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THE

OCEANIC INSTITUTE

MILKFISH PROGRAM

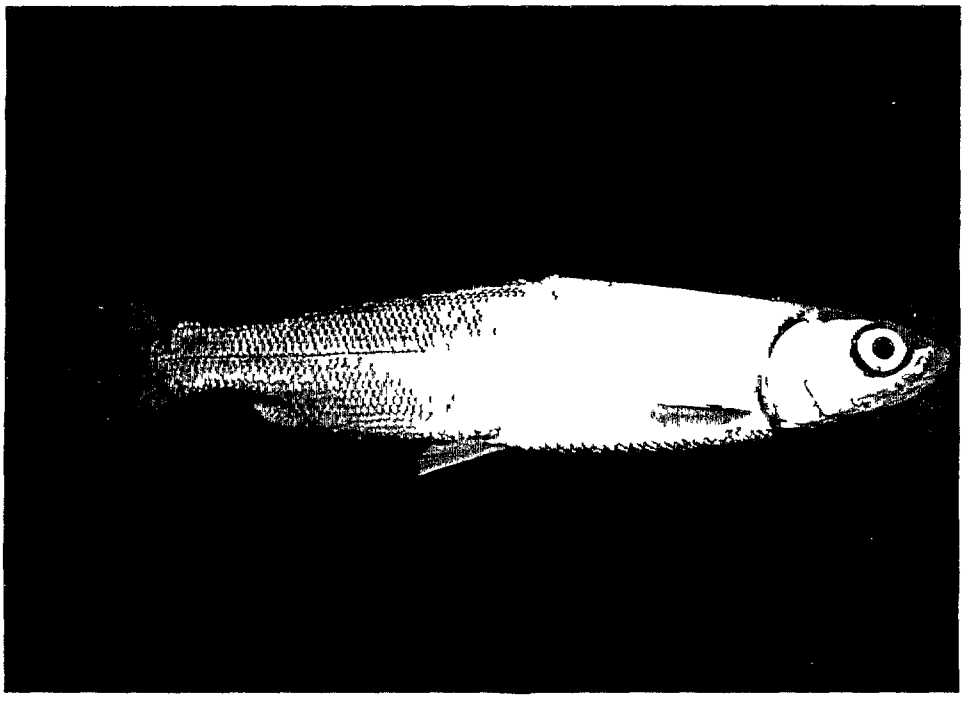

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Plate 1 An aerial view of the Oceanic Institute

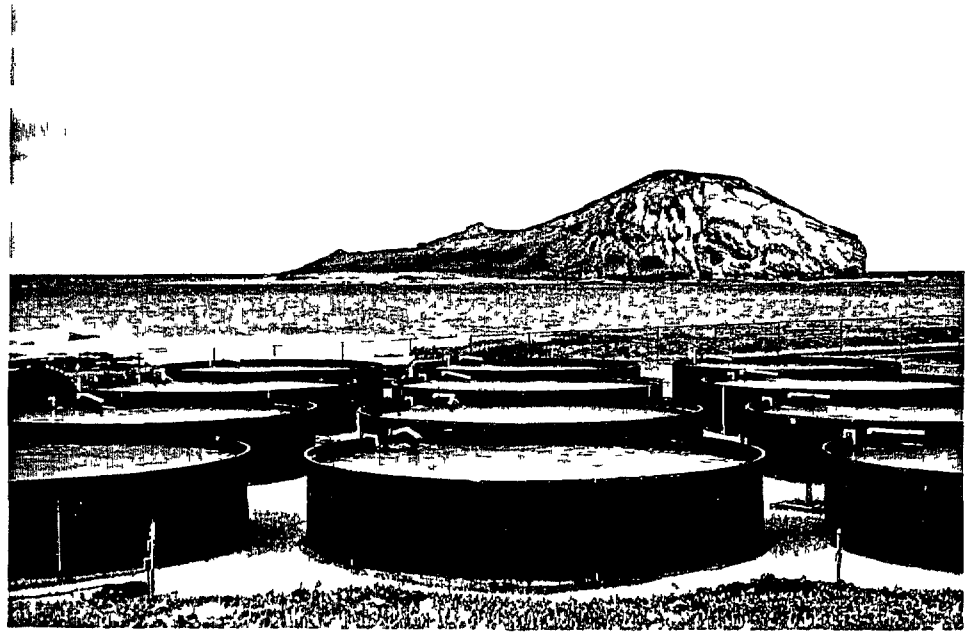


Plate 2 Experimental tanks for conducting maturation experiments on milkfish.

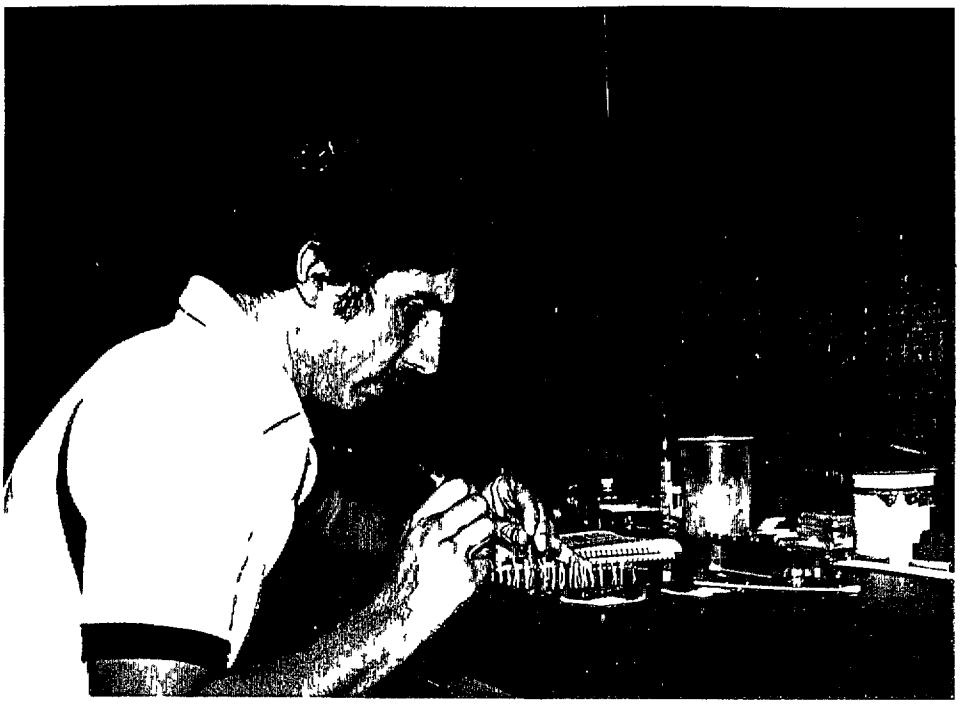


Plate 3 Hormone implant preparation

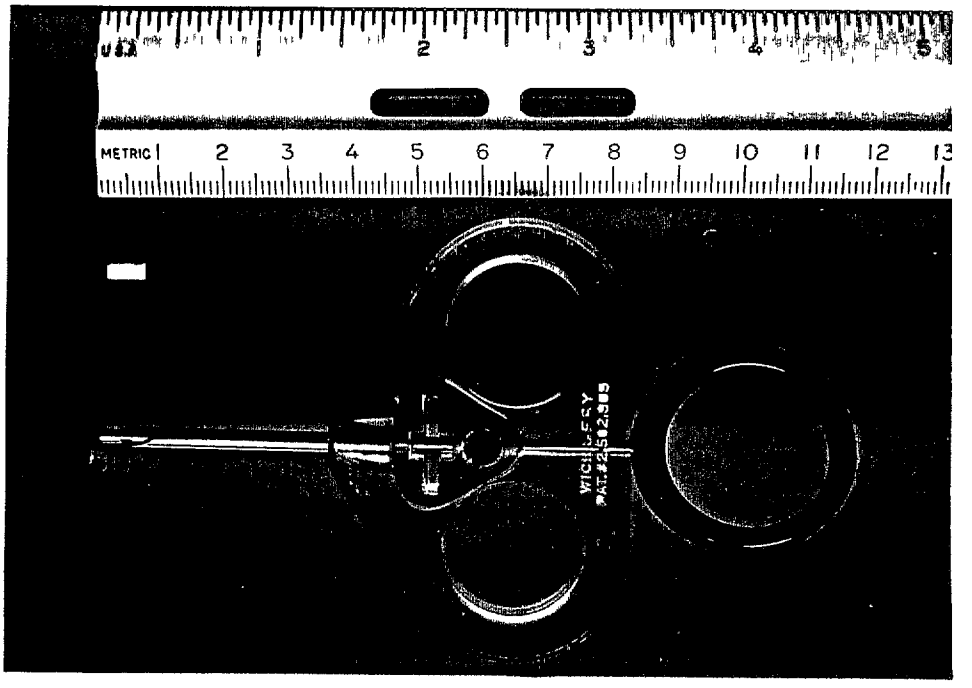


Plate 4 A hormone implantation device with a slow hormone releasing cholesterol pellet

Plate 5 Monthly blood sampling of milkfish for analyzing circulating hormone levels

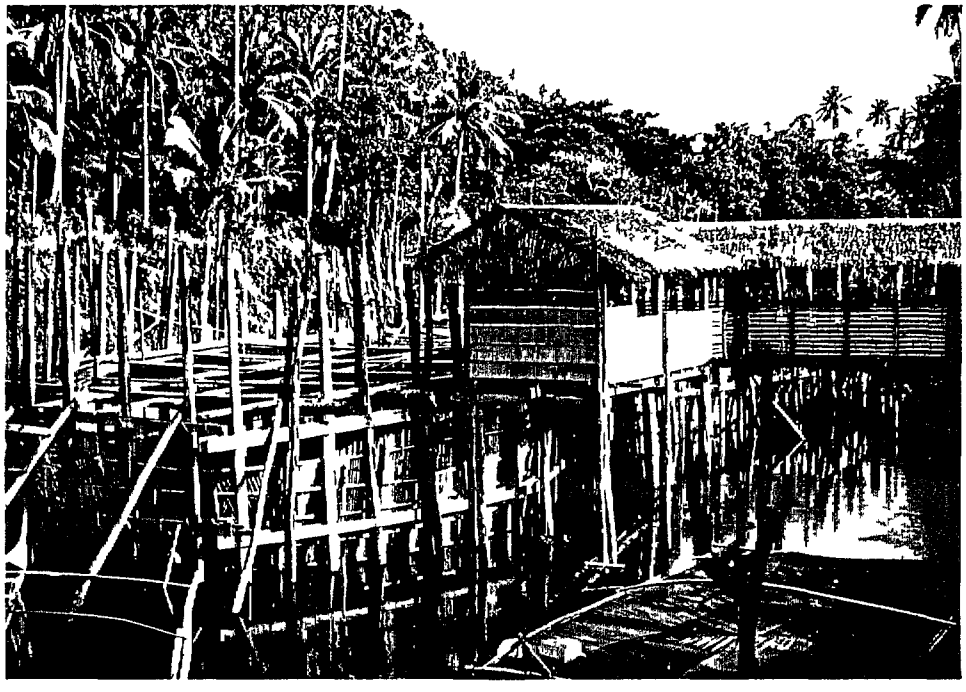


Plate 6 A fish trap for milkfish at Naujan Station, part of SEAFDEC, a cooperative institute in the Philippines

Plate 7 A workshop on milkfish reproduction and culture held at Tungkang Marine Laboratory, Taiwan, another cooperative institute overseas

Plate 8 An example of transferring new technology developed at the Oceanic Institute via a demonstration on hormone implantation at the Milkfish Workshop

PAPERS FOR STATE-OF-THE-ART-REVIEW

AUTHOR	TITLE	REC'D	REVISED	FINAL
Hong, L Q	Milkfish General Biology	X		
Kuo, K H	Pathology			
Lee, C S. & Weber, G.	Artificial Propagation	X		
Lee, C S.	Reproduction of Milkfish	X		
Liao, I C & Chen, T I	Milkfish, Chanos chanos, Culture	X		
Santiago, C.B.	Milkfish Nutritional and Feeds	X		
Shang, Y C	Economic Aspects of Milkfish Farming in Asia	X		
Tamaru, C S.	Population Structure of the Milkfish, Chanos chanos, Past and Proposed Analysis	X		
Villaluz, A.	Collection, Handling Fry			
Watanabe, W.	Larvae and Larval Culture of Milkfish Chanos chanos Forsskal	X		

PAPERS PRESENTED AT MILKFISH WORKSHOP

AUTHOR	TITLE	REC'D	REVISED	FINAL
Chen, F H	Traditional Milkfish Culture in Taiwan			
Chin, C C	Deep Water Pond System for Milkfish Culture			
Crim, L W	Acute and Chronic Hormone Administration	X		
Fukusho, K	Status of Marine Larval Culture in Japan			
Hanyu, I & Razani, H	Environmental Factors in Fish Reproduction	X		
Kanazawa, A	Nutritional Factors in Fish Reproduction			
Kuo, C M.	A Review of Induced Breeding of Milkfish	X		
Lam, T.J	Induced Spawning in Fish	X		
Lee, C S.	Environmental Factors in the Reproduction of Milk-fish	X		
Lee, C.S., Tamaru, C S Crim, L.W.	Techniques for Hormone Implantation in Milkfish	X		
Lin, L.T.	My Experience in Artificial Reproduction of Milkfish			
Liao, I C.	Milkfish, Chanos chanos, Culture in Taiwan	X		
Pamplona, S.D. & Mateo, R T	Milkfish Culture in the Philippines	X		
Tamaru, C.S.	Population Structure of the Milkfish, Chanos chanos Past and Proposed Analysis	X		

Table 1. Date of implantation and spawning
(Data in parentheses gives average eggsize in millimeters ± standard deviation

Fish #	Treatment	Hormone Implantation 1st	Hormone Implantation 2nd	Hormone Implantation 3rd	Spawning 1st	Spawning 2nd
1	LHRH-A & Liquid Testosterone	3/7/85 (NA)	4/9/85 (NA)	5/7/85 (0 768±0 044)	5/9/85 (1 220±0 042)	
2	LHRH-A & Liquid Testosterone	3/14/85 (NA)	4/11/85 (0 435±0 042)	5/10/85 (0 857±0 051)	5/12/85 (1 290±0 042)	
3	LHRH-A & Liquid Testosterone	3/14/85 (NA)	4/11/85 (0 790±0 029)	5/10/85 (0 583±0 075)	4/13/85 (1 269±0 027)	
4	LHRH-A	3/7/85 (NA)	4/9/85 (0 887±0 071)	5/2/85 (0 317±0 037)	4/11/85 (1 284±0 038)	
5	LHRH-A	3/14/85 (NA)	4/11/85 (0 853±0 032)	5/9/85 (0 634±0 078)	4/13/85 (1 204±0 037)	
6	LHRH-A	2/28/85 (NA)	4/15/85 (0 375±NA)	5/6/85 (0 905±0 066)	3/26/85 (NA)	5/8/85 (1 345±0 049)

* No third implantation
NA Data not available

Table 2. Number of maturing fish in different groups.

Group #	Treatment	Maturing Female	Maturing Male	Not Maturing	Total	% of Maturing Fish
1	LHRH-A & Testosterone	6	9	4	19	79
	Sham Control	1	1	2	4	50
2	LHRH-A	4	3	13	20	35
	Sham Control	0	0	4	4	0
3	LHRH-A	2	1	7	10	30
	Sham Control	0	0	4	4	0
4	Control	0	0	24	24	0

OCEANIC INSTITUTE FINFISH PROGRAM

OVERALL OBJECTIVES

1 To understand and control the reproduction of selected finfish in captivity

2 To achieve economical mass production of finfish fry for food production

3 Technical transfer

NEAR TERM GOALS

1 To develop technology for controlled reproduction of milkfish in captivity

Implementation Plan (next page)

2 To develop mass production techniques for milkfish fry.

Milkfish is the most important cultured marine fish in the world In Taiwan, Indonesia, and the Philippines, about 600 million pounds of milkfish are cultured annually This represents about half of the production of all cultured marine fish in the world In these three countries, up to one million people are employed in the milkfish industry

Milkfish aquaculture has been practiced in Asia for centuries Many of the traditional methods are still practiced today For example, all of the juvenile fish needed to stock the ponds, the seed for this crop, are still gathered from the sea

For this important industry to continue providing the peoples of Asia with inexpensive protein, a more reliable supply of seed needs to be developed To do this, milkfish will have to be reproduced in captivity. The Oceanic Institute is committed to achieving this goal

The Oceanic Institute is a private, nonprofit foundation located on Hawaii's main island of Oahu The Oceanic Institute is dedicated to applied science in the areas of aquaculture and oceanography 1985 marks OI's 25th anniversary Oceanic Institute's involvement in this program results from its internationally recognized leadership in marine finfish reproduction Helping to improve the world's food producing capabilities is the number one objective of the Oceanic Institute

Modern science knows a great deal about animal reproduction We have known how to reproduce the terrestrial domestic animals for thousands of years Indeed, controlled reproduction is a necessary first step in the domestication process Few aquatic animals are easily reproduced. In spite of many attempts, reliable methods for reproducing milkfish do not exist

A cooperative agreement sponsored by the United States Agency for International Development (U S AID) has been initiated to solve this pressing problem

In this program, the Southeast Asian Fisheries Development Center in the Philippines, the Tungkang Marine Laboratory in Taiwan, and The Oceanic Institute in Hawaii are collaborating to tackle this important problem of milkfish captive reproduction

Research activities at all three labs will focus on the difficult task of reproducing milkfish in captivity State of the art techniques developed for controlled reproduction in other animals will be applied to milkfish

The AID-sponsored program at OI encompasses five areas of activity These are

1 The state-of-the-art literature review and publication of a book presenting all that is known about milkfish

2 The organization of an international workshop focusing on milkfish reproduction and culture

3 The determination of the population structure of milkfish in the Pacific Ocean

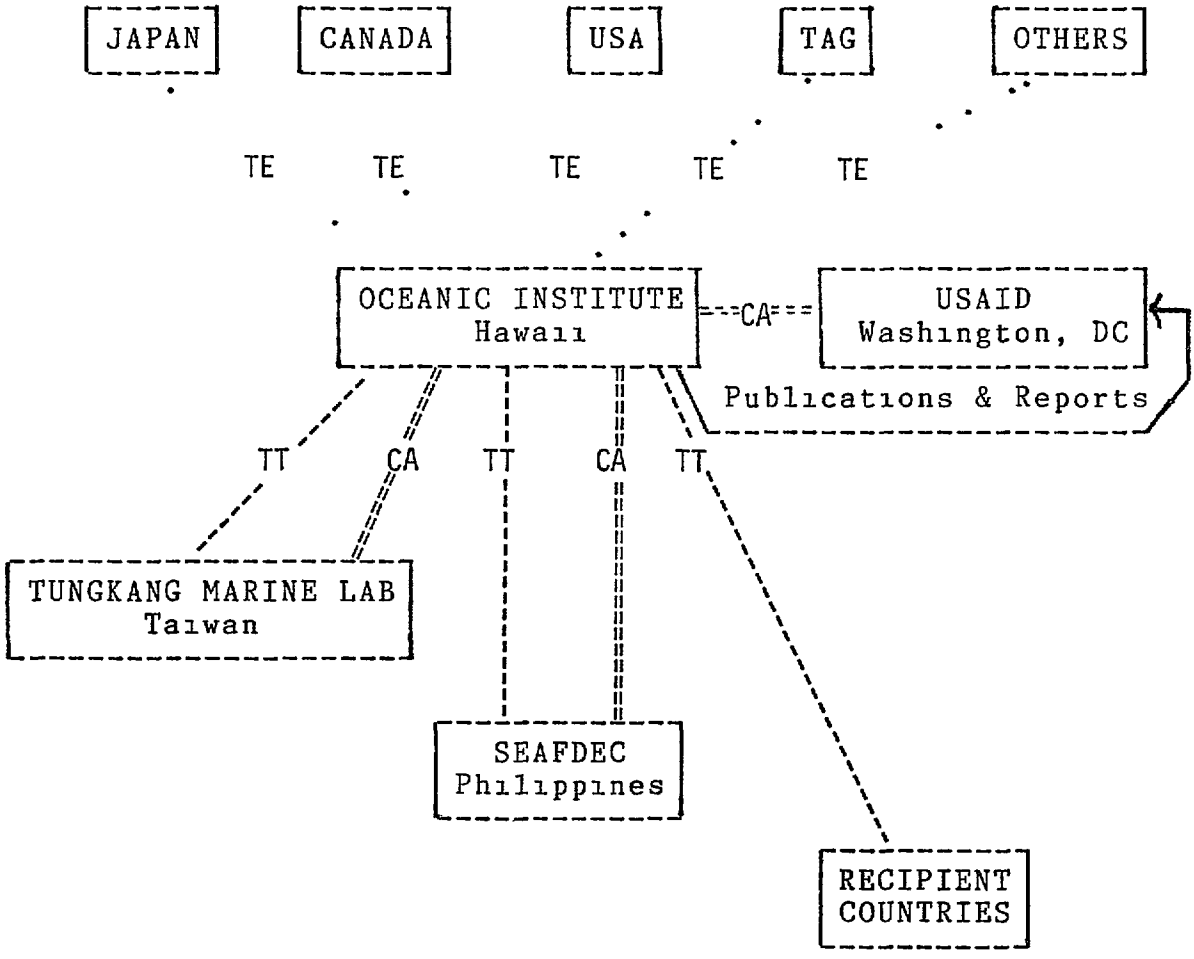
4 The maturation of male milkfish by feeding testosterone to the fish.

5 The controlled reproduction of milkfish by hormone implantation

As the technology for reproducing milkfish in captivity is being developed, the Oceanic Institute will be training personnel from various interested countries in the state-of-the-art technology as it develops

Milkfish aquaculture provides high quality animal protein to the peoples of these countries at a relatively inexpensive price--it is truly the "People's Fish"

ORGANIZATION CHART



CA = Cooperative Agreement
TT = Technical Transfer
TE = Technical Exchange
TAG = Technical Advisory Group

1985 IMPLEMENTATION PLAN

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1 0 IMPLANTATION													
1 1 Tank Preparation	X												
1 2 Get Fish	X→	→											
1 3 Technique Developed	X→	→	→										
1 4 Pellet Study		X→	→				X→	→	→	→			
1 5 Experiment Begin			X→	→	→	→	→	→	→	→	→	→	→
1 6 Maturity Check				X	X	X	X	X	X	X	X	X	X
1 7 Analysis							X→	→	→	→	→	→	→
1 8 Start Another Experiment										X→	→	→	→
1 9 Sacrifice/Sample Fish													X
2 0 Collect Blood - RIA							X	X	X	X	X	X	X
2 1 Analysis												X→	→
2 2 Publication					X		X						X
3 0 STATE OF THE ART LITERATURE REVIEW													
3 1 Letter to Authors	X												
3 2 Response		X											
3 3 Chapters First Draft				X									
3 4 Review Chapters					X→	→	→						
3 5 Final Draft							X→	→	→				
3 6 Publish Book											X		
4 0 POPULATION STUDY													
4 1 Setup Lab	X												
4 2 Test Lab	X→	→											
4 3 Collect Fish	X→	→	→	→	→								
4 4 Electrophoresis Data													
Taiwan & Oahu Samples (4)							X→	→	→				
PI adults									X→	→	→	→	
4 5 Data Analysis										X→	→	→	→
5 0 TESTOSTERONE EXPERIMENT													
5 1 Get Fish	X												
5 2 Feed Testosterone	X→	→	→	→	→	→							
5 3 Collect Blood - RIA	X	X	X	X	X	X							
5 4 Sacrifice/Sample fish		X											
5 5 End Experiment 1 (20 weeks)						X							
5 6 Data Analysis							X→	→	→				
6 0 COOPERATIVE ACTIVITIES-TAIWAN													
6 1 Hormone Implant					X→	→	→	→	→	→	→	→	→
6 2 Data Collection								X	X	X	X	X	X
6 3 Water Quality Tests	X→	→	→	→	→	→	→	→	→	→	→	→	→
6 4 Testosterone Experiment				X→	→	→	→	→	→				
7 0 COOPERATIVE ACTIVITIES-PHILIPPINES													
7 1 Fish Collection		X→	→	→	→	→							
7 2 Hormone Implant								X→	→	→	→	→	→
7 3 Population Study					X→	→	→				X→	→	
8 0 TAG MEETINGS					X						X		
9 0 MILKFISH WORKSHOP					X								
9 1 Publish Workshop Proceedings								X					

X Action Taken

THE OCEANIC INSTITUTE

MILKFISH MATURATION AND REPRODUCTION TRAINING PROJECT

FOR INDONESIAN CANDIDATES

SUMMARY

The training will be conducted April 1 through June 30, 1986, at the Oceanic Institute at Makapuu Point, Waimanalo, Oahu, Hawaii, U S A The training will follow the research objectives of the U S AID funded milkfish research program being conducted at the Oceanic Institute The main subject will be the hormone induced maturation and spawning of milkfish (Chanos chanos) Student/trainees will be working with milkfish throughout the training period Upon completion of the three month study period, student/trainees will be familiar with the basic techniques involved, and have hands-on experience in the hormone induced maturation and reproduction of this finfish

The training project can accommodate four (4) Indonesian trainees and will cost $75,000 for the three month training period This fee includes round trip air fare, room and board expenses, instruction fees and supplies The trainees should have had biological sciences and some previous experience with the culture of aquatic organisms English comprehension must be excellent

COURSE CURRICULUM

I Background

A Introduction and Orientation to Facility Systems
1 air and seawater supply
2 spawning facility
3 hatchery facility
4 phytoplankton and zooplankton culture facility

B Species Introduction
1 life history

C Basic Laboratory Procedure
1 sterile techniques
2. microscope use and care

D Water Quality Determination and Parameters
1 temperature
2 salinity
3 dissolved oxygen (DO)
4. pH

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E Basic Knowledge of Hormones and Their Role in Induced Spawning
1 types of hormones
2 physiological responses
3 natural vs synthetic hormones
4 costs, availability, and effectiveness

II Techniques

A Broodstock Maintenance
1 nutritional requirements
2 water quality parameters
3 light as a factor
a photoperiod
b intensity
c spectrum

B Broodstock Maturity Determination and Selection
1 identifying the sexes
2 determination of maturity in females
3 sperm evaluation
4 health assessment

C Hormone Preparation and Administration
1 handling and weighing fish
2 determination of hormone dosage
3. implantation preparation and administration
4 injection preparation and administration
5 oral preparation and administration
6 assessment following hormone administration

(Assuming successful spawning)

D Egg Quality Identification and Egg Incubation
1 collection of eggs
2 handling and care of eggs
3 determining fertilization rate
4 fecundity rate
5 staging egg development
6 facility set-up

E Hatchery Overview
1 population estimates
2 determination of health
3 nutritional requirements
4 water quality parameters
5 estimation of required facilities

August, 1985

METHODS FOR ACUTE AND CHRONIC HORMONE ADMINISTRATION IN FISH

Laurence W. Crim

Marine Sciences Research Laboratory
Memorial University of Newfoundland
St John's Newfoundland A1C 5S7
Canada

Many methods are available for administering hormones to fish. The variety of methods includes simple injections, hormone baths, incorporating the hormone into the feed and more elaborate methods of controlled hormone release from sustained-release formulations which are implantable. The choice of methodology depends primarily upon economic and convenience considerations while endeavoring to minimize the trauma associated with hormone treatment protocols. As improvements are developed in the area of sustained-release devices, more efficient hormone delivery protocols will be available in the future.

ENVIRONMENTAL FACTORS IN FISH REPRODUCTION

Isao Hanyu and Hossein Razani

Department of Fisheries
Faculty of Agriculture
The University of Tokyo
Bunkyo-ku, Tokyo 113, Japan

In the rose bitterling, Rhodeus ocellatus ocellatus, which continues cyclic spawning from spring through summer, gonadal maturation was induced by raising the temperature above 10°C in early spring Gonadal regreassion at the termination of spawning was effected by shortening the daylength below 13L. This photoperiodic involvement developed during July, probably in connection with fatigue in the endocrine system. At a photoperiod over 14L, the regressed fish could be soon brought into recrudescence In the spring-spawning tabira bitterling, Acheilognathus tabira, the lower limiting temperature for maturation was about 13°C, while the gonadal involution was caused by temperature rising beyond 25°C in early summer. If the fish kept spawning under moderate temperatures, they were found to develop photoperiodism within a few months During autumn, the spring-spawning goldfish could be rematured and suppressed respectively under long and short daylengths combined with 24°C At 16°C, however, the photoperiodic response was depressed and maturation could be completed regardless of daylength Moreover, maturation cycles were repeated for many months Patterns of environmental regulation of ovarian activity were compared, and common features were discussed.

ENVIRONMENTAL FACTORS IN THE REPRODUCTION OF MILKFISH

Cheng-Sheng Lee

Oceanic Institute
Matapuu Point
Waimanalo, Hawaii 96795

The environmental factors required for the maturation and spawning of milkfish are not yet defined These factors include temperature, photoperiod, salinity, lunar cycle, space, tank shape and stress and will be discussed in this chapter.

Long daylight regimes and warm water temperatures seem to be suitable for final maturation. In nature, water temperature determines the length of the spawning season. Salinity does not affect gametogenesis, but no spawning occurs below a salinity of 8% The lunar cycle relates to the spawning cycle in nature but there is no relation under culture conditions Maturation and spawning are not inhibited in a 25 m^2 tank

NUTRITIONAL FACTORS IN FISH REPRODUCTION

Akio Kanazawa

Faculty of Fisheries
Kagoshima University

Although more than 300 species of fish have been cultured in various countries, the seed of these fish has mostly depended on the larvae from wild fish To establish the mass production of seed fish, it is necessary to obtain lots of good eggs and healthy larval fish.

It is likely that the diets used for culture of parent fish may affect the ovarian maturation, spawning, and egg qualities But, only a little information is available on these field.

In this presentation, the effects of proteins and amino acids, lipids, minerals, vitamins and pigments in diets on the qualities of eggs of Ayu fish, rainbow trout, carp, milkfish, red sea bream and Sigunas guttatus, were discussed. As a results, it seems probable that the improvement of diets for parent fishes, in the formula of proteins, essential fatty acids, phospholipids, minerals, vitamins, and pigments, promotes the suitable production of good eggs required for fish culture.

STATUS OF MARINE LARVAL CULTURE IN JAPAN

A Short History of Study to Solve Lordosis of Red Seabream

K Fukusho

National Research Institute of Aquaculture

The technology for mass larval rearing of marine fishes has been remarkably developed for the last 15 years, e g , 6 3 x 10^6 juveniles (red seabream Pagrus major and porgy Acanthopagrus schlegeli, 12.1-16.0 mm in TL) were produced in a hatchery within three month period There are several reasons for the rapid and successful development of technique. As one of the important factors, introduction of a rotifer Brachionus plicatilis as a food organism and the development of its culture should be pointed out (the production mentioned above was supported by the production of rotifer, 1 2 x 10^{12} individuals = ca 2 5 t in wet weight). Establishment of spawn-taking method by natural spawning in tank is also another important factor (a female red seabream of 1 kg spawns 2 x 10^6 eggs for the period of 1.5 month) Furthermore, special attention and improvement in environmental management for larval rearing and mass culture of the rotifer promoted the development of fry production technique, therefore, rearing with large-scale tank (100 t tank with harvest of 10^6 juveniles of 10 mm in TL) and mass culture of the rotifer with big tank (40 t tank with harvest of 152.4 x 10^8 rotifers = ca. 45 kg for 18 days) have become to be possible This paper deals with the importance of environmental management of larval rearing of marine fishes, illustrating the serious problems of lordosis in red seabream and the history of research for its solution as an example of the successful management.

CONTENTS

I. Mass fry production

1. Mass production at National or Prefectural Fish Farming Center

1) Spawn taking
2) Larval rearing
3) Rotifer culture

2 Mass production by aquaculturists

1) Rotifer culture
2) Larval rearing

II. A new minute alga, Tetraselmis tetrathele for rotifer culture

1. Nutritional value of rotifers with T tetrathele

2. Larval rearing of red seabream by the rotifer fed with T tetrathele

III. Deformation

1. Lordosis of red seabream -- a short history of study to solve lordosis

2. Anomalous coloration of a flounder, Paralicthys olivaceus

IV. Brood stock

1. Stimulation and acceleration of maturation

2. Formula feeds for maturation

V. Breeding

POPULATION STRUCTURE OF THE MILKFISH CHANOS CHANOS, PAST AND PROPOSED ANALYSIS

Clyde S. Tamaru

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The most widely accepted definition of a "species", for sexually reproducing organisms is that of a group of individuals that can and do interbreed among themselves In turn, this group of individuals remain reproductively isolated from other such groups The term interbreeding implies that there is genetic uniformity within the taxon However, organisms that exhibit a large geographic distribution have obvious geographic, environmental, and temporal barriers to gene flow. In fact, most organisms do not behave as a single panmictic group but exhibit some degree of genetic heterogeneity This within species differentiation has been explained by the existence of demes, populations, or races Defining the population structure of a wide ranging marine teleost such as the milkfish should provide insight into the forces that shape within species differentiation. Such information is highly relevant to understanding how new species originate

The state of the art method used in determining the population divisions of a particular species is discussed In addition, the past work on stock structure of milkfish is presented followed by the proposed analysis to be carried out at the Oceanic Institute

MILKFISH CULTURE IN TAIWAN

I-Chiu Liao

Tungkang Marine Laboratory
Tungkang, Taiwan 916, R O C

Continuous modification for almost three hundred years gives milkfish culture in Taiwan a traditional style of its own It is called the shallow water pond or fertilizing culture system in which the farmer grows benthic algae by treatment of tillage, fertilization and sunning. This method fully utilizes a balance ecosystem in the milkfish ponds.

Another culture system is recently developed and improved It is called the deep water pond or feeding culture system in which the unit productivity may reach four to five times of that of the traditional style Due to the higher profit in the modern style than the traditional one, the former is becoming more and more popular. Nevertheless, the total national production increases rapidly and the imbalance of supply and demand results in a reduction of profit and even bankruptcy It becomes a big shock to milkfish farming industry

Brief introduction and comparison of the above-mentioned culture systems are made to investigate their advantages and disadvantages A prospect of milkfish culture in Taiwan is also described.

MY EXPERIENCE IN ARTIFICIAL PROPAGATION OF MILKFISH

Lieh-Tang Lin

A special diet was formulated to rear 110 10-11 years old milkfish broodstock The body weights ranged from 3 0-7 5 kg The dimension of three broodstock ponds was 750 m^2 or 1,000 m^2 by 1.3 m - 1 5 m in depth.

Natural spawning and fertilization of eggs occurred 62 times between the time period from April 8 to September 21, 1984 The number of eggs collected from all of the spawns were estimated to be total 61,836,000 Fertilization rates from individual spawning events ranged from 10% to 95% The total number of hatched larvae from all of the spawns was estimated at 27,765,000 After a rearing period between 13-24 days approximately 4 4 millions fingerlings ranging from 1.0-1 6 cm in length were obtained

Larvae were reared in outdoor nursery ponds The highest survival rate was estimated at 76.2% with an average of approximately 17 7%

Maturation, spawning, and massive production of larvae were shown to be feasible and practical for milkfish reared in earthen bottom ponds

TRADITIONAL MILKFISH CULTURE IN TAIWAN

F.H. Chen

The traditional shallow-water milkfish culture is practised according to the seasons in the Chinese Agricultural Calendar There are 24 "seasons" in a year Each one is given a name describing the weather or natural condition. Each "season" lasts for 15 days

"Spring found", (February 4), marks the beginning of the working year. During this period preparation of the ponds are performed. This is followed with fry stocking which begins at "Brightly clear", (April 5). Over-wintered fry are the first to be stocked New fry are stocked after "Sowing rain", (April 20)

Depending upon the growth of the fish and the prevailing market situation, fish may be harvested during the period from "Summer Solstice", (June 21) to "First frost", (October 23) Over-winter ponds are prepared during the time between "Autumn found", (August 5) and "Cold dew", (October 8) At "First frost" (October 23), fish ready for over-winter are placed into their respective over-winter ponds. All preparations are completed before "Winter Solstice", (December 22)

Improvement of the traditional practices of shallow-water milkfish culture are discussed Stocking densities and fish production have fluctuated annually. Increases in production have resulted in the drop of fish prices. Hence, the management of milkfish culture should be adjusted accordingly. Suggestions focused on the improvement of the marketing and processing of milkfish are presented.

DEEP WATER POND SYSTEM FOR MILKFISH CULTURE

C C Chiu

For several hundred years, milkfish culture in Taiwan is performed by building 30 cm deep ponds along the coast Seawater is induced into the ponds and benthic algae are grown by application of rice bran as fertilizer and sunlight.

An improved modern culture system is developed recently by taking advantage of the euryhaline characteristics of milkfish Fresh water is used to culture the fish in 2 m deep ponds. Aerators and artificial feeds are applied Hence, the unit stocking density is allowed to increase 2 to 3 times, resulting in a production increase of 3 to 4 times. This modern culture method is shown to be a great success

A NEW HORMONE IMPLANTATION TECHNIQUE FOR THE MILKFISH (*Chanos chanos*) FORSSKAL

Cheng-Sheng Lee, et al

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Makapuu Point
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A common approach to bring about the maturation of gonads in milkfish is to utilize a series of hormone injections Such a technique requires that the individual fish be handled repeatedly for each injection. This part of the procedure often times introduces a stress factor which undoubtedly has some negative effects on the action of the hormone.

The development of a technique that delivers the desired hormone and minimizes the stress due to handling would be extremely advantageous. Such methods are available and usually employ slow time release pellets that have an effective duration of between weeks to months

The preliminary results employing an LH-RH choloesterol based pellet conducted at the Oceanic Institute have shown some very promising results This includes the first reported induced natural spawning of a milkfish in captivity that has resulted in a fertilization rate of 95%.

OPENING REMARK

Mr. C C Young

Ladies and gentlemen

It is my great pleasure to be here to participate in the "Workshop on Reproduction and culture of Milkfish" and to welcome foreign friends as well as local colleagues As Confucius' saying goes "How happy to greet friends from remote places", I feel the same

During my assignment as deputy chief of Ministry of Economics, I have many chances to visit the Tungkang Marine Laboratory There were limited facilities and few staff at that time However, I find a rather new atmosphere in TML today not only because of the new buildings and wonderful facilities, but also because of the fantastic potential that the aquaculture scientists have expressed. In addition, I realize that this Workshop is part of the activities of an international cooperative research program and would like to congratulate the Oceanic Institute, South East Asian Fisheries Development Center and Tungkang Marine Laboratory for such a successful beginning

For centuries, the culture of milkfish has provided a source of protein for the peoples of South East Asia. In Taiwan, the traditional methods of shallow water culture of milkfish are giving way to the more productive deep water techniques However, such practices require a larger amount of investment in both time and capital. Both the traditional methods as well as the more recent methods in milkfish culture, however, still depend on the wild stocks of milkfish fry. Fluctuations in the amount of wild fry available have continuously plagued the milkfish farmers both old and new Such fluctuations can be economically devastating,

especially to the farmers practicing the new culture methods Obviously, a more reliable source of fry will provide a more stable market.

The key for a more dependable source of milkfish fry is the control over the reproductive traits of the milkfish However, failures in the demonstration of regulating that aspect of the milkfish's life history has continued to frustrate scientists from all over the world. It will probably take a combined effort of both minds and resources to solve the problems that have prevented success to date In addition, the solution of those problems associated with milkfish reproduction has many far-reaching aspects Culturing of a desirable fish species has become a viable alternative to relying on the availability of natural stocks.

For all these reasons, it is especially gratifying for me to see the most respected scientists and most experienced milkfish culturists gathering together in a cooperative effort to help solving the problems of reproduction and culture in milkfish On behalf of the China Fisheries Association may I extend my greetings Furthermore, I wish you a fruitful and constructive workshop