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REPORT OF A STUDY TRIP TO JAPAN

III. Fisheries Education and Extension Activities

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In Japan, Dr. K. Fukusho and Dr. T. Honjo (the 1986-87 and 1987-88 chairmen of the UJNR Aquaculture Panel's Visiting Scientist Program Committee) were responsible for arranging the majority of my itinerary. Their kindness and efficiency are greatly appreciated. Dr. K. Nakaya, Dr. M. Kaeriyama, and Dr. T. Seki were contacted independently and they were also extremely helpful and hospitable. Everyone I met in Japan was very generous with their time and information, and I feel very lucky to have developed a number of personal friendships which I hope will persist "long distance" in years to come.

A \$1000 travel stipend was awarded by the California Sea Grant Program to allow me to spend a greater amount of time concentrating on molluscan aquaculture in Japan. During this time my salary was provided through University of California Cooperative Extension sabbatical leave funding. Preparation of this report was funded in part by California Sea Grant NA-80AA-D-00120 and State Resources Agency Grant A/EA-1.

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INTRODUCTION

I visited Japan for five weeks in March and April, 1987, under the auspices of the Scientist Exchange Program of the US-Japan Cooperative Program in Natural Resources (UJNR). UJNR was formed in 1964 following the Third Cabinet-Level Meeting of the Joint United States - Japan Committee on Trade and Economic Affairs. UJNR consists of several "panels" of experts from each country in areas of mutual interest (ie, national park management, desalinization of seawater, forestry, air pollution, etc.). US and Japanese counterpart panels on Aquaculture were formed in 1969. Semi-annual meetings between the two panels have covered a wide variety of topics. Reports of those meetings are published in the NOAA/NMFS Technical Report series. In addition to the semi-annual meetings, panel members in each country organize study trips for visitors who are recommended to them by members of their counterpart panel, and that is how most of my trip was arranged.

The purposes of this trip were to:

- 1) Learn about Japanese aquaculture, with an emphasis on salmonid and cold-water molluscan species;
- 2) Learn about coastal fisheries, organization of fishermen's cooperatives, and methods of marketing seafood products;
- 3) Learn about fisheries and aquaculture extension activities; and
- 4) Learn about fisheries education and training programs in Japan.

The trip was extremely well organized by my Japanese hosts and, in the course of visiting facilities in five prefectures (Figure 1) and meeting with nearly 100 biologists and members of the Japanese fishing industry, I was able to satisfy most of the objectives listed above. I gained the most information about cold-water molluscan aquaculture, salmonid aquaculture, and fisheries education and extension. Three reports have been prepared to make this information available to interested parties:

Report of Study Trip To Japan, March - April, 1987

I. Molluscan Aquaculture and Fisheries

II. Salmonid Aquaculture and Fisheries

III. Fisheries Education and Extension Activities

These reports are available from the California Sea Grant College Program, University of California, A-032, La Jolla, CA 92093.

Following the text of each section, a list of relevant publications collected in Japan are listed in Appendix 1. Copies of these are available at cost from the author.

Names and addresses of researchers and people in the fishing industry who I met in Japan are listed in Appendix 2 of the section(s) corresponding to each person's area of expertise. A complete list of all contacts made in Japan is available from the author on request. Similarly, I would be happy to share information collected on subjects not included in the three reports with anyone interested. Other topics about which I gained information while in Japan included aquaculture of sea urchins, flatfish, yellowtail, red sea bream, and various species of marine algae; fisheries for squid, saury, and coastal species caught with gillnets and small trawls; and operations of fish markets and fishermen's cooperatives. I would also be happy to share advice with anyone contemplating a similar trip relative to finances, language, getting around, potential problems which might be encountered by your spouse, and other logistical/cultural concerns.

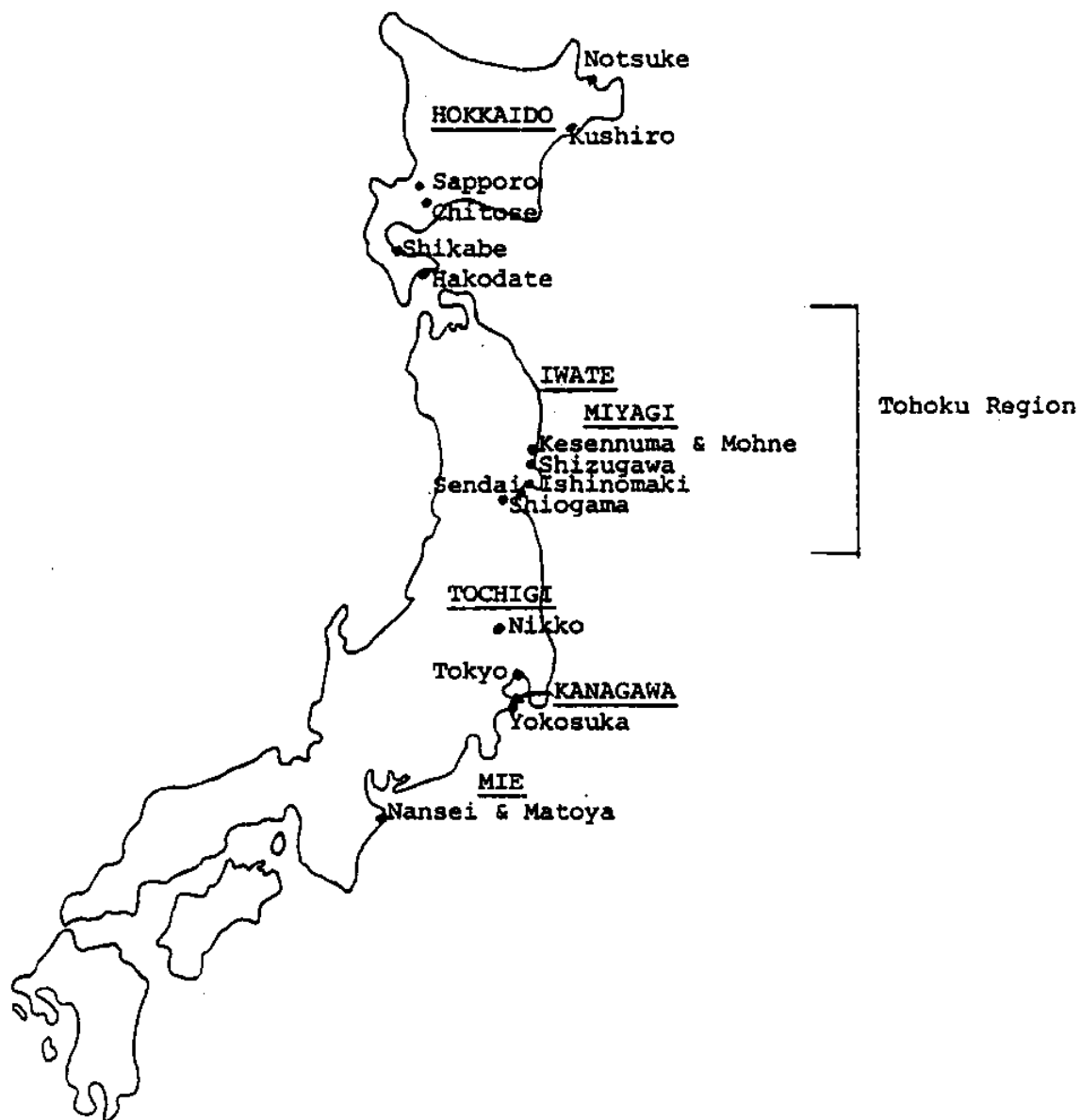


Figure 1. Map of Japan showing principal areas visited and described in text.
Names of prefectures are underlined.

Hokkaido University Faculty of Fisheries

I visited the Laboratory of Marine Zoology at Hokkaido University Faculty of Fisheries and met with Dr. Kazuhiro Nakaya, Dr. K. Amaoka, and several undergraduate and graduate students. I also visited the Usujiri Fisheries Laboratory on Funka Bay, which is an affiliated teaching facility.

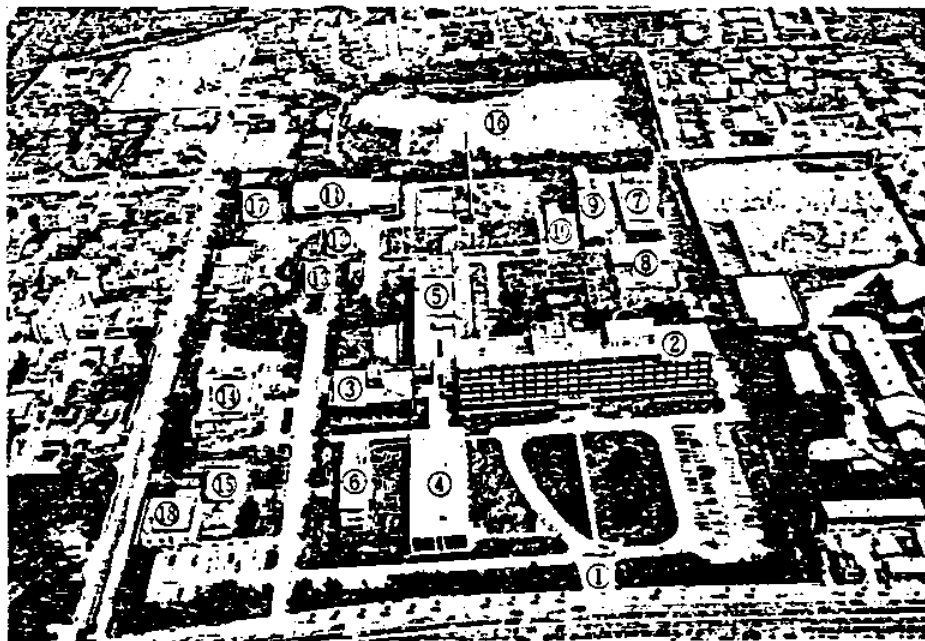
The main campus of Hokkaido University is located in Sapporo. Students are required to complete at least 68 semester hours of work in the Department of General Education at the Sapporo campus before transferring to the Faculty of Fisheries in Hakodate. This generally takes 1-1/2 to 2 years. Bachelor of Fisheries Science degrees are awarded to students who complete all required subjects within one of the four departments of the facility, which usually takes 2 to 2-1/2 years. A senior thesis is also required. Students who complete an additional 30 units, prepare a thesis, and have at least two years in residence receive a Master of Fisheries Science (Suisangaku-Shushi) degree. Candidates for the Doctor of Fisheries Science (Suisangaku-Hakushi) must remain in residence an additional three years (5 years total) and submit a dissertation which demonstrates an ability to do independent research.

In addition to several teaching and research buildings on campus (Figure 2), the Faculty of Fisheries also has two research vessels (crew of 35 + 60 students) which are used primarily in the North Pacific (summer) and Indian Ocean (winter), and one research vessel used in coastal waters of Japan. Besides the Usujiri Fisheries Laboratory near Shikabe, other affiliated facilities include a limnological station, a freshwater fish culture station, and training factories for food processing and fishery chemistry. The affiliated Research Institute of North Pacific Fisheries has seven faculty members studying mechanisms of productivity (especially eddies and oceanic fronts) in the North Pacific.

The four departments of the Faculty of Fisheries are: Biology and Aquaculture, Food Science and Technology, Chemistry, and Fishing Science. Within each department there are several "laboratories", which may be thought of as research sections or sub-departments. I will describe the curriculum and major research areas in some detail since many people have expressed an interest in comparing training of Japanese fisheries biologists with their own training.

Courses taught in the Department of Biology and Aquaculture are listed in Table 1. Within this department there are seven laboratories. Undergraduates are assigned to one of these laboratories during their senior year, and they spend much of that year working on their senior thesis. They are given office and laboratory space during this time. There are about 200 students within this department, including unassigned sophomores and juniors, and assigned seniors and graduate students. In the Laboratory of Marine Zoology, six seniors are admitted each year and eight graduate students are currently in residence. Within this department there is one professor, one associate professor, and one lecturer associated with each laboratory, for a total of 21 faculty members. The laboratories and their current activities are as follows:

Hakodate Campus



- | | |
|--|--------------------------|
| 1) Main gate | 10) RI Laboratory |
| 2) Main building | 11) Gymnasium |
| 3) Library | 13) Auditorium |
| 4) Teaching building | 13) Old building |
| 5) Training laboratory | 14) Student center |
| 6) Research Institute of North Pacific Fisheries | 15) Fisheries museum (A) |
| 7) Training factory | 16) Stadium |
| 8) Experimental aquarium | 17) Extracurricular room |
| 9) Towing tank | 18) Fisheries museum (B) |

Figure 2. Faculty of Fisheries of Hokkaido University.

Table 1. Courses taught in the Department of Biology and Aquaculture.
at Hokkaido University Faculty of Fisheries.

UNDERGRADUATE CURRICULUM

Students in this department are required to take 59 credits from required subjects and at least 25 credits from elective subjects.

Required Subjects

Marine Zoology	Laboratory Work in the Physiology of Aquatic Animals
Ecology of Aquatic Animals	Laboratory Work in Marine Botany
Marine Botany	Laboratory Work in Animal Embryology
Fresh Water Fish Culture	Laboratory Work in Ichthyology
Ichthyology	Laboratory Work in Fresh Water Fish Culture
Population Ecology	Laboratory Work in Mariculture
Physiology of Aquatic Animals	Laboratory Work in Planktology
Animal Embryology	Field Training at Marine and Limnological Stations
Planktology	Graduation Thesis
Mariculture	Seminar on Biology
Fisheries Chemistry	
Statistics	
Laboratory Work in Marine Zoology	

Elective Subjects

Fish Physiology	Nutritional Chemistry
Animal Histology	Applied Physics
Limnology	Genetics
Management of Marine Resources	Diseases of Fishes
Civil Engineering in Fisheries	Comparative Endocrinology
Fisheries Law	Ecology of Coastal Waters
Meteorology	Milieu of Fresh Water Fish Culture
Marine Products Industry	
Economics of the Fishery Industry	Laboratory Work in Animal Histology
Oceanography	Field Training in Fish Culture and Propagation
Fishing Science	
Microbiology	
Cold Storage	
Laboratory Work in Fish Physiology	
Laboratory Work in Microbiology	

GRADUATE CURRICULUM

Advanced Marine Botany	Laboratory Work in Advanced Mariculture
Laboratory Work in Advanced Marine Botany	Advanced Lecture on Fresh Water Fish Culture
Seminar on Advanced Animal Embryology	Laboratory Work in Advanced Fresh Water Fish Culture
Advanced Marine Zoology	Seminar on Advanced Marine Ecology
Laboratory Work in Advanced Marine Zoology	Advanced Marine Productivity
Seminar on Advanced Animal Physiology	Advanced Limnology
Advanced Planktology	Special Lecture on Biology and Aquaculture
Laboratory Work in Advanced Planktology	Seminar on Advanced Fresh Water Fish Culture
Seminar on Advanced Mariculture	Advanced Marine Ecology
Seminar on Advanced Marine Botany	Laboratory Work in Advanced Marine Ecology
Advanced Animal Embryology	Seminar on Advanced Marine Productivity
Laboratory Work in Advanced Animal Embryology	Advanced Lecture on the Milieu of Fresh Water Fish Culture
Seminar on Advanced Marine Zoology	Integrated Seminar on Biology and Aquaculture
Advanced Animal Physiology	Special Laboratory Work in Biology and Aquaculture
Laboratory Work in Advanced Animal Physiology	
Seminar on Advanced Planktology	
Advanced Lecture on Mariculture	

Marine Botany - taxonomy, ecology, cytology, and physiology of marine algae.

Embryology and Genetics - speciation of fishes on the basis of eco-morphological considerations; genetic analysis of muscle protein and isozyme polymorphisms by electrophoresis; polyploidy and chromosome engineering; developmental disorders; sex control.

Marine Zoology - Phylogeny and taxonomy of fishes and invertebrates, especially those in northern seas; developmental morphology and taxonomy of larval fishes; ichthyofaunal research of coastal and inland waters of Hokkaido.

Physiology and Ecology - formation and destruction of hard tissues in aquatic animals; calcium metabolism in fishes; otolith interpretation; blood cell physiology in fishes.

Planktology - taxonomy, ecology, and biogeography of plankton; measurement of aquatic productivity; marine food chain investigations.

Fresh Water Fish Culture - sex differentiation and development of gonads; biology of viviparity; endocrinology of vitellogenesis; oocyte maturation and fertilization; artificial control of maturation.

Mariculture - theory and technology of extensive mariculture; shellfish mariculture techniques and management; population dynamics and production of benthic invertebrates; environmental factors of culture grounds.

Courses taught in the Department of Food Science and Technology are listed in Table 2A. I don't know how many students are enrolled in this department. There are two instructors in some laboratories, so the total number of faculty members is 18. The five laboratories and their primary research areas are as follows:

Food Chemistry I - analysis of seafood components; physio-chemical properties of marine food, interactions of food components.

Food Chemistry II - paralytic shellfish poison, anasakiasis; arsenic compounds in marine algae; germination of Clostridium perfringens.

Biochemistry - structure and function of glycolytic enzymes in fish muscle; comparative biochemistry of muscle proteins; storage and processing of fish muscular proteins.

Microbiology - microbiology of marine products; viral and bacterial fish diseases; taxonomy and ecology of marine microorganisms.

Marine Food Technology - food processing and preservation technology; food quality and water activity; water mobility in marine food; frozen storage of fish.

Courses taught in the Department of Chemistry are listed in Table 2B. There are 21 faculty members in the five laboratories listed below:

Table 2. Courses taught at Hokkaido University Faculty of Fisheries in:
A. Department of Food Science and Technology and
B. Department of Chemistry.

A

UNDERGRADUATE CURRICULUM

Students in this department are required to take 71 credits from the required subjects and at least 19 credits from elective subjects.

Required Subjects

Food Chemistry I & II
Nutritional Chemistry
Food Hygiene I & II
Food Additives
Food Quality Control
Biochemistry I & II
Enzyme Chemistry
Microbiology I & II
Applied Microbiology
Food Technology I & II
Cold Storage
Canning
Food Plant Design

Elective Subjects

Inorganic and Physical Chemistry
Analytical Chemistry
Instrumental Analysis
General Mechanical Engineering
Economics of the Fisheries Industry
Marine Biology
Oceanography
Off Campus Practice in Commercial Factory

GRADUATE CURRICULUM

Advanced Food Chemistry
Advanced Nutritional Chemistry
Advanced Food Hygiene
Advanced Food Quality Control

Advanced Marine Food Technology
Advanced Food Preservation
Advanced Food Environmental Engineering
Seminar on Advanced Food Chemistry
Seminar on Advanced Food Hygiene

Laboratory Work in Chemical Analysis
Laboratory Work in Food Chemistry I & II
Laboratory Work in Biochemistry
Laboratory Work in Marine Food Technology
Laboratory Work in Microbiology
On-Campus Practice in Training Factory
Seminar on Food Science and Technology
Graduation Thesis

Organic Chemistry
Utilization of Marine Products
General Electric Engineering
Applied Mathematics
Fishing Science
Marine and Fresh-water Culture
Meteorology

Advanced Biochemistry
Advanced Protein Chemistry
Advanced Microbiology
Advanced Applied Microbiology

Seminar on Advanced Biochemistry
Seminar on Advanced Microbiology
Seminar on Advanced Marine Food Technology
Special Lectures on Food Science and Technology
Special Laboratory Work in Food Science and Technology

B

UNDERGRADUATE CURRICULUM

Students in this Department are required to take 72 credits from the required subjects and at least 17 credits from elective subjects.

Required Subjects

Physical Chemistry
Inorganic Chemistry
Organic Chemistry I
Industrial Physical Chemistry
Chemical Engineering I & II
Instrumental Analysis
Biopolymer Chemistry
Lipid Chemistry
Materials for Marine Products Industry
Outline of Biochemistry

Outline of Fisheries Science
Analytical Chemistry
Marine Chemistry I & II
Utilization of Biocatalyst
Chemical Technology of Marine Oil and Fish Meal
Laboratory Works and Training
Seminar on Chemistry
Graduation Thesis

Elective Subjects

Outline of the Chemical Industry I & II
Water Conditioning
Activation Analysis
Process Control

Food Processing
Food Chemistry
Food Additives
Oceanography
Study Tour of Chemical Plants
Organic Chemistry II
Marine Resource Chemistry
Chemical Reaction Engineering
Principles of Engineering Drawing

Chemical Engineering Design
Numerical Calculation for Chemistry
Principles of Electrical Engineering

Biochemical Engineering
Principles of Mechanical Engineering
Industrial Administration
Utilization of Marine Products
Cold Storage
Marine Biology
Meteorology

GRADUATE CURRICULUM

Advanced Biopolymer Chemistry
Advanced Natural Products Chemistry
Advanced Lipid Chemistry
Advanced Marine Chemistry
Advanced Analytical Chemistry
Advanced Chemical Engineering
Advanced Marine Productivity
Chemical Process Engineering
Special Lecture on Advanced Chemistry

Seminar on Advanced Biopolymer Chemistry
Seminar on Advanced Lipid Chemistry
Seminar on Advanced Marine Chemistry
Seminar on Advanced Analytical Chemistry
Seminar on Advanced Chemical Engineering
Seminar on Advanced Marine Productivity
Laboratory Work in Advanced Fisheries Chemistry

Bipolymer Chemistry - polysaccharides of marine organisms; invertebrate muscular protein biochemistry and molecular biology; chemistry of UV-absorbing compounds in marine algae.

Marine Lipid Chemistry - chemistry and biochemistry of marine lipids; chemistry of antioxidants; instrumental analysis of marine organic products.

Marine Chemistry - this laboratory provides basic education in organic and inorganic chemistry for students using the faculty research vessel. It also conducts studies on the distribution of nutrients, organic substances, heavy metals, and other substances in seawater and sediments.

Analytical Chemistry - most work is on heavy metals, radionuclides, and micro-nutrients in seawater.

Chemical Engineering - flocculation process of suspensions by polymer and colloidal flocculants; recovery of heavy metals from seawater; absorption of ions and molecules on solid particles; mass transfer operations in fish processing; mechanical and physical-chemical separation techniques in solid-liquid systems.

The Department of Fishing Science is an extremely applied branch of the Faculty of Fisheries. Students can specialize in Fishing Ground Science or Fishing Technology. One building on campus houses a tow tank for gear testing and the department catalog lists many instruments available for testing gear and studying behavior of fish at sea. This appears to be the largest department, having 31 faculty members. Courses are listed in Table 3 and the eleven laboratories and their research activities are described below:

Principles of Fishing Grounds - fisheries ecology; formation of fishing grounds; migration and schooling of fish; early life history of fish.

Oceanography and Meteorology - physical oceanography of North Pacific; upwelling mechanisms; oceanography of Funka Bay.

Fish Population Biology - racial analysis of fish populations; population dynamics; distribution and mortality of fish eggs and larvae.

Fish Navigation - effects of sea condition on speed and course; optimum ship weather routing; prediction of drifting position of boats; error boundaries of determined positions.

Operational Technology of Fishing - improvement of fishing gear and methods; systems engineering studies of fishing gear and its operation.

Fishing Gear Engineering - theory and design of fishing gear; catch efficiency of gear; strength of fishing gear materials; design of aquaculture facilities; geometrical structure of fishing twines.

Mechanical Engineering for Fishing - mechanization of fishing processes; basic design of net and line haulers; fishing pump systems.

Table 3. Courses taught in the Department of Fishing Science at
Hokkaido University Faculty of Fisheries.

UNDERGRADUATE CURRICULUM	
Students in this Department are required to choose one of two courses, Fishing Ground Science or Fishing Technology.	
The Course of Fishing Ground Science	
Students of this course are required to take 48 credits from the required subjects, and at least 26 credits from the first group and 10 credits from the second group of elective subjects.	
Required Subjects	
Fishing Grounds I & II	Principles of Fishing
Operation of Fishing Gear	Schooling Behavior of Fish I
Planktology	Biology of Fish Population
Oceanography	Principles of Fish Finner
Fishing Navigation I	Fisheries Law
Marine Zoology	Seminar on Fishing Grounds
Seminar on Oceanography	Seminar on Fishing Navigation
Field Training I	Shipboard Training I
Colloquium	Laboratory Work in the Biology of Fish Population
Graduation Thesis	
The First Group of Elective Subjects	
* Principles of High Sea Fishing	Statistics of Fish Population
* Schooling Behavior of Fish II	Dynamics of Fishing Gear
* Meteorology	Techniques of Fishery Machinery
* Instrument Engineering for Fishing	Fishery Economics
Fishing Navigation II	Laboratory Work in the Operation of Fishing Gear
History of Fishing Techniques	Seminar on the Statistics of Fish Population
Applied Mathematics I & II	Seminar on the Schooling Behavior of Fish
Laboratory Work in the Schooling Behavior of Fish	Seminar on Meteorology
Principles of Coastal Fishing	Field Training II
The Second Group of Elective Subjects	
* Applied Physics	Shipboard Training II
* Naval Architecture of Fishing Boat	* Fishery Electrical Engineering
* Marine Engineering	Marine Engineering
* Navigation Law	Fishing Boat Seamanship
Chemistry of Fishing Gear	Physiology of Aquatic Animals
Outline of Marine Products	Outline of the Propagation of Marine Resources
Industry	Marine Resources
Design and Drawing of Fishing Boats	Laboratory Work in Fishery Electrical Engineering
* Laboratory Work in Fishing Boat Seamanship	Laboratory Work in Nautical Dynamics
* Practice in Communications	
GRADUATE CURRICULUM	
Students are required to take 49 credits from required subjects and at least 25 credits from the first group and 10 credits from the second group of elective subjects.	
Required Subjects	
Principles of Fishing	Fishery Economics
Dynamics of Fishing Gear	Laboratory Work in the Operation of Fishing Gear
Design of Fishing Gear	Seminar on Fishing Gear Design
Techniques of Fishery Machinery	Field Training I
Nautical Dynamics	
Colloquium	Laboratory Work in the Techniques of Fishery Machinery
Operation of Fishing Gear	Laboratory Work in Nautical Dynamics
Instrument Engineering for Fishing	Shipboard Training I
Naval Architecture of Fishing Boats	Graduation Thesis
Fishing Grounds I	Schooling Behavior of Fish II
Fishery Business Economics	
The First Group of Elective Subjects	
* Applied Mathematics I & II	Applied Physics
* Instrument Engineering	Principles of Coastal Fishing
* Principles of High Sea Fishing	Fishing Gear Materials
* Fishery Electrical Engineering	* Fisheries Principles of the Fish Finner
Principles of Mechanical Engineering	Marine Engineering
* Oceanography	* Meteorology
Fisheries Law	History of Fishing Techniques
Laboratory Work in Fishing Gear	Laboratory Work in Fishery Electrical Engineering
Materials	Design and Drawing of Fishing Boats
Laboratory Work in the Schooling Behavior of Fish	Seminar on Fishery Business Economics
Design and Drawing of Machines	Field Training II
The Second Group of Elective Subjects	
* Fishing Boat Seamanship	Marine Zoology
* Fishing Navigation I & II	Biology of Fish Population
Schooling Behavior of Fish I	Outline of the Marine Products Industry
Outline of the Propagation of Marine Resources	Practice in Fishing Boat Seamanship
Chemistry of Fishing Gear	* Seminar on Oceanography
* Seminar on Fishing Navigation	* Practice Communications
* Seminar on Meteorology	
* Shipboard Training II	
* Navigation Law	
(Subjects with an asterisk are compulsory for students proceeding to the Specialized Training Course in Pelagic Fisheries.)	
GRADUATE CURRICULUM	
Students are required to take 49 credits from required subjects and at least 25 credits from the first group and 10 credits from the second group of elective subjects.	
Required Subjects	
Principles of Fishing	Fishery Economics
Dynamics of Fishing Gear	Laboratory Work in the Operation of Fishing Gear
Design of Fishing Gear	Seminar on Fishing Gear Design
Techniques of Fishery Machinery	Field Training I
Nautical Dynamics	
Colloquium	Laboratory Work in the Techniques of Fishery Machinery
Operation of Fishing Gear	Laboratory Work in Nautical Dynamics
Instrument Engineering for Fishing	Shipboard Training I
Naval Architecture of Fishing Boats	Graduation Thesis
Fishing Grounds I	Schooling Behavior of Fish II
Fishery Business Economics	
The First Group of Elective Subjects	
* Applied Mathematics I & II	Applied Physics
* Instrument Engineering	Principles of Coastal Fishing
* Principles of High Sea Fishing	Fishing Gear Materials
* Fishery Electrical Engineering	* Fisheries Principles of the Fish Finner
Principles of Mechanical Engineering	Marine Engineering
* Oceanography	* Meteorology
Fisheries Law	History of Fishing Techniques
Laboratory Work in Fishing Gear	Laboratory Work in Fishery Electrical Engineering
Materials	Design and Drawing of Fishing Boats
Laboratory Work in the Schooling Behavior of Fish	Seminar on Fishery Business Economics
Design and Drawing of Machines	Field Training II
The Second Group of Elective Subjects	
* Fishing Boat Seamanship	Marine Zoology
* Fishing Navigation I & II	Biology of Fish Population
Schooling Behavior of Fish I	Outline of the Marine Products Industry
Outline of the Propagation of Marine Resources	Practice in Fishing Boat Seamanship
Chemistry of Fishing Gear	* Seminar on Oceanography
* Seminar on Fishing Navigation	* Practice Communications
* Seminar on Meteorology	
* Shipboard Training II	
* Navigation Law	
(Subjects with an asterisk are provided for students belonging to other courses in the Department of Fishing Science and other departments.)	

Instrument Engineering for Fishing - hydroacoustic research; estimation of fish abundance by hydroacoustics; fish tracking by radiotelemetry; applications of underwater television to fishing operations; light attraction of squid.

Engineering of Fishing Boats - economization of fishing boats (scale, speed, etc.); properties of fibreglass-reinforced plastic board; improvement of vessel efficiency.

Fishing Boat Seamanship - safety at sea; seakeeping qualities and maneuverability of fishing boats; statistical analysis of ship motion and wave data; casualty analysis.

Fisheries Business Economics - economic structure of industry; analysis of fishery management options; economic problems in the utilization of fishing grounds; marketing fishery products.

There are no grants awarded for research work and no teaching assistantships or research assistant positions - at least not in the Department of Biology and Aquaculture, where I talked to faculty and students. Most students (or their families) pay their own way, except for a very few receiving government scholarships. Some materials, equipment, and access to regularly scheduled cruises is available, but otherwise graduate students are on their own. There is a one-time entrance fee of 150,000 yen (\$1071.43), an entrance exam fee of 18,000 yen (\$128.57), and annual tuition is 252,000 yen (\$1800.00).

There is a special study program available for foreign students. Intensive Japanese language training is included. For more information and a catalog in English, you can write to:

Faculty of Fisheries
Graduate School of Fisheries Science
3-1-1 Minato-Cho, Hakodate 041, JAPAN

Kanagawa International Fisheries Training Center

I visited the Kanagawa International Fisheries Training Center; met with several faculty members including T. Sakamoto, S. Takasugi, Y. Tawara, and M. Kusama; gave a seminar to students on fisheries extension activities in California; and had a chance to talk to a few of the students.

The Center was built in 1974 in Nagai, near Yokosuka, to train people from developing countries in fisheries and aquaculture techniques. So far they have trained 800 students from about 80 countries, primarily in Southeast Asia, Latin America, Africa, and the Middle East. The Center is a part of the Japan International Cooperation Agency (JICA), which is similar to U.S.A.I.D. Japan pays for travel, living expenses, and cost of the courses for all applicants accepted into the program. Students are primarily instructors or extension agents in their own countries, so the information they learn is supposed to be passed on to others. Japan also has "overseas cooperation volunteers", similar to Peace Corps volunteers, who often work to assist former students of the Center set up projects in their home countries.

The Center has two training sessions a year, from January-June and from July-December. During the first session up to 10 students can enroll in each of the following courses: General Aquaculture, Coastal Fishing Gear and Methods (Theory), and Small Boat Hull and Engine Maintenance. During the second session students can enroll in either Fishery Cooperatives or Coastal Fishing Gear and Methods (Practice). The course outline for Coastal Fishing Gear and Methods (Practice) is included as Table 4. In addition to intensive training in the course they are enrolled in, all students take three months of Japanese language lessons and attend group lectures and field trips of mutual interest. English is the common language spoken at the Center. The Center includes dormitories, a dining hall, lecture rooms, a wet lab, an engine shop, a fishing gear laboratory with a tow tank, and three vessels of varying sizes for research and practice.

One of the most useful aspects of the Center that I found, is their publication of a number of books and training manuals in English. These describe Japanese fisheries and aquaculture methods, fisheries legislation, finance and business, and organization of cooperatives. Mr. Sakamoto was kind enough to give me a complete set of their manuals as well as two excellent English publications by Yamaha Motor company which describe coastal fisheries, processing, and marketing. These can be loaned out or copied on request.

My visit to this facility was one of the most pleasant parts of my trip to Japan because everyone spoke English, because I learned more about fisheries (as opposed to aquaculture) here than at other facilities and because everyone was involved in extension activities so we had some very informative exchanges about the nature of this type of work. Mr. Sakamoto, in particular, was very interested in U.S. extension activities and Sea Grant and would be interested in corresponding with other fisheries extension agents/advisors. (His address is included in Appendix 1.) Many comments on extension work in Japan from faculty members at the Center are included in the following section.

Table 4. Excerpt from course outline for Coastal Fishing Gear and Methods (Practice), a six-month class taught at the Kanagawa International Fisheries Training Center.

SEPTEMBER

DATE	SUBJECT	INSTRUCTOR	DATE	SUBJECT	INSTRUCTOR
1(Mon) through 5(Fri)	Study trip to Shizuoka Prefecture and Odawara City Visited the following organizations : * Outboard Engine and FRP Fishing Boat Mfg. Plant of YAMAHIA Co., Ltd. * Lake Hamana Fish Culture Fisheries Cooperative Association (Cultivation and Processing of Eel) * Uchiura Marine Fish Culture Farm * On-board Observation on Large-scale Set Net Fishing Operation * Odawara Fish Market * Marine Products Processing Factory * Kanagawa Prefectural Fisheries Experimental Station, Sagami Bay Branch	Mr. Takasugi Mr. Notsu Mr. Yatsuboshi	24(Wed)	Sea-going practice on shark longline fishing	Mr. Senga Mr. Iiwata Mr. Kimura Mr. Notsu Mr. Matsumoto
6(Sat)	Free		25(Thu)	Prac. Model set net making ditto	Mr. Matsumoto
8(Mon)	Lec. Practical trawl fishing	Mr. Suzuki	26(Fri)	Prac. Model set net making ditto	Mr. Matsumoto
9(Tue)	ditto		27(Sat)	Study trip to Hokkaido Visited the following organizations : * Kikonai Senior High School * "Towa Denki" Automatic Squid Angling Machine Mfg. Co., Ltd. * Northern Sea Museum * "Hakodate Seimo Sengu" Fishing Net & Rope Mfg. Co., Ltd. * "Taipo Seisakusho" Fish Processing Machine Mfg. Co., Ltd. * "Suda Shokuhin" Squid Processing Co., Ltd. * Hokkaido University, Faculty of Fisheries * Observation on squid angling by commercial fishing boat * Observation on Large-scale Set Net Fishing Operation * Courtesy Call to Hakodate City Office * Courtesy Call to Minami Kayabe Town Office * Courtesy Call to Hokkaido Government Office * Hokkaido Pref. Salmon and Trout Hatchery Station	Mr. Ohno Mr. Senga Mr. Notsu
10(Wed)	Lec. Purse seine fishing in general	Dr. Osawa	29(Mon) through October 7(Tue)		
11(Thu)	ditto				
12(Fri)	Lec. Line fishing in general	Mr. Okawara			
13(Sat)	ditto				
15(Mon)	National Holiday (Respect-for-the-Aged Day)				
16(Tue)	Sea-going practice on vertical longline fishing	Mr. Senga Mr. Iiwata Mr. Kimura			
	Prac. Model set net making	Mr. Matsumoto Mr. Notsu			
17(Wed)	Prac. Model set net making	Mr. Matsumoto			
	Prac. Netting	Mr. Senga			
18(Thu)	Lec. Fishery extension activities	Mr. Takasugi			
19(Fri)	Examination of basic computations for fishing gear construction	Mr. Senga			
	Orientation on study trip to Hokkaido	Mr. Senga Mr. Notsu			
20(Sat)	Free				
22(Mon)	* Recreation Day of KIFTC (Wholeday bus tour to Tokyo Disney Land)	Mr. Ohno Mr. Notsu			
23(Tue)	National Holiday (Autumnal Equinox Day)				

Extension Activities

Dr. Ito introduced me to Mr. Sugai, a fisheries extension agent from Nemuro, who provided information about extension activities on Hokkaido. Dr. Maru and Dr. Hayashi also provided information about extension activities on Hokkaido. Dr. Koganizawa introduced me to Mr. Wata, Mr. Ushimi, and Mr. Saito, who described extension activities in Miyagi Prefecture. Mr. Sakamoto, Mr. Tawara, and Mr. Takasugi described extension activities in Kanagawa Prefecture.

Before going to Japan I had trouble describing my own occupation as an extension advisor and also had trouble communicating that I wanted to meet people in a similar line of work over there. For anyone else in the same situation, the term in Japanese is "suisangyo kairyo fukyuin" (fishery development advisor) and the characters are:

水産業 改良普及員

Fisheries extension agents in Japan work for prefectural fisheries agencies, not the universities. One of the advantages of this arrangement is that they are closely tied in to the experimental stations and fish farming facilities in each prefecture. Extension agents can transfer out of extension and into other branches of the prefectural fisheries agency. I was told that some people transfer back and forth from the experimental station staff to the extension staff every few years. I did get the impression, however, that most people considered extension to be more of an entry-level job which was filled primarily by younger men. (I'm not aware of any women in any capacity other than secretaries in the prefectural fisheries agency stations I visited.) All of the senior staff of the Miyagi Prefectural Fisheries Agency, for instance, had at one time in their careers served as extension agents. This may be one reason why the fisheries agencies are more in the business of developing fisheries in Japan, rather than regulating them, and why it appeared to me that fishermen and fisheries biologists seem to understand each other better in that country than in the U.S.

Most extension agents have a degree in fisheries or a related subject, but this is not usually required for the job. The main criterion is a high score on a national test that's given for prospective fisheries extension agents. A certificate is awarded upon successful passage of the test. Prefectures may also have tests of their own. In Miyagi Prefecture the national test is only required of people applying for specialist positions. Only the prefectural test is required for advisors. In Kanagawa I was told that everything depended on the national test. In these two prefectures, at least, there is no preference given to "locals". Advisors are just as likely to come from another part of Japan as from the area they end up serving.

As in the U.S. there are advisors, who have multiple responsibilities in one geographical area, and specialists, who are experts in one subject and provide information to advisors and others throughout the prefecture.

Hokkaido has by far the largest fisheries extension program in Japan. There are 125-130 advisors and four specialists on the island. Of the advisors, 64 are the same as other prefectural extension agents and the rest were hired originally by towns and cities and have slightly different job descriptions. Now all work for the prefectural fisheries agency, but they are in two different classifications. The advisors work out of 28 offices scattered around the island (Figure 3) and the specialists work out of one office in Shikabe.

Most of the work done by advisors is survey work, similar to the scallop survey described in Part I - Molluscan Aquaculture and Fisheries. Mr. Sugai told me that 80 of the advisors on Hokkaido spend 100% of their time doing surveys which, I assume, are mostly related to scallop culture. As mentioned in Chapter 2, extension agents and other biologists are responsible for determining when scallops will spawn and when and where fishermen should put their collectors. They also maintain experimental hanging culture operations to keep track of growth rates and they do surveys of sowing areas to check on movement of scallops, growth rates, and predation. In areas with rich cooperatives, such as Notsuke, the coop's maintain research boats for this purpose. In other areas arrangements must be made with individual fishermen. The extension advisors don't have boats of their own.

There are 5-7 educational meetings put on for fishermen each year, but I was given the impression that this is a very small part of the advisors' jobs. I asked about newsletters and publications for fishermen, hoping to bring some back, and Mr. Sugai indicated they had none. Most information was passed on verbally and, when written materials were required, they just xeroxed gear diagrams and other types of information.

In Miyagi Prefecture the extension program was established in 1961. From 1961 to 1967 the advisors' work was all technical transfer and they were very decentralized. During this time there were many handouts and publications. In 1967 the extension program became centralized in Ishinomaki (although there are a few field offices in other locations) and the work became much more project-oriented. The rationale was that fishermen were all up to speed on existing technology, but improvements in areas such as seed production and ocean grow-out of oysters were needed as well as implementation of projects such as artificial reefs.

Today there are 15 extension agents in 5 offices in Miyagi Prefecture. In the southern area each of the four advisors has a specialty (seaweed, shellfish, etc.) and they move around to support each other as necessary, but the primary responsibility of each one is a particular geographic sub-area within the southern region. There are 15,000 fishermen in the prefecture, so the average is 1000 per advisor (the range is 600-1200 per advisor). As in the U.S., many of these fishermen are only part-timers, so the number of "serious fishermen" may only be 400-600 per advisor.

To facilitate working with fishermen, the main contact for the extension agents is through the "study group" or "research group" of each cooperative. This is generally a group of younger fishermen who are appointed by the coop to try to improve existing methods or solve problems they are having. The first duty of the extension advisors is to meet regularly with the study groups (there may be a dozen in each advisor's

territory) and find out their problems. He may be able to provide them with existing information to solve the problem or he may have to initiate a project or get the experimental station to start a project to solve it. There are two specialists in aquaculture in Miyagi Prefecture, and these would also be called in at this point.

Since 1967, the written publications have become increasingly more specific and technical. It has been many years since they've published any general publications meant for wide audiences. Mr. Wata gave me two recent publications on nori management practices and diseases of nori as examples of their current approach.

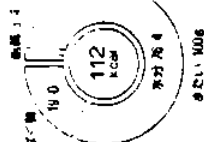
One problem that Miyagi Prefecture is having is a manpower shortage in recent years. As in agencies like the California Dept. of Fish & Game, work has increased while staffing has remained unchanged. This has resulted in the extension agents having to spend more time in the office doing non-extension activities to help out the other fisheries biologists. They complained that they are saddled with more "deskwork" and can spend less time in the field than in years past.

In Kanagawa prefecture there are three extension offices and about 15 extension advisors. There are also four specialists who cover fishing machinery, aquaculture, fishing gear, and fish processing. Extension agents also work primarily with the cooperatives' "research groups" as in Miyagi Prefecture and each agent serves about 500 fishermen.

One of the main extension activities in this prefecture is to organize study tours for fishermen to visit other areas and learn new techniques. Flatfish trawl fishing wiped out the population in one area and was outlawed, so a group of fishermen was sent to another prefecture to learn how to troll and longline for them. These methods are now working well.

Another example of extension work in Kanagawa Prefecture was development of a mechanical line hauler for red sea bream fishing. This used to be done with hand lines and was very hard work. An extension agent took the idea for a mechanical hauler to a commercial manufacturer and together they worked out a system that would work for red sea bream. All the fishermen now use these mechanical line haulers.

Extension agents have also developed materials to promote fisheries products from Kanagawa Prefecture. They made a video tape of a demonstration that the local fishermen's wives organization put on, showing how to cook sardines. This video has been shown throughout Japan and has increased sales of fresh sardines. Similarly, extension agents put together a booklet called The Sakana (Fishes), which was published by several fishermen's associations, describing the various types of seafood produced in Kanagawa Prefecture and how to cook them. I was given a copy of this booklet, which won an award at a national federation of fisheries cooperatives meeting (Figure 4).



日本産のタイの仲間にはマダイ、チダイ、クロダイなどがあります。タイの話をしましょう。沿岸の岩礁地帯にすみ、タイ類で最大で、全長1mをこえるものもあります。4〜6月が産卵期で、そのころが最も美味で、特にサクラタイといいます。タイは飯にもうまみがあることをお忘れなく。

淡水魚のまみもあるという魚。素材の味はいを大切に料理に生かしたいもの。皮のうまみも利用。

●●“皮箱降り”の刺身川をサラダに使って

③④⑤⑥⑦⑧⑨⑩⑪⑫⑬⑭⑮⑯⑰⑱⑲⑳㉑㉒㉓㉔㉕㉖㉗㉘㉙㉚㉛㉜㉝㉞㉟㊱㊲㊳㊴㊵㊶㊷㊸㊹㊺㊻㊼㊽㊾㊿

ワインの味

「肉には赤、魚には白」とではよくいわれることですが、これは単に色のことではなく、味のことも含めて言われています。ワインに出会うことは、その両方を知ることになります。



168 kcal

●魚+緑黄色野菜+乳製品の健康と美容食、

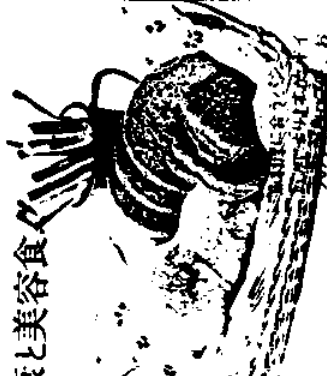
マスの身はサケより柔らか。風味を楽く、②のに人じんしむためにあまり手を加えない料理せ。と小玉ねぎを加え

マスのグリーン」兼
144(4人分) マス4切れ にんじん
1本、小豆ねぎ2個 プロコリ一
片 にんにく1かけ バター大、2
ダズイヨン2片、ローリエ1枚 牛乳2
プーマニエ(バター、小豆粉各

大、3）塩、こしょう
きり方 ①マスを1切れを2～3つに
切り分け、軽く乾く。こしょうをま
き、油をひいて、フライパンで焼く。
②マスを1切れを2～3つに切り分
け、軽く乾く。こしょうをまき、油
をひいて、フライパンで焼く。

①⑤が蒸立つ直前に
ーを加え、ブールマ
ないように落かし、④の人に
とろみをつけます。

なじみアフランスのパンが
ツトなどが最盛です。
地味な味わいのパンよ
りは、ライ麦のパンな
ど二重はしく、また酸
味のあるパンなどか不
思議に魚料理には合う
ようです。イギリスの
マフィン、イタリアの
ブリッシー二もびつた
りの料理です。



I was told that the three goals of fisheries extension in Kanagawa Prefecture are:

1. Maintain and increase the fisheries resource. (This includes promotion of aquaculture, ocean re-seeding, and habitat improvement such as artificial reefs).
2. Improve fisheries techniques to save manpower.
3. Promote greater utilization of the catch.

If all of the prefectures (except Hokkaido) with ocean coastlines average 10-15 fisheries extension agents, I estimate that there might be between 450 and 600 agents and perhaps 150 specialists in Japan.

APPENDIX 1

List of fisheries education and extension activities
reprints and publications obtained on study trip to Japan

Copies are available at cost from C. Toole

1. Hayashi, U. 1985. Accounting and financial statement analysis in fishery cooperatives. Kanagawa International Fisheries Training Center. 79. p. (English).
2. Hokkaido University Faculty of Fisheries. Catalog. (English).
3. Kanagawa International Fisheries Training Center. (No date). Manual on fishermen's cooperatives. (appears to be reprinted from FAO). 124 p. (English).
4. Kanagawa International Fisheries Training Center. (Multiple authors). 1974. Japanese fishing gear and methods. 300 p. (English).
5. Kanagawa International Fisheries Training Center. (Multiple authors). 1975. Outline of aquaculture. 164 p. (English).
6. Kanagawa International Fisheries Training Center. 1984. Major fisheries legislations of Japan. 228 p. (English).
7. Kanagawa International Fisheries Training Center. 1986. Outline of fishing gear and method. 123 p. (English).
8. Kanagawa International Fisheries Training Center. Several pamphlets describing the Center and the course offerings. (English).
9. Koyama, T. 1984. Trawl fishing method. Kanagawa International Fisheries Training Center. 31 p. (English).
10. Maruyama, T. 1983. Inland aquaculture. Kanagawa International Fisheries Training Center. 140 p. (English).
11. Nomura, M., and T. Yamazaki. 1977. Fishing techniques (1). Kanagawa International Fisheries Training Center. 206 p. (English).
12. Nomura, M. 1981. Fishing techniques (2). Kanagawa International Fisheries Training Center. 183 p. (English).
13. Nomura, M. 1981. Illustration of fishing gear designs. Kanagawa International Fisheries Training Center. 38 p. (English).
14. The Sakana. Booklet on fishery products prepared by extension agents in Kanagawa Prefecture. (Japanese).

APPENDIX 2

List of people involved in fisheries education
and extension met on study trip to Japan

NAME	AFFILIATION	COMMENTS
Kazuhiro NAKAYA	Laboratory of Marine Zoology Faculty of Fisheries Hokkaido University Minato-machi, Hakodate Hokkaido 041, JAPAN	Associate Professor Expert on sharks
Kunio AMAOKA	"	Professor of Ichthyology
Minoru ISHIDA	"	Graduate Student
(Also met several other students-didn't record names)		Most were working on systematics and taxonomy
(Didn't record name)	Usujiri Marine Station of Hokkaido University Faculty of Fisheries (Address in Japanese)	<u>Laminaria</u> culture technician
Mr. SUGAI	Nemuro-Hokubu Fisheries Extension Office (no address given - near Notsuke)	Extension agent who works primarily on scallops
Akio SAITO	Miyagi Prefectural Fisheries Agency Headquarters (Address in Japanese) Ishinomaki, Miyagi, JAPAN	Director Prefectural fisheries agency
? USHIMI	"	Chief of Fisheries Development
? WADA	"	Chief of Extension Activities
Takashi SAKAMOTO	Kanagawa International Fisheries Training Center Japan International Cooperation Agency(JICA) 5-25-1 Nagai-cho Yokosuka, Kanagawa 283-03, JAPAN	Instructor
Masayuki KUSAMA	"	Instructor
Shigemitsu TAKASUGI	"	Head of Facility
Yozo TAWARA	"	Director
? NOMURA	"	Instructor (fisheries gear classes)
Tokuo SANO	Laboratory of Fish Pathology Tokyo University of Fisheries 4-5-7 Konan, Minato-ku Tokyo 108, JAPAN	Guest lecturer of Kanagawa Training Center