

A SURVEY OF SEAFOOD SCIENCE
AND ENGINEERING PROBLEMS AND OPPORTUNITIES
AT OREGON STATE UNIVERSITY

A Planning Report to the
OSU Sea Grant College Program

February 1985

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Publication No.: ORESU-Q-85-001

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INTRODUCTION

On June 8, 1983, Bill Wick, director of OSU Sea Grant, directed us to survey the seafood science and engineering research needs and priorities of greatest interest to the West Coast and Alaska. This survey was to provide guidance in planning Sea Grant programs for the next five years. What follows in this report is a description of the methods used in gathering the information, the sources of that information, and a summary of the results themselves.

On September 27 and 28, 1983, selected seafood researchers and extension specialists from all three West Coast States and Alaska met in Portland, Oregon, to form a plan for gathering information on research and education needs. (A list of attendees is included as Appendix A of this report.) During the course of this meeting the participants reviewed the proceedings of the May 1982 Washington, D.C., Seafood Science and Technology Workshop (SS&TW) to see how the problems it identifies and ranks coincide with the participants' existing knowledge of the West Coast industry. A summary of those problems can be found in Appendix B of this report.

After reviewing the SS&TW proceedings, members of the group shared with each other the various research and education activities of their individual organizations. An attempt was then made to list the more obvious West Coast and Alaska problems in some detail. Appendix C briefly outlines these problems.

The group also decided to solicit input from industry, government, and university seafood researchers and educators on the West Coast and in Alaska. This was accomplished by a survey mailed October 17, 1983, followed by a meeting of some survey participants on October 28, concurrent to Fish Expo in Seattle. We obtained additional responses to the survey as a result of a presentation and request for input at the annual meeting of the Pacific Fisheries Technologists, February 27 in Anchorage, Alaska. The results of all survey responses are summarized by category and reprinted verbatim in appendices D and E of this report.

The following discussion of state and regional priorities is the result of the authors' assessment of research and education needs for Oregon State University. The authors' interpretation is not intended to speak to the priorities as seen by research and education agencies in California, Washington, and Alaska.

PRIORITY AREAS OF EFFORT FOR OREGON STATE UNIVERSITY

The appendices to this report indicate a number of areas in which an effort is needed to make better use of the fisheries

resources off the west coast and Alaska. This section lists those areas which the authors feel are of the greatest interest and relevance to the program at Oregon State University. All of the problems listed are considered important, and no priorities are implied. While selecting problems and areas of tentative OSU effort, the authors additionally considered

- a) the interests of other West Coast Sea Grant and NMFS programs and the potential for collaboration;
- b) the interests and talents of research and extension personnel at OSU and at other institutions in the region; and
- c) an emphasis on food science and engineering as opposed to other important areas such as marketing, resource management, aquaculture, and fishing gear development.

The first section below describes problems and tasks directly related to the fisheries of Oregon. Following that are several problems that have a wider interest and may be considered "regional," to include the Pacific Northwest and Alaska.

Problems for the Fisheries of Oregon

- Nontraditional species are not being used in a profitable way for the high-quality food products.

Priority task:

- develop means for using Pacific Whiting for surimi or other minced product forms

Other important task:

- identify necessary handling, processing, and storage requirements to enable use of such species as squid, short belly rockfish, shad, carp
- The quality of fresh rockfish available to consumers is often low.

Priority tasks:

- demonstrate increased quality that can result from better onboard preservation and handling (e.g., boxing, bleeding, gutting, shelving; use of CSW; better hold design), modified catch strategies and methods (e.g., length of tow, long-lining vs. trawling, etc.), and improved shipping procedures and equipment

- develop and demonstrate methods (existing and new) to rapidly assess quality of Oregon rockfish at several critical points in the handling chain

Other important tasks:

- demonstrate economic payoff resulting from making higher-quality rockfish available
- characterize Oregon rockfish species by common quality, handling, and spoilage properties
- The inability to use plant wastes hurts productivity in some cases and threatens new processing ventures such as shore-based surimi production.

Priority tasks:

- demonstrate alternative uses for solid wastes and evaluate economic payoffs
- develop procedures and guidelines for liquid waste management and water reuse in shore-based surimi processing

Other important task:

- develop procedures and guidelines for recycling water in existing Oregon processing plants
- The quality of Oregon seafood is unpredictable because of variable conditions within the distribution chain.

Priority tasks:

- develop and demonstrate handling and transport technologies such as containers for shipment of fresh and frozen products; good frozen storage practice; methods to monitor temperatures and other parameters throughout shipping period
- develop and demonstrate methods to extend shelf life of the product such as chemical dips, gas packaging, and new packaging materials
- demonstrate freezing (both on board and ashore) as a means to extend high-quality period for Oregon seafood; look at freezing rates, methods, storage conditions, and economic factors

Other important tasks:

- evaluate and alert industry to handling conditions that can lead to problems of product safety

- continue educational efforts on good quality control, directed to retailers, consumers, processors, and fishermen

Regional Problems of Interest to OSU Programs

- High-quality frozen U.S. fish products are not readily available to the consumer.

Priority task:

- demonstrate the food handling and quality control, engineering and equipment requirements, and economic costs and benefits that relate to production, transport, and storage of high-quality frozen bottomfish fillets such as pollock, cod, Pacific whiting, soles, and other rockfish
- Waste management and use are becoming problems in the general seafood processing area. Means are sought to decrease pollutant levels in adjacent harbors, decrease costs of municipal waste management, and extract and use solid waste materials that are now discarded.

Priority tasks:

- develop ways to recycle water, use wastes, and avoid high waste levels in shore-based surimi production
- develop uses for solid wastes from seafood processing plants
- The U.S. industry is not yet in a position to use the vast pollock resource in the North Pacific

Priority tasks:

- develop and demonstrate technology to produce "value added" products, to include fillets, processed (e.g., battered or breaded) portions, and minces
- develop and demonstrate nontraditional techniques to produce products similar to surimi and kamaboko in shore plants

Other important task:

- improve offloading practice. Two examples would be to document effects on quality of various offloading technologies (vacuum pumps, wet pumps, bucket unloaders, etc.) and to devise means of continuing weighing.

APPENDICES

Appendix A

List of attendees at the September 1983 Steering Committee meeting in Portland:

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Appendix B

A prioritized list of problems from Proceedings of the Seafood Science and Technology Workshop. Held May 24-26, 1982, Washington, D.C. C. A. Thoroughgood, ed., Univ. of Delaware Sea Grant Program. DEL-SG-13-82.

Priority Problems

- 1 Maintaining quality of fresh fisheries products in distribution channels
- 2 Lack of methods for shipboard handling, pretreatment, and storage of fish that are essential to the subsequent quality of all fisheries products
- 3 Management of fisheries wastes: improved technology; recovery of high-value products; recovery of low-value, high-volume components for food and feed. Study of functionalities and properties of fisheries by-products and isolates from wastes
- 4 Determination of maximum shelf life for fresh fish and effect of handling and unit processing operations on ultimate quality
- 5 Characterization and utilization of nontraditional species
- 6 Maintaining quality of frozen fisheries products through the transportation and distribution chain
- 7 Inadequate technology for extending shelf life of processed fisheries products: need for flexible packaging, controlled-environment storage, dehydration, thermal processing, etc.
- 8 Failure to apply state-of-the-art technology to produce fisheries products of high quality
- 9 Lack of rapid methods to judge fish quality
- 10 Lack of nutritional information for seafoods as marketed and consumed

- 11 Technological problems and other impediments to the production and utilization of minced fish for food use
- 12 Low value of nontraditional species: need for conversion into product forms suitable for food use
- 13 Common names that discourage purchases; for example, ratfish
- 14 Determination and control of sodium in fisheries products
- 15 Limited variety of products from traditional fish and seafood species for the retail and related food services industry
- 16 Chemical contamination of fisheries products
- 17 Lack of suitable standards for fisheries products suitable for human consumption
- 18 Control of microbial flora of raw fisheries products through better handling techniques and use of processing aids
- 19 Absence of information on and procedures for implementing optimum time-temperature regimes for quality maintenance of frozen food
- 20 Inadequate measures for water and energy conservation during seafood processing
- 21 Control of lipid oxidation in seafood
- 22 Lack of reliable tests for fish quality and methods of projection of shelf life of fresh fish
- 23A Development of cost-effective waste treatment methods
- 23B Lack of market-research information that will guide development of new products

- 24 Lack of mariculture/aquaculture systems
- 25 Lack of analytical tests for seafood freshness, safety, and identity
- 26 Absence of procedures for packaging fisheries products in retortable pouches
- 27 Lack of "microwavable" fisheries products
- 28A Detection of pathogenic viruses in molluscs
- 28B Detection of ciguatoxin in fisheries products
- 29A Wasted fish protein
- 29B Lack of procedures for safely storing fisheries products in controlled or modified atmospheres
- 30A Lack of information on merits of dating fresh and frozen fisheries products
- 30B Inadequate technology in firms of small and medium size for marketing fabricated fisheries products
- 31 Extending the frozen shelf life of processed, prepared fisheries products
- 32 Lack of grades and quality standards for fisheries products
- 33A Limited use of current technologies in certain areas of the seafood industry
- 33B Detection of paralytic shellfish poisoning and detoxification of edible molluscs
- 34 Lack of technology for using fisheries products as meat extenders

- 35 Lack of information on food application, functionality, availability, toxicology, and nutritional quality of chitin, chitosan, and related products
- 36 Lack of technology for use of surimi as a resource in simulated shellfish products
- 37 Effect of microbial-secreted enzymes on storage quality of frozen fish fillets
- 38 Lack of size-selective harvesting gear
- 39A Species identification data bank through isoelectric focusing
- 39B Identification and removal of naturally occurring parasites in fisheries products
- 40A Textural changes in fish caused by protein denaturation
- 40B Bone in minced fish
- 40C Uneconomical methods for chemical and microbiological depuration of molluscan shellfish
- 41 Absence of fully developed technology for using heat treatment in preserving quality of fish fillets
- 42 Lack of information on unique nutritional components of fisheries species
- 43 Relationship between the physiological condition of live, marine animals and quality of the resulting product
- 44 Small Pelagic resource definition for commercial exploitation
- 45 Low fish-to-fat-batter ratio in battered and breaded fisheries products
- 46 Production of low-fat, prefried battered and/or breaded products

- 47A Migration of moisture from the fisheries product component into the breading or batter of coated fisheries products
- 47B Determination in-shell of net weight of crab products and other block frozen fisheries products
- 47C Lack of optimum procedures for preserving fresh fisheries products through irradiation, and finding a suitable name for labeling and process

Appendix C

Outline of important West Coast problems identified by Steering Committee in September 1983 Portland Meeting.

1. Recent research on vacuum and Co₂ packaging shows danger of clostridian outgrowth when product is mishandled (at greater than 38°F). Existing distribution channels do not safeguard against mishandling.

Industry cannot take advantage of marketing and economic benefits of this process.

Industry needs help setting standards and safeguards for distribution systems of finding other ways of eliminating botulism hazards.

2. Oregon rockfish volume is down due to low stocks. Price is also down due to increased supplies from Canadian and foreign sources. The Oregon industry needs to look for higher-margin markets and cut production costs. However, it does not appear to have the technology and capital to do so.
3. Industry does not seem to be able to sell frozen fish although markets for high-quality fish exist. Problems may include
 - a) poor ex vessel quality
 - b) Lack of plant technology and capital
 - c) lack of plant incentive
 - d) lack of demonstrated profits from frozen seafood
 - e) low-priced competition.
4. Oregon fish waste volume is too variable and spread out to allow economic collection and recovery. Disposal is often most cost effective. Economic collection and recovery need to be demonstrated.
5. The Alaska whitefish industry needs engineering and technological capabilities before resources can be developed economically. These capabilities include processing and onboard handling.
6. The Alaska industry's traditional resources (crab and shrimp) are in low supply. These resources must be rehabilitated.

7. The overall quality of West Coast products must improve in order to compete with imports and alternative supplies. This involves both fresh fish and frozen.
8. U.S. production of surimi for developing U.S. markets must suit the needs of those markets. Little is known about how products might be used and what alternatives there are to traditional surimi production techniques.
9. Quality control at the dock is hard to accomplish because there are few good practical objective tests available. Dockside quality is poorly defined. Specific needs are
 - rapid tests for fish quality
 - methods to indicate remaining shelf life
 - better data on shelf life vs. time and temperature
10. The relationship between onboard handling and fish quality is not well understood with respect to various market requirements.
11. Various rockfish species need to be characterized in relation to shelf life and organoleptic qualities.
12. New names should be found for some species such as sharks.

Appendix D

Summary of results of survey--West Coast Seafood Science and Engineering Problems and Opportunities.

<u>No.</u>	<u>Topic</u>	<u>SS&TW* No.</u>
	Restaurant education	
2	Regulation at harvest for even production	
1	Direct-marketing--education	2
5	Onboard fish handling--education	
2	PSP test for toxin	33-B
1	Frozen fish temperature monitors	
3	Better salmon canning equipment	2, 7
2	Lack of surimi technology	36, 11
3	Lack of standards	17
3	Lack of new product market information	23-B, 15
1	Lack of irradiation procedures	47-C
3	Lack of shelf life extension techniques	7
1	Lack of nutritional information	10
6	Maintaining quality--fresh	1
3	Maintaining quality--frozen	6
1	Lack of quality assessment techniques	9
3	Water and energy conservation	20
1	Parasites	39-B
1	Dehydration or salt/dehydration for third world countries	
4	Nontraditional species	12, 5
6	Waste utilization	3
Response distribution	University Government Industry	5 0 10

*Refers to priority numbers in Proceedings of the Seafood Science and Technology Workshop, May 24-26, 1982, Washington, D.C.

Appendix E

Detailed responses from the survey West Coast Seafood Science and Engineering Problems and Opportunities.

A. From Industry Respondents:

Priority 1

- Quality throughout the chain from fisherman to the consumer. The only increase in profit for the traditional species will be through increasing the recovery and quality.

The bottom line is to show how some profit can be made. It won't do any good just to show it can be done.

- PSP (Paralytic Shellfish Poisoning). A big problem. When solved, could open up a billion dollar mollusk/bi-valve business in Alaska (SSTW#33B)*.
- Lack of consistent quality of fresh seafood products destined for the fresh and/or frozen market:
 - quality begins in the water;
 - if the fish is not handled properly when caught, it is not going to improve;
 - handling efficiently without excess quality loss;
 - what is the incentive to the fisherman for delivering a superior product?;
 - methodology (i.e., how to measure quality easily);
 - develop a guideline program for onboard handling of fish. Also establish a point type system for fish buying that takes into consideration over-all quality and the effort of the catching boat to assure the minimal loss of quality prior to delivery to the processor.
- Lack of methods for shipboard handling, pretreatment, and storage of fish that are essential to the subsequent quality of all fisheries products (SSTW#2).

*Refers to item listed as priority 33B in a list of needs outlined in "Seafood Science and Technology Workshop" Proceedings, 1982. Univ. of Delaware Sea Grant Report DEL-SG-13-82.

- If at all possible, I would like to see the development of a color change indicator for frozen fish. For example, when we shut the doors of a Sealand van, we have no way of knowing a week later in Seattle if a van got up to temperatures above freezing and I think the same thing could be used in the frozen section of a supermarket.
- Quality assurance--quality control programs.
- Product development--new product, consumer acceptance.
- Need to apply stat-of-the-art technology to produce fisheries products of the highest quality, and that are economically feasible, and can be acceptable to the consumer.

Priority 2

- Use of nontraditional species. If the fisheries off of Washington-Oregon-California are to have any growth we must use the nontraditional species. We need species-by-species programs. Pacific whiting, jack mackerel, tom cod, etc.
- Water and energy conservation. Need some "down-to-earth" practical advice--especially simple ways and means to use boiler stack heat, recirculate flume water, the benefits of ventilation, etc. (SSTW#20).
- Three items in the SSTW report: These include:
 - #1 - Maintaining quality of fresh fisheries products in distribution channel.
 - #6 - Maintaining quality of frozen fisheries products through the transportation and distribution chain.
 - #9 - Lack of rapid methods to judge fish quality.

These problems relate to quality maintenance of fresh and frozen products in the distribution channel. The ability to measure this quality level is poor at best, especially as it regards the frozen product. Obviously, the development of a rapid test is the key issue. Perhaps a test that could be based upon attainable indicator that can be determined as quickly as pH or something. One that could be performed with a portable piece of equipment would be the best situation.

- Lack of suitable standards for fisheries products suitable for human consumption (SSTW#17).

- Resource cycles--the largest problem of Bristol Bay is the influx of salmon during a 2-week span. It would be nice to work on a fish that spread its reproduction cycle over the 3-month period. Maybe it can be done with the fish that are already here but bring them back in waves.
- Marketing and advertising:
 - a) Promoting quality seafood products;
 - b) Dispelling the "fresh fish" is better than "fresh frozen fish" myth.
- Quality assurance.
- Development of consumer acceptable products utilizing surimi-type processes (other than "crab" legs).

Priority 3

- Waste. This is a big problem in some places along the coast already. Instead of making any profit from waste, some processors are paying to have it hauled away.
- Removal of parasites. Parasites are still drawing severe consumer reaction (SSTW#39B).
- Dehydration or combination of salting/dehydration to preserve food for Third World or even here in the USA.
- Lack of market-research information that will guide development of new products (SSTW#23B).
- Lack of technology for use of surimi as a resource in simulated shellfish products. This is currently #36 in the SSTW proceedings; but it should be moved higher on the priority list and include products other than shellfish. Surimi is possibly our only salvation for the near future in the seafood industry.
- The state-of-the-art salmon canning equipment is outdated. New ideas for filling/weighing machines should be looked into.
- Value added product development.
- Waste utilization.
- Aquaculture.
- Harvest, catcher techniques and handling equipment and techniques.

- Consumer education--seafoods.
- New packaging technology.
- Utilization of nontraditional species.
- Extending shelf life after thawing of frozen fisheries products.
- Utilization of fish/seafood waste.
- Reduction of energy usage in processing seafoods.
- Lack of optimum procedures for preserving fresh fisheries products through irradiation, and finding a suitable name for labeling the process (SSTW#47C).

B. From university respondents:

Priority 1

- Utilization of fishery waste to produce marketable products that will increase the profit margin for fish processing units.

The composition of the fisheries waste that is available is of high quality, but currently only a limited number of products have been developed for using this material. In comparison to the red meat processors, which derived their profit margin from the use of the waste materials that are derived from processing, the fishery either pay or receive a minimum of compensation for their waste. A variety of products could be developed that would more effectively utilize this natural resource.

Research projects between university researchers, extension agents and industry could be developed that would address these problems.

- Inadequate technology for extending shelf life of processed fisheries products; need for flexible packaging, controlled environment storage, dehydration, thermal processing, etc. (SSTW#7).
- For marketing:
 - Education for restaurants on proper preparation of seafood;
 - New methods of fisheries regulation so that markets aren't flooded for a short time, then only frozen products sold the rest of the year;

- Direct marketing of seafood products.

For the producer:

- Onboard fish handling techniques;
- Paralytic shellfish poisoning/test for the toxin.
- Secondary and tertiary processing.
- Fishery waste utilization.

Priority 2

- Use of natural resource contained within the 200 mile limit for domestic use should be increased.

The development and utilization of the resources available to US fishermen should be an area of major emphasis. Additional federal support is needed to improve the capabilities of the US commercial fishery industry in order for them to become more competitive with other government supported industries.

- Lack of nutritional information for seafoods as marketed and consumed (SSTW#10).
- Business management of industrial-scale fish processing operations.
- Technology for extending shelf life.

Priority 3

- Development of new products and increased efforts in marketing fishery products.

In order for the maximum of human grade products to be produced from current fishery resource, available new products will need to be developed. Emphasis should be directed towards maximizing the amount of human grade products being produced and minimizing the amount of processing wastes. This is an area where there is a large amount of additional research effort needed.

Since many processors do not have the staff or technical expertise to develop and evaluate new products, this could be an area that state and federal researchers could provide much needed input.

- Lack of suitable standards for fisheries products suitable for human consumption (SSTW#17).

- Water and energy conservation.
- Freshness of fresh fish in marketing channels.

C. From Unknown Respondents:

Priority 1

- Can seams--can technology--emphasize the need for proper presentation of a "clean" can to the seamer; an educational program with hard data.
- Study bruising in fish--especially salmon to determine where, who, what is causing it. Study should encompass from catch time to freeze time.

B. Priority 2

- Study methods and economics of fish waste (byproduct) retrieval--to include solids and liquids.

C. Priority 3

- Study extending shelf life of fresh fish.
- Shipboard handling.