headed down the Mississippi flyway and came across ponds stocked at up to 6,000 pounds per acre with catfish, what would you do? With more than 100,000 acres in catfish production in Mississippi state alone, it is easy to see the potential for some serious problems.

In recent years, populations of normally migratory birds have remained near fish production facilities year-round

The birds most often responsible for damage are herons, cormorants, and pelicans. Besides eating fish, these birds can injure and stress fish, disrupt feeding activity, eat the fish's food, disturb breeding behavior, and contribute to poor fish health.

Currently, the catfish industry is dealing with a parasite problem that moves into ponds via pelican droppings, with a snail as an intermediate host and the catfish as the final host. In larger fish, the result is reduced feeding, which stunts growth. In smaller fish, the organism can be lethal. Infected fish cannot be sold.

Large numbers of birds often roost on shellfish culture structures. Because of the birds' fecal droppings, some sites repeatedly fail to meet standards set up by health service agencies. The aquacultured product can't be sold until water quality is improved.

Some farms have reported annual losses in excess of $200,000. In the lower Mississippi Valley, estimates are as high as $18 million.

These fish-eating bird populations all seem to have experienced rapid growth in the last 30 years. This can be attributed to the ban of DDT, reduction in wetlands, and protection under the Migratory Bird Treaty Act.

Control can be difficult and costly. Bird-dissuasion devices (e.g., air cannons and other scare tactics) are of limited success. Devices such as cages or netting to cover the rearing area are expensive and interfere with daily chores. Simple control methods rarely solve the problem.

Colin French

Brandts cormorants nesting at Yaquina Head, Oregon

The US Department of Agriculture has issued a Cormorant Depredation Order, which is in effect in 13 states. This order allows for controlled harvesting of cormorants that pose an immediate threat to fish farmers' livelihoods. It is hoped that this order will be expanded to include all 50 states in the near future.

Management of birds must be considered at the flyway level to yield meaningful results. Localized efforts can produce some results but will not modify population nor significantly change levels of predation.

There must be international cooperation as well as dialogue among all interested parties, including bird lovers and those who feel that all fish-eating birds are a danger to their livelihood. Somewhere in the middle, a decision must be reached setting upper and lower population numbers that are acceptable to all. ≈

Pacific Aquaculture Caucus—Conference & Workshops

Colin Nash, Pacific Aquaculture Caucus, 2002

past, present, & upcoming meetings

Conference

In October, the Pacific Aquaculture Caucus (PAC) held a one-day conference before its annual general meeting in Seattle. PAC Chair, Dan Swecker, welcomed invited speakers and about 50 members and their guests.

Bill Dewey, representing the National Aquaculture Association, gave the keynote address, "*Aquaculture: A national perspective for a new century.*"

A lively panel discussion followed on "*Public policy issues: A Pacific perspective—What aquaculture issues face the region, and what role can PAC play?*" Ken Chew (WRAC) was the panel facilitator, and panel members included John Forster (Forster Consulting), Dan Cheney (Pacific Shellfish Institute), Marc Hershman (UW, School of Marine Affairs), and Conrad Mahnken (NMFS).

The morning session concluded with a series of industry and regional presentations, about "*Opportunities for expansion, public policy issues, and research needs.*" Individual contributors included Bill Dewey (Pacific Shellfish Growers Association, Dan Swecker (Washington Fish Growers Association), Ray RaLonde (Sea Grant Marine Advisory Program, Alaska), and Jim Johnson (Department of Agriculture, Oregon).

Lunchtime speaker, Dan Herman, of the National Fisheries Institute, spoke on "*NACNFI Updates and Projects.*" After lunch, there were status reports on the "*Development of Industrial Codes of Practice*" by Pete Granger, on the work of the Washington Fish Growers Association, and Robin Downey spoke about the work of the Pacific Coast Shellfish Growers Association. A lengthy General Working Session on Codes followed, which became an open forum.

Annual General Meeting

At the ensuing annual meeting, it was announced that the 12 Board of Directors were returned to office following postal elections. Subsequently, the Board members elected Dan Cheney as Chair, and Dan Swecker as Vice-Chair. The Board made no change to membership dues.

At the dinner reception after the meeting, Ken Chew spoke about the work of WRAC.

Upcoming Workshops

Spring

As we go to press, PAC is organizing a two-day workshop to be held in Sequim, Washington on March 26 and 27, 2002. The first day is on Aquaculture Regulations and the second day is on Research Goals—both from the West Coast perspective.

PAC is inviting agency policy makers; industry leaders; Native American tribal leaders; academic aquaculture researchers; and leaders in local, state, and federal government to come together to help:

- Develop a regional legal framework, with coordinated regulatory policy, to enable economically viable and environmentally sustainable aquaculture development while still preserving cultural and social values.
- Create a regional administrative framework to enable aquaculture development to meet the challenge of the nation's aquaculture production goals.
- Identify and prioritize areas of research to achieve production objectives, such as:

  Increase production in existing facilities in environmentally compatible ways.

  Demonstrate the benefits of aquaculture to the environment.

  Develop environmental mitigation programs using "restoration aquaculture."

- Create a system for monitoring and evaluating regional aquaculture development.

Summer

On June 25 and 26, 2002, PAC is assisting NMFS, the Idaho Department of Fish and Game, and the Oregon Department of Fisheries and Wildlife to carry out a workshop on *Captive broodstocks for recovery of imperiled salmon populations* in Gig Harbor, Washington. The organizers are calling for posters, and arranging for plenary discussion papers.

Information on the Spring and Summer Workshops can be found on the PAC home page: *http://www.pacaqua.org* ≈

The State of Alaska Aquaculture: A Changing Perspective

American Fisheries Society Newsletter, July 2001

On these facing pages, we present two articles reflecting the changing times, efforts, concerns, and interests surrounding aquaculture in Alaska. The first was published in the American Fisheries Society newsletter in July 2001; the second was written in February 2002 by Ray RaLonde, an aquaculture specialist at the University of Alaska.

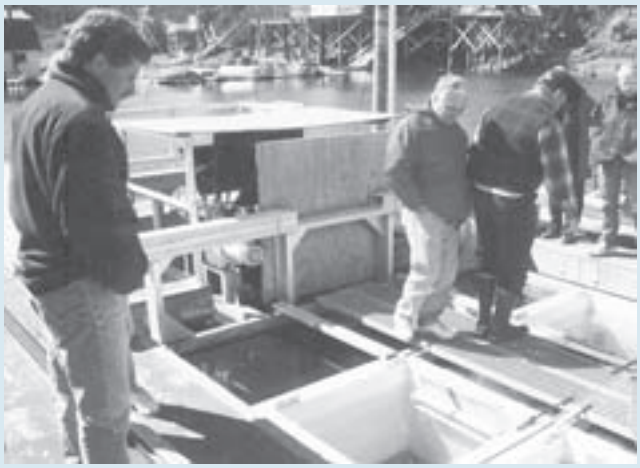
—Ken Chew

July 2001

Alaska fishermen and legislators have taken an unyielding approach to aquaculture for many years in an effort to protect wild fisheries. The state prohibits all forms of finfish aquaculture.

For shellfish, the state recently proposed to prohibit a clam or oyster farm if it might disrupt shorebirds, milling salmon, or threatened wildlife within a critical habitat area, or if the farm is some place that might be used for cultural or ceremonial purposes or for commercial fishing. Shellfish farmers say these restrictions could pretty well rule out any beach or cove in Alaska.

The proposal sets quarantine rules for transferring species such as scallops and mussels from one location to another. Farmers say this rule would effectively make scallop and mussel farming illegal. Although the regulations are being modified in the face of these objections, they represent the view that aquaculture is a threat to the state's economy, rather than a potential benefit.



Ken Chew

An upwell flupsy barge nursery system for Pacific oysters at Halibut Cove, in Alaska

Farmed fishing's impact

The original reason for opposition to aquaculture was fear of mixing farmed and wild Pacific salmon stocks, leading to the genetic weakening of wild salmon. Today, a more important reason is concern for markets. Alaska used to be the primary source for salmon in the world. Over the years, they have watched each of their salmon markets become more and more dominated by farmed fish.

The US retail market for salmon is overwhelmingly served by farms in Chile, Canada, Maine, and Norway. Alaskan salmon has become a niche player in this market. Some fishermen in Alaska are now asking the US government to restrict Chilean imports—although they have not filed any type of formal trade complaint.

The US food service market has more room for Alaskan salmon because it is promoted effectively as a seasonal item. The Copper River fishery, for example, is promoted as the first wild salmon of the season.

The primary Alaskan salmon market in Japan for Bristol Bay sockeye has been impacted by Chilean coho salmon to the point where Bristol Bay prices are now set by the overall price of farmed coho salmon in Japan.

Now, the state's halibut fisherman are wondering if they are next. Recently, in Anchorage, the Alaska Seafood Marketing Institute heard a presentation suggesting that farmed halibut was on the verge of becoming a widely produced, affordable consumer product. For holders of halibut licenses who recently won the right to individual fishing quotas, that represents a threat.

Some Alaska legislators are working on a proposal to impose a marketing tax of 1% on halibut permit holders, similar to the marketing tax on salmon permit holders, to provide funds to market Alaskan wild fish.

But, as the state is gearing up to fight farmed halibut, it has to be asked if the industry would be better off with a complete change of direction? Norway has seen its farmed salmon industry become one of the leading industries in the country, while its existing whitefish processors have struggled to retain fish and make profits.

Most analysts see the major areas of growth in the seafood industry coming from increased efficiencies in fish farming, and the expansion of economical farming techniques to more species, including cod, halibut, flatfish, and eventually crustaceans. Alaska has tremendous natural resources, in terms of growing areas and pro-

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Raymond RaLonde, Aquaculture Specialist, University of Alaska, School of Fisheries & Ocean Sciences, February 2002

February 2002

Alaska is often considered to be a hotbed of opposition to aquaculture since the legislature banned finfish farming in 1990. Such a notion is ill conceived. Aquaculture operators in other parts of the United States have a general misunderstanding of the role of aquaculture in Alaska. Even in Alaskan fisheries circles where opposition to aquaculture is still enormous, discussions on fish farming are no longer behind the scenes.

Alaska is very active in the aquaculture industry. In fact, the salmon ranching industry is the best ocean ranching program in the United States in terms of its production and economic impact, and shellfish farming is on the verge of major development.

Salmon ranching from 31 private nonprofit hatcheries releasing smolt into the North Pacific ultimately contributed over $56 million into the pockets of Alaskan fishermen in 2000. The cost-recovery income resulting from terminal harvests near hatcheries contributed $26 million to aide in operational costs for the hatcheries. Cost-recovery income is officially defined as agriculture production, making aquaculture Alaska's number one agriculture commodity.

Some critics of Alaska's hatchery system condemn the salmon ranching program because a number of private nonprofit salmon hatcheries are behind in their construction loan repayments to the state. But, for dollars input and income generated, the salmon hatcheries have been one of the state's best investments.

Alaska salmon hatchery operators are some of the most skillful fish culturists in the nation. They operate their production facilities with extraordinary attention to fish health, labor under enormous regulatory safeguards, and provide real income to the commercial fishermen that support them through their harvest assessment program.

As America's last frontier, Alaska is in the unenviable position of being under the environmental protectionist microscope. Politically, congressmen from states far removed from Alaska have a profound affect on the development of the state's marine resources. As a new enterprise for Alaska, shellfish aquaculture must conform to a stringent set of environmental rules. As an example, Alaska regulations ban the importation of exotic species for the purpose of aquaculture, with the exception of Pacific oysters that do not reproduce in Alaska waters.

In addition, considerable conflict has recently surfaced between the industry and the Alaska Department of Fish and Game (ADF&G) Habitat Division over the possible environmental impacts of on-bottom clam farming. As often occurs during times of conflict, considerable misinformation fuels the fire.

In response, a conference sponsored by ADF&G, the Pacific Aquaculture Caucus, Alaska Export Council, and Alaska Sea Grant was held in Anchorage last fall to "*Explore On-bottom Shellfish Aquaculture*" and to provide information on environmental impacts. The Alaskan Shellfish Growers Association, with a grant from the Alaska Conservation Alliance, is nearing completion of a draft environmental code of practice for the industry, another step to address environmental concerns.

Alaskan shellfish aquaculture, because of the exotic species import ban, could only raise Pacific oysters until 1997 when the state built its first shellfish hatchery. This state-of-the-art facility (the Qutekcak Shellfish Hatchery), coupled with the talents of Jon Agosti, hatchery manager, has been able to produce seed for four indigenous species: Littleneck clam *Protothaca staminea*, purple hinge rock scallop *Crassadoma gigantea*, basket cockle *Clinocardium nuttalli*, and geoduck clam *Panopea abrupta*. Growout studies are underway, and a number of farmers are participating.

The Aquatic Farm Act of 1990 specifically states, "It is the policy of the state to encourage the establishment and responsible growth of an aquatic farming industry." Two important events have eased regulatory constraints since 1998: development of a 10-year tidelands leasing program within the Alaska Department of Natural Resources and hiring a proactive Mariculture Coordinator within ADF&G. Despite recurring problems within current aquaculture regulations, University of Alaska and the shellfish aquaculture industry initiatives are moving ahead at breakneck speed. Equipped with over $425,000 of grant funding, hatchery research, growout projects, product quality studies, marketing, and aquaculture zoning projects are now underway.

The Western Regional Aquaculture Center plays an important role in Alaskan aquaculture. Alaska has representatives on all of WRAC's committees and the Board of Directors. Salmon ranchers have received benefits from WRAC's IHN research and feed development, and effluent water quality research will provide information necessary to meet future water quality discharge requirements. Current WRAC research in the development of oyster broodstock and studies on the impact of

continued on next page

Alaska Aquaculture

July 2001
American Fisheries Society Newsletter

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cessing infrastructure, which could benefit from a surge in fish farming. At what point will the fishing interests in the state determine that they have more to gain from joining this new wave of seafood production instead of philosophically opposing it?

Producing areas live and die by their markets. No producing area can afford to indefinitely ignore such major market changes as are taking place with seafood. ≈

February 2002 Ray RaLonde

continued from page 13

on-bottom aquaculture will provide significant, practical results that will benefit shellfish aquaculture.

As an indication of the changing mood about aquaculture, the University of Alaska, Qutekcak Shellfish Hatchery, and representatives of the Alaska Shellfish Growers Association were invited to give a presentation to the legislative Fish Caucus. Traditionally, the Caucus focuses on commercial fisheries; for aquaculture to be invited is a significant event. The presentation so impressed legislators that support for shellfish aquaculture has been pushing forward legislation that could open up a substantial number of farming locations and provide funding for planning industry growth.

Based upon the premise that shellfish aquaculture is an economic opportunity for coastal Alaskans in dire need of assistance and is compatible with commercial fishing, expect Alaska to pursue shellfish aquaculture as a positive and progressive new industry for the last frontier. ≈

WRAC seeks
Committee Nominations

WRAC is soliciting nominations for leaders in the aquaculture industry to serve as representatives on the Industry Advisory Council (IAC) and as members of the Technical Committee's (TC) Research Subcommittee. Nominations are invited from all sectors of the aquaculture community in the twelve states of the western region. *(You may nominate more than one individual for both IAC and TC.)*

Industry Advisory Council

Members are selected from all sectors of the aquaculture industry, including finfish and shellfish producers, suppliers of goods and services, and marketing and distribution personnel.

Technical Committee's Research Subcommittee

Individuals with extensive scientific expertise in any of the following disciplines are desired:

General fish culture	*Fish nutrition*	*Physiology*
Diseases of shellfish	*Engineering*	*Product quality/preservation*
General shellfish culture	*Marketing*	*Diseases of fish*
Shellfish nutrition	*Water quality*	*Reproduction*
Broodstock management	*Genetics*	*Economics*

To submit a nomination, provide the information requested below, specifying whether the nomination is for the IAC or TC. Please include your name, phone number, and e-mail, in case further information is needed. Forward the information via:

e-mail: cjn4@u.washington.edu
fax: 206-685-4674
mail: Carla Norwood, WRAC Administrative Office
School of Aquatic and Fishery Sciences
University of Washington, Box 355020
Seattle, WA 98195-5020.

If you have questions regarding the nomination process, contact Carla Norwood: ph: 206-685-2479; email (see above)

NOMINATION DEADLINE IS FRIDAY, APRIL 12, 2002

☐ Technical Committee ☐ Industry Advisory Council

Name of nominee _____

Address _____

Phone _____

Area(s) of expertise _____

Your name _____

Your phone _____

East Coast Shellfish Growers Association: A Possibility

Ken Chew, WRAC Director, School of Aquatic & Fishery Sciences, University of Washington

On February 25–27, 2002, the Milford Aquaculture Seminar held in New Haven, Connecticut, was the scene of an important discussion concerning the prospects of forming an East Coast Shellfish Growers Association (ECSGA).

Interest in an East Coast association has been growing for several years. The Pacific Coast Shellfish Growers Association's activities, organized efforts to maintain a viable industry, and development of a Best Management Practice code have demonstrated what can be accomplished by a regional organization.

Karen Rivara of Aeros Cultured Oyster Company in New York, presented the rational for forming an association. She noted that over the past 25 years, shellfish aquaculture has grown on the East Coast in spite of many obstacles. New owners and operators of East Coast aquaculture facilities come from many sectors of the economy, from retired school teachers and recent college graduates to members of the traditional fisheries who look to aquaculture to maintain a sustainable living on the water. Established shellfish companies continue to use and improve various culture methods to meet the challenges of consistent production presented by losses due to disease and the loss of good cultivation areas. A regional organization would enable aquaculture operators to work as a group to handle issues which confront the East Coast industry, from legislative reform to litigation procedures.

Other stakeholders in the marine environment have challenged the growth of shellfish aquaculture. According to Rivara, this challenge stems predominantly from a lack of understanding regarding the impacts of the shellfish aquaculture industry. Shellfish aquaculture is sometimes viewed as an impediment to the development of other industries in the marine environment (i.e., recreation, port development). In addition, many benefits of the industry such as increasing seafood production, jobs, and economic development are overlooked.

Unfortunately, many of those opposed to the industry have taken their grievances to legislators and the press, fostering a lack of understanding and animosity in government attitudes and public opinion. Often, aquaculturists are put in the position of having to take time from their business to defend their livelihood against unreasonable public opposition.

Rivara and colleagues have worked together to develop goals for the proposed association:

- Establish an association that represents our strength and diversity.
- Organize to respond to growers' needs in each state and the region as a whole.
- Promote and protect the industry.
- Work effectively with other stakeholders and organizations.
- Involve the industry, academia, extension, government, public shellfish, and other stakeholders in the task of enhancing the shellfish aquaculture industry.

At the seminar, participants discussed these goals and other issues important to the industry. They also stressed the importance of getting as many industry representatives as possible to attend the National Shellfisheries Association (NSA) annual meeting in April, 2002, where on April 15, there will be a major all-day session to discuss the formation of an East Coast Shellfish Association. We encourage industry members to attend this day-long discussion session—there will be a special reduced registration fee for participation in this one-day event only.

The complete NSA annual meeting will be held on April 14–18, 2002 at the Hilton Mystic Hotel in Mystic, Connecticut. (To reach the hotel directly, call 806-572-0731.) For information on NSA registration, call Ms. Joyce Wood-Martin at 860-405-9152. ≈

Ken Chew

Gef Flimlin, Rutgers Cooperative Extension, and Karen Rivara, Aeros Cultured Oyster Co., discussing the formation of ECSGA to industry representatives

naa news National Aquaculture Association "One Industry• One Voice" Newsletter, 2001

John R. "Randy" MacMillan

Courtesy of R. MacMillan

President's Message

There is considerable wisdom in the words of Sören Kierkegaard, the 10th century Danish philosopher and theologian who said, "Life must be lived forwards, but can only be understood backwards." The mission of the NAA is "to provide a unified national voice for aquaculture that ensures its sustainability, protects its profitability, and encourages its development in an environmentally responsible manner." As the NAA looks back over the past year, we develop some sense of accomplishment but we also are sobered by the realization that many of our tasks will require persistent, long-term effort.

As the NAA has reached a critical mass of talent and support, we have become intimately involved in a wide variety of national issues. For example, we have been deeply involved in trying to guide the US Environmental Protection Agency (EPA) to develop appropriate, scientifically based and economically feasible effluent guidelines. We have been, along with various terrestrial animal interests, a significant force in trying to secure additional flexibility for the Food & Drug Administration (FDA) to ultimately improve the availability of essential therapeutic agents for minor animal species such as all aquatic animals.

The NAA is intimately involved in the debate regarding non-indigenous, invasive aquatic animals, striving to ensure that the programs developed nationally or regionally are practical and of course, appropriate. We have attempted to steer debate about national organic standards for aquacultured animals and we have been involved in national aquatic animal health management issues.

As the NAA has reached a critical mass of talent and support, we have become intimately involved in a wide variety of national issues

While these efforts, and others, are bearing fruit and we have made positive steps, our involvement has still not resulted in a substantively improved national regulatory climate for US aquaculture. There are several reasons for this situation, but paramount has to be that the complexity of the issues and the forces, often competing, require a long-term commitment and at times an adaptable approach.

The NAA must continue to look forward, adapt to inevitable change, stay focused on our mission, and at times, be patient. To illustrate the dilemma, we need only look at our efforts with EPA and FDA. The national effluent guidelines efforts of EPA will soon reach a climax with the proposal of effluent guidelines in 2002. Considerable effort by many parties including the NAA has been put forth to provide EPA with credible information hoping to better educate the decision makers about US aquaculture. In spite of these efforts, there continues to be other less well-informed forces apparently influencing EPA. The outcome of these efforts is in doubt so we need to continue. Our effects through the Minor Use and Minor Species (MUMS) legislation to provide FDA with greater flexibility to ultimately provide additional therapeutic agents for aquaculturists, while proceeding, is moving very slowly through Congress.

We have been working on this legislative issue for over two years. Congress has recently been preoccupied with terrorism, biosecurity, and economic issues. For us to move forward, MUMS will require a concerted effort by everyone to recruit cosponsors, but we also will need to provide the legislation's sponsors some flexibility on how to get the bill passed. Above all, we must maintain our commitment, be persistent, and look forward.

For the NAA to continue its efforts on your behalf, we will need your continued support. We need your financial support and your talents. We need thoughtful ideas and sometimes, a commitment of your time. We are fortunate to have a very talented staff with Betsy Hart and Mary Wiltshire but they cannot do everything. If we are to be successful, we all must participate. If we all participate, the burden on any individual will be lessened. Thank you for your support. ≈

One Industry - One Voice

The National Organic Standards Board (NOSB) established an Aquatic Animal Task Force and two working groups to advise the NOSB on organic certification standards for operations that produce aquatic animals. The working groups submitted minority and majority recommendations. NAA recently wrote Secretary of Agriculture Ann Veneman and requested a delay in voting until further investigation. The minority recommendation from the Task Force was to limit fish meal oil to 5%. It is hoped that the majority recommendation will prevail, allowing for optimum natural feed requirements for each species.

NAA submitted comments to the Gulf of Mexico Regional Panel on "*An initial characterization of non-indigenous aquatic species in the Gulf of Mexico region*" and effected withdrawal of the document from public circulation. The Panel then agreed to a review by an NAA-appointed committee of industry experts from the southeastern US whereby many errors were corrected.

NAA participated in evaluating proposals submitted to NOAA's National Marine Aquaculture Initiative Request for Proposals. NOAA's ambitious policy calls for increasing the value of US aquaculture products annually from $1 billion to $5 billion by 2025. The US trade deficit in seafood products is $7 billion annually. NOAA's initiative stresses applied research leading to commercial production and awards points for private sector participation and commercial applications of results by private users.

NAA joined other animal Agriculture Coalition members in submitting written testimony to the Committee on Agriculture, Nutrition, and Forestry concerning the Research, Extension, and Education Title of the 2002 Farm Bill. The committee was urged to protect and increase the federal investment in agriculture research and education programs and facilities.

NAA joined other members of the Food Industry Dioxin Working Group in a letter to EPA Administrator Christine Todd Whitman that expressed continuing concern over deficiencies in EPA's Draft Dioxin Reassessment. The deficiencies could, if not addressed correctly, cause unnecessary loss of consumer confidence in foods of animal origin, affecting domestic markets and international trade.

NAA submitted written testimony urging support of full funding for the Regional Aquacultural Centers to the House Subcommittee on Agriculture, Rural Development, FDA, and Related Agencies.

NAA joined other animal and agriculture groups in submitting a joint letter of support to the Subcommittee on Agriculture, Rural Development, FDA, and related agencies to strengthen Wildlife Service's resources and to ensure a continued federal partnership in the responsible management of our nation's wildlife.

NAA met with FDA's The Aquaculture Partnership (TAP) to discuss dioxin, import tolerances, extra-label use of medicated feeds for minor species, Vietnamese catfish misbranding import alerts, biotechnology in seafood, and possible development of good aquaculture practices for human pathogen reduction in the international shrimp industry.

NAA submitted comments regarding the Aquatic Nuisance Species Task Force draft strategic framework.

NAA participated in a workshop hosted by the Commission for Environmental Conservation on Preventing the Introduction and Spread of Aquatic Invasive Species in North America.

NAA submitted comments on a brochure that is being developed by the Western Region Panel on Aquatic Nuisance Species for invasive species educational purposes.

NAA participated as a steering committee member reviewing the National Fish Hatchery System. The Sport Fishing & Boating Partnership Council released a report title "*Saving a System in Peril: A Special Report on the National Fish Hatchery System.*"

NAA participated in the first comprehensive assessment of federal policy/regulatory issues on a framework for offshore marine aquaculture in the 3–200 mile US ocean zone. The report describes the status of marine aquaculture in the US, the rationale for siting projects offshore, using reviews, case studies, alternative approaches, and international experience, and it identifies and advocates approaches for development in the US Exclusive Economic Zone. A follow-up study with national workshops and regional meetings from areas currently involved in developing offshore aquaculture (New England, Gulf of Mexico, and Hawaii) will be held to discuss and later revise the policy framework. The final intent is to present Congress, federal agencies, and other interested groups with a policy framework for future offshore marine aquaculture development. ≈

Healthy Eating

NUTRITIONAL VALUE OF SHELLFISH

A Washington Sea Grant Publication

Faye M. Dong, Professor
School of Aquatic and Fishery Sciences
University of Washington

Maintaining good health and a sense of well-being are top priorities for many people today. Both health and well-being are strongly related to diet. The relationship of diet to overall health and the effect of diet on the incidence of certain chronic illnesses, such as heart disease and cancer, continue to be active areas of nutrition research. Compared to the past, people today are generally more careful in managing their diets to reduce the chances of getting life-threatening diseases. People are also paying more attention to better managing any diseases they may already have, and to changing their lifestyles to sustain longer and healthier lives. Based on current dietary recommendations, this paper examines whether shellfish should be included in a healthful diet.

For a copy, contact:
Washington Sea Grant Program
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fax: 206-685-0380,
email: *seagrant@u.washington.edu*

Healing Mouth Sores

People who suffer from mouth sores can find a lasting cure in a new medicine made of shrimp and crab shells, Chinese scientists say. The medicine, made of substances extracted from shells of shrimp and crabs was developed by scientists with the Water Treatment Center under the State Oceanic Administration in Hangzhou, capital of China's Zhejiang Province.

Although ulceration of the oral cavity, or mouth sores, are not considered serious, they usually take a long time to cure and cause discomfort for patients when they are speaking or eating.

The medicine must be applied twice a day to the affected area, said Sun Ziuzhen, a researcher with the center, who has studied the shells of shrimp and crabs for nearly ten years.

—American Fisheries Society Newsletter

Helping Autistic Kids

Two-thirds of children with autism are likely to have a fatty acid deficiency that may be responsible for some of the behaviors and symptoms of autism. Dr. Gordon Bell of Stirling University in Scotland, compared 55 autistic and non-autistic children looking for signs of a fatty acid deficiency. He found that 65% of autistic children with 12% of non-autistic children showed symptoms of the nutritional imbalance. He recommended fish-oil supplements. He said: "when we treat some of these kids by replacing depleted fatty acids we see improvement in some of the behaviors and characteristics of autism, their concentration improves and their sleep patterns stabilize.

—Netdoctor.co.uk

Cutting the Risk of Ovarian Cancer

Eating fish and vegetables may reduce women's risk of developing ovarian cancer, while frequent consumption of red meat may increase the risk, a new study showed.

The results showed that frequent consumption of red meat was associated with an increased risk of ovarian cancer. Women who had high intakes of bread, soup, sugar, pasta, and rice also had a slightly increased risk of ovarian cancer.

Women who consumed high quantities of fish, cheese, vegetables and edible seeds such as peas and beans had lower incidences of ovarian cancer. The study appears in the Sept. 15 issue of the *International Journal of Cancer*.

—FaxWatch Inc., September 24, 2001

Health Benefits of Omega-3 Fatty Acids

There is a growing weight of evidence that the health benefits of fish oils are so manifest, and so varied, that they may soon be considered a legitimate and widely used health aid rather than a simple, healthy food product.

In the April 24, 2001 issue of the *New York Times*, several current and recent health studies were examined, covering fish's various effects on a broad array of illnesses, conditions, and diseases. While the consensus among health professionals is that more extensive research is needed, every study cited fatty fish, including sardines, tuna, and salmon, to be a legitimate health aid and in some cases, a critical dietary component.

Among the recent findings:

Heart disease

Last year, the American Medical Association (AMA) recommended that people eat two servings of fatty fish per week. The AMA concluded that there is a beneficial effect on nerve conduction in the heart, which can help forestall potentially dangerous cardiac arrhythmia. Other recent heart-related research indicates that fatty acids may prevent heart attacks due to clotting, help reduce atherosclerosis, and reduce blood triglyceride levels.

Stroke

A study published in the *Journal of the American Medical Association* found that women who ate fish once per week suffered strokes at a rate 22% less than women who ate fish just once a month. Significantly, the health benefits increased with greater levels of fish consumption. Women who ate fish five times per week were 50% less likely to have ischemic (clotting, rather than hemorrhagic) stroke than the control group. The report examined 80,000 women enrolled in the Nurses Health Study, one of the nation's oldest, largest, and most respected research efforts, and was adjusted for age, smoking, and other risk factors.

Arthritis

The anti-inflammatory properties of fish oils have been put to the test in more than a dozen studies, and the medical consensus is that people with rheumatoid arthritis can mitigate their symptoms with regular consumption of fish. Fish oils were found to be particularly effective in lessening levels of joint stiffness and fatigue.

Crohn's disease

A recent study in the *New England Journal of Medicine* of patients with Crohn's disease and chronic irritable bowel syndrome indicated that more than half of the people studied remained symptom-free if they took Omega-3 along with their medication.

Mental health

Among the most intriguing and important developments in fish oil research has been the potential it has to address mental disorders and psychiatric health.

Dr. Andrew L. Stoll, director of the Psychopharmacology Research Laboratory at McLean Hospital found that in a small study, the patients he was treating for bipolar disorders did so much better with fish oil supplements, he began administering the treatment to his control groups halfway through the study. In his recent book, "The Omega-3 Connection," Stoll argues that, while research on psychiatric applications was still in its infancy, Omega-3s are a critical component of brain health and may help mitigate a wide range of psychiatric disorders.

Dr. Joseph Hibbeln, a psychiatrist with the National Institutes of Health, has found a critical link between Omega-3 fatty acids and depression, asserting that decreased levels of an Omega-3 component, DHA, were directly linked to depression. A large study is under way at the National Institute of Mental Health to verify these links between Omega-3s and mood disorders.

—WorldCatch News, 2001

SOURCES OF OMEGA-3*

Sardines	1.5 grams
Atlantic mackerel	2.5 grams
Herring	1.7 grams
Lake trout	1.6 grams
Salmon	1.2 grams
Striped bass	0.8 grams
Tuna	0.5 grams
Pacific halibut	0.4 grams
Channel catfish	0.3 grams
Shrimp	0.3 grams

** per 100 grams of raw fish*

Source: American Dietetic Association

Trout Farmers Not Deterred by USDA Report

Adapted from an article by Cindy Snyder, The Times-News, April 11, 2001

Idaho producers remain optimistic about sales

Trout producers in the Magic Valley in Idaho aren't putting much stock in a US Department of Agriculture (USDA) report that shows the value of trout sales fell last year.

For one thing, the reported total sales of $76 million from 20 trout-producing states represents a decrease of just 1% from 1999 sales. And while the USDA estimate is the best number available, there is some question about how accurate the number is.

The USDA sends out forms for trout producers to report sales for the past calendar year, but most companies operate on a fiscal year that is different from the calendar year. Just the process of converting numbers from one system to another can introduce errors.

Early concerns that seafood sales would fall off as the US economy slowed have not yet shown up in the numbers

Randy MacMillan, who has the advantage of heading up research for Clear Spring Foods in Buhl and serving as president of the National Aquaculture Association, said it's difficult to generalize what happened last year. While sales continue to be strong for Clear Springs Foods, other trout companies may not be doing as well—depending on where they market the trout and how the trout is sold.

Early concerns that seafood sales would fall off as the US economy slowed have not yet shown up in the numbers. MacMillan said an abundance of cheap aquaculture-produced salmon on the market continues to lure consumers to the seafood counter. "That's a good thing; it increases consumer interest in seafood," he said.

According to the USDA's March 2001 *Aquaculture Outlook*, most of the decrease in sales in 2000 came from lower sales of food-sized fish—trout that are 12 inches or more in length. Nearly 59 million food-sized fish were sold in 2000, down 4% from 1999. The value of those sales was $63.7 million, down 2% from the previous year. Most of that decrease was seen in Idaho, which accounts for 53% of the total value of trout sold in the nation. Increased food-size fish sales from California, Pennsylvania, and Washington partially offset the loss of Idaho.

Sales of stockers (fish 6 to 12 inches) totaled 7.6 million fish in 2000 with a value of $6.7 million—both figures are up from a year ago. Nearly half the stockers were sold to private organizations to stock rivers and fish; the rest were sold to other producers or processors.

Both the sales volume and value of fingerling sales (fish under 6 inches) were about the same as 1999. Trout egg sales in 2000 were valued at $4 million, down 19% from 1999.

According to the report, 44.5 million pounds of trout were sold in 2000, down from 46 million pounds in 1999. Sales totaled $36.9 million in 2000, down from $37.2 million in 1999.

Looking at the report, MacMillan sees reason for optimism for the aquaculture industry. Consumers continue to gobble up imported tilapia, Atlantic salmon, and shrimp. There's a large domestic market for aquaculture products. US producers just have to find a way to take advantage of it. ≈

Ken Chew

Trout farm located along the Snake River in Idaho

Fish Farming Insurance

American Fisheries Society Newsletter, October 2001

Insurance targets fish farming business

Fish farmers need no longer flounder in their search for appropriate insurance protection. The Hartford Financial Services Group, a major insurer of livestock, has created a new insurance program to target the fast-growing fish farming business. Whether a fish farm is an indoor or outdoor operation, the Hartford can protect this livestock through its Fishstock Mortality Program.

The program provides fish farmers broad coverage to ensure their operations are protected if fishstock die from weather conditions, disease, or mechanical and electrical breakdowns.

The Hartford has introduced a customized insurance policy that partners fish farmers with their local insurance agents to review specific needs.

The basic Fishstock Mortality Program covers fishstock that die as a result of specific causes of loss. Optional coverage can protect a fish farmer when a heating system breaks down, causing water temperature to fall, or when foreign or toxic substances infect the fishstock, all resulting in death of the fishstock. Special coverage includes transportation, fatal fish disease, and deoxygenation of the water from the breakdown of an aeration system.

"Our goal was to develop a policy that makes fish farmers comfortable," said Dave Berry, vice president of Livestock at The Hartford. "With so many things to think about in running a business, fish farmers need the security of knowing that their stock is well protected by an experienced, first-class insurance carrier.

The Hartford has worked with the livestock industry and the independent agents that serve this industry for 85 years. Most recently, the company has built on that experience and its relationships with independent agents to develop the industry-leading coverage and top-quality service that the fish farming industry demands. Fish such as tilapia, salmon, and striped bass are popular among fish farmers, but require knowledge and care to raise successfully.

"The Hartford and its agents have the training and knowledge to assist farmers in this growing industry," said Berry. The Hartford Financial Services Group, Inc. is one of the nation's largest insurance and financial services companies, with 2000 revenues of $14.7 billion. ≈

AFS Aquaculture Policy

Fish Farming News, September/October, 2001

The American Fisheries Society (AFS) has published a policy statement on commercial aquaculture. The following are some excerpts:

Commercial production is essential in meeting increasing demands for food fish and for sport fishing, the provision of aquarium fishes and bait fish, and the local production of fish to replace imports.

Such rapid expansion of the industry, however, has raised many AFS concerns. Disease problems, genetic pollution, escape of exotic and introduced species, and eutrophication are areas of greatest concern.

There is the possibility of amplifying pathogenic organisms in an intensive culture system, which might be released with or without fish into wild populations. All states and provinces should have fish health programs, but because of the diverse nature of these programs, only the federal government may be able to consistently apply equal standards throughout the country.

In supporting the orderly development of aquaculture, and to protect the integrity of native aquatic communities, the AFS advocates the following principles:

Federal, state and provincial agencies should cooperate to ensure the health of aquatic organisms, control the transfer and introduction of aquatic organisms, and inspect processing plants and fish and fish productions to safeguard human health.

When commercially cultured fish are considered for stocking, every consideration should be given to protecting the genetic integrity of native fishes.

Aquaculture facilities should meet prevailing environmental standards. Aquaculture is a form of agriculture. The principle responsibility for development of aquaculture is in the private sector. Government should support these initiatives directly through research and development, fish inspection, and fish health certification, and indirectly by reducing unnecessary regulatory constraints, mediating in resource user conflicts, and coordinating the involvement of a diversity of government departments.

AFS has also developed a seven-part "policy regarding commercial aquaculture advocates." For information on this policy, call AFS at 301-897-8616 or visit the society's website at *www.fisheries.org*. ≈

Mediterranean Mussels: Pearls of Puget Sound

Christine Cyr, FIS North America, American Fisheries Society Newsletter, October 2001

Mediterranean mussels spawn in winter and peak in between September and May, filling a niche when Penn Cove mussels are not at the best quality

An emerging summer treat for mussel connoisseurs throughout the United States and Canada is Puget Sound farmed Mediterranean mussels, or *Mytilus edulis galloprovincialis*. The "meds" as they are called, originate from the Mediterranean and were discovered growing in Puget Sound, Washington, in 1989. Since then, the mussels have become popular for summer, as traditional mussel varieties are weak from spawning.

Spawning can cause mussels to lose up to a third of their body weight, leaving the meat soft or bitter. The native mussel to the Puget Sounds is the *Mytilus edulis trossulus*, also known as the Penn Cove mussel. Penn Cove mussels spawn in the summer and peak in July and August. Mediterranean mussels spawn in the winter and peak between September and May, filling a niche when Penn Cove mussels are not at the best quality.

Ken Chew

Mussel farmer Ian Jefferds (right) showing a student a mussel operation. Jefferds is holding up a string of seed mussels from one of his rafts

The meds, like other mussels and oysters cultivated in the Puget Sound, are grown using rope culture. This method, which originated in Spain, uses nylon tubes connected with mussel spat, or baby mussels. These tubes are suspended from lines hanging off floats or floating rafts. Once mussels are mature, the ropes can easily be removed from the water and stripped.

Rope culture is in opposition to bottom culture, a type of aquaculture where mussel seed is spread over a section of the ocean bottom and harvested with a mesh dredge. According to Gordon King, manager at Taylor Shellfish Farms in Shelton, Washington, rope culture allows mussels to mature younger and with a higher ratio of meat.

"Sales of Mediterranean mussels were high this year," said King. "Meds come in a separate niche of the suspension culture market." Taylor Shellfish Farms, along with Kamilche Sea Farm and Penn Cove Shellfish, are the largest cultivators of Mediterranean mussels in Puget Sound. According to King, Taylor Shellfish Farms, the largest cultivator of the three, sold around a million pounds of Mediterranean mussels this year in the United States and Canada.

Penn Cove Shellfish and Taylor Shellfish Farms also produce triploid mussels that are treated to create three sets of chromosomes. The third chromosome prevents triploids from spawning so that they can be harvested at a better quality all year long. (See related triploid article on rainbow trout on page 9.)

According to King, an advantage to cultivating Mediterranean mussels over Penn Cove mussels is that they are more disease resistant. Penn Cove mussels are susceptible to a disease call Hemic neoplasia. The disease does not affect humans but can be fatal to mussels, and limits the period of time in which they are harvested. ≈

Professor Comes Home to Hawaii

Helen Altonn, Honolulu Star-Bulletin, May 17, 2001

Jo-Ann C. Leong, professor and former chair of Oregon State University's Department of Microbiology (and current WRAC board member), is closer to her hundreds of island relatives as director of the University of Hawaii's Institute for Marine Biology (HIMB).

Ken Chew

Jo-Ann Leong, director of UH Institute of Marine Biology

Her appointment began in September, 2001. "She's a real winner," said C. Barry Raleigh, dean of the School of Ocean & Earth Science and Technology. E. Gordon Grau, former HIMB interim director who now directs the Sea Grant College Program, said Leong is "top notch" in her field and an outstanding administrator and scholar. "She does interesting and important research. We had to work very hard to recruit her," he said.

Leong said HIMB "is doing sensory biology in the broadest sense of the word, not only looking at marine mammal echolocation, but at how other fish sense their environment and respond to lunar cycles as well as climate and ultraviolet radiation, etc."

Cutting-edge work is being done on coral reef biology, stirring a lot of interest because of problems with coral reefs around the world, Leong said. "Hawaii, fortunately because of its isolation, has an opportunity to begin to look at coral reefs before they decline." The laboratory also has a group looking at the response of reef organisms to pollution and other intrusions in the environment, she said.

With a large laboratory building funded by the Pauley Foundation and new faculty who will be recruited, Leong said: "We have an opportunity to make something pretty spectacular. I'm excited about it."

Leong earned a bachelor's degree in zoology from the University of California-Berkeley and a doctorate degree in microbiology from the University of California-San Francisco Medical Center. She has been on the Oregon State University faculty since 1995, and in 1998 was named the second recipient of the Emile F. Pernot Distinguished Professorship in Microbiology, which was established to enhance the study of microbiology.

She is a nationally recognized specialist on viral diseases in salmon, trout, and aquatic animals, and was a key figure in the creation of a Center for Salmon Disease Research at Oregon State.

She was appointed chair of the OSU Microbiology Department in 1996 and has received awards for her teaching, research, and service.

A research virologist, she teaches virology, molecular biology of HIV, disease of Pacific salmon, and immuno-pathogenesis of HIV. Leong does research on human retroviruses, such as HIV, and on viral diseases that devastate fish stocks. She also holds patents on vaccines to control viral infection of fish. ≈

Recipe

Charlie Swanton

Easy Sesame Halibut

Ingredients

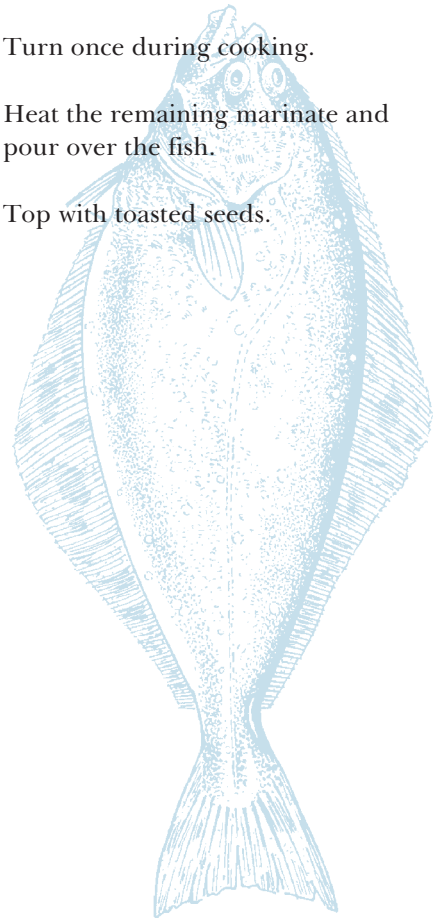
2 lb halibut fillets or steaks
1/4 C orange juice
1 Tbsp soy sauce
3/4 tsp sesame oil
1 Tbsp toasted sesame seeds
2 Tbsp ketchup
1 Tbsp fresh lemon juice
1/4 tsp pepper
1 Tbsp brown sugar

Marinate the fillets for 2 hours in orange juice, ketchup, soy sauce, lemon juice, pepper, oil, and brown sugar.

Turn once during cooking.

Heat the remaining marinate and pour over the fish.

Top with toasted seeds.



Publications

Books

1897 Manual of Fish Culture

The Fish Culture Section (FCS), American Fisheries Society has reprinted the 1897 manual, an excellent historical reference of the techniques used during the early era of fish culture in the USA. The first in a three-volume series planned by FCS. To order this publication, contact:

Nick C. Parker, USGS, Biological Resources Div.
Texas Coop. Fish & Wildlife Research Unit
Texas Tech Univ., Lubbock, TX 79409-2120
nparker@ttu.edu Ph: 806-742-2851
Fax: 806-742-2946

or

American Fisheries Society,
Attn: Orders Department
1650 Bluegrass Lakes Pkwy
Alpharetta, GA 30004
Phone: 687-366-1411 Fax: 770-442-9742

Fish Hatchery Management, Second Edition

Expands and updates the original *Fish Hatchery Management*, the preeminent fish culture manual in North American since 1982. Rewritten to include advances in hatchery operations, practical knowledge about raising high-quality fish, and optimal use of culture fishes in management programs. Covers advances in production; water issues; transportation; stocking; open, controlled, and semi-controlled systems; broodstock and spawning; nutrition; fish health. Order from AFS (see above).

Harmful Algal Blooms on the North American West Coast

Proceeds from a conference to organize a West Coast effort for research and monitoring harmful algal blooms (HAB) held in 1999 in Anchorage. HABs are a pervasive health and economic problem on the North American West Coast. Paralytic shellfish poisoning and domoic acid are the most prominent.
Edited by: Raymond RaLonde
Price: $10
To order: 888-789-0090
fax: 907-474-6285
online: *www.uaf.edu/seagrant/bookstore*

Heaven on the Halfshell

There's a certain romance to the oyster industry of the Pacific Northwest. To most, it conjures images of men in oilskins, working from low boats and braving the elements to bring in the harvest: fresh, succulent oysters from the pristine bays and inlets of northern California, Oregon, Washington, British Columbia, and Alaska.

Yesteryear's wood tongs and hand-powered dredges have been replaced by state-of-the-art shellfish hatcheries and bio-engineered broodstock. Still our love affair with the oyster, and our fascination for the men and women who devotedly tend its beds, remain strong. Savory Pleasant Cove, Hamma Hamma, Dabob Bay, and Malaspina oysters from the Northwest are known as some of the finest shellfish in the world.

Entertaining text and engrossing historic and contemporary photos present the efforts of pioneering aquaculturists, scientists, field technicians, oyster connoisseurs, and others who have shaped this unique industry.

Eighteen oyster recipes round out this lively portrait of the bivalve we love best.

Authors: David G. Gordon, Nancy E. Blanton, and Terry Y. Nosho

To order: Washington Sea Grant Program
3716 Brooklyn Avenue NE,
Seattle, WA 98105-6716
phone: 206-543-6600
fax: 206-685-0380,
email: *seagrant@u.washington.edu*

Online

Transgenic Seafood: Q&A

Biotechnology is having a great impact on medicine and the world's food supply. For example, some companies are developing transgenic technology that will allow them to speed up the growth of salmon or make other seafood species resistant to certain illnesses. WorldCatch assembled the following links to provide detailed information.

- *Q & A about transgenic fish*
  US Food & Drug Administration
  http://www.fda.gov/cvm/index/consumer/transgen.htm
- *Are transgenic fish and shellfish in our future?*
  US Food and Drug Administration
  http://www.fda.gov/cvm/biotechnology/shellfish/index.htm
- *Under the microscope: We can build super fish, but should we?*
  SeaFood Business
  http://www.seafoodbusiness.com/99may/issue.html
- *Designer fish flounder over legal hurdles*
  The Christian Science Monitor
  http://www.csmonitor.com/durable/1999/03/04/fp19s1-csm.shtml
- *Transgenic fish could threaten wild populations*
  Purdue University
  http://www.uns.purdue.edu/html4ever/0002.Muir.trojan.html
- *Something fishy—environmental defense*
  http://www.edf.org/pubs/Reports/Aquaculture/transgenic.html
- *Aqua Bounty Farms—The company's goal is to develop fish for aquaculture with improved growth rates and other economically desirable traits through the use of transgenics*
  http://www.fda.aquabounty.com/

— WorldCatch News Network, 5/15/01

Marine Aquaculture: Opportunities for Growth

National Academy Press (1992)

Coastal farming and ocean ranching of marine fish, shellfish, crustaceans, and seaweed are a major and growing industry worldwide. In the US, freshwater aquaculture is becoming a significant commercial activity; however, marine aquaculture has lagged behind. This book examines the obstacles to developing marine aquaculture in the US and offers recommendations for technology and policy strategies to encourage this industry. The book provides comparisons between US and foreign approaches to policy and technology and information on the diverse species under culture. It describes problems of coordination of regulatory policy among federal, state, and local agencies and escalating competition for the use of coastal waters. It addresses environmental concerns and suggests engineering and research strategies for alleviating negative impacts from marine aquaculture operations. Available for download at *http//:www.nap.edu/books/0309046750/html*

Bivalve bibliography

The Santa Barbara Museum of Natural History announces an online bivalve bibliography containing over 4,800 references, primarily from its book, *Bivalve Seashells of Western North America*(*http:www.sbnature.org/atlas/bivbook.htm*). Access the bibliography at *http://205.180.85.170/RIS/RISWEB.ISA*. Select the database "bivalve.pdt" Bibliography may be queried by author, title, date, or keywords. Any questions or problems with the database? Contact: Paul Valentich Scott, Senior Associate Curator, Dept. of Invertebrate Zoology, Santa Barbara Museum of Natural History, 2559 Pueta del Sol Road, Santa Barbara, CA 93105. Ph: 805-682-4711, ext. 319; fax: 805-569-3170; email: *pvscott@sbnature2.org*

Aquaculture training database

http://www.was.org

A World Aquaculture Society (WAS) initiative—to maintain a database of universities, colleges, and institutions that offer training and degree programs in aquaculture. Because WAS does not place information on the site without consent, they urge any interested university and college to use the "submit training" section of the site. Simply go to the WAS site; click on the "Training" link; click on the "Submit training" link; fill out the form; click the "Submit" button. Your institution then becomes part of the global aquaculture information network. If you have any questions, contact Carl Webster, at *cwebster@dcr.net*

Sea urchins

http://zoology.unh.edu/faculty/walker/urchin/gametogenesis.html

Harbor Branch Oceanographic Institute courses

http://www.aquaculture-online.org

Calendar

March 2002

28–29 Burrowing Shrimp Workshop
Contact: Dr. Brett Dumbauld
ph: 360-665-4166
email: *dumbabrd@willapabay.org*

April 2002

14–18 National Shellfisheries Association 94th Annual Meeting
Mystic, Connecticut
Contact: Carolyn Friedman
School of Aquatic & Fishery Sciences
Box 355020, University of Washington
Seattle, WA 98195-5020
ph: 206-543-9519
email: *carolynf@u.washington.edu*

23–27 World Aquaculture 2002
Beijing, China
Annual mtg. of World Aquaculture Society
Contact: John Cooksey
ph: 760-432-4270 fax: 760-432-4275
email: *worldaqua@aol.com* web: *www.was.org*

June 2002

4–8 4th Int'l. Conf. on Molluscan Shellfish Safety
Galicia, Spain
Contact: Conference Secretariat, ICMMS Centro de Investigacions, Mariñas Aptdo. 13, 36620
Vilanova de Arousa, Pontevedra, Spain.
ph: +34 986500155 fax: +34 986506788
email: *icmss@cimacoron.org*
web: *www.atlanticocongresos.com/moluscos/index.html*

August 2002

3–7 American Malacological Soc. 68th Annual Mtg.
Charleston, South Carolina
Contact: Rob Dillon ph: 843-953-8087
email: *dillonr@cofc.edu*
web: *www.cofc.edu/~dillonr/AMS2002.htm*

September 2002

2–6 4th Int'l. Symposium on Aquatic Animal Health
New Orleans, Louisiana
Contact: ISAAH2002,
Dept. of Pathobiological Sciences
School of Veterinary Medicine
Louisiana State Univ., Baton Rouge, LA 70803
fax: 225-578-9701
email: *ISAAH2002@vetmed.lsu.edu*
web: *www.vetmed.lsu.edu/isaah2002.htm*

17–20 Aquaculture Canada '02
Charlottetown, Canada
19th annual meeting
Aquaculture Association of Canada
Contact: Cyr Couturier
ph: 709-778-0609 fax: 709-778-0535
email: *cyr@mi.mun.ca*
web: *www.mi.mun.ca/mi/aac*

November 2002

15–16 Northeast Aquaculture Conference & Expo
Warwick, Rhode Island
Contact: Ann Marie Rathbun
ph: 401-461-8848, ext. 391 or 800-292-8787
email: *arathbun@narraboay.com*

20–24 6th Int'l. Conference on Shellfish Restoration
Charleston, South Carolina
Contact: Elaine Knight
ph: 843-727-6406 fax: 843-727-2080
email: *Elaine.Knight@scseagrant.org*
web: *www.scseagrant.org*
Info on submitting an abstract, contact: Rick Devoe
ph: 843-727-2078 fax: 843-727-2080
email: *Rick.Devoe@scseagrant.org*

NSA 2002 AUCTION

For the benefit of the student endowment fund

It is never too early to start collecting any new or used shellfish-related items for the annual auction in benefit of the Student Endowment Funds. Items can include, but are not limited to: books and other publications (historically important reprints), home brews and vintages, jewelry, artwork, and of course, t-shirts and other articles of clothing.

Please bring items with you to the NSA '02 meeting in Mystic, Connecticut or send them to:

Sandy Shumway
Southampton College, LIU,
Southampton, NY 11968
ph: 631-287-8407
fax: 631-287-8419
email: *sshumway@southampton.liu.edu*

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School of Aquatic and Fishery Sciences
Box 355020
Seattle, WA 98195-5020

Or forward via email: *wrac@u.washington.edu*
or fax: 206-685-4674.

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Waterlines is a semiannual publication intended to inform the general public and various aquaculture groups regarding WRAC activities and regional news. These include highlights of USDA/CSREES-funded research and extension projects; a calendar of scheduled meetings and events; and articles regarding aquaculture and related topics appropriate to the Western region. Readers are encouraged to submit material for inclusion in the newsletter. Publication of material in *Waterlines* does not imply endorsement by WRAC.

Submit material to:
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web: *www.fish.washington.edu/wrac*

Printed on recycled paper using vegetable-based inks,

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