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**THE
INLAND FISHERIES PROGRAM
OF THAILAND**

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**Title: Increasing Fish Production
by Improved Fishcultures**

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FISH SPECIES CAPTURED OR CULTURED IN THAILAND

<u>Scientific Name</u>	<u>Common Name</u>	<u>Thai Name</u>
<u>Anabas testudineus</u>		Pla Mor
<u>Aristichys nobilis</u>	Bighead carp	Pla Soong-Hue
<u>Catlocarpio siamensis</u>		Pla Kaho
<u>Chanos chanos</u>	Milkfish	
<u>Cirrhinus microlepis</u>		Pla Nuan Chan
<u>Clarias batrachus</u>	Walking catfish	Pla Duk Dam
<u>Ctenopharyngodon idellus</u>	Grass carp	Pla Chao-Hue
<u>Cyprinus carpio</u>	Common carp	Pla Nai
<u>Hampala dispar</u>		Pla Soot
<u>Heleostoma temmincki</u>	Kissing goramy	Pla Mortan
<u>Hypophthalmichthys molitrix</u>	Silver carp	Pla Lin-Hue
<u>Lates calcarifer</u>	Sea bass	Pla Kapong
<u>Moina macrocopa</u>		
<u>Morulus chrysophekadion</u>		Pla Ka
<u>Notopterus chitala</u>		Pla Krai
<u>Ophicephalus striatus</u>	Snakehead	Pla Chon
<u>Osphronemus goramy</u>	Giant goramy	Pla Ret
<u>Osteochilus hasselti</u>	Nilem	Pla Prom
<u>Pangasanodon gigas</u>		Pla Buk
<u>Pangasius larnaudii</u>		Pla Tepo
<u>Pangasius sutchi</u>		Pla Sawai
<u>Pristolepis fasciatus</u>		Pla Mor Chang Yieb
<u>Probarbus jullieni</u>		Pla Eesok
<u>Puntius gonionotus</u>	Puntius	Pla Tapien
<u>Tilapia melanopleura</u>	Congo tilapia	Pla Khang Lai
<u>Tilapia mossambica</u>	Java tilapia	Pla Morted
<u>Tilapia nilotica</u>	Nile tilapia	Pla Nin
<u>Trichogaster pectoralis</u>	Sepat Siam	Pla Salid

CRUSTACEAN SPECIES CAPTURED OR CULTURED IN THAILAND

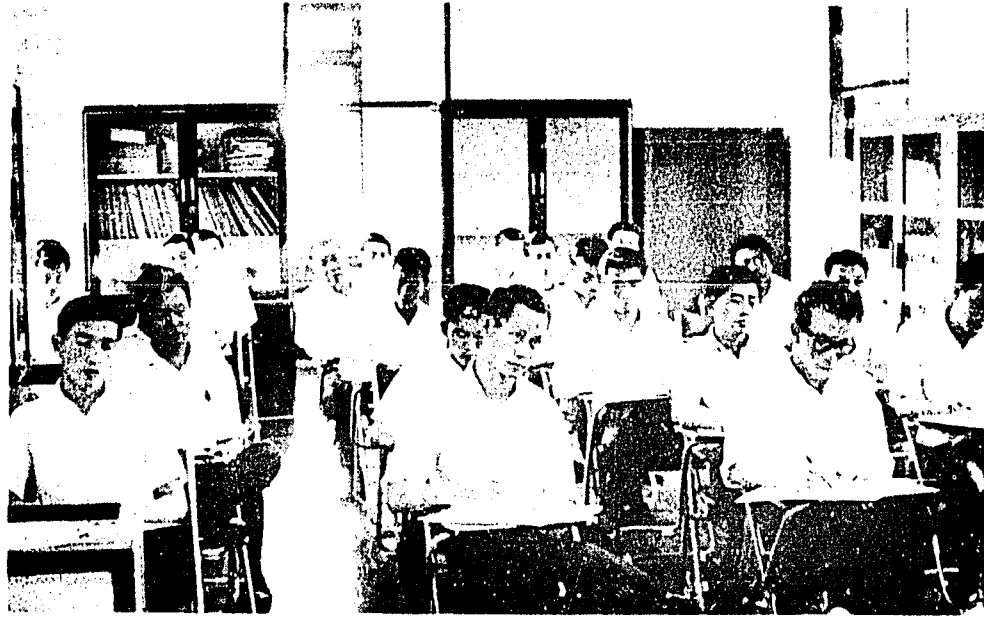
<u>Macrobrachium rosenbergii</u>	Shrimp	Kung Kam Kram
<u>Scylla serrata</u>	Blue crab	Pu Tha Le

MONETARY UNITS OF THAILAND

100 satangs = 1 baht (\$.05 U.S.)
20 baht = \$1.00 U.S.

UNITS OF AREA IN THAILAND

1 rai is equal to 1,600 square meters (.16 hectare) or 0.4 acre.



Figs. 1 and 2. Under AID/csd-2270 project, Auburn University is providing assistance in planning research and extension, and on-the-job training at the fisheries stations on water chemistry, hatchery management, cage culture, reservoir management and various aspects of fishculture and inland fisheries. This has included lecture-demonstrations (upper picture) and work in the field. The lower picture shows examination of soils with a soil auger to determine their suitability for pond construction.

1.0 RECOMMENDATIONS

1.01 The following recommendations for an expanded program of fisheries development in Thailand are based upon conferences held with personnel of the Thai Department of Fisheries and the USAID Mission, and observations made during visits to practically all existing government fishery research and training facilities during two surveys conducted in 1969.

Alternate proposals are presented below relative to technical assistance, with the first plan being most desirable for maximum results.

1.011 The Auburn University Contract should be modified to provide one specialist in aquaculture to be located in Bangkok for a 2-year period or longer to assist the Fisheries Department and to advise the AID Mission on fisheries development. In addition, one trip yearly will be made to Thailand by two fisheries specialists from Auburn University to evaluate the program, assist in planning research-extension, and to provide specialized training for Thai personnel. One month would be spent in Thailand by this group.

1.012 Or, continue the present contract in which no full-time fishery specialist would be stationed in Thailand, but two trips per year would be made by fishery specialists from Auburn University to assist the Fisheries Department in planning research-extension and to furnish on-the-job specialized training for Thai fishery research and extension personnel. Each visit would be for a period of one month, with members of the Auburn Team composed of two specialists for the first visit and

and three specialists for the second visit approximately six months later.

The specialists considered most useful in advancement of the program will be sent, with changes in areas of subject matter from visit to visit.

1.02 The research program necessary to acquire the information for an effective extension program to increase fish production is outlined as follows:

1.021 Methods for Increasing Hatchery Production of Fingerlings for Stocking

Increasing hatchery production of fingerlings can be accomplished by selection of superior brood fish, their maintenance on an adequate diet during the period of egg-formation, careful handling during transfer to the spawning ponds, improvement in spawning techniques, control of parasites and diseases and use of fertilizers and feeds to grow fry to fingerlings.

1.022 Testing for Species Efficiency to Determine Those Most Desirable for Culture Purposes

In testing for species efficiency, a coordinated system for all stations will give maximum results in the shortest period of time. Important factors to be considered for a coordinated system include the size and number of fish stocked per rai, and the number of replications per test (3 is a minimum). Rates of fertilization with phosphate fertilizer and kinds and rates of feeding should be standardized, with a common reference species (Pla Nai) to be used at all stations in the initial period of the testing program.

1.023 Development of Systems of Culture

After the more promising species have been found through testing, they should be stocked into experimental ponds individually and in various combinations with different rates of stocking, fertilization and feeding to determine the most productive and most profitable procedure to be recommended to farmers. Accurate accounts should be kept of cost of fish for stocking, amounts and cost of fertilizer and feeds, total weight of fish produced, and their sale value. The extension program will be a success only if methods recommended for culture of fishes or shrimps enable the farmer to raise and sell at a profit.

1.024 Determine Species Yielding the Highest Sustained Annual Catch in Village Ponds and in Small Irrigation Reservoirs

To determine the best species to use in village ponds and small irrigation reservoirs, rotenone sampling for standing crops should be conducted and the composition of the catch recorded.

The percentages (E values) of the total weight due to each species can then be calculated for both the standing crop and the catch. Relative desirability of each species will be determined in part by the catch per unit of area and in part from the index of harvestability = $\frac{E \text{ (in catch)}}{E \text{ (in standing crop)}}$. This will indicate the species most suitable for stocking new small reservoirs and village ponds.

Stomach analyses should be made to determine the kinds and amounts of biota consumed by each species. This will provide information

needed to determine which species should be stocked in various ecological habitats to insure that all types of food organisms produced in the impoundment are properly utilized.

The effect of phosphate fertilization on catch and standing crop in village ponds should be tested. Records should also be maintained on the kinds and extent of aquatic weed growth before and after fertilization.

1.025 Determine Species Yielding the Highest Sustained Annual Catch in Large Reservoirs

To determine fish species yielding the highest sustained annual catch in large reservoirs, rotenone sampling for standing crop should be conducted at periodic intervals and the following information should be recorded on all species collected: numbers, length, weight, maximum body depth, and maximum mouth width. In addition, weight, number, and the species composition of the catch by fishermen should be obtained to determine the species most often caught.

1.026 Establish a Laboratory at the Central Bangkok Station to Develop Effective Pelleted Fish Feeds

Personnel from the Bangkok Laboratory should receive 6 months of training at Auburn University learning methods of analyzing, formulating, processing, and testing fish feeds. Subsequently, close cooperation will be established between the two groups to develop suitable feeds for various aquacultures in Thailand.

In addition, two persons should receive two-year graduate training abroad in the general field of Fish Nutrition and Feeds.

1. 027 Establish a Laboratory for Development of Methods of Control of Fish Parasites and Diseases

A six-months training program for two persons should be organized at Auburn University to initiate the program and there should also be a two-year training program for two persons at the graduate level. Since the Fish Parasite and Disease courses are taught in the Winter and Spring Quarters, short-term personnel should be in Auburn at that time.

1. 028 Need for Fellowships in Other Areas of Fisheries

In addition to the specialized training programs that should be made available for fishery personnel in areas of fish diseases and fish feeds and feedings, a minimum of two graduate fellowships annually should be made available to qualified workers for a period of two years. At least two particularly well-qualified biologists should be trained at the Ph.D. level. The latter biologists, upon their return to Thailand, would then work closely with other fishery personnel to coordinate and improve effectiveness of the research program.

1. 029 Construction at the Inland Stations

The Central Bangkhen Station should be expanded to provide a minimum of 100 additional earthen excavated ponds for research on aquaculture. This will necessitate either moving the station or purchasing land for the construction of new ponds as near to the present location as possible.

Sakol Nakorn Station should be expanded so that it can more effectively serve as a regional substation for the Northeast. An additional

50 ponds should be constructed and an improved system developed to fill and drain existing ponds on the station. Expansion of this station is recommended because of its strategic location in the Northeast and because of the abundant water supply available to the station from Nong Harn Reservoir.

Chieng Rai Station should be developed as the regional substation for research and extension in the North. It is strategically located and has an adequate water supply.

Ubol Rajthani Station is in an important strategic location in the Northeast, but the Station is on sand and the ponds will not hold water. It should be relocated where good soils and adequate water will be available.

1.03 The Village Pond Construction program should be expanded to provide tractor equipment and additional funds to greatly increase the rate of construction. This program is one of the most effective ways of rapidly improving living conditions in many local areas of the Northeast where shortage of water is a common fact of daily life during the dry season. These multipurpose ponds can also be managed for high fish production.

1.04 Methods of sealing soils to reduce water seepage from ponds, reservoirs and irrigation ditches should be tried experimentally in various soil types in the Northeast. In many areas reservoirs dry up because of excessive seepage during the dry period.

THE INLAND FISHERIES PROGRAM OF THAILAND¹

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January 1, 1970

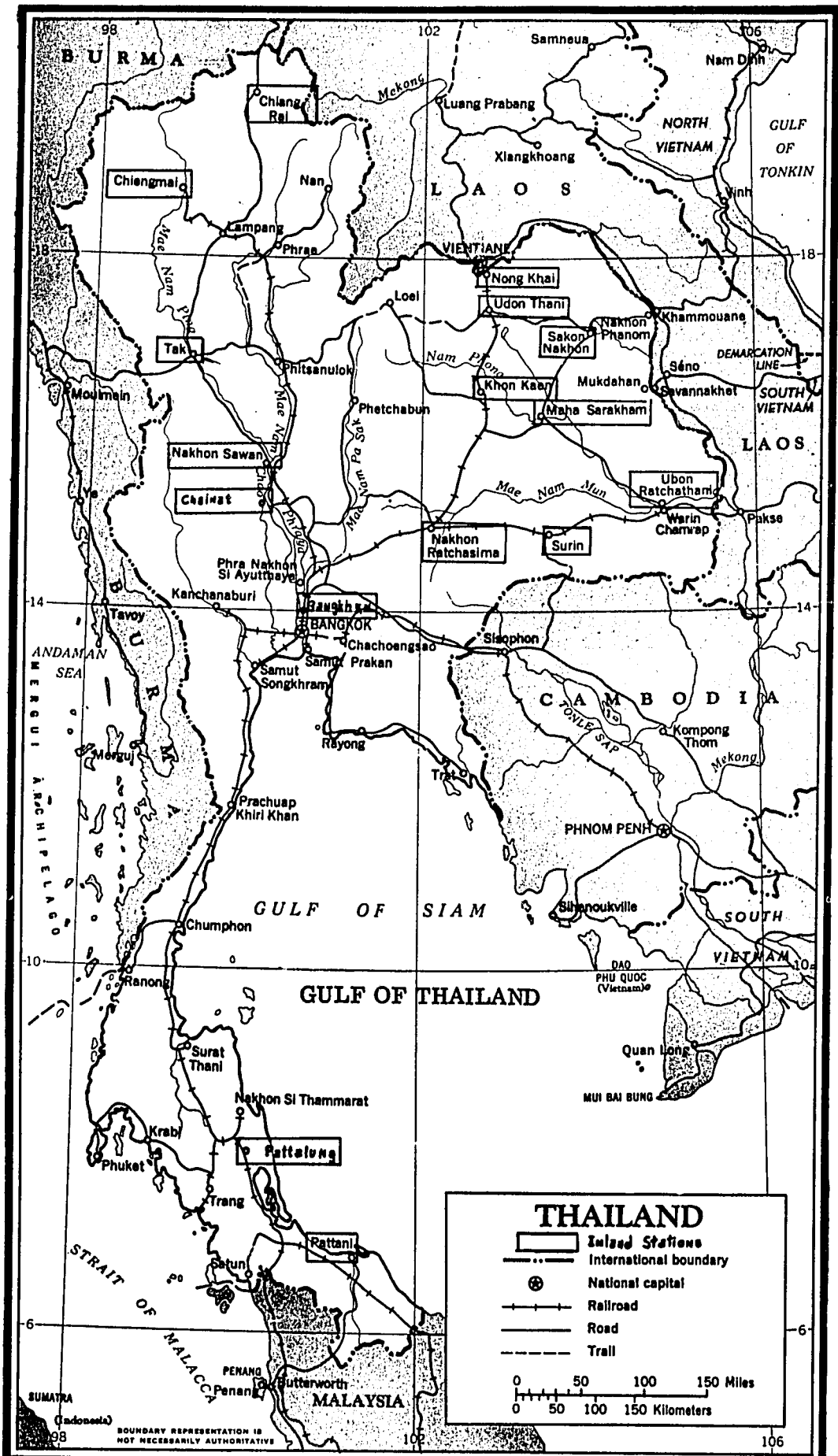
2.0 INTRODUCTION

Locations of the inland fisheries stations of the Department of Fisheries are shown on the following map. Chieng Mai, Chieng Rai and Tak are located in North Thailand. Khon Kaen, Maha Sarakham, Nakorn Rajsima, Nong Khai, Sakol Nakorn, Surin, Ubol Rajthani, and Udorn Thani are located in Northeast Thailand. Bangkhen, Chainat and Nakhon Sawan (Bung Bora Pet) are located in Central Thailand, while Pattalung and Pattani are in South Thailand.

Most of the fisheries research in Thailand is conducted at the various fisheries stations in Thailand. Fisheries research is also conducted at the College of Fisheries, Kasetsart University, which is located approximately 20 miles north of Bangkok and immediately adjacent to the Bagkhen Fisheries Station.

In addition, fisheries research is conducted at the Northeast Agricultural Center near Khon Kaen, the Ditch and Dike Project at Chainat, and the Fishery Taxonomy Unit and Fishery Biology Survey Unit at Bangkok.

1. This report is based on information gathered during surveys conducted October 9 - November 12, 1967, June 4 - June 18, 1968, November 23 - November 29, 1968, April 14 - May 17, 1969, and August 20 - September 21, 1969.



The names of the Fisheries Stations Udorn Thani, Sakon Nakhon, Udorn Ratchathani, Nakhon Ratchasima; and of the River, Chao Phraya appear as Udorn Thani, Sakol Nakorn, Ubol Rajthani, Nakorn Rajsima, and Chao Phya, in this report.

3.0 FISHERY RESEARCH PROGRAMS

3.01 Projects Active or Recently Completed

The research programs conducted at the various stations are summarized in the following table according to categories: (1) Culture of fishes in baskets or cages; (2) Culture of fishes in ponds; (3) Culture of fishes in rice fields; (4) Culture of molluscs; (5) Culture of shrimps; (6) Culture of marine and brackish-water fishes; (7) Diseases of fishes; (8) Feeds and feeding; (9) Life History; (10) Pollution; (11) Spawning fishes; (12) Surveys of impoundments or streams; (13) Taxonomy; and, (14) Miscellaneous. The Auburn Team discussed the results of each of these projects in detail and made suggestions for the extension or improvement of each. Additionally, 9 new projects of importance to fisheries of the Northeast were designed.

Culture of Fishes in Baskets or Cages

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Chainat	Cage culture of Pla Sawai, <u>Pangasius sutchi</u>		*	*
Maha Sarakham	Growth rate of common carp in baskets		*	*
Nong Khai	Common carp culture in nylon baskets			*
Sakol Nakorn	Experiment on culturing common carp in baskets		*	*
Surin	Common carp culture in baskets			*
Surin	Durability of basket materials			*

Culture of Fishes in Ponds

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Bangkhen	Growth rate of Pla Sawai, <u>Pangasius sutchi</u>	*	*	
Bangkhen	Culture of <u>Moina macrocopa</u>	*		
Bangkhen	Effect of pH on fingerling pond fishes			*
Bangkhen	Production of <u>Tilapia nilotica</u> fry using various ratios of ♂:♀ brood			*
Chainat	Culture of Nile tilapia with common carp			*
Chieng Rai	Inorganic fertilizer for production of Pla Salid, <u>Trichogaster pectoralis</u>			
Khon Kaen	Growth rate of nilem, <u>Osteochilus hasselti</u>	*	*	
Maha Sarakham	Growth rate of Pla Salid, <u>Trichogaster pectoralis</u>	*		
Tak	Production of <u>T. nilotica</u> with or without fertilization, with multiple harvest			*

Culture of Marine and Brackishwater Fishes

<u>Station or Unit</u> ¹	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Chanthaburi	Sea bass, <u>Lates calcarifer</u> , culture in ponds			*
Chanthaburi	Sea bass culture in baskets			*
Chanthaburi	Blue crab culture in ponds with feeding of trash fish			*
Prachuap	Sea bass culture with <u>T. mossambica</u>			*

1. These stations are described in the report, "The Marine and Coastal Fisheries Stations of Thailand", dated July 30, 1969, by H. S. Swingle and R. O. Smitherman.

Prachuap	Milkfish culture in ponds and abundance of fry in coastal waters	*
Songkhla	Sea bass culture in baskets	*
Songkhla	Kinds and abundance of benthos in Songkhla Lake	*
Songkhla	Kinds and abundance of plankton in Songkhla Lake	*
Songkhla	Biology of Mullet	*

Culture of Fishes in Rice Paddies

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Chainat	Carp culture in field with different spacings of rice			*
Chieng Mai	Experiment on rice-field fish culture in the North (tilapia and carp)	*	*	
Ditch & Dike	Common carp culture in rice fields by using animal manure		*	
N. E. Center	Experiment on rice-field fish culture (common carp)	*	*	*
Sakol Nakorn	Common carp production			*
Udorn Thani	Evaluation of rice-field fish culture in Udorn Thani and Nong Khai Provinces (common carp)	*	*	*

Culture of Molluscs

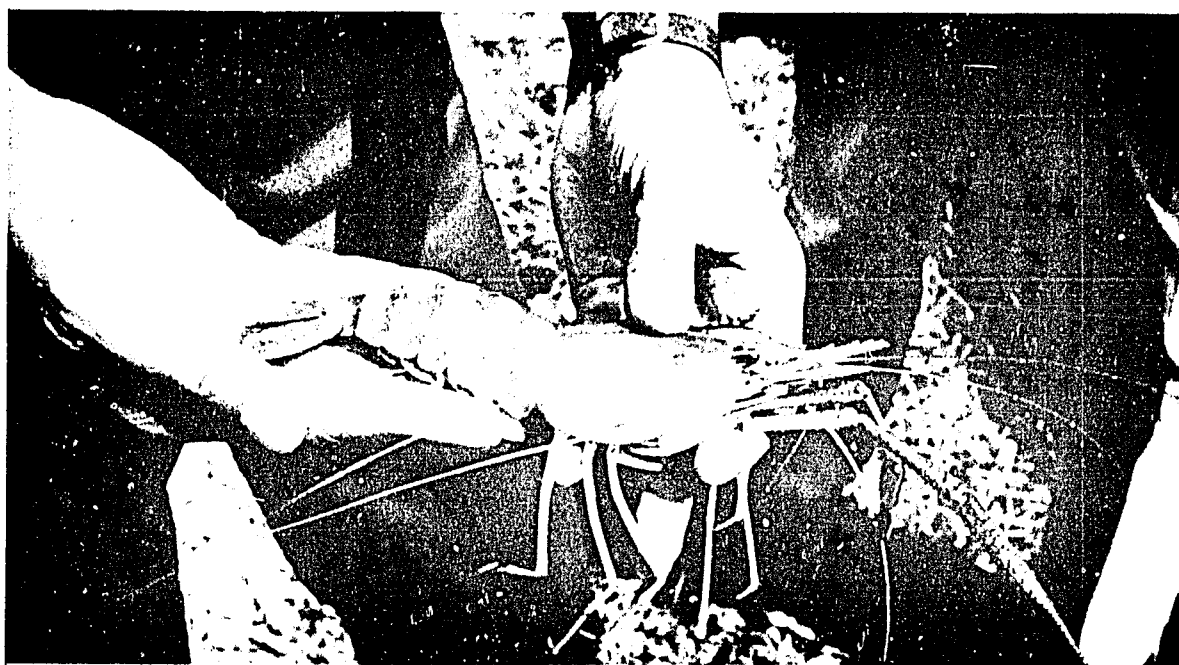
<u>Station or Unit</u> ¹	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Chanthaburi	Study on oyster culture		*	*

1. These stations are described in the report, "The Marine and Coastal Fisheries Stations of Thailand", dated July 30, 1969, by H. S. Swingle and R. O. Smitherman.



Fig. 3. Concrete-lined water supply canals are used at Maha Sarakham and Khon Kaen. Overhead tanks are used to supply small ponds or concrete pools constructed above soil level.

Fig. 4. The freshwater shrimp, Macrobrachium rosenbergii, reaches a weight of 500 grams. It spawns in brackishwater and the juvenile shrimp migrate inland distances of 250 km where they grow to adult size. Research on spawning and raising these shrimp is being conducted at the Songkhla Station and at Kasetsart University. Raising juveniles to marketable size is being investigated at the Chainat Station.



Chanthaburi	Experiment on culture of <u>Scylla serrata</u>	*	*
Prachuap	Study on oyster culture	*	*
	1. Raft culture of <u>Pycnodonta numisma</u>		*
	2. Japanese oyster (<u>Crassostrea gigas</u>)		*

Culture of Shrimps in Ponds

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Chainat	Growth rate of the giant prawn, <u>Macrobrachium rosenbergii</u>	*	*	*
Chainat	Production of <u>Macrobrachium rosenbergii</u> in combination with <u>Trichogaster pectoralis</u> and <u>Puntius gonionotus</u>		*	
Chanthaburi ¹	Production of shrimps (<u>Penaeus sp.</u>) in brackishwater ponds with and without phosphate fertilization		*	*
Songkhla ¹	Spawning, production of juvenile and commercial production of <u>Macrobrachium</u>			*
Songkhla ¹	Abundance of juvenile peneid shrimp in Songkhla Lake			*

Disease of Fishes

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Bangkhen	Disease of fish	*	*	
Bangkhen	Parasites and diseases of pond fishes			*

1. These stations are described in the report, "The Marine and Coastal Fisheries Stations of Thailand", dated July 30, 1969, by H. S. Swingle and R. O. Smitherman.

Feeds and Feeding

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Bangkhen	Feeding, consumption, and digestive rates of fingerling <u>Pangasius sutchi</u> and <u>Clarias batrachus</u>	*	*	
Bangkhen	Feeding <u>Clarias batrachus</u> with trash fish, and with Auburn No. 2 pelleted feed			*
Bangkhen	Development of supplementary feeds for common carp fingerlings			*
Khon Kaen	Natural foods of <u>Morulius chrysophekadion</u> in Ubol Ratana Reservoir			*
Nakhon Sawan	Natural foods of fishes in Bung Bora Pet Reservoir			*
Surin	Comparison of growth of common carp given 3 different feeds		*	
Ubol	Termites as food for common carp		*	*

Life History

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Bangkhen	Morphological development of Pla Salid		*	
Bangkhen	Preliminary study on biology of <u>Anabas testudineus</u>			*
Biological Survey Unit	Life history of <u>Probarbus jullieni</u>		*	
Chieng Mai	Life history of Pla Tapien Khao		*	
Chieng Rai	Life history of <u>Pristolepis fasciatus</u> in Kwan Payao Reservoir		*	
Chieng Rai	Life history of Pla Krai, <u>Notopterus chitala</u>			*

Khon Kaen	Food habits of Nilem, <u>Osteochilus hasselti</u>	*	
Khon Kaen	Food habits of <u>Morulius chrysophekadion</u> in Ubol Ratana Reservoir		*
Maha Sarakham	Fecundity and young production of <u>T. nilotica</u>		*
Maha Sarakham	Life history of <u>Hampala dispar</u>		*
Tak	Biology of <u>Puntius</u> sp.		*

Pollution

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Ditch & Dike	Toxicity of insecticides to fish in rice fields	*		
Ubol	Effect of pollution from Kanaf retting to fish in irrigation tanks		*	*

Spawning of Fishes

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Bangkhen	Selective breeding of <u>Cyprinus carpio</u>	*	*	*
Bangkhen	Artificial breeding of Chinese carps (silver, grass, bighead)	*	*	*
Bangkhen	Ovarian development of silver carp			*
Bangkhen	Induced spawning of <u>Cirrhinus microlepis</u>			*
Chieng Rai	Induced spawning of Chinese carps (silver, grass, bighead)		*	*
Nakhon Sawan	Induced spawning of Pla Sawai, <u>Pangasius sutchi</u> , by pituitary injections		*	*

Surveys of Impoundments and Streams

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Biological Survey Unit	Fisheries survey in Ubol Ratana, Nam Pung, Klong Prao, Kaeng Kracharn	*	*	*
Biological Survey Unit	Fisheries survey in irrigation tank and water areas of the Khong River project	*	*	*
Biological Survey Unit	Fish population survey of Bung Si Fi			*
Biological Survey Unit	Fisheries survey of Khong River project	*	*	
Biological Survey Unit	Fisheries survey on Ayuthaya Province	*		
Biological Survey Unit	Fisheries survey of Nan River		*	
Biological Survey Unit	Fish population survey of Lam Pao and Lam Pra Pleing			*
Chieng Mai	Study on populations of fishes in the reservoir		*	
Chieng Rai	Fisheries survey in Kwan Payao Reservoir	*		
Khon Kaen	Fish population survey of Ubol Ratana Reservoir			*
Khon Kaen	Fishing methods and fishing gear of Ubol Ratana Reservoir			*
Maha Sarakham	Evaluation of fish stocking in Kaeng Lerng Charn Irrigation Tank		*	
Maha Sarakham	Survey of production of fish in Huey Sithon Irrigation Tank	*		
Nong Khai	Survey of fishes in Nong Khai Province			*
N. E. Center	Fisheries surveys in Huey Syo, Huey Yang, Huey Tuey, Kok Muang, Ta Pra, Nong Taeveraj, Nong Pa Ko, Soak Rung	*	*	*
N. E. Center	Huey Yai and Huey Sai Irrigation Tank			*

N. E. Center	Fisheries survey of Sok Ruak Irrigation Tank				*
Sakol Nakorn	Fisheries survey of Nam Pung Irrigation Tank	*	*		*
Sakol Nakorn	Fisheries survey of Nong Harn Reservoir	*	*		*
Tak	Fishing methods and fishing areas of Bhumipol Reservoir				*
Tak	Fisheries survey of Nong Luang Irrigation Tank				*
Ubol	Survey of fishes and fishing gear in Moon River				*

Taxonomy

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Inland Fishery Section	Taxonomy of freshwater fishes of Thailand	*	*	*
Inland Fishery Section	Taxonomy of the Genus <u>Pangasius</u>			*
Inland Fishery Section	Characteristics of the Genus <u>Clarias</u>		*	*
Ubol	Taxonomy of fishes in Lam Nam Moon		*	*

Miscellaneous

<u>Station or Unit</u>	<u>Project Title</u>	<u>Year Active</u>		
		<u>1967</u>	<u>1968</u>	<u>1969</u>
Bangkhen	Transportation of fish in polyethylene bags			*
Nakorn Rajsima	Role of sodium cyanide in fish culture		*	*
Prachuap ¹	Efficiency of various gears for collecting milkfish fry			*
Surin	Physical-chemical characteristics of flood waters in the province of Surin			*

1. This station is described in the report, "The Marine and Coastal Fisheries Stations of Thailand", dated July 30, 1969, by H. S. Swingle and R. O. Smitherman.

3.02 Summary of Research at the Fisheries Stations

The results of research dealing with efficiency of various species of fishes, and that on the effects of rates of stocking, fertilization and feeding upon fish production in rice paddies, ponds and cage cultures are summarized below:

3.021 Relative Efficiency of Various Species of Fishes

Some records of production have been obtained with the common carp, Pla Nai, (Cyprinus carpio) in ponds, rice paddies and in floating cage cultures. Isolated production records have also been obtained on Pla Sawai (Pangasius sutchi), Pla Nin (T. nilotica), Pla Morted (T. mossambica), Pla Duk Dam (Clarias batrachus), Pla Salid (Trichogaster pectoralis), and Pla Kaho (Catlocarpio siamensis). However, no research has been conducted upon the relative efficiencies of the various species under natural conditions, or with fertilization or with feeding. The common carp appears to be preferred by farmers in the Northeast, but much higher production can probably be obtained by the use of other species alone or in combination. Tilapia nilotica is a plankton feeder and should give almost twice the production per rai that is obtained by use of the carp which feeds on insects. Information on the relative efficiencies of the various species is urgently needed for high production. These tests are being planned so that comparable results will be obtained at the various stations.

3.03 Production of Fish in Rice Paddies

3.031 The Species Used

In paddy-fish culture, Pla Nai (Cyprinus carpio) was used in all areas. Pla Salid (Trichogaster pectoralis) was stocked in combination with carp in Ubol

Rajthani and with Pla Nin (Tilapia nilotica) to a limited extent in Khon Kaen.

3.032 The Numbers Stocked Per Rai

Insufficient research has been conducted upon the rates of stocking needed for best production and most economical use of fish. The rates per rai used were as follows:

Pla Nai : 300 at Khon Kaen
400 at Sakol Nakorn
500 at Ubol Rajthani
645 at Udorn Thani

Pla Nin : 300 at Khon Kaen

Pla Salid : 400 with 100 carp at Ubol Rajthani

3.033 Fertilization

There is no information from research at the stations on the effects of rates of fertilization on production of fish in the paddy fields. Some research on this problem is being conducted at the Chainat Station.

3.034 Feeding

Some experiments are in progress at Udorn Thani on the effects of feeding carp in the rice paddies.

3.035 Production of Fish Per Rai

The production of fish in combined rice paddy-fish culture was:

Ubol Rajthani : 29 kg carp; carp + Pla Salid

Sakol Nakorn : 20 to 30 kg carp

Udorn Thani : 42 kg carp

Khon Kaen : 29 to 33 kg carp
44.5 kg Pla Nin

Chainat : 26 to 39 kg carp

Huey Sithon : 18 kg carp

3.04 Production of Fish in Ponds

3.041 Species Used in Ponds

The fish most commonly cultured in ponds are: Pla Nai (Cyprinus carpio); Pla Salid (Trichogaster pectoralis); and Pla Nin (Tilapia nilotica). Additional species are: Pla Sawai (Pangasius sutchi); Pla Mortan (Heleostoma temmincki); Pla Duk Dam (Clarias batrachus); Pla Chon (Ophicephalus striatus); Pla Chao-Hue (Ctenopharyngodon dellus); Pla Soong-Hue (Aristichys nobilis); Pla Tapien (Puntius gonionotus); Pla Kapong (Lates calcarifer); Pla Lin-Hue (Hypophthalmichthys molitrix); and Pla Tepo (Pangasius larnaudii).

There are no experiments on production that can be obtained using each species alone or in combination.

3.042 Rates of Stocking

The rates of stocking ponds varied from 2,000 to 8,000 fish per rai. There were no experiments on the best rates of stocking ponds without fertilization, with fertilization or with feeding for species alone or in combination. Fish farmers stock Pla Duk Dam (Clarias batrachus) at rates of 64,000 to 320,000 per rai.

3.043 Fertilization

Now experiments have been conducted in the Northeast to evaluate the increase in fish production that could be obtained with either organic or inorganic fertilizers. Fertilizers commonly used are manures from cows, buffaloes, pigs, and chickens. Inorganic fertilizers are not presently used.

Khon Kaen had used chicken manure as fertilizer at the rate of 320 kg per rai monthly in the culture of Pla Prom (Osteochilus hasselti). Production for a 1-year period varied from 32 to 48 kg per rai. No similar experiments have

been conducted with other species.

The production that can be obtained by use of inorganic fertilizers, specifically phosphates, should be determined on various soil types.

3.044 Feeding

At present, the principal feed used by many local farmers is termite nests. The food value was determined at Ubol Rajthani by feeding termites to carp in cages. The nest contained 5 per cent termites by weight. It required 5.2 kg termites to produce 1 kg carp. The cost of the termites was calculated at 2.5 baht per kg, thus costing 13 baht to produce 1 kg of fish. The carp sold for 20 baht per kg.

Some commercial fish farmers used rice bran and broken rice to feed fish. Also used were Ipomea, duckweed and other aquatic weeds, soybean cake, peanut cake, fish meal, and fresh or frozen trash fish. The value of these various materials as supplemental fish feeds has not been measured experimentally.

3.045 Fish Production

There are few data in the Northeast on production obtained from pond culture of various species of fish in unfertilized ponds or in fertilized ponds with or without feeding. This information must be obtained by the stations so that intelligent planning for future production may be possible.

Bangkhen has not evaluated the effect of pond fertilization upon production. However, since this varies with local soils, it should be carried out at the outlying stations on their particular soil types.

Measured in cooperation with commercial fish farmers south of Bangkok, average production of Pla Duk Dam (Clarias batrachus) was 10 to 15 tons per rai

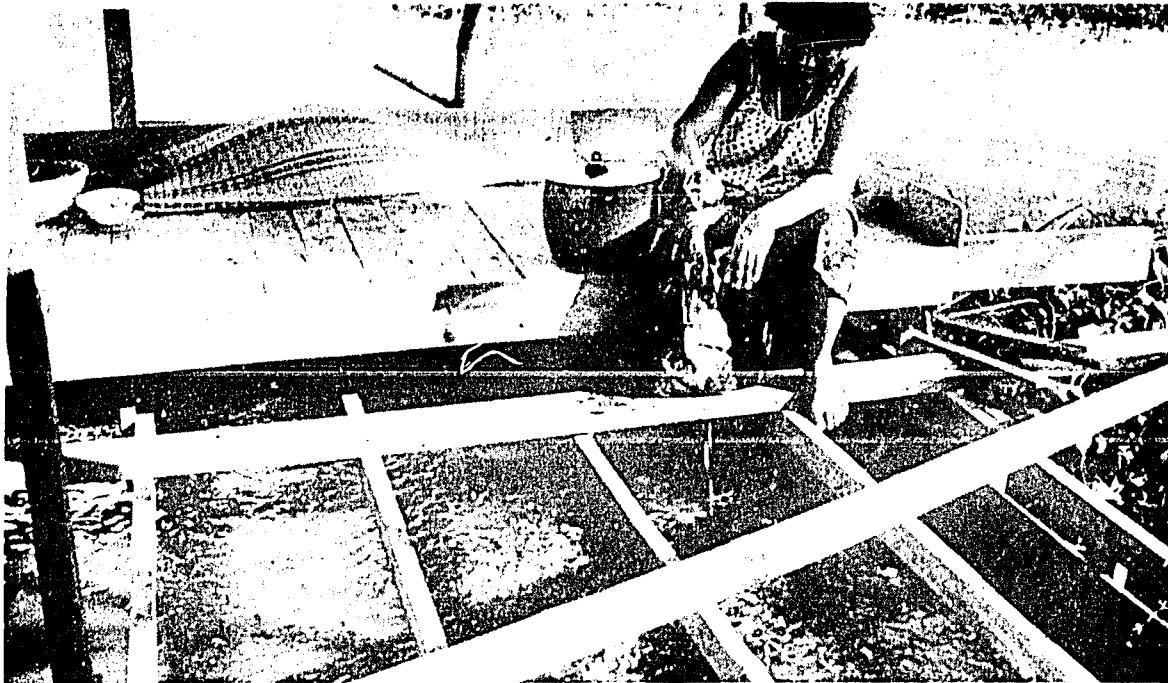


Fig. 5. Two species of catfish, Pla Sawai and Pla Tepo, are cultured in floating cages. They are fed chopped *Ipomea*, boiled broken rice, rice bran, fish and other available wastes. This culture began over 50 years ago.

Fig. 6. Two species of the walking catfish (*Clarias*) are cultured in ponds near the Gulf of Thailand. This air-breathing fish is fed heavily and annual production ranges from 1.0 to 15 tons fish per rai (25 to 37 tons per acre) by raising two crops per year. Research on this culture is conducted by the Bangkhen Station.



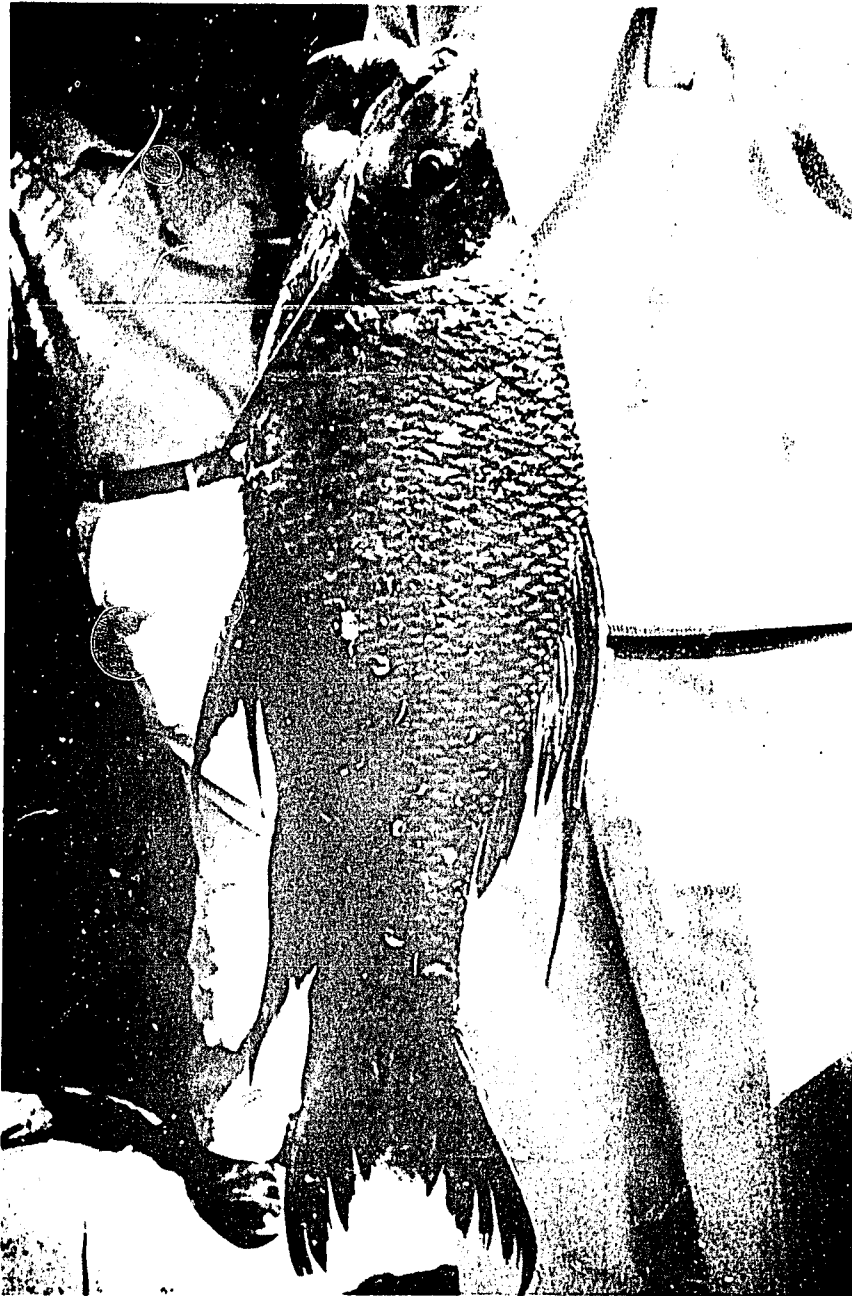


Fig. 7. Methods of spawning and culturing various endemic species are under experimentation. Pla Kaho (shown above) is one of the largest cyprinid fishes in the world. It reaches a maximum length of 2.5 meters and weights in excess of 50 kg. The Chainat Station is attempting to spawn this fish.

when the fish were stocked at the rate of 180 fish m^2 and were fed on a mixture of fresh ground trash fish (90 per cent) plus rice bran (10 per cent). It required 5.3 kg of the mixture to produce 1 kg of the catfish.

Other experiments with various mixtures of feed are being conducted with carp, tilapia and hybrid tilapia. In one rai of pond stocked with a mixture of Chinese carps and receiving the wastes from 5 to 8 hogs, production was 400 kg. Pla Kaho (Catlocarpio siamensis) yielded 173 kg per rai in a pond receiving fertilization plus feeding.

3.05 Production of Fish in Floating Cages

3.051 Species Used in Cage Culture

Experiments on raising fish in cages suspended in the surface waters of reservoirs are being conducted on Pla Nai (Cyprinus carpio) at Ubol Rajthani, Sakol Nakorn and Nong Khai. Similar experiments with Pla Nin (T. nilotica) are in progress at Ubol Rajthani and with Pla Salid (Trichogaster pectoralis) at Sakol Nakorn. Culture of Pla Sawai (Pangasius sutchi) in cages is conducted at Chainat in an irrigation canal with flowing water.

3.052 Rates of Stocking Used in Cage Culture

For production to marketable size, carp were stocked at 80 per m^2 at Ubol Rajthani, and at 70 per m^2 at Sakol Nakorn. These rates were too low for maximum production and experiments were planned to determine optimum stocking rate. From research at Auburn University, it appears that the rate of stocking can be increased to between 300 and 500 fish per m^2 .

For holding fingerling fishes for sale, 3,000 fingerlings 3 to 5 cm were held in 6 m^2 cages, or 500 per m^2 .

3.053 Feeding Fish in Cages

Requirements for feeding fish in floating cages are different from those in ponds. In the latter case, the feed used does not need to be nutritionally complete as the fish obtain part of their diet from natural fish-food organisms produced in the pond. When fish are grown at high concentrations in cages, however, few natural foods are available and the feed used must be nutritionally complete.

At Ubol Rajthani, the feed used was a pelleted commercial chicken feed, but the conversion rate to fish flesh was not yet determined.

In cage cultures near the coast, ground fresh trash fish were used to feed Pla Duk Dam (Clarias batrachus) and the Pla Kapong (Lates calcarifer). The ground fish were usually mixed with 10 to 20 per cent rice bran. Conversion obtained with Pla Duk Dam was approximately 6.5 kg feed per kg of fish on a wet-weight basis.

Experiments are being planned at the Bangkhen Central Research Station to devise and test various feed mixtures for fish from locally available materials. These will then be furnished to stations in the Northeast for local testing.

3.054 Production in Cage Cultures

In the commercial production experiments at Ubol Rajthani, carp stocked at 70 per m² reached a total weight of 6 kg per m² in 5 months. Much more extensive testing is in progress at Sakol Nakorn.

In experiments conducted at Auburn University, productions in excess of 100 kg of marketable fish per m² have been obtained.

If a high-quality feed is available, high production in cage cultures is possible because the waste products from the fish pass through the nylon net into

the pond or reservoir or river. In the river wastes pass downstream, but in the pond or reservoir, these products must be dissipated by biological processes. Consequently, the amount of fish that can be produced in cages suspended in a pond or reservoir is limited by the dilution of wastes. Usually, more kilograms of fish can be produced per rai of pond where the fish are free to distribute themselves over the entire pond area than can be produced in cages suspended in the same pond. However, cage cultures are very useful in better utilization of reservoirs, lakes, rivers, and coastal waters.

3.06 Projects for the Future

Pertinent areas for further research are being studied, and certain existing projects should be expanded as pond space at the stations permit. These include feeds and feeding, culture methods of most species to maximize both fingerling production at the hatchery and yield from the ponds, impoundment management, and life histories of important native species which may be of promise for intensive fish culture. The Auburn Team will work closely with the Thai Fisheries Department to re-evaluate the research aimed at increasing fish production.

4.0 HATCHERY PRODUCTION AND FISH DISTRIBUTION

4.01 Species of Fishes Propagated in Hatcheries

The species presently being propagated in the stations are:

<u>Scientific Name</u>	<u>Common Name</u>	<u>Thai Name</u>
<u>Aristichys nobilis</u>	Bighead carp	Pla Soong-Hue
<u>Ctenopharyngodon idellus</u>	Grass carp	Pla Chao-Hue
<u>Cyprinus carpio</u>	Common carp	Pla Nai
<u>Heleostoma temmincki</u>	Kissing goramy	Pla Mortan
<u>Hypophthalmichthys molitrix</u>	Silver carp	Pla Lin-Hue
<u>Osphronemus goramy</u>	Giant goramy	Pla Ret

(table continued)

<u>Scientific Name</u>	<u>Common Name</u>	<u>Thai Name</u>
<u>Osteochilus hasselti</u>	Nilem	Pla Prom
<u>Pangasius sutchi</u>	Pangasius	Pla Sawai
<u>Puntius gonionotus</u>	Puntius	Pla Tapien
<u>Tilapia melanopleura</u>	Congo tilapia	Pla Khang-Lai
<u>Tilapia mossambica</u>	Java tilapia	Pla Morted
<u>Tilapia nilotica</u>	Nile tilapia	Pla Nin
<u>Trichogaster pectoralis</u>	Sepat Siam	Pla Salid

In 1969, the propagation of Pla Morted was discontinued, as the farmers and the general public preferred Pla Nin which had been recently introduced from Japan. Research is currently being conducted at Nakhon Sawan on the spawning and culture of Pla Sawai. Also, work has begun at Khon Kaen on the spawning of Pla Prom and Pla Kaho (Catlocarpio siamensis) brood fish are being sought for experimental spawning. One male and one female Pla Buk (Pangasanodon gigas) are being kept at Ubol Rajthani for experimental spawning.

4.02 Number of Fingerlings Produced for Stocking in 1968

Following is the number of each species produced by all hatcheries combined:

<u>Thai Name</u>	<u>Common Name</u>	<u>Number Produced</u>
Pla Nai	Common carp	6,057,414
Pla Nin	Nile tilapia	2,947,400
Pla Salid	Sepat Siam	1,755,090
Pla Morted	Java tilapia	882,290
Pla Tapien	Puntius	634,528
Pla Khang-Lai	Congo tilapia	555,515
Pla Lin-Hue	Silver carp	473,000
Pla Sawai	Pangasius	119,000
Pla Mortan	Kissing goramy	166,000
Pla Ret	Giant goramy	29,500
	Total	13,619,737

The distribution of fingerlings by various areas of Thailand was as follows:

<u>Area</u>	<u>Number</u>
Northeast	6,902,798
North	2,971,639
Central	3,429,000
South	<u>316,300</u>
Total	13,619,737

4.03 Number of Fish Stocked in Ponds, Paddy Fields and Reservoirs

The following table gives the total number of fish, and the total water area stocked with fish in 1968 in the North, Northeast, Central, and South.

A total of 7,911 ponds were stocked with 5,443,235 fingerlings at a rate of 1,788 fish per rai. The average pond had an area of 0.4 rai, or approximately 640 m².

Rice paddies on 833 farms totaling 3,520.6 rai were stocked with 1,172,590 fingerlings. This averaged 333 fingerlings per rai.

Irrigation reservoirs at 128 locations received a total of 2,561,995 fingerlings in 566,123 rai; this was equivalent to 4.5 fish per rai.

The fish stocked usually varied from 2 cm to 5 cm in total length. In some areas, smaller fry were stocked.

Other areas for which 418,472 fish were supplied by the stations were swamps, water canals on vegetable and fruit farms, and floating baskets.

For stocking natural waters, for extension-demonstration ponds and paddy fields, for village ponds, and for governmental use, the fish are supplied without charge. Private individuals pay at the rate of 1 baht for 10 fingerlings.

NUMBER AND AREA OF PONDS, RICE PADDY FIELDS, AND
RESERVOIRS, AND NUMBER OF FISH STOCKED IN 1968

Item	North	Northeast	Central	South	Total
<u>Ponds</u>					
Number	969	5,227	1,377	338	7,911
Rai	190	2,370.1	418	66	3,044.1
Fish	857,124	2,915,040	1,587,394	83,677	5,443,235
<u>Rice Paddy Fields</u>					
Number	96	695	42	-----	833
Rai	203	3,015.1	285.5	17	3,520.6
Fish	91,030	957,010	98,350	26,200	1,172,590
<u>Irrigation Reservoirs</u>					
Number	19	109	-----	-----	128
Rai	449,959	116,162	-----	3.8	566,122.8
Fish	843,808	1,224,175	-----	494,012	2,561,995
<u>Village Ponds</u>					
Number	-----	19*	-----	-----	19
Rai	-----	2,107	-----	-----	2,107
Fish	-----	113,900	-----	-----	113,900
<u>Other Areas**</u>					
Fish	72,400***	231,030	54,950	60,092***	418,472

* Data for area of 3 of these ponds not available.

**Includes swamps, irrigation ditches, and cage culture.

***Based on data obtained while in Thailand.

4.04 Fingerling Production in Hatchery Ponds

The average production per rai of ponds at various stations in the 4 regions

was:

<u>Region</u>	<u>Station</u>	<u>Fingerlings</u>
North	Chieng Mai	75,002
	Chieng Rai	98,591
	Tak	80,617
Northeast	Khon Kaen	85,224
	Maha Sarakham	81,900
	Nakorn Rajsima	141,958
	Nong Khai	-----*
	Sakol Nakorn	69,867
	Surin	106,955
	Ubol Rajthani	6,180,000**
Udorn Thani	101,032	
Central	Bangkhen	240,750
	Chainat	41,837
	Nakhon Sawan	260,000
South	Pattalung	150,610

* Nong Khai was under construction in the period.

**Produced 1,545,200 fingerlings in 101 floating net cages 0.25 rai; cages were suspended in the surface water of a 2,144-rai reservoir.

The stations producing fingerlings at the lower rates used only various rates of fertilization, while those with highest production used fertilization plus feeding. The highest production (Ubol Rajthani) was with fish in net cages that were fed a pelleted chicken feed. The wastes from the fish and feed passed through the netting into the reservoir water.

Where wastes from fish and feed must be disposed of by biological and physical processes within the pond itself, feeding must be at lower rates than in suspended cages and production per unit of water is less. However, feeding

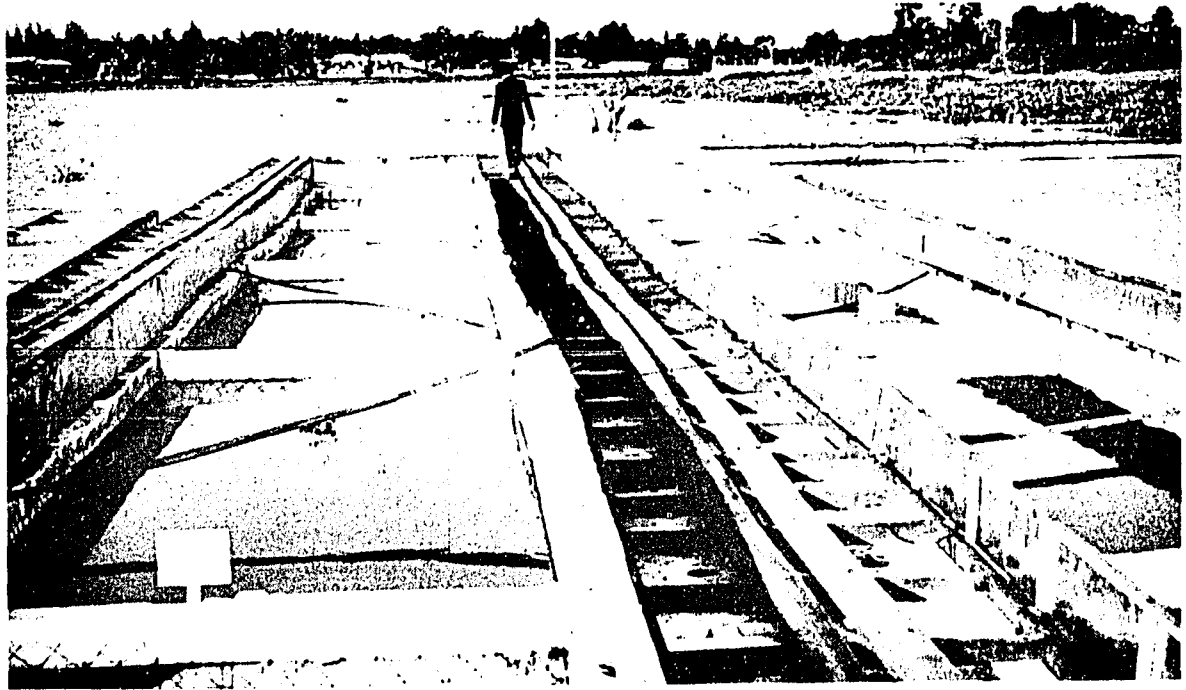
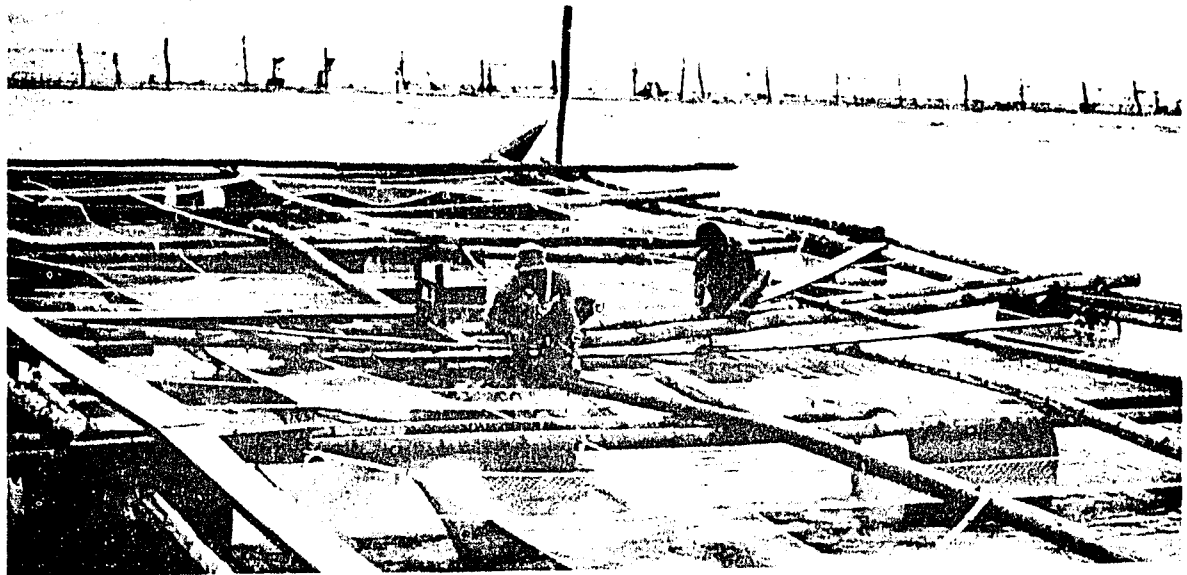


Fig. 8. The entire hatchery production at Ubol Rajthani is conducted in floating baskets on a reservoir. A total of 1,545,200 fingerling fish were produced in 101 cages totaling 400 square meters.

Fig. 9. Intensive culture of fish in net cages suspended in the top waters of a 48,000-rai reservoir is being studied at the Sakol Nakorn Fisheries Station.



is being used in hatchery ponds to greatly increase production of fingerlings.

At Bangkhen, fertilization and feeding were used to obtain the average production of 240,750 fingerlings per rai. When ponds were fertilized with 13-13-13 inorganic fertilizer, using 60 kg per rai distributed in 3 applications and the young fish were fed rice bran, 400,000 fingerlings per rai were grown to a size of 3 to 5 cm in 3 months.

At Nakorn Rajsima, 100,000 fingerling carp per rai were produced to a size of 3 to 5 cm in 1 month by stocking fry into ponds fertilized with 120 kg of 13-13-13 inorganic fertilizer per rai, following fertilization with chicken manure at the rate of 400 kg per rai, and daily feedings with rice bran. The stations had succeeded in spawning Pla Nai (Cyprinus carpio) monthly from February to May, thus making possible multiple crops of fingerlings per year. At most stations, 3 to 4 crops per year were raised when necessary to supply to demand.

4.05 Possibilities for Using Station Ponds for Research

At present, some stations produce in excess of their needs, while others produce only sufficiently to supply local demand. With efficient utilization of existing ponds, the distribution requirements of each station could be met, and also free some station ponds for needed research.

On the following page, a table is presented listing the stations by regions and giving the number of fingerlings produced and the number distributed.

A certain amount of fingerling fish are lost each year because after the fingerlings are produced, they are held in ponds until sold to farmers or distributed to public waters. If the fingerlings are disposed of within a short period of time, the loss is small. If held for several months, losses up to 50 per cent may occur.

<u>Region</u>	<u>Station</u>	<u>Produced</u>	<u>Distributed</u>	<u>Fish Unused</u>
North	Chieng Mai	997,524	697,468	300,056
	Chieng Rai	1,321,115	1,057,294	263,821
	Tak	653,000	37,200	15,800
Northeast	Khon Kaen	1,320,980	647,225	673,755
	Maha Sarakham	409,500	472,290	-----
	Nakorn Rajsima	340,700	263,000	77,700
	Nong Khai	-----	346,000	-----
	Sakol Nakorn	1,341,443	1,516,905	-----
	Surin	1,005,375	687,315	318,060
	Ubol Rajthani	1,545,200	1,146,840	398,360
	Udorn Thani	939,600	361,580	578,020
Central	Bangkhen	2,889,000	1,384,974	1,504,026
	Chainat	410,000	345,220	64,780
	Nakhon Sawan	130,000	10,500	119,500
South	Pattalung	316,300	603,889	-----

Since farmers are raising fish in more ponds and paddies each year, the demand for fingerlings for stocking increases annually. Production will need to be increased at Sakol Nakorn, Pattalung, and at Surin. This will not require additional pond space, but more effective usage of ponds already available. At Sakol Nakorn, a large hatchery development in floating cages on Nong Harn Reservoir could be used to free many of the ponds for badly needed research on methods of stocking, feeding, and management.

5.0 STATUS OF FISHERIES EXTENSION AND PRODUCTION PROGRAMS

5.01 Northeast Extension Programs

5.011 Programs and Activities

A vigorous extension program is principally being developed in the Northeast where 54 extension specialists work from the 8 stations. Of the various stations, the best extension programs appear to be those at Sakol Nakorn and at Ubol Rajthani.

At Sakol Nakorn, 15 extension personnel held 64 meetings at the station to teach selection of brood fish, spawning, and rearing of fish in ponds and rice paddies. Farmers attending these meetings numbered 2,700. A meeting room is available that can seat 40 or more at a time. Also, 302 meetings were held in the province, where movies of fish culture were shown. Also featured was a musical trio: one member plays the kaeyn and the other two - a man and a girl - sing and recite the values of raising fish and methods to be used in developing ponds and paddy fishculture in the old traditional Thai manner of musical recitation. It is quite effective in holding the interest of the audiences. Also, demonstrations were set up on paddy fields in 16 locations, and 144 farmers were visited and advised on fish management on an additional 576 rai of paddies. Several commercial fish farms are in operation and others are under construction.

At Ubol Rajthani, 11 extension personnel worked in the sensitive areas along the border, holding 220 group meetings and setting up 24 demonstrations, as well as advising farmers who are presently engaged in raising fish in ponds and in rice paddies. Commercial fish farming on a large scale is beginning to develop in the area. Twelve short courses on fish propagation and fishculture, with a total of 600 attending, were held at the station, although limited facilities were available for this purpose.

Other stations with active extension personnel are: Udorn Thani (11); Nong Khai (7); Khon Kaen (4); and Maha Sarakham (3). These grounds have held a total of 20 meetings at the stations and 301 meetings with groups in the provinces. Udorn Thani had 26 demonstrations in rice paddy-fishculture.

5.012 Village Ponds**5.0121 Methods of Construction**

A program is underway at the Northeast stations to locate suitable areas and to assist through technical services and supplies in the construction of ponds at villages where they are urgently needed. The village usually supplies labor for building the dam. This program is supported in part through Accelerated Rural Development (ARD). Engineers from the Engineering Division of the Fisheries Department are located at the various stations to assist in the program. Their responsibility is to select sites, plan the dams, do the necessary surveying and then supervise the construction.

The station at Ubol Rajthani reported that there were 14 community ponds in the province. They had assisted in the construction of 8 of these ponds. Locations for 458 village ponds had been investigated and construction planned for villages where they were needed. However, under the present level of available funds and personnel, only 3 ponds per year can be constructed. The head of the station considered the program of great importance and urged that tractor equipment be made available so that a much greater number of ponds could be constructed each year.

At Sakol Nakorn, the station has also assisted in the construction of 2 to 3 village ponds per year, but many more are needed. Tentative sites for several hundred have been located. In Udorn Thani, the station had participated in the construction of 1 village pond last year and was planning to assist in the construction of 3 this year.

At all stations, the difficulty in construction by the use of labor furnished by the village was pointed out. It required 20 men 4 months to build a dam by hand at Ubol Rajthani. The dam was 200 m long, 2 m high and the top was 2 m wide, containing approximately 2,000 m³ of fill. While labor construction by the village appears to be a good idea, it was pointed out that the father, mother, and all the children of a family spent each day gathering food for the day and it was difficult for them to furnish the labor required for construction of a community pond. One dam was half built by 40 laborers in one month, while the other half was built by a tractor rented by the station in 2 days.

5.0122 Methods of Operation

As soon as a village pond begins to fill with water, it is stocked with fish by the extension personnel and subsequently the village is advised on its management. Some of these have developed into a productive fishery in addition to their other uses. In some villages, no restrictions or fees are required for fishing. In others, fishermen are charged a small fee, the returns from which are used for upkeep of the reservoir and the balance for village improvement.

5.0123 Evaluation of the Program

The program of assistance for the construction of village or community ponds appears to be an excellent one. It is probably the fastest way of helping large numbers of people in the rural areas of the Northeast where water shortage is a common fact of life during the long dry season. In addition to its other multiple uses, the village pond can be managed for high fish production and thus can serve as a demonstration of fishculture in the local areas. The expansion of this program and the use of tractor equipment for its more rapid

implementation should receive high priority. The extension personnel and engineers at the stations have demonstrated that they are quite capable of conducting an effective program of village pond construction.

5.02 Huey Sithon Fisheries Demonstration and Extension Unit

At the Huey Sithon Fisheries Demonstration and Extension Unit near Kalasin, fish culture in rice fields produced an added income of 144 baht per rai. This program was so popular that the area devoted to rice-fish culture increased from 44 rai in 1967 to 220 rai in 1968. During the same period, the number of fish ponds increased from 44 to 135.

5.03 Extension Handbooks Published

Since the beginning of 1935, the Extension Division of the Fisheries Department has published and made available for distribution to the public the following information on fish culture:

Shrimp Farming

The Species and Life History of Shrimp

The Culture of milkfish, Chanos chanos

The Culture of Chinese carp

The Culture of Pla Duk, Clarias sp.

The Culture of Nile tilapia, Tilapia nilotica Linnaeus

The Culture of common carp, Cyprinus carpio Linnaeus

The Culture of Sepat Siam, Trichogaster pectoralis Regan

The Culture of Java tilapia, Tilapia mossambica Peters

The Rice Field Fish Culture

Handbook for Fish Culture

The Pond Culture of Fish

The Products from Java tilapia, Tilapia mossambica Peters

6.0 INLAND FISHERIES STATIONS AND UNITS OF THE DEPARTMENT OF FISHERIES

6.01 Fisheries Stations in North Thailand¹

6.011 Chieng Mai

The Chieng Mai Fisheries Station was established in 1953 and is located in North Thailand approximately 18 miles outside the city of Chieng Mai. There are 26 earthen and 29 cement ponds for a total water surface area of 13 rai on 53 rai of station land. There is no land on the station for expansion, but land is available nearby.

The water supply for the hatchery comes from diversion canals which supply rice paddies adjacent to the station.

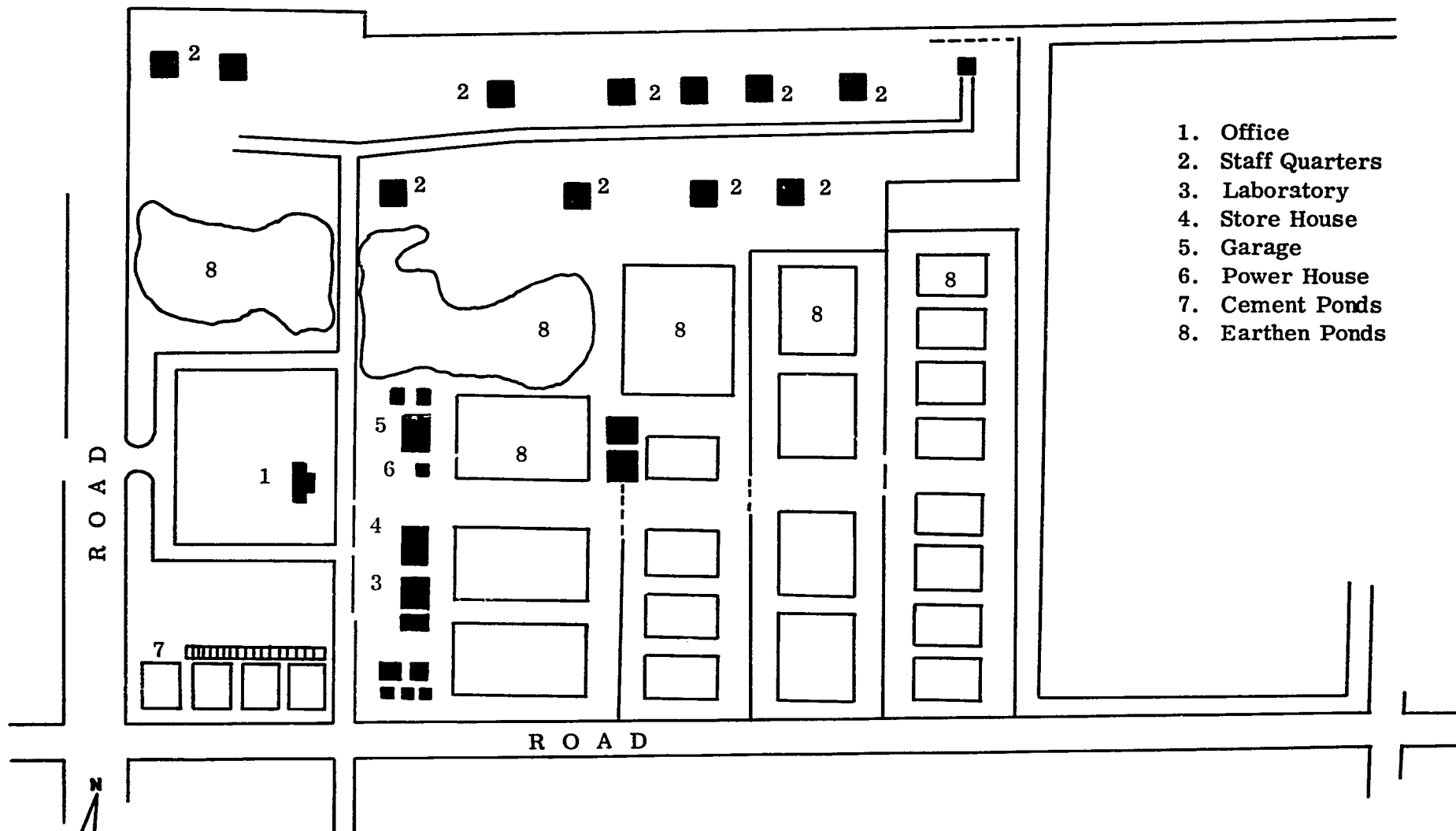
Total rainfall for the area varies from 865 to 1,354 mm and occurs principally during the period June to October.

In addition to the head of the station, there is 1 biologist, 4 extension workers, 14 permanent laborers, and 8 temporary laborers.

Fish production on the station included four species with a total of 997,524 fish in 1968. Current research projects include the biology of Puntius gonionotus, rice-fish paddy culture, and a fish population study of Nong Bau Reservoir.

Extension activities in 1968 included stocking 32 ponds with four species

1. Additional information on each station is given in the Appendix, including names of the technical staff, and equipment available for research and extension.



- 1. Office
- 2. Staff Quarters
- 3. Laboratory
- 4. Store House
- 5. Garage
- 6. Power House
- 7. Cement Ponds
- 8. Earthen Ponds

R O A D

R O A D



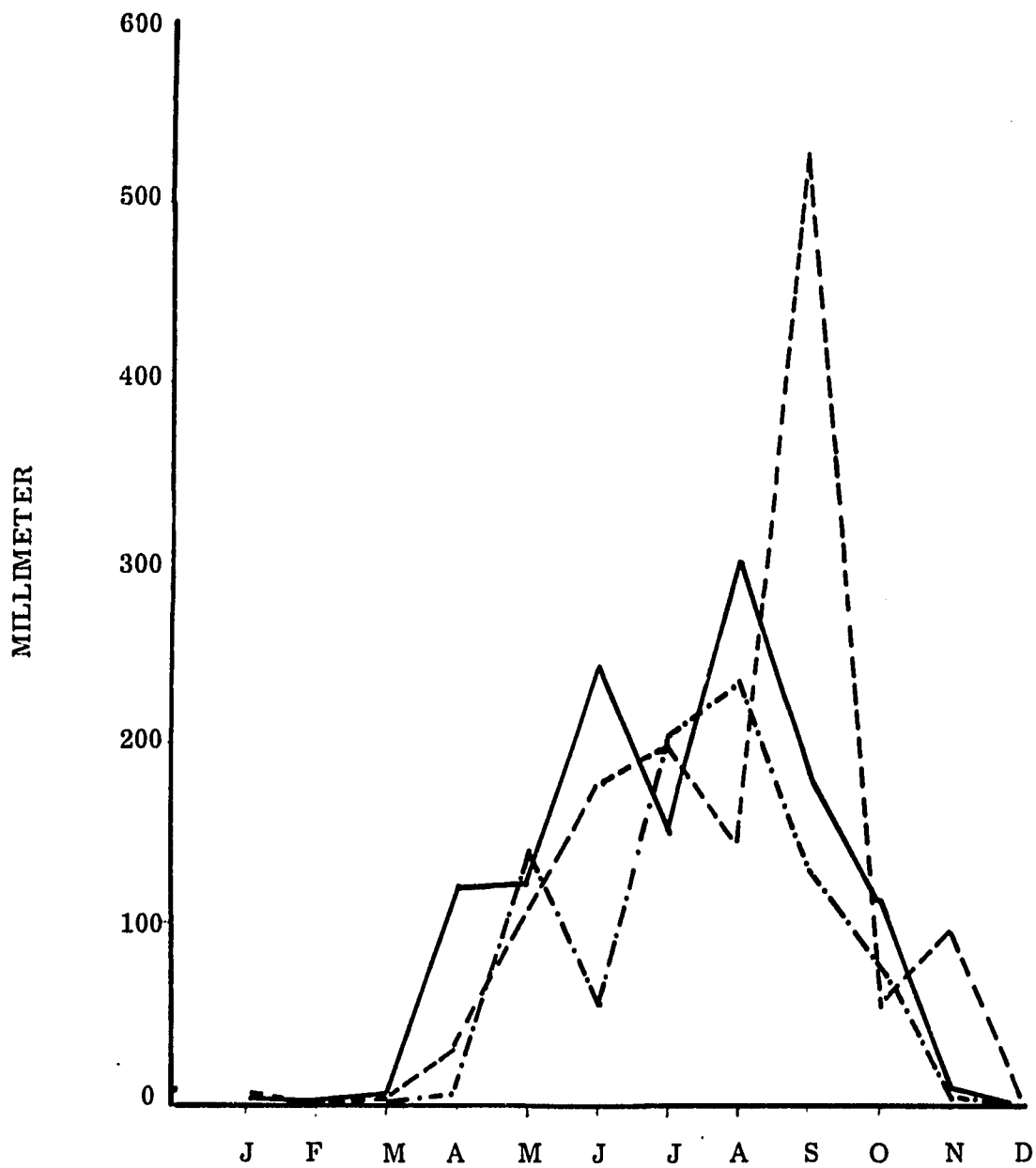
MAP OF CHIENG MAI FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

CHIENG MAI



----- 1966
----- 1967
----- 1968

of fish at 4,000 per rai, and 11 rice paddy fields with 400 Pla Nai (Cyprinus carpio) per rai.

6.012 Chieng Rai

The Chieng Rai Fisheries Station was established in 1941 and is the northernmost fisheries station in Thailand, located in the small town of Payao approximately 50 miles south of Chieng Rai. There are 14 earthen ponds and 27 cement ponds for a total of 20 rai of water on 67 rai of land. There is no land on the station for expansion but privately owned land nearby can be purchased. The station was not well planned in regard to the size and location of ponds; as a result, ponds are scattered in a random manner on the station grounds.

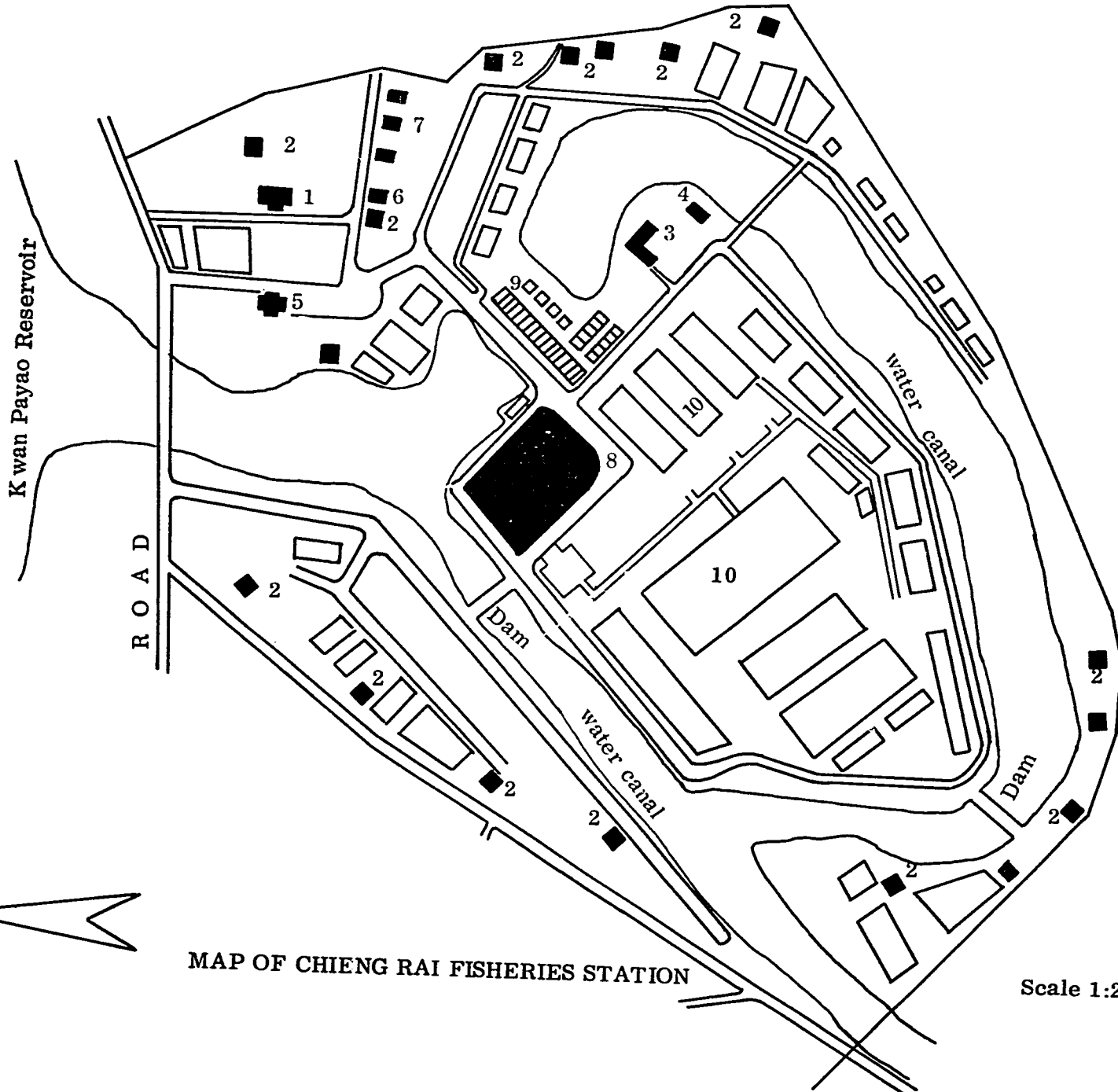
The water supply for the hatchery flows from the 10,400-rai Kwan Payao Reservoir by gravity and all ponds on the station are drained by gravity. The water supply for this station is the best of the northern stations.

Total rainfall for the area varies from 1,833 to 2,099 mm and occurs principally during the period May to October.

Personnel of the station consists of the station head, 2 biologists, 5 extension workers, 33 permanent laborers, and 3 temporary laborers.

Five species of fish are produced on the station and a total of 1,321,125 fish was produced in 1968. In addition to experiments on basket culture in the reservoir canal, experiments on breeding Chinese carp and featherback fish are being conducted.

Two rice paddy fields of 10 rai were stocked with Pla Nai (Cyprinus carpio) at a rate of 300 per rai and two reservoirs of 400 rai were stocked per



- 1. Office
- 2. Staff Quarters
- 3. Laboratory
- 4. Hatchery
- 5. Aquarium
- 6. Store House
- 7. Garage
- 8. Boat House
- 9. Cement Ponds
- 10. Earthen Ponds



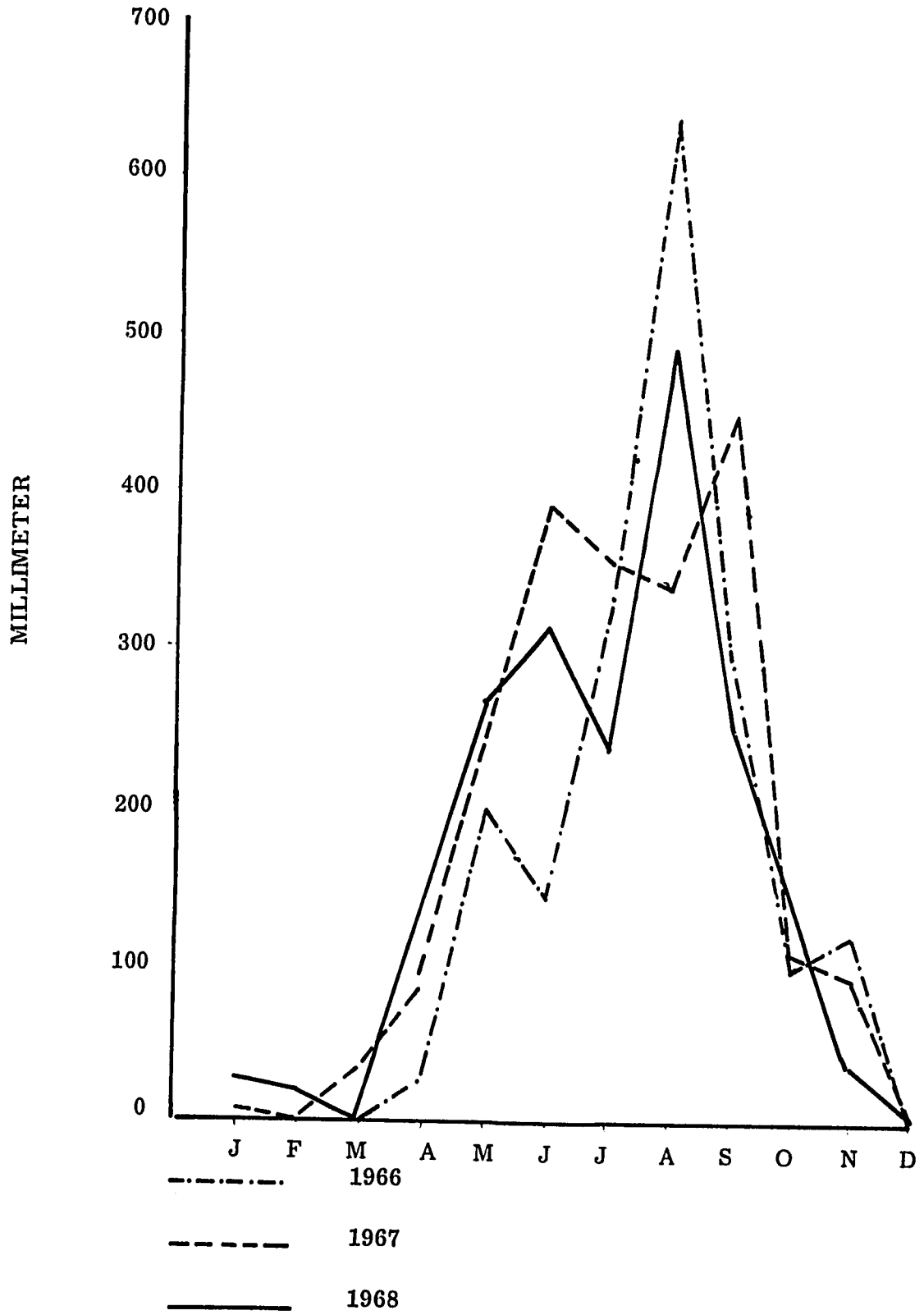
MAP OF CHIENG RAI FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

CHIENG RAI



rai with 150 fish of three separate species by the Extension Unit during 1968.

6.013 Tak

Tak is the most recent of the Northern fisheries stations, established in 1963 and located on Bhumipol Reservoir approximately 100 miles south of Lampang. This station contains 50 rai of water with 150 rai of land. There are 18 earthen and 20 cement ponds which contain 50 rai of water. There is limited room for expansion on station lands.

Bhumipol Reservoir (250,000 rai) supplies the water for the station ponds. Tak receives most of its annual rainfall during the period April to June and August to December. Total amounts of annual rainfall vary from 765 to 1,108 mm.

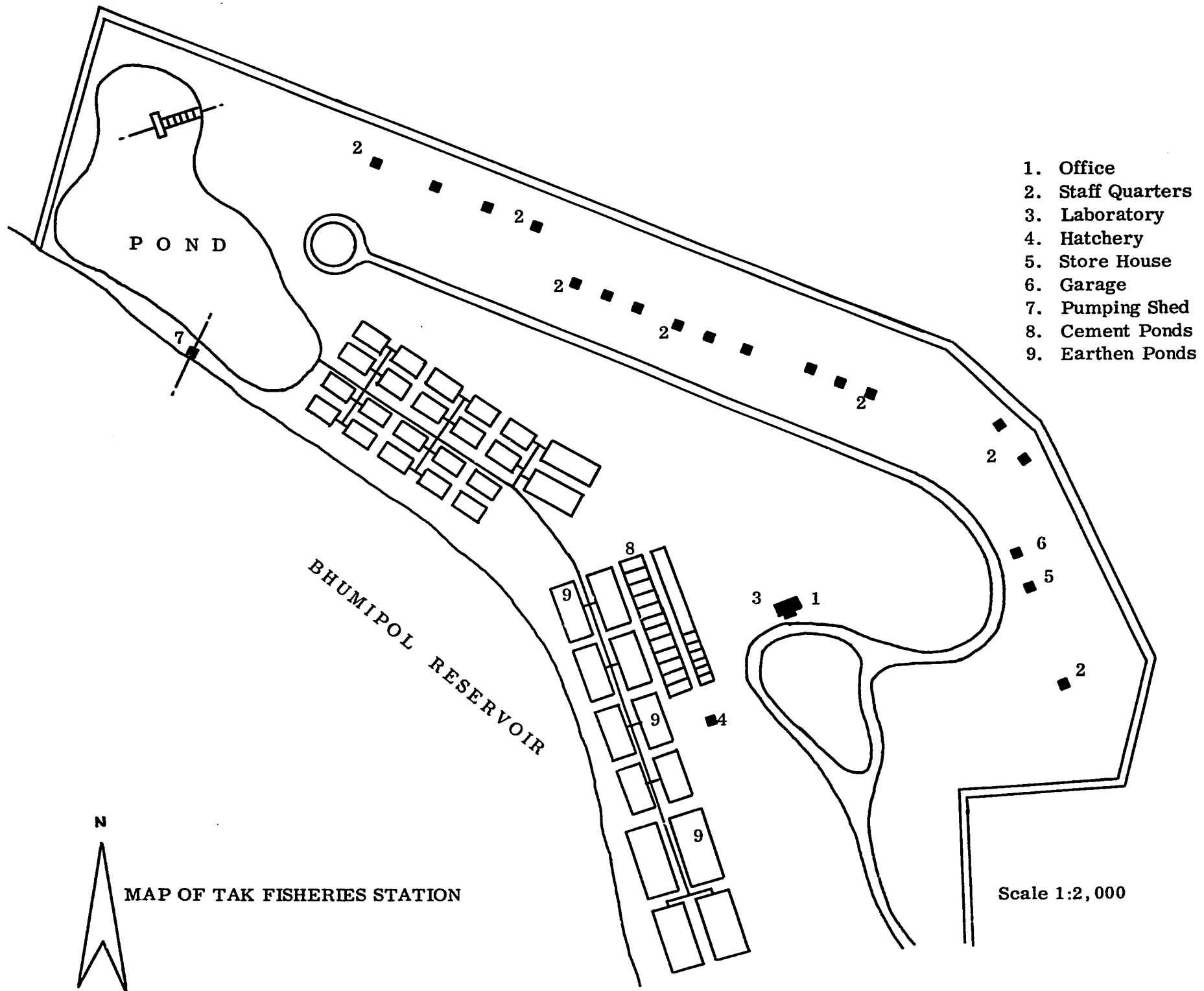
A total of 43 people is employed at the station including the station head, 3 biologists, 7 extension workers, 18 permanent laborers, and 14 temporary laborers.

A total of 656,000 fish of five species was produced on the station in 1968. Research projects are concerned primarily with the limnology and fishing methods of Bhumipol Reservoir. One project is also concerned with pond-cultures of Pla Salid (Trichogaster pectoralis) using various inorganic fertilizers.

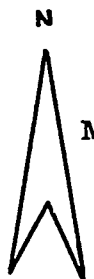
6.02 Fisheries Stations in Northeast Thailand

6.021 Khon Kaen

The Khon Kaen Fisheries Station was established in 1953 in the town of Khon Kaen in the central portion of Northeast Thailand. There are 65 earthen ponds and 41 cement ponds for a total water surface area of 30.4 rai on 81.75 rai of land. There is available land surrounding the station for expansion.



- 1. Office
- 2. Staff Quarters
- 3. Laboratory
- 4. Hatchery
- 5. Store House
- 6. Garage
- 7. Pumping Shed
- 8. Cement Ponds
- 9. Earthen Ponds



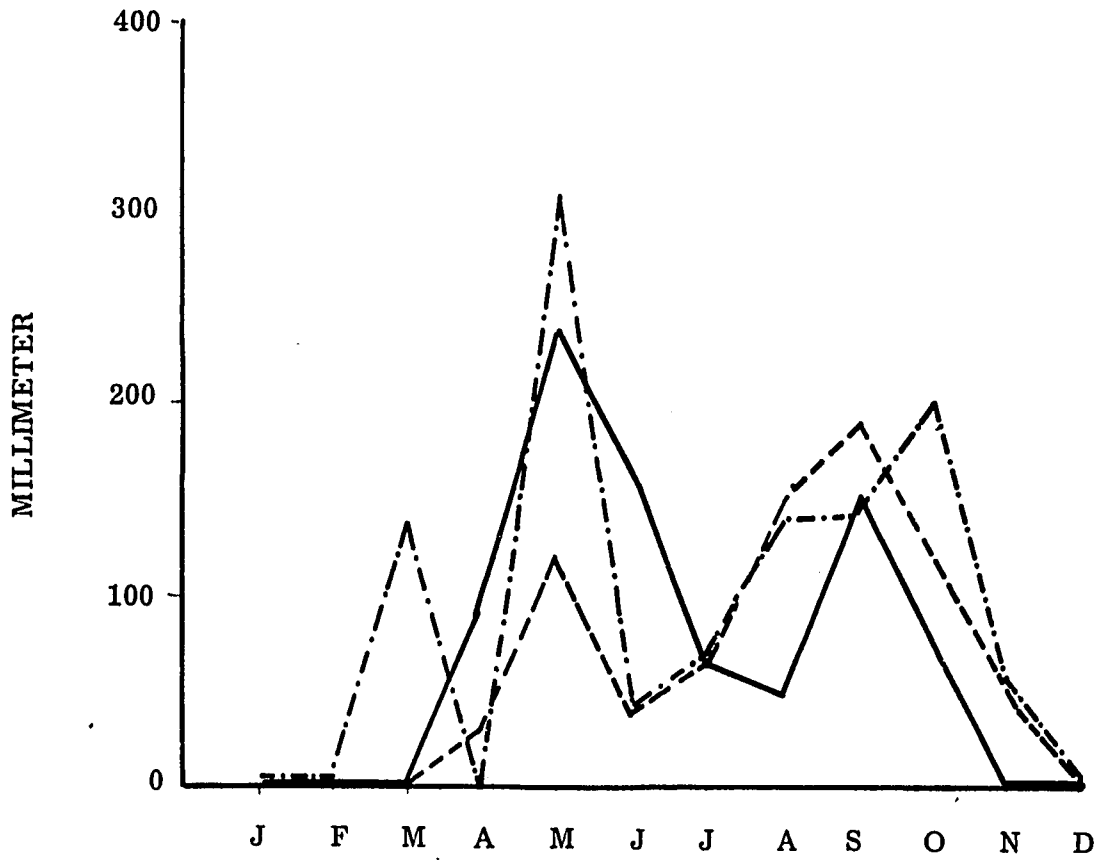
MAP OF TAK FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

TAK



---·---·--- 1966
----- 1967
————— 1968

The ponds are supplied with water from a nearby reservoir of 2,000 rai called Tung Srang. Water runs by gravity into a pond of 5 rai on the station. Water from this storage pond, in turn, is pumped into a system of concrete-lined water supply ditches which go to individual earthen ponds. The ponds can only be drained by pumps. A series of concrete ponds is fed by gravity from tanks on a tower filled by pumping from the 5-rai storage pond. Some ponds have salt deposits which have leached out of the bottom soils. In the dry season, certain ponds develop salinities of approximately 10 ppt in which none of the fishes on the station except Pla Morted (T. mossambica) can reproduce. All species can be grown and spawned in the ponds during the rainy season when the salt is diluted. These salt deposits in the northeast arid regions can be quite important in dictating the species of fish to be cultured.

Additional ponds could be built for research at Khon Kaen. Since soils containing salt are common to many areas of the northeast, this station would be highly suitable for the development of management practices in saline waters.

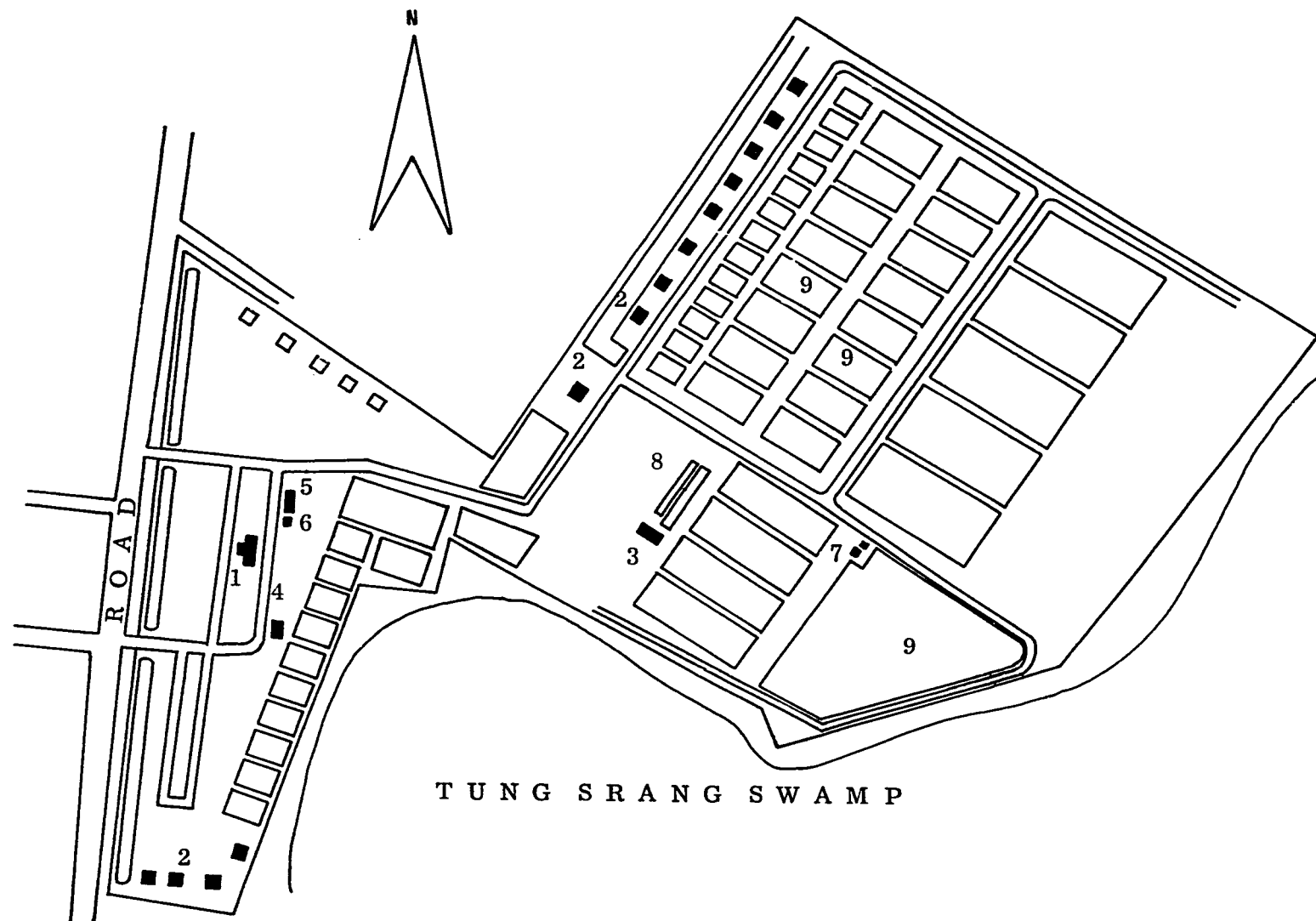
Most of the rain falls during the period April to October and annually varies from 931 to 1,366 mm.

In addition to the head of the station, there are 3 biologists, 4 extension workers, and 21 permanent laborers.

The fish produced at Khon Kaen are stocked in waters of 11 provinces. The station, however, is responsible for only two provinces, Khon Kaen and Loei. Only three species presently are being produced at the station. Four crops of Pla Nai (Cyprinus carpio) have been produced per year totaling 221,200 fingerlings per rai.



Fig.10. Soils in many areas of the Northeast contain large amounts of salt. Ponds constructed on such soils at Khon Kaen have salinities during the dry season of 9.4 ppt and are too salty for many freshwater fishes. Tilapias, however, do well under such conditions. Salt deposits left left by receding waters are shown above.



1. Office
2. Staff Quarters
3. Hatchery
4. Store House
5. Garage
6. Fuel Store House
7. Pumping Shed
8. Cement Ponds
9. Earthen Ponds

TUNG SRANG SWAMP

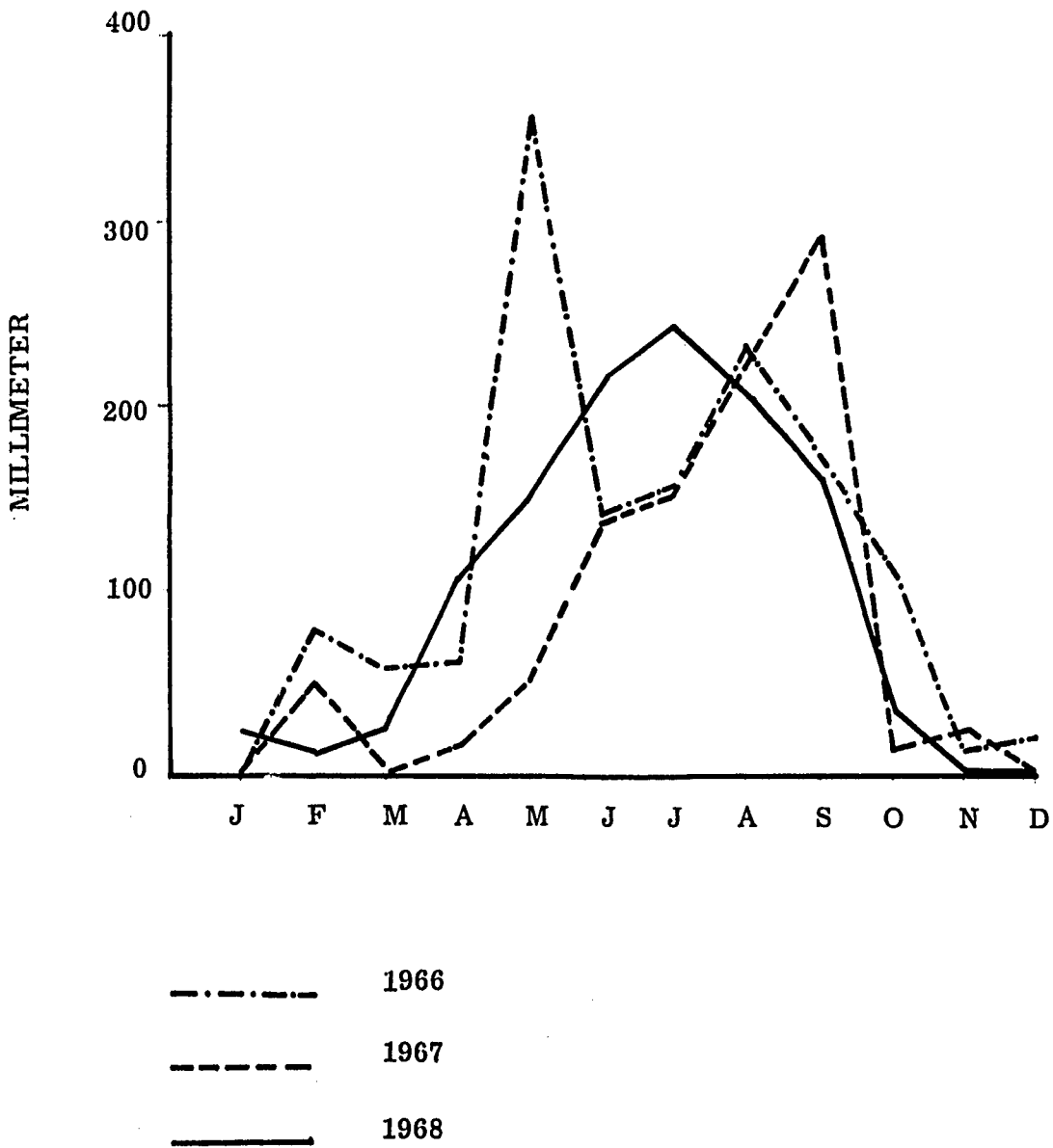
MAP OF KHON KAEN FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

KHON KAEN



Current research includes studies on the spawning and production of Pla Prom (Osteochilus hasselti), the food habits of Pla Ka (Morulius chrysophekadion), and a fish population and fishing gear study of Ubol Ratana Reservoir.

Seven commercial ponds were stocked with four species of fish by the extension workers and 32-rai paddy fields were stocked at 300 per rai with two species of fish.

6.022 Maha Sarakham

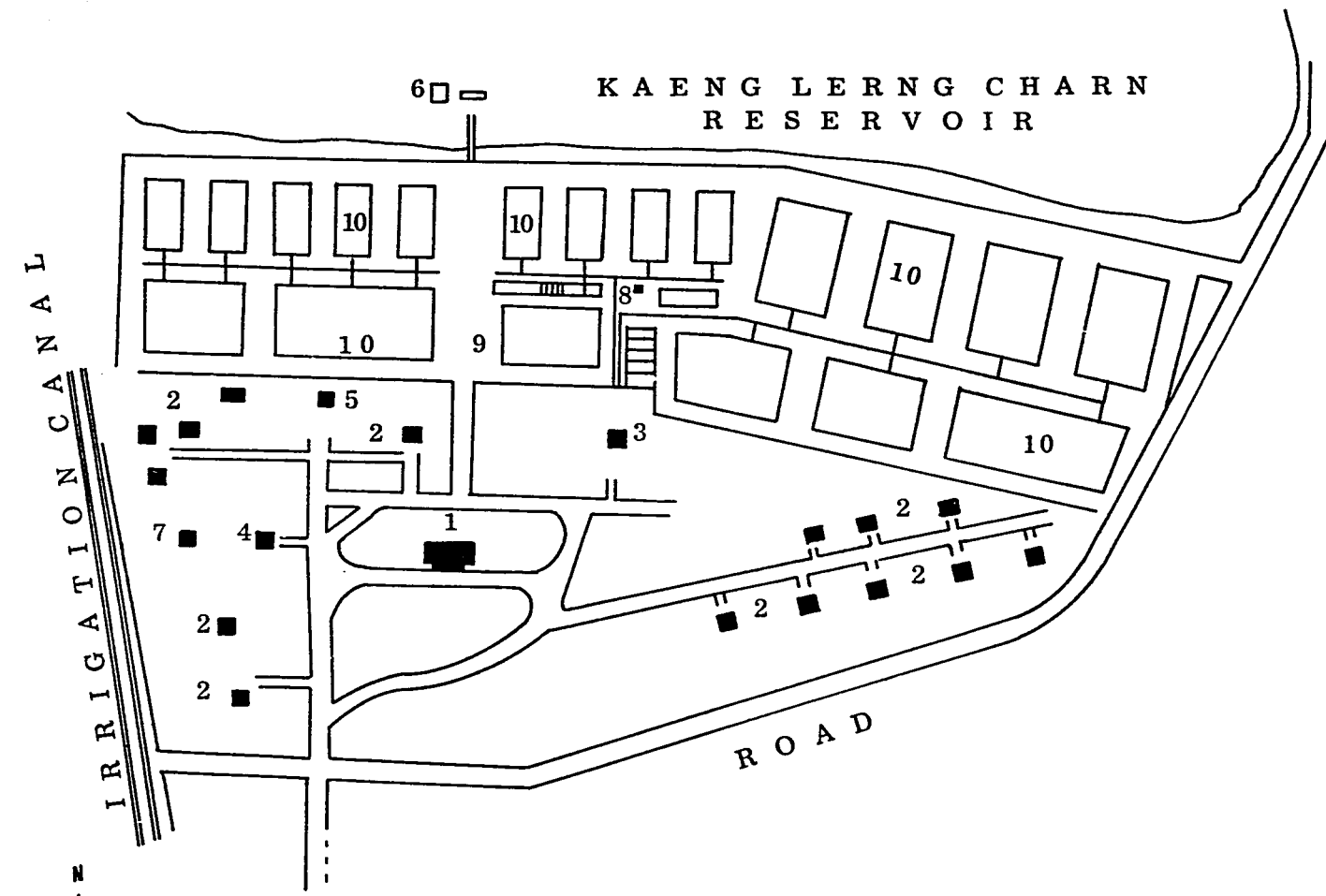
The Maha Sarakham Fisheries Station was established in 1953 and is located southeast of Khon Kaen approximately 50 miles. There are 21 earthen ponds and 9 cement ponds on the station for a total water surface area of 4 rai on 20 rai of land. There is an additional 10 rai of land belonging to the Irrigation Department which can be used for expansion of the station.

Water is supplied from the adjacent Kaeng Lerng Charn Irrigation Reservoir, which is approximately 2,000 rai in surface area. The station ponds are so deep that they must be pumped out to drain. Water must also be pumped through a concrete canal from the reservoir to fill the ponds.

Total rainfall for the area varies from 970 to 1,528 mm and occurs principally during the period April to November.

In addition to the head of the station, there are 3 biologists, 3 extension workers, 6 temporary laborers, and 14 permanent laborers.

Ten small mesh nylon baskets, 2 x 2 x 1 meter deep are placed in the reservoir for holding fingerlings of Pla Nai (C. carpio) and Pla Nin (T. nilotica) for sale or distribution. Fingerlings are sold at 10 satang each to private fish farmers but are stocked free into irrigation ponds, village ponds, or natural waters.



- 1. Office
- 2. Staff Quarters
- 3. Hatchery
- 4. Store House
- 5. Garage
- 6. Boat House
- 7. Power House
- 8. Pumping Shed
- 9. Cement Ponds
- 10. Earthen Ponds

52

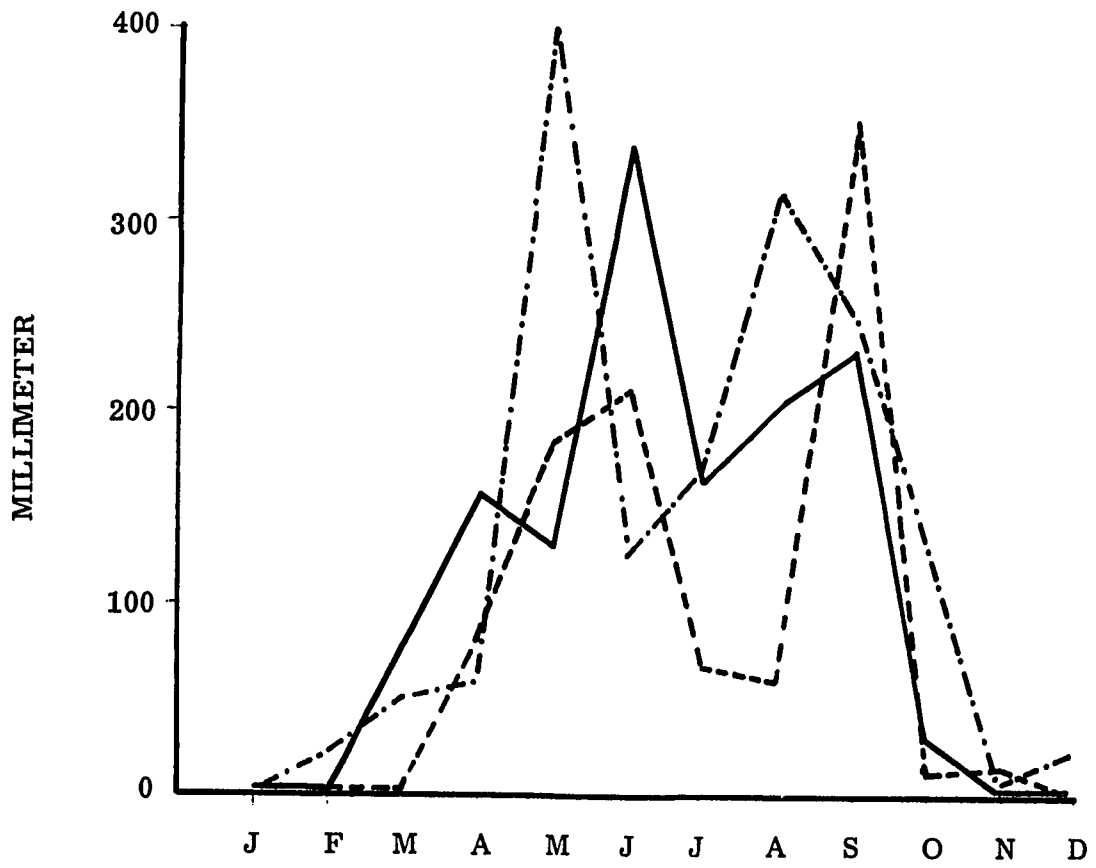
MAP OF MAHA SARAKHAM FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

MAHA SARAKHAM



---·--- 1966
----- 1967
———— 1968

At present, the station uses 800 brood tilapia per rai in the ponds. Ponds are fertilized with 9 kg per rai of 13-13-13 (N-P-K) fertilizer seven days before the brood stock are added. The young are seined out as needed. Production is 180,000 fingerlings per rai in six months.

Fisheries research is concerned with the growth rate of Pla Salid (Trichogaster pectoralis), life history of Pla Soot (Hampala dispar), fishery survey of Kaeng Lerng Charn Reservoir, stocking evaluation in irrigation tanks and a study on the fecundity of various sizes of Pla Nin (T. nilotica).

No extension activities were reported for 1968.

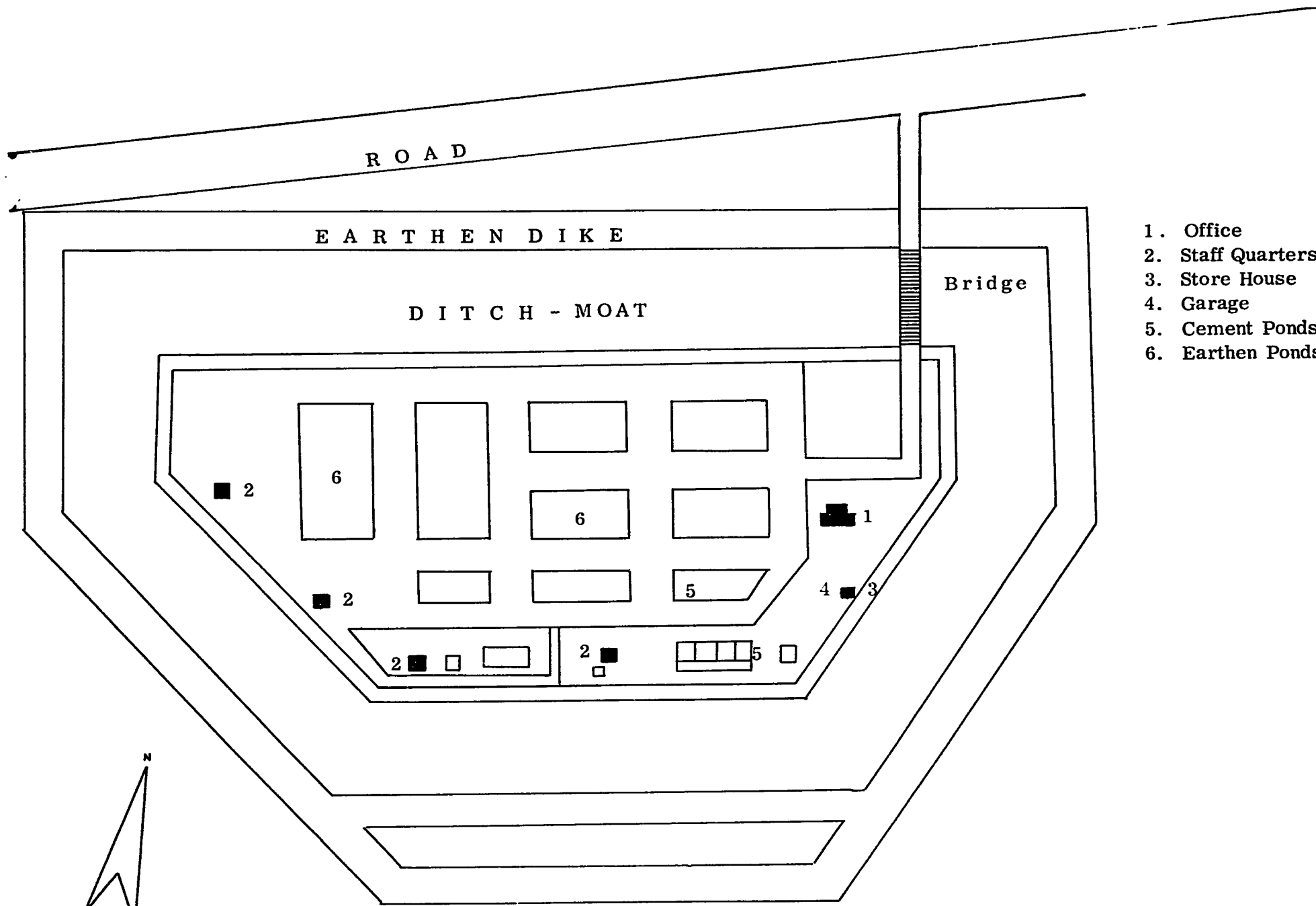
6.023 Nakorn Rajsima

Nakorn Rajsima Fisheries Station was established in 1953 and is located at Korat, 108 miles south of Khon Kaen and 168 miles north of Bangkok. There are 7 earthen ponds and 14 cement ponds for a total of 2 rai of water on 24.5 rai of land. The station is extremely small with no room for expansion and located in the middle of town. It is unique in that the water supply reservoir is in the form of a moat about 75 feet wide encircling the station. The reservoir is 17 rai in area.

Total rainfall varies from 920 to 1,318 mm yearly and occurs primarily during April to October.

In addition to the head of the station, there are 2 biologists, 3 extension workers, 3 temporary laborers, and 10 permanent laborers.

Pla Nai (C. carpio) and Pla Nin (T. nilotica) fry are produced at the station; in 1968, production averaged 170,900 fish per rai. The station produced 100,000 more fry than it stocked and therefore the fry produced and normally



- 1. Office
- 2. Staff Quarters
- 3. Store House
- 4. Garage
- 5. Cement Ponds
- 6. Earthen Ponds

55

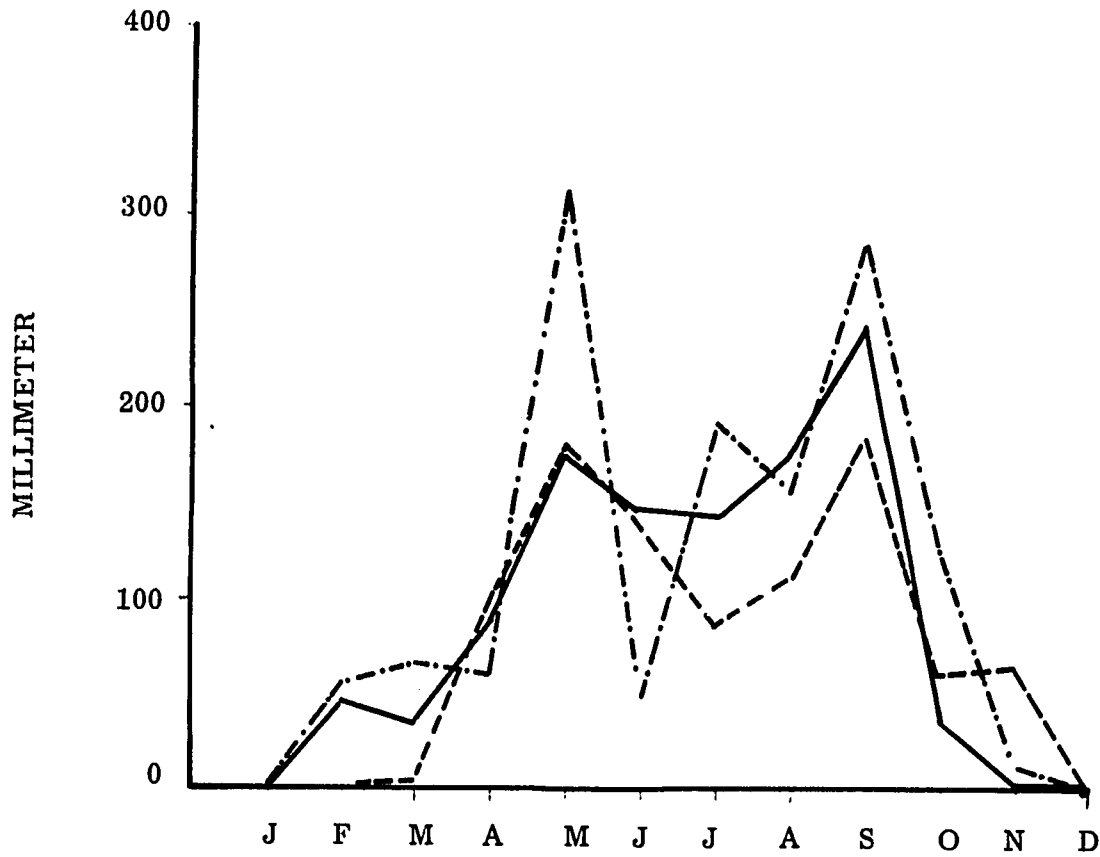
MAP OF NAKORN RAJSIMA FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

NAKORN RAJSIMA



----- 1966
----- 1967
————— 1968

stocked could be held at the station until the fish were fingerlings. If this procedure is followed, increased survival of fish stocked in paddy fields or other waters could be achieved.

Current research is concerned with the role of sodium cyanide in fish culture.

Extension personnel were active in stocking 500 fish per rai of two species into 10 rai of water during 1968, and aided in the distribution of 65,000 fingerlings.

6.024 Nong Khai

The Nong Khai Fisheries Station was established in 1968 and is located beside Nong Kirk Reservoir along the Mekong River. The reservoir is 706 rai in surface area. There are 10 earthen ponds and 6 cement ponds with a total water area of 7 rai on 125.5 rai of land. Apparently there is no room for expansion of this station unless private lands could be purchased nearby.

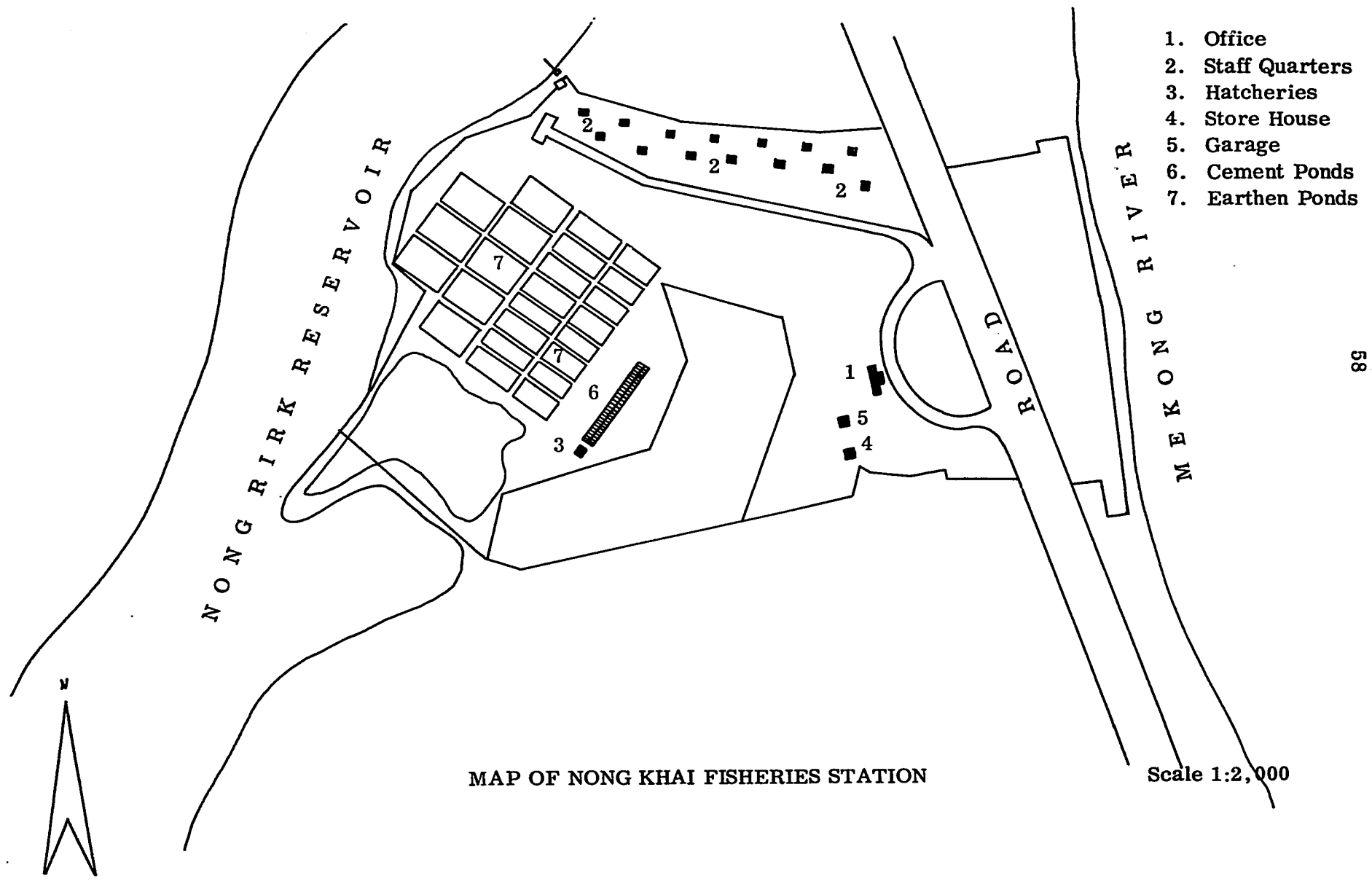
Primary rainfall occurs from April to October and total annual amounts vary from 1,582 to 1,645 mm.

A total of 41 persons are employed on the station including the station head, 1 biologist, 7 extension workers, 2 civil engineers, 8 permanent laborers, and 22 temporary laborers.

No fish production has been reported from the newly established station, but 3 species of fish have been stocked into brood ponds.

Current research includes carp culture in nylon baskets and fish collection in Nong Khai province.

Extension activities include stocking 50 rice paddy fields with 400 fish per rai of two species.



1. Office
2. Staff Quarters
3. Hatcheries
4. Store House
5. Garage
6. Cement Ponds
7. Earthen Ponds

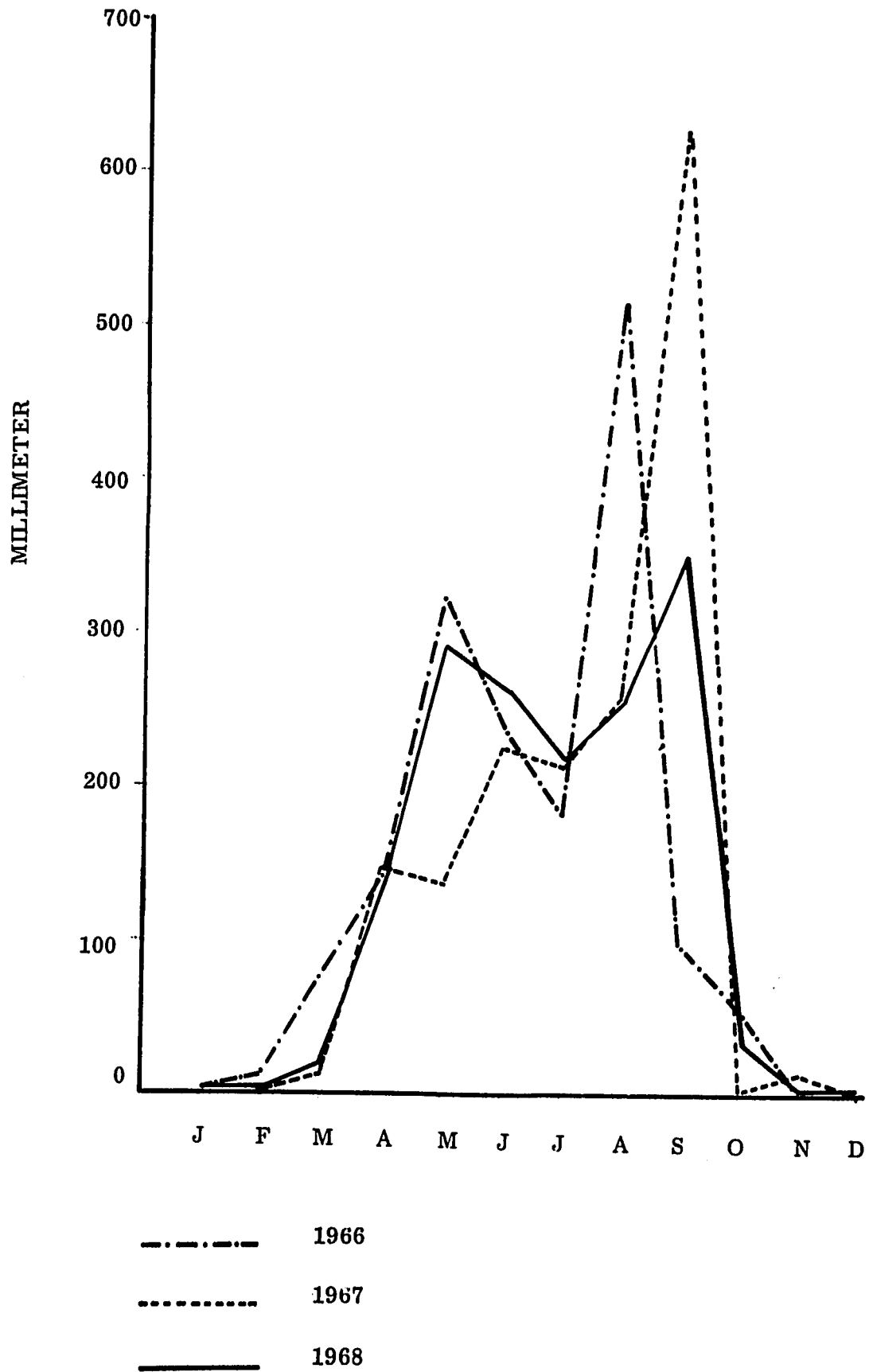
MAP OF NONG KHAI FISHERIES STATION

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MONTHLY RAINFALL

1966 - 1968

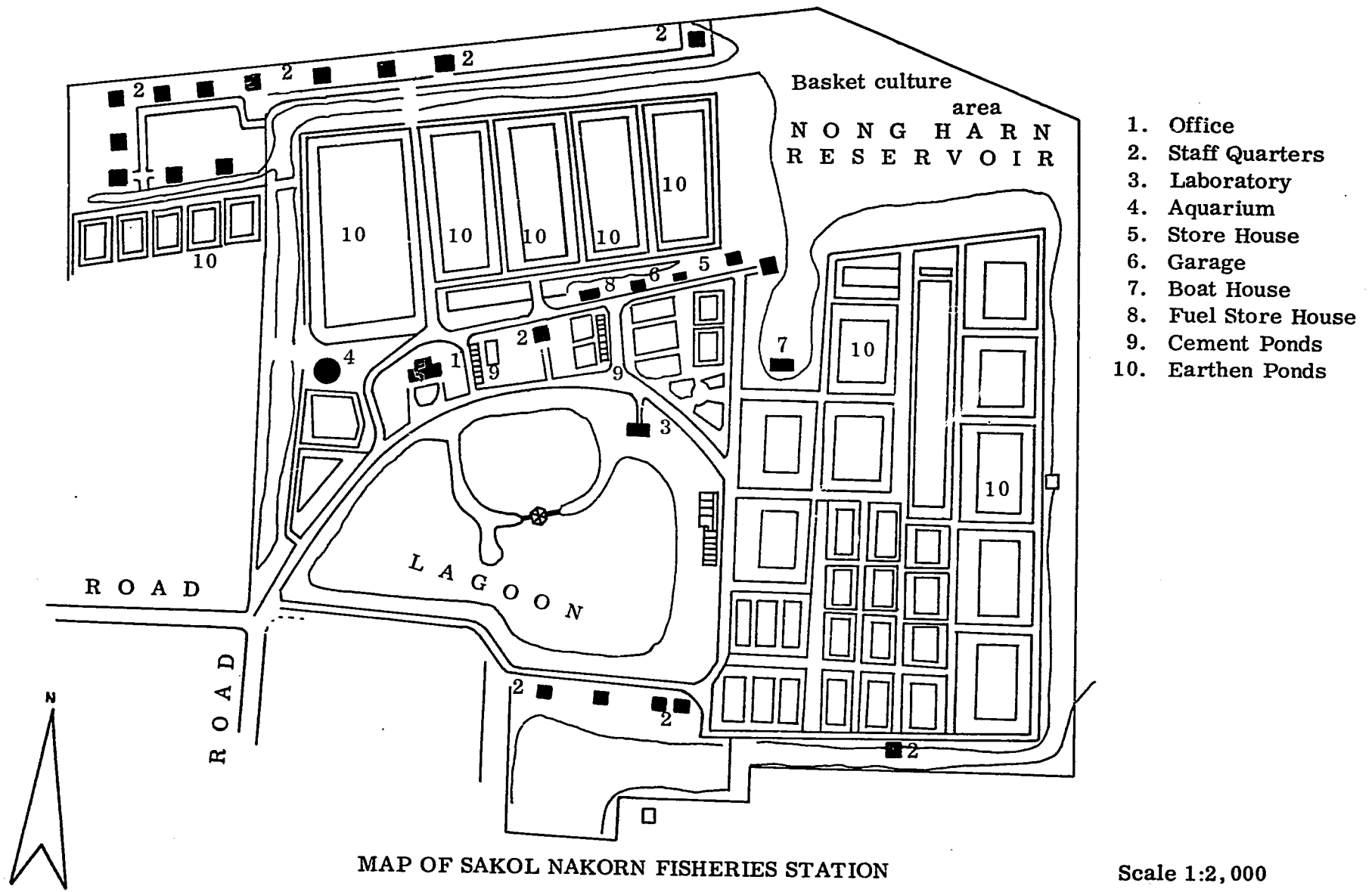
NONG KHAI



6.025 Sakol Nakorn

This station was established in 1942 and is located on the edge of town. It is partially surrounded by a 50,000-rai reservoir (Nong Harn). There are 42 earthen ponds and 33 cement ponds for a total of 18.75 rai of water area on 128.8 rai of land. Buildings include a new laboratory for chemistry and biology, a lecture room, office buildings, and an aquarium building. There is no room for expansion on the station but the Fisheries Department has control of a 2,000-rai area below the dam of Nong Harn Reservoir. This area could be used to construct experimental ponds designed so that they can be filled and drained by gravity. The soils of this area should be examined to determine if they are suitable for pond construction.

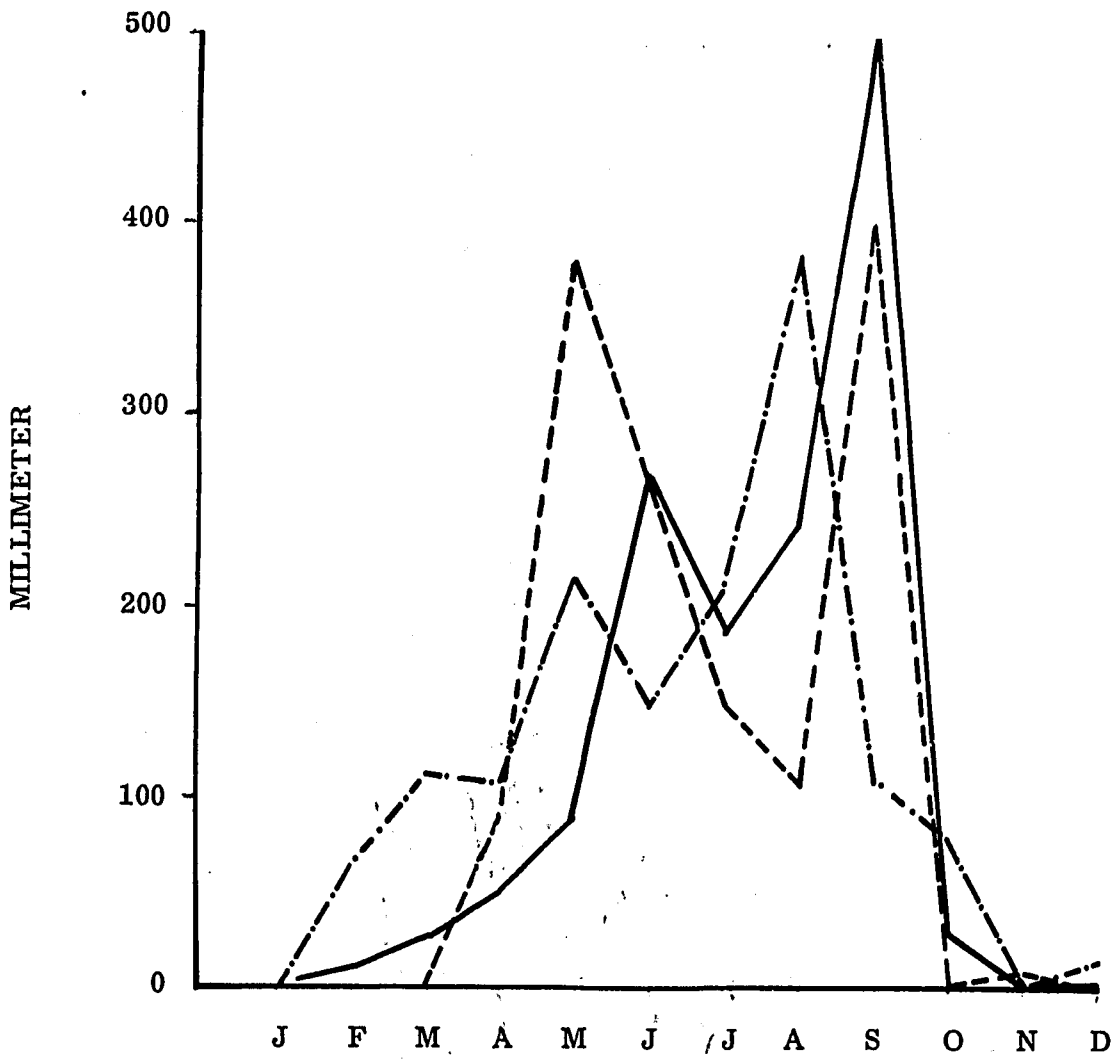
The water level in some of the station ponds rises and falls with that of the lake, almost drying up in dry weather and flooding during wet weather. This is apparently caused by layers of sand extending from the ponds into the lake and underlying perimeter flood protection dam. Borings should be made with a soil auger to determine if the seepage could be prevented by clay or concrete-filled ditch around the inside of the dams. Also, no provision has ever been made to pump water from the lake to the ponds to maintain water levels during the dry period. A better system of draining and filling the ponds should be devised and constructed, with an electric pump installed to pump the water from the lake into a water canal supplying the ponds. Possibly the same canal could be used as a drainage canal with a pump placed at the outlet to pump the water over the exterior flood protection dam.



MONTHLY RAINFALL

1966 - 1968

SAKOL NAKORN



---·--- 1966
- - - - 1967
_____ 1968

Total rainfall for the area varies from 1,408 to 1,494 mm and occurs principally during the period April to October.

In addition to the head of the station, there are 2 biologists, 15 extension workers, and 40 permanent laborers.

The station produced 1,341,443 fingerlings in 1968, distributed to the provinces of Sakol Nakorn and Nakorn Phanon. Five species were produced as follows: Pla Nai (C. carpio) - 753,453; Pla Nin (T. nilotica) - 299,800; Pla Morted (T. mossambica) - 261-690; Pla Salid (Trichogaster pectoralis) - 500; and Pla Ret (Osphronemus goramy) - 26,000. After rearing to 3 to 4 cm, the fingerlings are held for sale in plastic screen boxes floated in a pond. Approximately 30,000 fingerlings are held in 6 square meters.

An excellent research area for cage culture has been developed in a protected bay of the lake 200 feet from shore. Included in the facilities is a small service house, piers for attachment of the cages, 14 cages, 6 x 6 x 2 m deep, made with 1.5 cm nylon mesh, and 6 cages, 2 x 2 x 1 m deep, made with 3 mm nylon mesh. The nylon mesh cages were purchased from Japan for 700 baht per cage (6 x 6 x 2) and last about two years. Pla Nai are cultured in the cages. The Pla Nai are 10 cm long when stocked into the small mesh and the smaller-sized cages which are placed inside the large cages. When the fish are large enough to remain inside the 1.5 cm mesh, they are removed from the smaller cages.

Pla Nai were stocked at 3,000 per cage and fed 10, 15, and 20 per cent of the total weight of fish present in each cage divided into three feeding periods per day. The formulation of the feed used is as follows: fish meal - 25%; rice

bran - 20%; peanut cake - 15%; and acacia leaves - 15%. In addition, the cages received 4 kg of soybean cake per day as a supplement. The ration for each feeding is mixed with water, rolled into a ball the size of a large grapefruit, weighed, and then placed on a platform about 2 feet below the water surface. When these balls are placed in the cages, much of the feed goes into suspension in the water and is lost to the fish.

The survival of Pla Nai in cages is 99 per cent but the feed conversion rates in the experiments feeding 10, 15, and 20 per cent total weight per cage per day varied from a low of 3.5 to a high of 9.6. The results of this experiment indicate that these feeding rates are too high for economical production of Pla Nai.

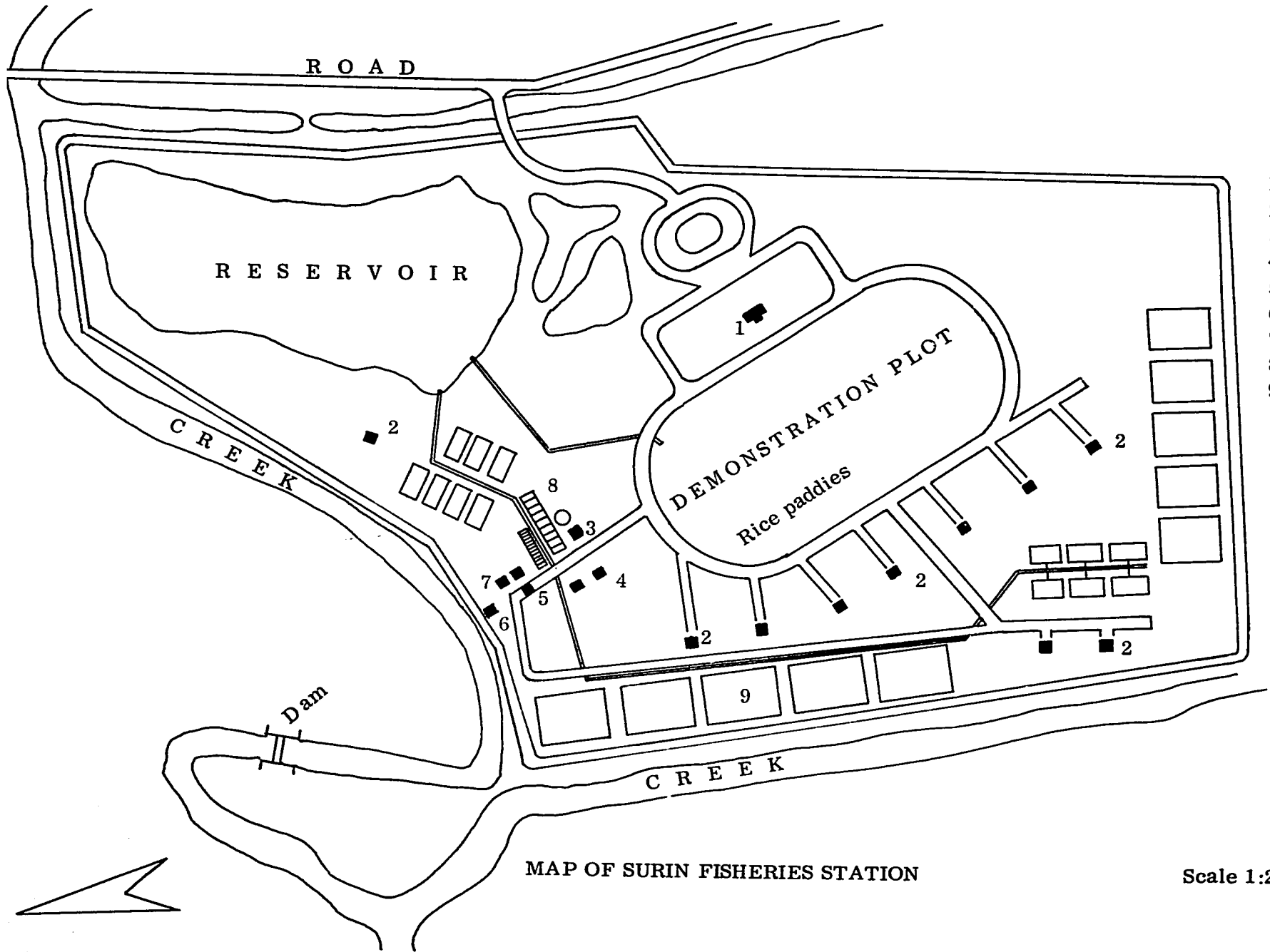
Sixteen rice paddy fields were stocked in 1968 with 400 fish per rai of Pla Nai.

6.026 Surin

The Surin Fisheries Station is located in Northeast Thailand 90 miles west of Nakorn Rajsima and was established in 1962. There are 23 earthen ponds and 20 cement ponds for a total water surface area of 19.47 rai on 75.45 rai of land. Fifteen rai of land are available for expansion of the station when necessary.

The water supply for the station ponds is by means of canals from a small reservoir located on the station. The reservoir receives its water from an irrigation canal on each of two sides of the station.

Total rainfall for the area varies from 1,172 to 1,627 mm and occurs principally during the period March to November.



- 1. Office
- 2. Staff Quarters
- 3. Hatchery
- 4. Store House
- 5. Garage
- 6. Fuel Store House
- 7. Pumping Shed
- 8. Cement Ponds
- 9. Earthen Ponds

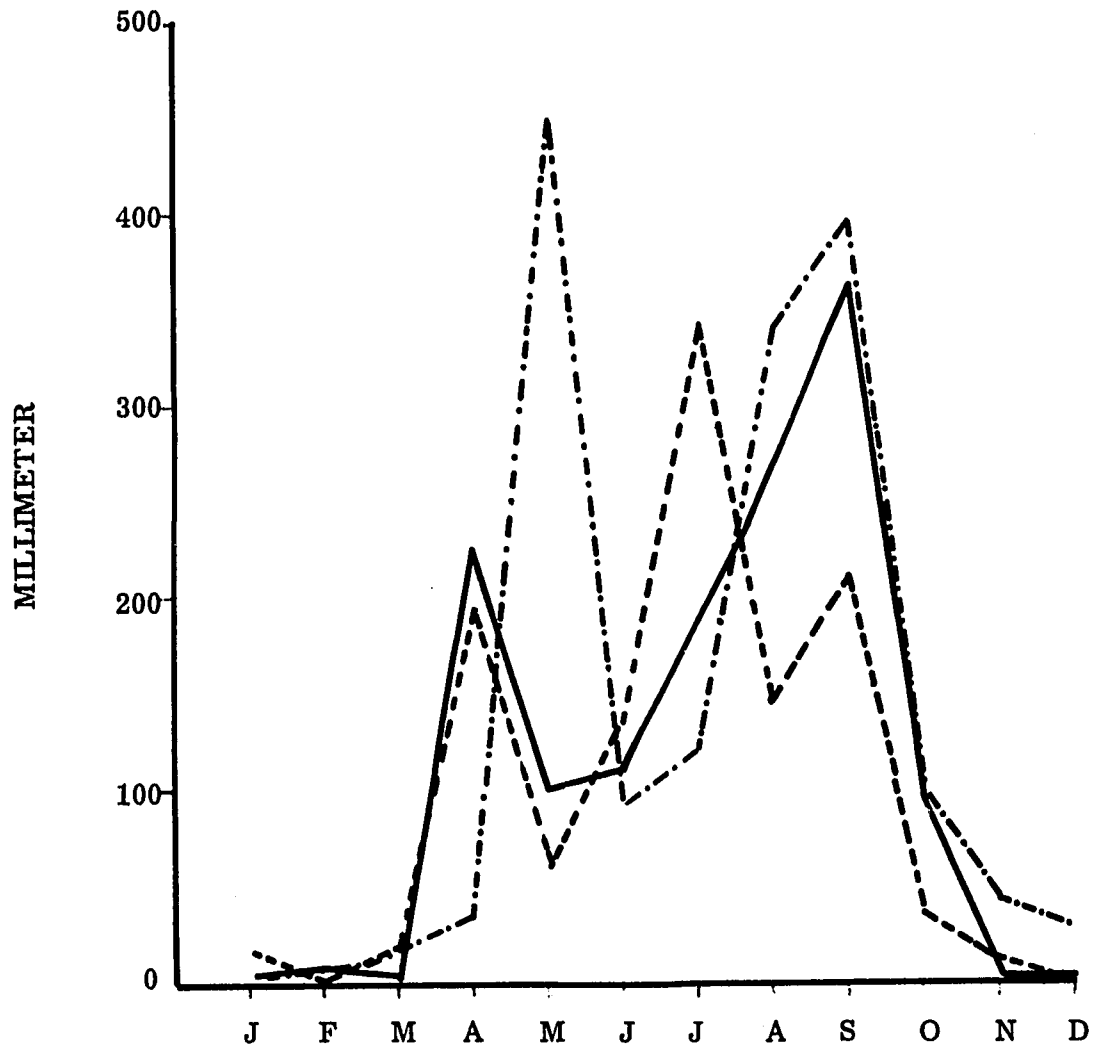
MAP OF SURIN FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

SURIN



---·--- 1966
---- 1967
_____ 1968

In addition to the head of the station, there are 2 biologists, 2 extension workers, 23 permanent laborers, and 3 temporary laborers.

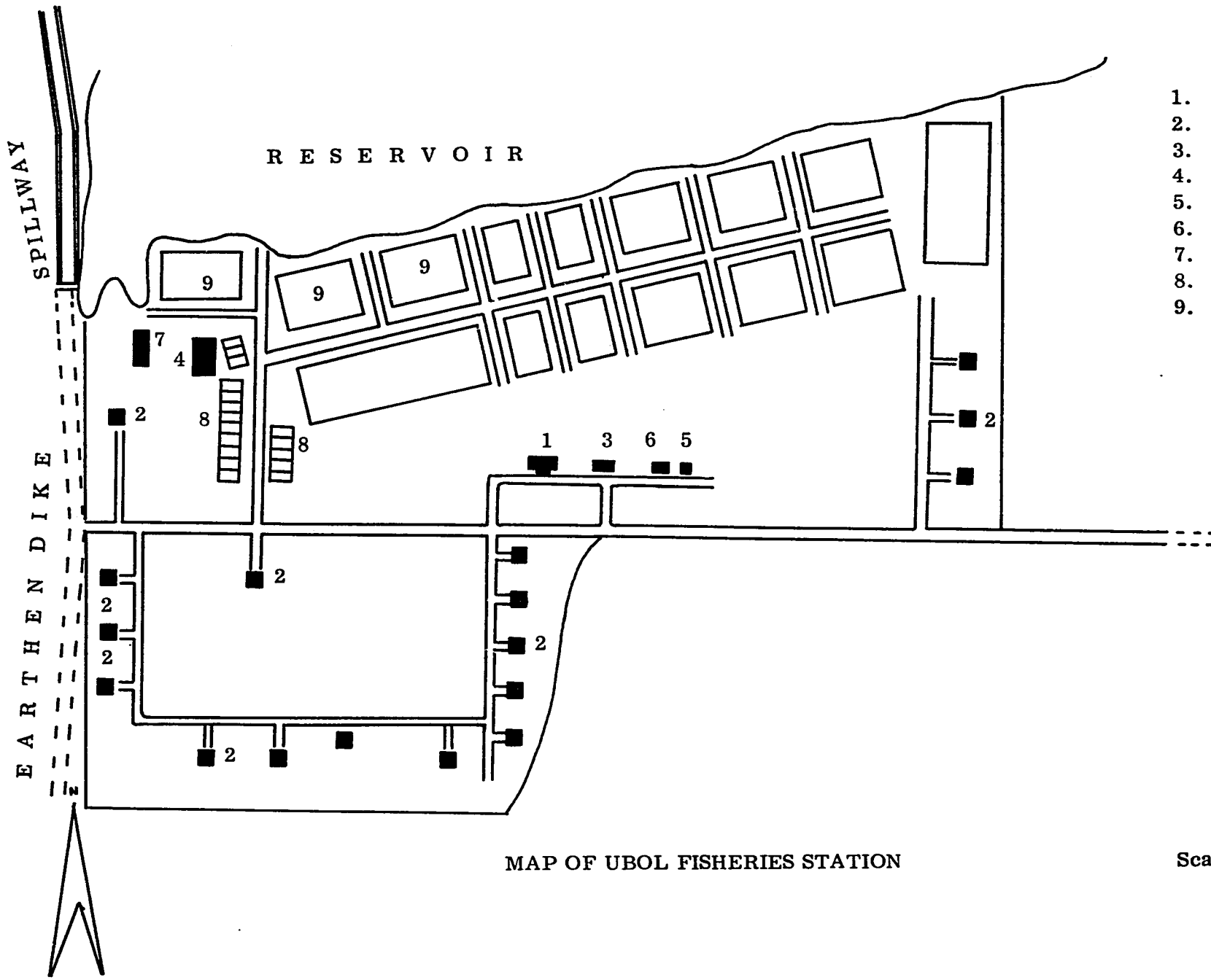
Fish production in 1968 included the following: Pla Nai (Cyprinus carpio) - 713,480; Pla Nin (Tilapia nilotica) - 198,435; and Pla Salid (Trichogaster pectoralis) - 93,460. Current research includes basket culture and various feeds for Pla Nai and limnology of various waters of Surin Province.

Extension activities in 1968 included stocking two rice paddy fields with Pla Nai at 400 fish per rai.

6.027 Ubol Rajthani

Ubol Rajthani Fisheries Station was established in 1954 and is located only 35 miles from Laos. There are 10 earthen ponds and 61 cement ponds for a total water area of 6 rai on 57.25 rai of land.

At this station, none of the excavated ponds will hold water as the station was built on sand. Consequently, no tests or demonstrations on methods of pond culture are possible there. Attempts were made to seal two ponds with asphalt, but these were not successful. Possibly the ponds could be sealed by soil cement, but this would be costly. Various methods of sealing leaking ponds and of reducing loss by seepage should be tried experimentally in this area. At present, adequate numbers of fingerlings for stocking are being produced in floating cages on Huey Muang Reservoir, which belongs to the Irrigation Department. However, area of the reservoir is only 144 rai and is too small for future production if considerable amounts of water are used for irrigation. It would probably be advisable to move the station to a new location nearby where the soils are suitable for construction of a reservoir and hatchery ponds.



- 1. Office
- 2. Staff Quarters
- 3. Laboratory
- 4. Hatchery
- 5. Fuel Store House
- 6. Garage
- 7. Pumping Shed
- 8. Cement Ponds
- 9. Earthen Ponds

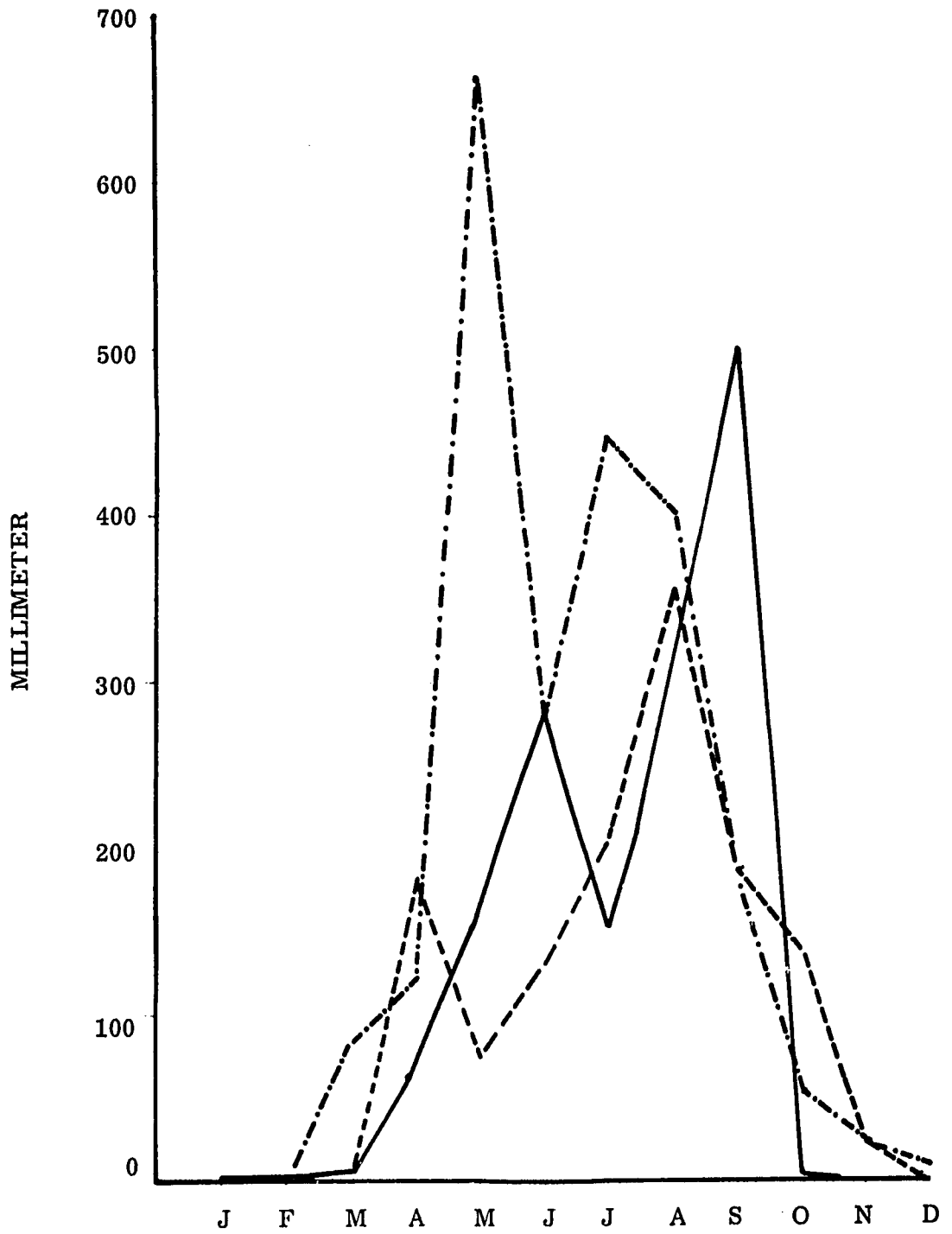
MAP OF UBOL FISHERIES STATION

Scale 1:2,000

MONTHLY RAINFALL

1966 - 1968

UBOL RAJTHANI



----- 1966

----- 1967

----- 1968

Rainfall occurs primarily between April and October and varies from 1,297 to 2,258 mm annually.

In addition to the head of the station, there are 2 biologists, 3 civil engineers, 11 extension workers, 22 temporary laborers, and 27 permanent laborers.

At Ubol Rajthani, the entire hatchery production was obtained by raising fish in floating cages on Huey Muang Reservoir. This method was initiated because none of the hatchery ponds would hold water.

Fingerling production in 101 cages with a total surface area of 402 m² (.025 rai) was 1,545,200. Production was 3,843 fingerlings per m². The best production in ponds was 125 fingerlings per m² when 4 crops of fish were raised per year. The higher production in cages was in part due to feeding the fry.

The species propagated were: Pla Nai (C. carpio), Pla Salid (Trichogaster pectoralis), Pla Morted (Tilapia mossambica), and Pla Nin (Tilapia nilotica).

In the commercial production experiments at the station, Pla Nai stocked at 70 per m² reached a total weight of 6 kg per m² in 5 months.

Extension activities in 1968 included the stocking of 120 rai of rice paddy fields with Pla Nai and Pla Salid.

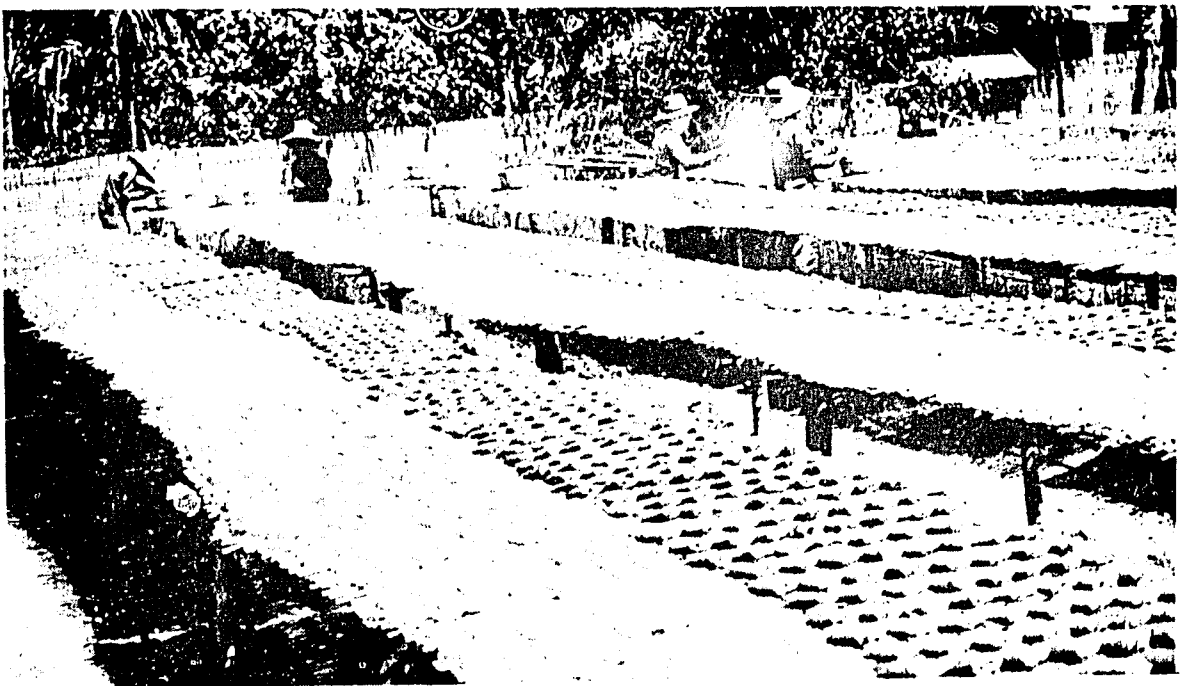
6.028 Udorn Thani

This station was established in 1954 and is located on the edge of the city across the highway from Prachuap Reservoir from which it gets its water by pipeline under the highway. The ponds can be filled by gravity when the reservoir is full and all ponds can be drained by gravity. This is a good system, but unfortunately, the reservoir dries up annually in April. Because of the location and the water supply problem, no enlargement of the station is possible.



Fig.11 Many farmers south of Bangkok are raising Pla Salid in what were formerly rice fields. Each week, approximately one-tenth the grass is cut or dragged under water by buffalo-drawn sleds. The fish feed on the periphyton and decaying weeds. Production, including wild fishes, varied from 200 to 500 kg per rai (1,100 to 2,700 pounds per acre) in a 10-month period. This culture is also being tried in various parts of the Northeast.

Fig.12 Pla Salid are dressed and salt-dried before sale. The market price of this delicacy is 75 - 80 cents per pound. Wastes from dressing the fish are used as feed for the walking catfish.



The station serves as a hatchery for Udorn Thani Province. It has 22 earthen ponds and 42 cement ponds for a total water area of 9.5 rai on 27.75 rai of land.

Total rainfall for the area varies from 1,428 to 1,594 mm and occurs principally during the period March to October with the largest amount falling between July and October.

In addition to the head of the station, there are 2 biologists, 2 civil engineers, 11 extension workers, 45 temporary laborers, and 24 permanent laborers.

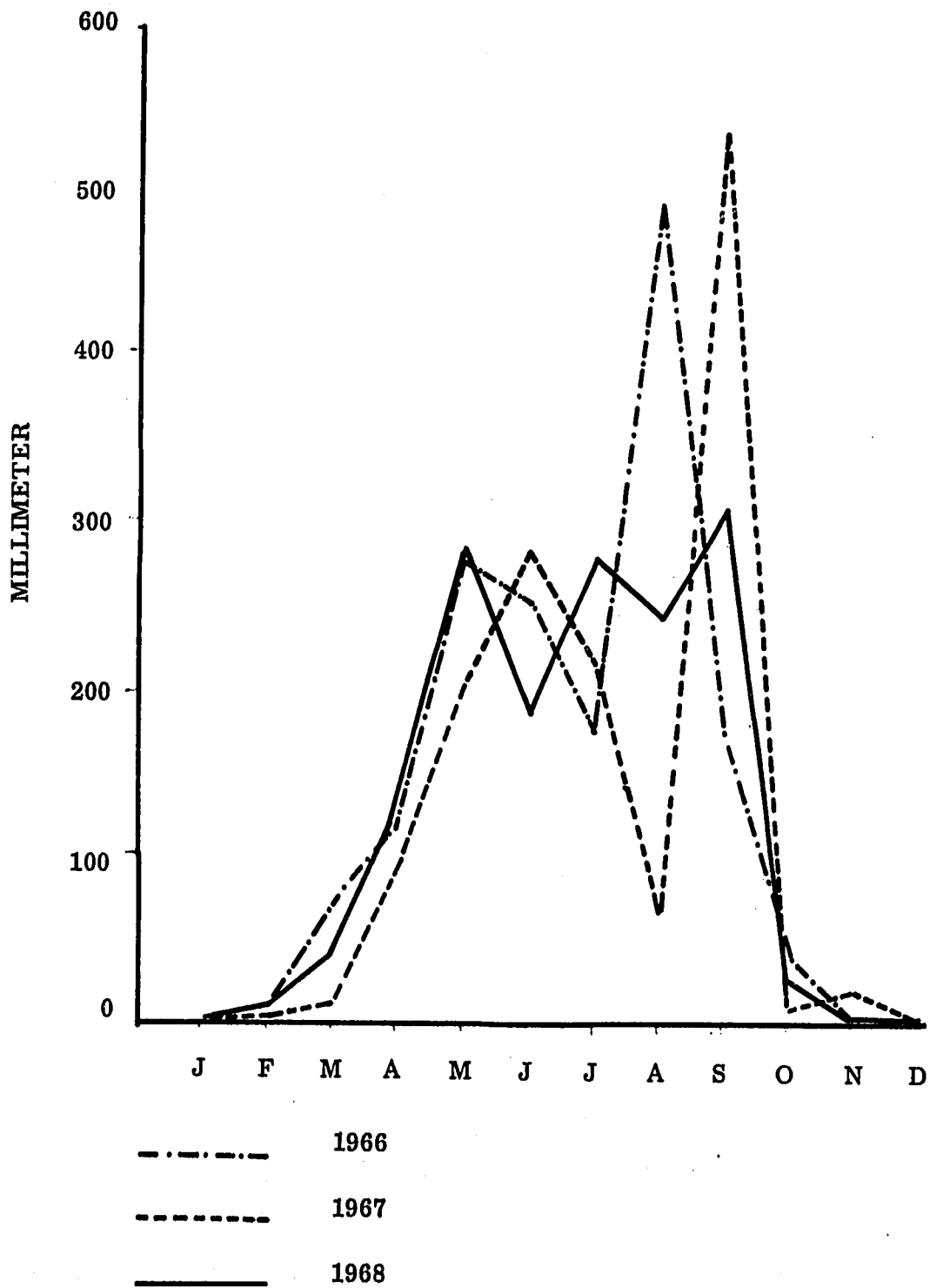
In 1968, a total of 939,600 fingerlings was produced as follows: Pla Nai (C. carpio) - 478,100; Pla Salid (Trichogaster pectoralis) - 348,200; Pla Nin (Tilapia nilotica) - 113,300. Four ponds were used for holding brood fish of Pla Morted (Tilapia mossambica), Pla Khang-Lai (T. melanopleura), Pla Mortan (Heleostoma temmincki), Pla Ret (Osphronemus goramy). Only small numbers of fingerlings of these species were produced. Production for Pla Nai was at the rate of 50,000 fingerlings per rai of pond. Current production is sufficient for the present demand in the area and for a portion of Nong Khai Province.

The station conducts research in paddy fishculture and has 20 paddies of 160 square meters each. Paddies were stocked with Pla Nai at the rate of 1 fish per square meter (which is too high) and the fish only grew to a size of 13 grams in 4 months even with feeding. A plan of research was developed for the next season with stocking of 500 fish per rai. Fish and rice production will be compared in paddies having a pond in the corner with a ditch on two sides; in paddies having a pond in the corner with a diagonal ditch; and in paddies having no pond and no ditch.

MONTHLY RAINFALL

1966 - 1968

UDORN THANI



Extension activities in 1968 included stocking 84 rai of rice paddy fields with Pla Nai. The stocking rate per rai was 645 fish and average production was 42 kg per rai.

6.03 Fisheries Stations in Central Thailand

6.031 Bangkhen

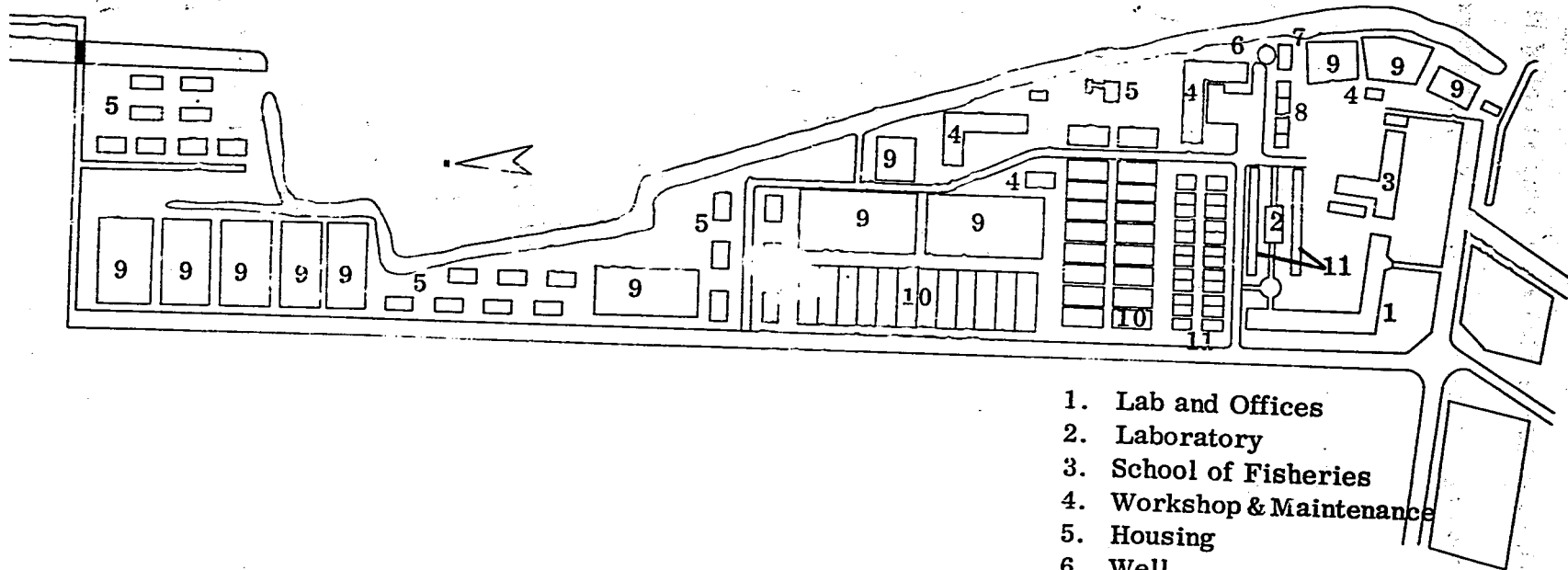
This station was established in 1937 and is located on the outskirts of Bangkok at the campus of Kasetsart University. There are 27 earthen ponds and 101 cement ponds for a total of 14.64 rai of water on 38 rai of land.

The station will lose 15 ponds and 16 rai of area to Kasetsart University. Since the old earthen ponds at Bangkhen were reconstructed into 98 ponds with concrete sides for experiments on feeds and feeding of fish, it is necessary to construct an additional 100 to 150 ponds for research if this is to be an effective center for fishcultural research. There is doubt that the water supplies from the irrigation canal at the edge of Bangkok can long remain unpolluted or can supply sufficient water. Because of this factor, it would be better to relocate the hatchery work and experimental testing of fishculture in ponds at a location farther away from Bangkok. A suitable area investigated was 35 kilometers from Bangkhen on heavy clay soils and beside a large irrigation canal at Pratum Thani. Also, the costs of land are much less there than at Bangkok. This area could be developed into an outstanding research center for fishcultures.

No extension activities were reported for 1968.

6.0311 Taxonomy and Fishery Survey Units

The Taxonomy and Fishery Survey Units are located at the Bangkhen Station. However, they conduct research programs throughout Thailand on the



MAP OF BANGKHEN FISHERIES STATION

1. Lab and Offices
2. Laboratory
3. School of Fisheries
4. Workshop & Maintenance
5. Housing
6. Well
7. Pump House
8. Reservoir and Filter Ponds
9. Earthen Ponds
10. Concrete Sided Earth Ponds
11. Concrete Ponds

Scale 1:1,000

various rivers and reservoirs of the country.

6.032 Chainat

Chainat was established in 1959 and is located in Central Thailand on the Chao Phya River above Chainat Dam. There are 53 earthen ponds and 20 cement ponds for a total of 17 rai of water on 34 rai of land. Fifty-one rai of land is available for expansion of this station. The water supply for the station comes from the Chao Phya Reservoir by a system of canals.

Total rainfall for the area in 1968 amounted to 1,095 mm of water and occurred principally during the period June to November.

In addition to the head of the station, there are 2 biologists, 3 extension workers, 23 permanent laborers, and 2 temporary laborers.

Fish production on the station included three species with a total of 410,000 fish in 1968.

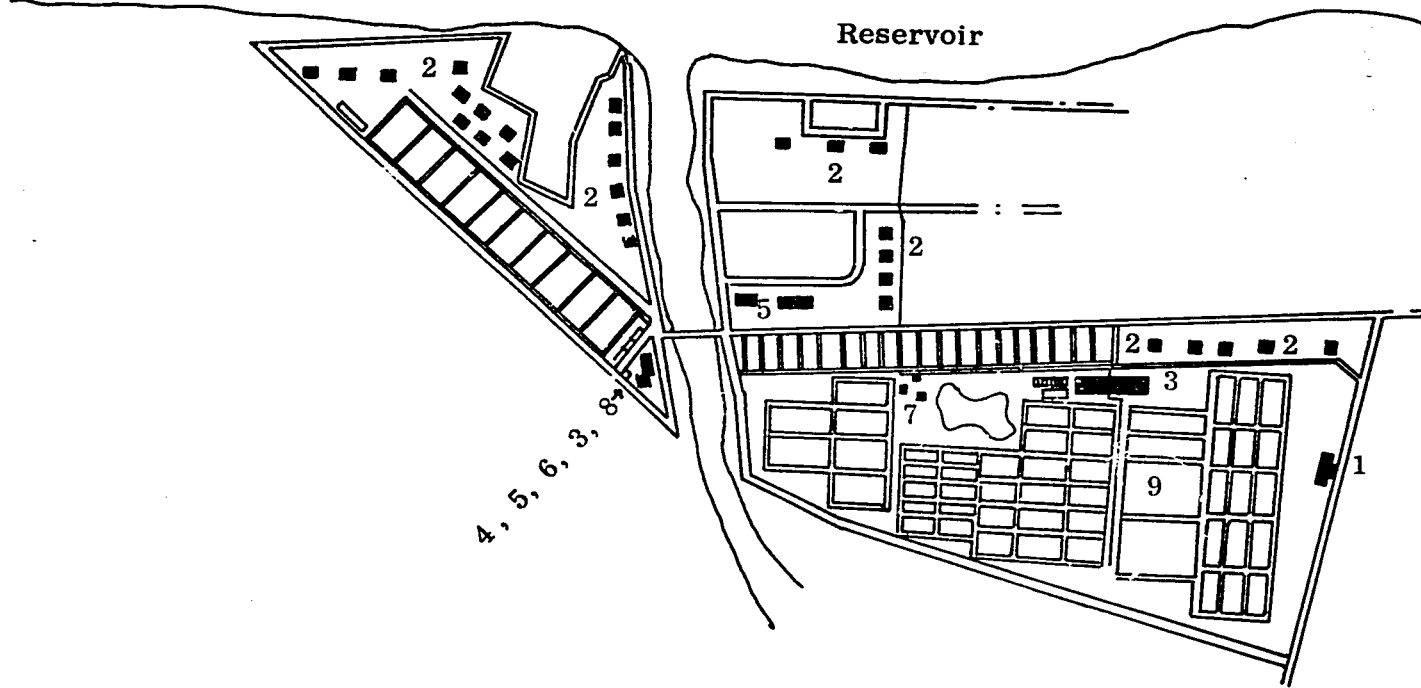
6.0321 Ditch and Dike Project

This project is currently working in the Chainat area on the culture of Pla Nai (Cyprinus carpio). There is a planned expansion for this project to other areas in Thailand.

6.033 Nakhon Sawan (Bung Bora Pet)

Nakhon Sawan Fisheries Station was established in 1927 in Central Thailand. There are 17 earthen ponds and 2 cement ponds for a total water surface area of 17 rai on 35 rai of land. It is located on Bung Bora Pet Reservoir which has an area of 150,000 rai. The ponds must be filled and drained by pumps and do not hold water well. There is no room for expansion on station lands.

CHAOPHYA RIVER



- 1. Office
- 2. Staff Quarters
- 3. Hatchery
- 4. Store House
- 5. Garage
- 6. Fuel Store House
- 7. Pumping Shed
- 8. Cement Ponds
- 9. Earthen Ponds

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MAP OF CHAINAT FISHERIES STATION

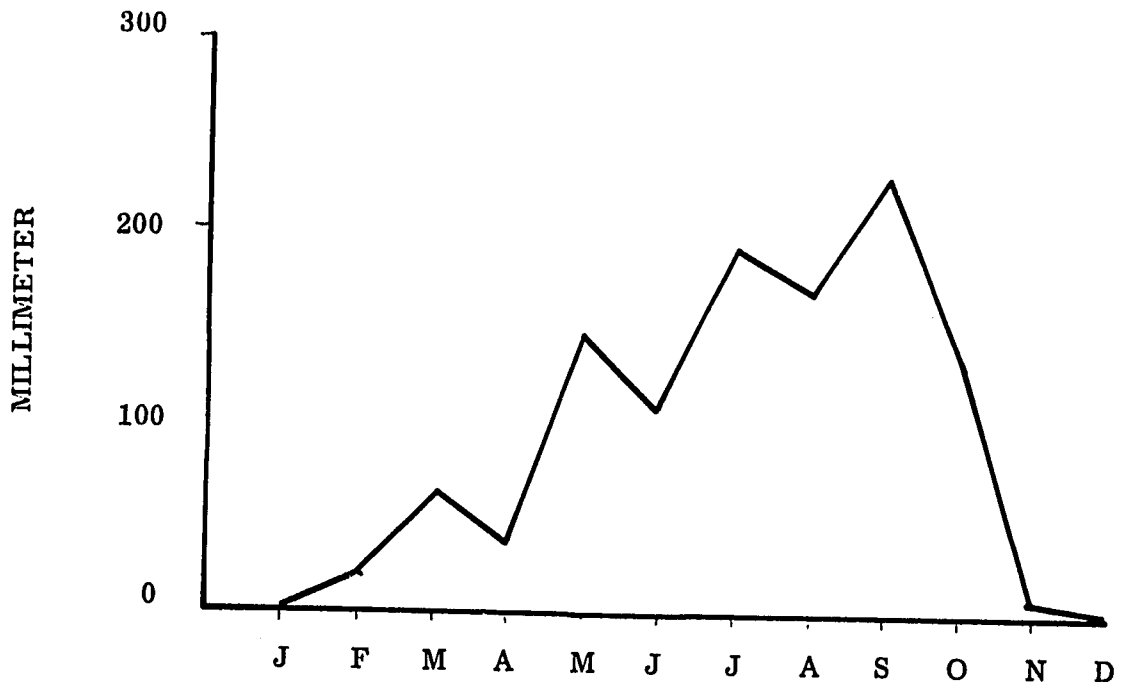
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MONTHLY RAINFALL

1968

CHAINAT



— 1968

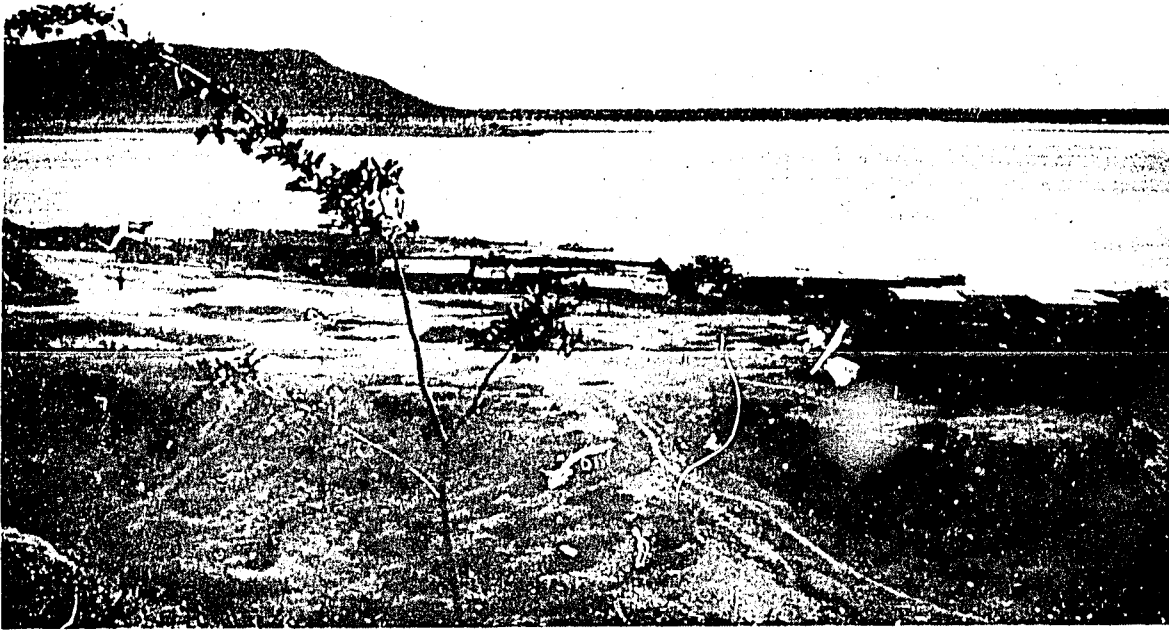
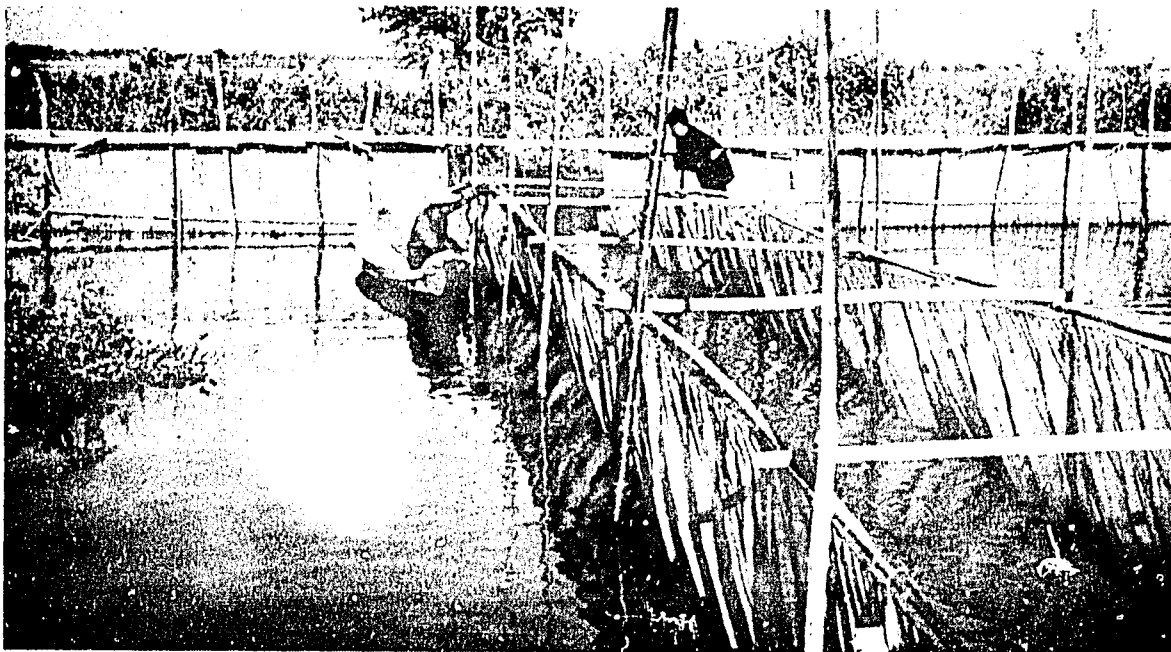


Fig.13 Ubol Ratana Reservoir (256,250 rai) is one of the many irrigation reservoirs now present in Thailand and many more are planned or being constructed. A research station dealing with reservoir fisheries is being established here. As a result of placing this reservoir in a dry land area containing poor soils, the productive fishery has resulted in a new fishing village, a new industry for the area, and higher standards of living.

Fig.14 The Thailand swamp fisheries presently supply approximately 50 per cent of the total catch. The swamps remain flooded 5 to 8 months during the wet period. During the dry period, barriers are constructed across the outlets to the river and all fish are harvested as the waters recede.



Total rainfall for the area varies from 886 to 1,439 mm annually with most of the rainfall occurring between June and December.

In addition to the head of the station, there are 3 biologists, 6 extension workers, 59 permanent laborers, and 8 temporary laborers.

Fish production on the station in 1968 included five species with a total of 142,486 fish. An additional 4,733 fish of two species were collected from areas other than station ponds. Current research projects include the artificial breeding of Pla Sawai (Pangasius sutchi) and a food habits study of the fish species in Bung Bora Pet Reservoir.

One earthen pond was stocked with Pla Nin (Tilapia nilotica) by extension personnel in 1968.

6.04 Fisheries Stations in South Thailand

6.041 Pattalung

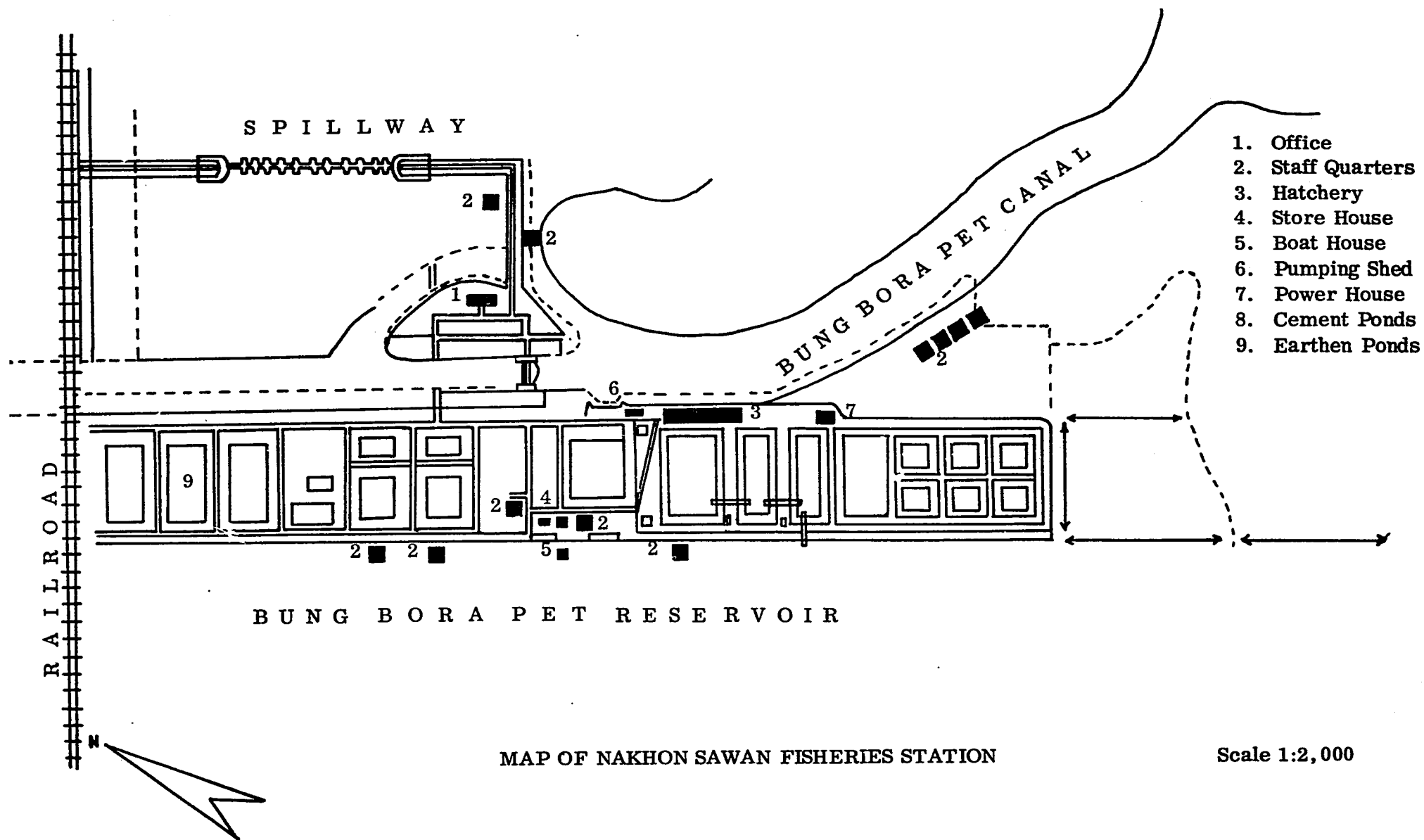
Pattalung Fisheries Station was established in 1954. There are 14 earthen ponds on the station for a total water surface area of 100 rai on 775 rai of land.

Total rainfall for the area varies from 1,574 to 3,070 mm and occurs principally during the period September to March. This area has the highest annual rainfall of any of the inland fisheries stations.

In addition to the head of the station, there are 2 extension workers, 4 permanent laborers, and 10 temporary laborers.

Fish production on the station included three species of fish with a total production in 1968 of 316,300.

One earthen pond of 247 rai stocked with Pla Nai and two rice paddy fields stocked with brood Pla Salid were supervised by the extension personnel in 1968.



- 1. Office
- 2. Staff Quarters
- 3. Hatchery
- 4. Store House
- 5. Boat House
- 6. Pumping Shed
- 7. Power House
- 8. Cement Ponds
- 9. Earthen Ponds

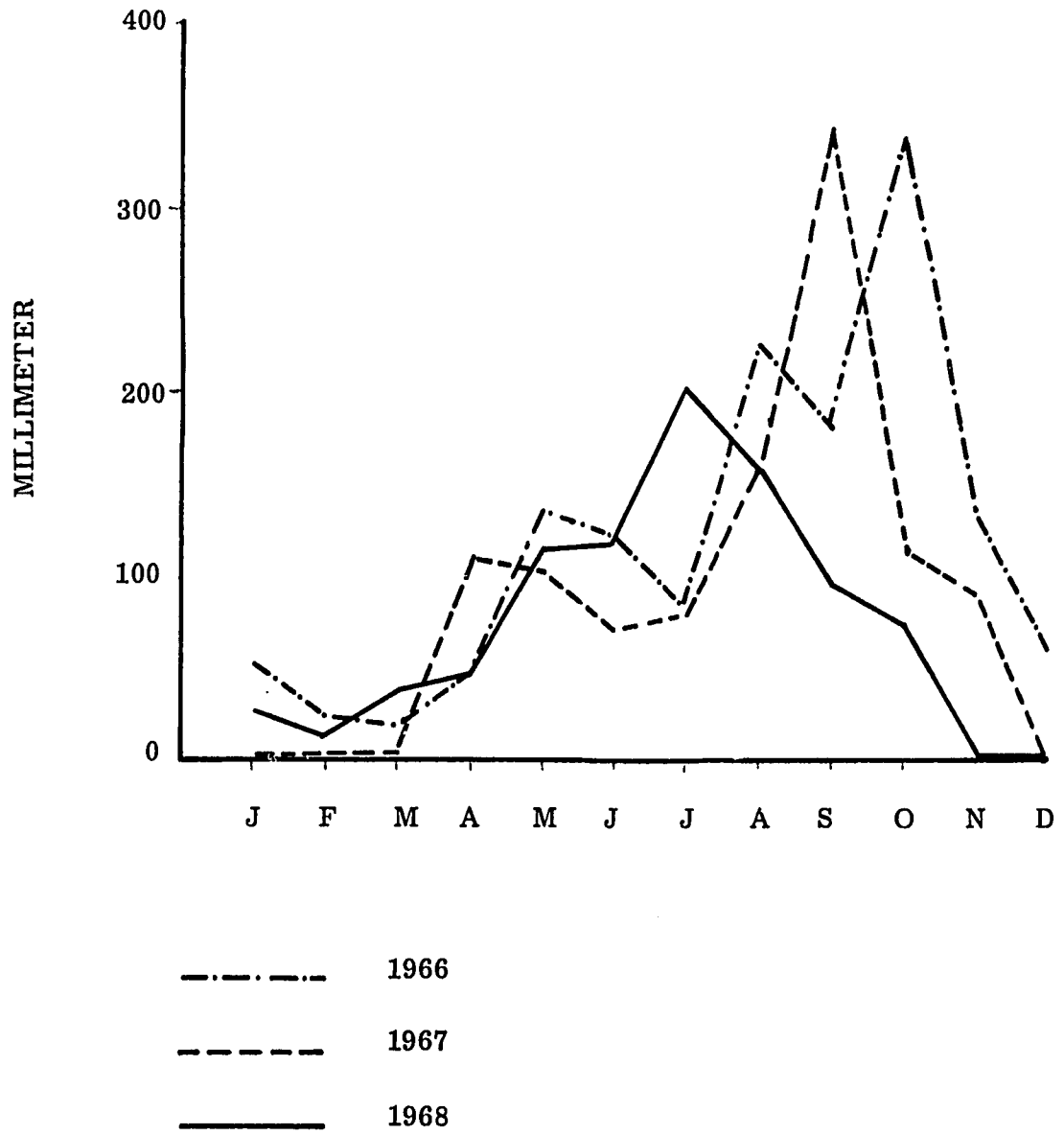
MAP OF NAKHON SAWAN FISHERIES STATION

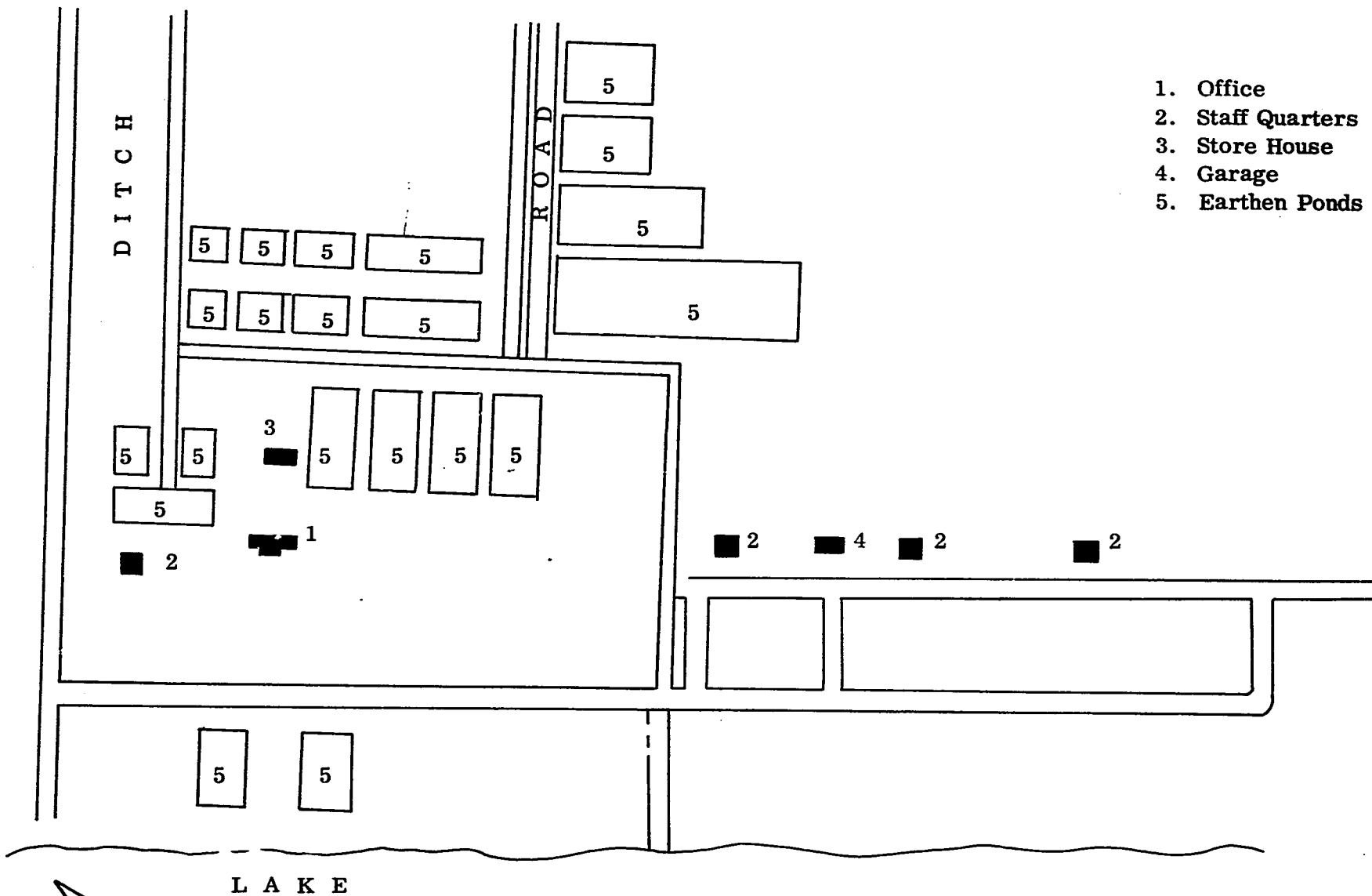
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MONTHLY RAINFALL

1966 - 1968

NAKHON SAWAN
(Bung Bora Pet)



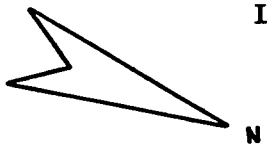


- 1. Office
- 2. Staff Quarters
- 3. Store House
- 4. Garage
- 5. Earthen Ponds

L A K E

MAP OF PATTALUNG FISHERIES STATION

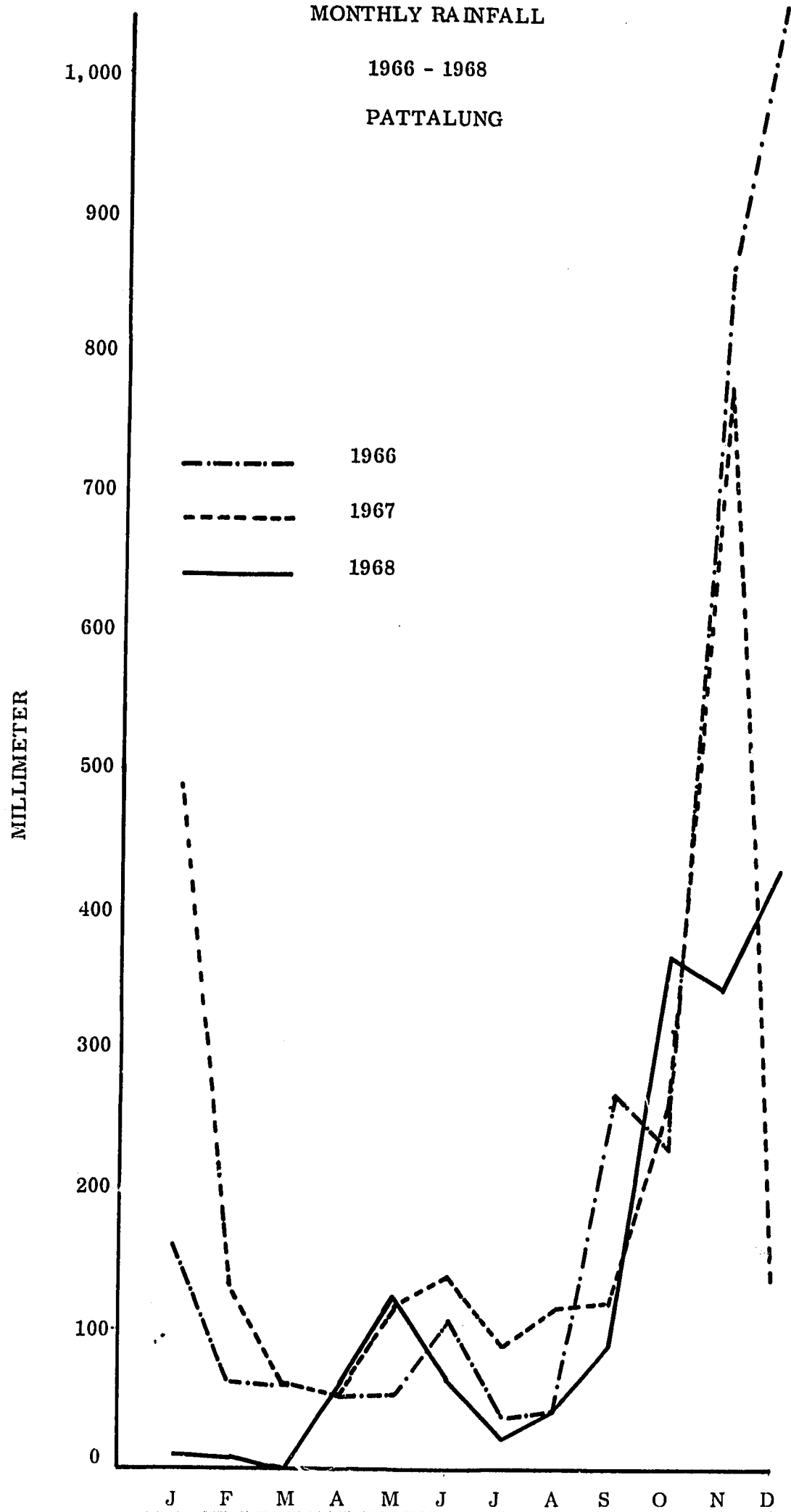
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MONTHLY RAINFALL

1966 - 1968

PATTALUNG



6.042 Pattani

The Pattani Fisheries Station is the southernmost fisheries station in Thailand located approximately 40 miles from the Malaysian border. The station is under construction at the present time and when completed, will have 116 earthen ponds and 44 cement ponds. There will also be a storage reservoir on the station with which to fill the station ponds. When completed, Pattani also will have the largest number of earthen ponds of any station in Thailand.

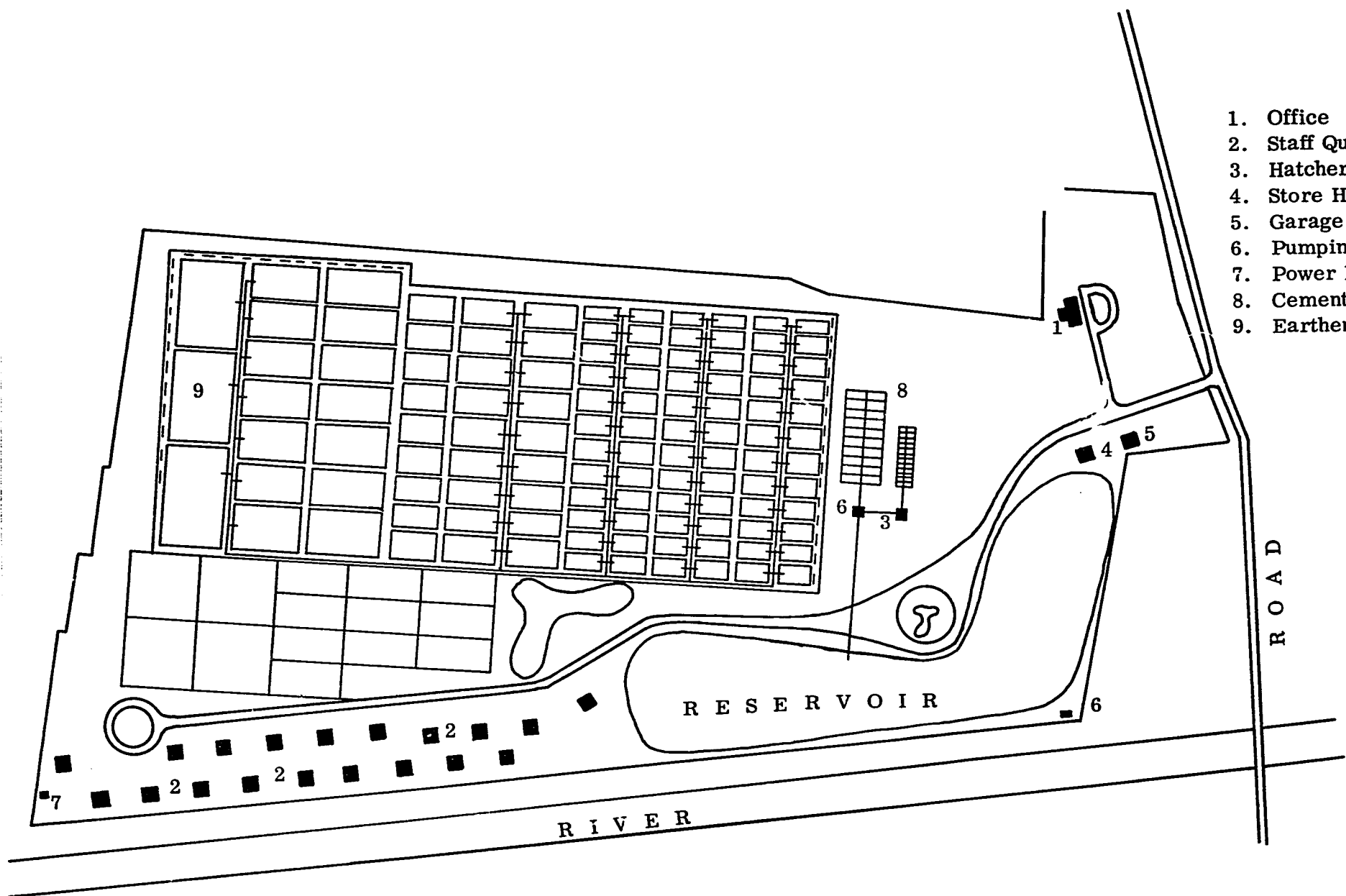
Annual rainfall for the area varies from 1,486 to 2,636 mm.

7.0 THE COLLEGE OF FISHERIES, KASETSART UNIVERSITY

This college must provide the basic training for the personnel who will make effective use of research facilities to devise improved fishcultural techniques, as well as for those who will perform the difficult task of persuading fishfarmers and fishermen to put these new techniques into practice. The outline of courses to be followed is good, but quality of training is a function of the excellence of teaching, not of outlines. There are 22 staff members, 1 with the Ph.D. degree, 7 with the M.S. degree, and 14 with the B.S. degree.

The college has 4 departments: Aquaculture, Fisheries, Fishery Products, and Fishery Biology. The enrollment is approximately 200, with 28 students graduating annually.

The College of Fisheries also has a research station on an area of 50 rai. There are 38 earthen ponds, 18 cement ponds, a laboratory and other buildings. It is within a mile of the Bangkhen Fisheries Station. The University is expecting to fill in all the ponds and build dormitories. Water pollution in one end of the canal was so severe that the water was not fit for use in fishculture. Pollution was from University sewage.



- 1. Office
- 2. Staff Quarters
- 3. Hatchery
- 4. Store House
- 5. Garage
- 6. Pumping Shed
- 7. Power House
- 8. Cement Ponds
- 9. Earthen Ponds

MAP OF PATTANI FISHERIES STATION

Scale 1:2,000

8.0 NORTHEAST AGRICULTURAL CENTER NEAR KHON KAEN

This experiment center, established in 1965 by the Thai government, has been staffed and developed in cooperation with the Kentucky Contract Team. Fisheries facilities at the center include a spacious laboratory, 4 aquaria, some jars in which to place fish, 20 rice-fish experimental plots each 400 m², and concrete retting tanks.

The fisheries program of the center is just beginning and 7 research projects have been proposed. In order of priority, these are:

1. Rice-field fishculture.
2. Preliminary investigations on life histories of selected species of fish in the Northeast.
3. Intensive fish raising in Kanaf retting tanks.
4. Fisheries survey of impounded waters.
5. Basket fishculture in flowing water.
6. Toxicity of Kanaf retting water to aquatic organisms.
7. Market survey of the Northeast.

The rice-field fishculture project is underway and the following results are available. Ditching along the sides of the rice paddies reduced the rice planting area about 25 to 30 per cent. Pla Nai (Cyprinus carpio) was stocked in 20 field plots of 0.25 rai at rates of 200, 300, and 400 per rai at an initial size of 8.5 cm and 12 grams weight. Survival was 94, 92, and 85 per cent and net production of fish was 29, 33, and 32 kg per rai. Production of rice was 251, 384, and 415 kg per rai with the control plot producing 227 kg of rice per rai. The presence of fish increased the yield of rice, almost doubling the yield

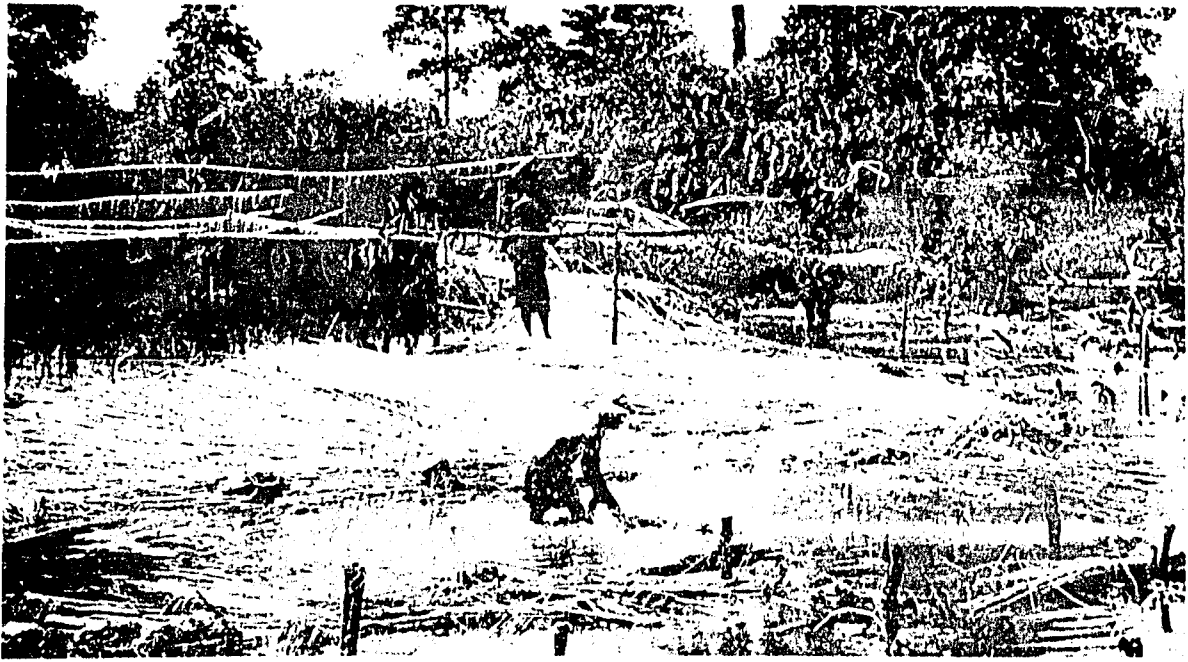


Fig.15 In the Northeast, the retting of Kanaf (jute) causes a severe pollution problem in streams, roadside canals and ponds. This problem is being investigated by the Ubol Station and by the Northeast Agricultural Center near Khon Kaen.

Fig.16 The combined culture of rice and fish has been investigated at all stations in the Northeast and in the North. Production of Pla Nai and Pla Salid varied from 20 to 45 kg per rai (94 to 211 pounds per acre). This method of fish-rice culture is being used extensively in the Northeast as a result of extension demonstrations.



at the 300 stocking rate, when compared to a similar plot with ditches along the sides but without fish. However, no controls were included without the ditches, which reduce the area planted in rice.

A cage culture experiment using Pla Tepo (Pangasius larnaudii) is proposed in the Nam Pong River about 20 kilometers below Ubol Ratana Dam. The cages are 4.5 cubic meters in volume and made of miyang wood and bamboo. The cost per cage was approximately 400 baht. The Pla Tepo are collected from the Nam Pong River at 4 to 5 cm total length.

A proposed pelleted feed consisting of: fish meal (25%); soybean cake (25%); rice bran (25%); dry cow manure (15%); kratin (a leafy legume) (10%); will be used in the experiments. Total cost per kg for the feed is 2.3 baht. The initial feeding rate will be 5 per cent per day.

9.0 APPENDIX

**9.01 Synopsis of Physical and Biological Data for
The Inland Fisheries Stations**

BANGKHEN

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Bangkhen	Amphur: Bangkhen Province: Bangkok	1937

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
38 rai - Land 14.64 rai - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Samran Dhamrongrut	B.S. Kasetsart Un.	1961
Biologists: Mr. Manu Potaros	M.S. U.S. Auburn Un.	1965
Mr. Prasit Ketsunchai	B.S. Kasetsart Un.	1961
Miss Kamolporn Thonguthai	B.S. Kasetsart Un.	1965
Mr. Prasert Sitasit	B.S. Kasetsart Un.	1966
Mr. Kamthorn Pothongkum	B.S. Kasetsart Un.	1967
Mr. Pithaya Pennapaporn	B.S. Kasetsart Un.	1967
Miss Wirutadamukraseewee	B.S. Kasetsart Un.	1968
Extension: 1	3 years experience	
Laborers: 54 Permanent 9 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen *</u>		<u>Cement</u>	
1	345	1	784
1	560	1	896
1	520	1	732
1	224	1	793
2	200	1	270
1	483	1	1,404
1	1,888	1	342
1	1,920	1	1,054
2	468	1	1,175
1	288	1	1,323
1	958	2	306
1	448	1	187

*concrete side-earthen bottom

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	1,400,000

Pla Salid	450,000
Pla Morted	310,000
Pla Mortan	130,000
Pla Ret	26,000
Pla Nin	430,000
Pla Lin-Hue	143,000

RESEARCH PROJECTS

1. Study on the development of silver carp's ovaries.
2. Primary study on induced spawning of Cirrinhus microlepis.
3. The experiments on the transportation of fish in polyethylene bags.
4. Study on the effect of pH of water on fingerlings of pond fishes.
5. Primary study on biology of Anabas testudineus.
6. Study on the production of T. nilotica fry with various ratios of male and female.
7. The experiment on feeding Clarias batrachus with trash fish and Auburn No. 2 pellets and with various rates of stocking.
8. Study on the problems of parasites and disease of pond fishes.
9. Study on the selective breeding of Cyprinus carpio.
10. The experiment on composition of supplementary feeding for fingerling common carp.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, willy; purchased in 1958; fair.
2. Volkswagon; purchased in 1962; O.K.
3. Nissan; purchased in 1963; O.K.
4. Truck, chevrolet; purchased in 1959; fair.
5. Truck, chevrolet; purchased in 1959; fair.
6. Truck, dodge fargo; purchased in 1962; O.K.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 1 50 m seine
2. 2 30 m seines
3. 1 25 m seine
4. 6 net cages
5. 1 dissecting microscope
6. 10 compound microscopes
7. 1 analytical balance (15 years old, fair condition)
8. 6 500 gm scales sensitive to 2 gm
9. 5 1 kg scales sensitive to 5 gm
10. 1 7 kg scale sensitive to 20 gm
11. 1 10 kg scale sensitive to 5 gm
12. 1 15 kg scale sensitive to 100 gm

13. 1 50 kg scale sensitive to 500 gm
14. 25 aquaria
15. 1 10 cu. ft. refrigerator
16. 5 plankton nets
17. 1 shadow graph
18. 1 current meter
19. 1 water distillation machine
20. 1 turbidity machine (no batteries)
21. 1 chemical centrifuge
22. 1 drying oven (max. 65° C)
23. 1 temperature recorder
24. 1 oxygen meter
25. 1 magnetic stirrer
26. 1 lab pH meter
27. 2 autoclaves
28. 2 calorimeters
29. 1 electric calculator
30. 1 barometer
31. 2 1 HP electric pump (2 years old)
32. 2 3 HP gasoline pump (7 years old)
33. 1 4-5 HP diesel pump (1 year old)
34. 1 5 HP gasoline pump (7 years old)
35. 1 5 HP gasoline pump (6 years old)
36. 1 6 HP gasoline pump (5 years old)
37. 1 9-12 HP diesel pump (1 year old)
38. 1 air pump (3-5 aquaria)

CHAINAT

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Chainat	Amphur: Sunphaya Province: Chainat	1959

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
-------------	--------------------------------

34 rai - Land	
17 rai - Water	51 rai

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Prasit Aguru	M.S. U.S. Auburn Un.	1966
Biologists: Mr. Pisan Choangpanich	B.S. Kasetsart Un.	1966
Mr. Manop Tungtrongpiroj	B.S. Kasetsart Un.	1968
Extension: 3	3 years experience	
Laborers: 23 Permanent 2 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
1	1 rai	10	50
20	200	10	5
8	400		
8	800		
12	200		
4	400		

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

1 55 CC motorcycle

Ponds and Fish Species Used

2 earthen 1 rai

Pla Nai 3,200

Pla Nin 3,200

6,400 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	253,000
Pla Nin	78,000
Pla Salid	79,000

RESEARCH PROJECTS

1. Pangasius sutchi culture in floating cages.
2. Pangasius sutchi culture in nylon net floating cages.
3. Food habits of Catlacarpio siamensis.
4. Cyprinus carpio culture in combination with Tilapia nilotica.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1964; fair.
2. Truck, international; purchase date unknown; no good.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 1 200 m seine
2. 1 100 m seine
3. 2 50 m seines
4. 2 25 m seines
5. 5 plankton nets
6. 2 dissecting apparatus
7. 1 Ekman dredge
8. 1 Kemmerer water sampler
9. 1 compound microscope
10. 1 dissecting microscope
11. 10 aquaria
12. 1 analytical balance
13. 1 current meter
14. 1 500 gm capacity balance
15. 1 200 gm capacity balance

CHIENG MAI

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Chieng Mai	Amphur: San Sai Province: Chieng Mai	1953

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
53 rai - Land	None on station
13 rai - Water	Land is available nearby for expansion

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Boonhai Thongsamui	B. S. Kasetsart Un.	1959
Biologists: Mr. Samrong Powhawm	B. S. Kasetsart Un.	1964
Mr. Rewat Rithaporn	B. S. Kasetsart Un.	1969
Extension: 4	3 years experience	
Laborers: 14 Permanent 8 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>	<u>Cement</u>
1 3,900	1 24
1 3,300	2 20
1 1,672	1 12
2 1,260	10 10
1 1,215	3 3
4 800	2 1.5
3 405	10 10
4 400	
4 375	
1 324	
4 180	

RICE PADDY FIELDS

15 400 (m²)

RESERVOIRS

Nong Bau 163,200 (m²)

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- 1 motorcycle
- 1 12 HP water pump
- 1 5 HP water pump

Ponds and Fish Species Used

32	13 rai
Pla Nai	8,000
Pla Tapien	28,000
Pla Khang Lai	6,000
Pla Nin	10,000

4,000 stocked per rai

Rice Paddy Fields and Fish Species Used

11	75 rai
Pla Nai	30,000

400 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Tapien	634,528
Pla Khang Lai	243,540
Pla Nin	48,700
Pla Nai	70,756

RESEARCH PROJECTS

1. Biology of Puntius gonionotus method of propagation and its embryonic development.
2. A study on fish population survey in Nong Bou Reservoir.
3. Fish culture in paddy fields.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1964; fair.
2. Truck, dodge power wagon; purchased in 1955; poor.
3. Truck, chevrolet pickup; purchased in 1953; poor.

EQUIPMENT AVAILABLE FOR RESEARCH

- | | |
|--------------------|---------------------------|
| 1. 1 100 m seine | 4. 2 compound microscopes |
| 2. 2 50 m seines | 5. 2 dissecting apparatus |
| 3. 2 plankton nets | 6. 10 aquaria |

- 7. 1 airpump with filter
- 8. 2 Ekman dredges
- 9. 1 Kemmerer water sampler
- 10. 1 refrigerator

- 11. 1 analytical balance
- 12. 1 500 gm capacity balance
- 13. 1 10 gm capacity balance
- 14. 1 portable pH meter

CHIENG RAI

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Chieng Rai	Amphur: Payao Province: Chieng Rai	1941

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
67 rai - Land	None on station
20 rai - Water	Privately owned land can be purchased

<u>PERSONNEL</u>		<u>TRAINING</u>	<u>YEAR</u>
Head:	Mr. Sawad Boonthai	3 years Kasetsart Un.	1948
Biologists:	Mr. Chanintorn Sritongsuk	B. S. Kasetsart Un.	1964
	Mr. Panu Tavaratmaneegul	B. S. Kasetsart Un.	1968
	Mr. Samruey Sipkhe	B. S. Kasetsart Un.	1969
Extension:	5		
Laborers:	33 Permanent		
	3 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
1	240	25	24
6	360	2	12
1	460		
1	730		
3	1,200		
2	1,440		

RESERVOIRS

Kwanpayao 10,400 rai

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- 1 motorcycle
- 1 7-12 HP pump
- 1 3-5 HP pump

Rice and Paddy Fields and Fish Species Used

2 10 rai

Pla Nai 3,000

300 stocked per rai

Reservoirs and Fish Species Used

2 400 rai

Pla Nai 10,000

Pla Khang Lai 25,000

Pla Nin 25,000

150 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	442,005
Pla Lin-Hue	330,000
Pla Khang Lai	311,975
Pla Nin	211,135
Pla Salid	26,000

RESEARCH PROJECTS

1. Experiments on artificial breeding of chinese carp.
2. Experiments on featherback fish (Notopterus chitala) breeding.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, willy; purchased in 1952; no good.
2. Jeep, land-rover; purchased in 1964; O.K.
3. Truck, dodge power wagon; purchased in 1955; no good.
4. Truck, fargo; purchased in 1966; O.K.
5. Boat, longtail, 10 HP; fair.
6. Boar, outboard motor; 25 HP; O.K.

EQUIPMENT AVAILABLE FOR RESEARCH

- | | |
|-----------------------------|-------------------------------|
| 1. 2 100 m seines | 8. 1 air pump with filter |
| 2. 1 25 m seine | 9. 1 Ekman dredge |
| 3. 1 plankton net | 10. 1 analytical balance |
| 4. 1 Kemmerer water sampler | 11. 1 100 gm capacity balance |
| 5. 1 dissecting apparatus | 12. 1 refrigerator |
| 6. 1 profile projector | 13. 1 binocular |
| 7. 15 aquaria | |

KHON KAEN

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Khon Kaen	Amphur: Muang Province: Khon Kaen	1953

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
81.75 rai - Land 30.4 rai - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Pratom Taweesak	B. S. Kasetsart Un.	1961
Biologists: Mr. Sanay Pholprasit	B. S. Kasetsart Un.	1964
Mr. Somprasong Mobhudit	B. S. Kasetsart Un.	1966
Mr. Isro Virakawooth	B. S. Kasetsart Un.	1968
Extension: 1		
3		
Laborers: 21 Permanent		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>				<u>Cement</u>	
17	800	4	1 rai	14	15
14	200	5	2.5 rai	27	1.5
11	240	14	200		

RESERVOIRS

Tung Srang 2,000 rai

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- 1 1966 motorcycle
- 2 5 HP water pumps

Ponds and Fish Species Used

7 5 rai (observation on commercial ponds)

Pla Sawai	3 ponds
Pla Lin-Hue	2 ponds
Pla Nai	1 pond
Pla Nin	1 pond

Rice Paddy Fields and Fish Species Used

32 48.2

Pla Nai 13,200

Pla Nin 900

300 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	567,020
Pla Salid	164,330
Pla Nin	552,830
Pla Morted	36,800

RESEARCH PROJECTS

1. A preliminary study on spawning of nilem, Osteochilus hasseltii.
2. A study on food habit of Morulius chrysophekadion in the Ubol Ratana Reservoir.
3. A study on fish population and efficiency of some kinds of fishing gear in the Ubol Ratana Reservoir.
4. Production of nilem (1968).

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, wagoneer; purchased in 1965; O.K.
2. Jeep, land-rover; purchased in 1965; poor.
3. Jeep, international scout; purchased in 1963; poor.
4. Truck, dodge power wagon; purchased in 1953; very poor.
5. Truck, dodge; purchased in 1953; very poor.
6. Truck, dodge fargo; purchased in 1967; O.K.

EQUIPMENT AVAILABLE FOR RESEARCH

- | | |
|------------------------------|----------------------------|
| 1. 1 100 m seine | 7. 1 dissecting microscope |
| 2. 2 50 m seines | 8. 20 aquaria |
| 3. 4 plankton nets | 9. 1 centrifuge |
| 4. 1 Kremmerer water sampler | 10. 2 sieves |
| 5. 1 Ekman dredge | 11. 1 refrigerator |
| 6. 1 binocular microscope | 12. 1 barometer |

13. 1 max - min thermometer
14. 1 electric thermometer
15. 1 analytical balance
16. 1 pocket pH meter
17. 1 electric pH meter
18. 2 water analysis lab kits
19. 1 7 kg capacity scale
20. 1 12 HP diesel water pump
21. 1 16 HP diesel water pump

MAHA SARAKHAM

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Maha Sarakham	Amphur: Muang Province: Maha Sarakham	1953

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
20 rai - Land 4 rai - Water	10 rai - belongs to Irrigation Dept.

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Wai Pinyo	3 years at Kasetsart Un.	1947
Biologists: Mr. Somdet Srikonut	B.S. Kasetsart Un.	1964
Mr. Manus Chantasut	B.S. Kasetsart Un.	1966
Mr. Krisna Thitikulrat	B.S. Kasetsart Un.	1969
Extension: 3	3 years experience	
Laborers: 14 Permanent 6 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
2	200	5	15
9	200	4	18
1	400		
3	500		
4	600		
1	800		
1	900		

RESERVOIRS

Kaeng Lerng Charn 2,000 rai

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- 1 motorcycle (3 years old)
- 1 12 HP water pump
- 1 5 HP water pump
- 1 35 mm camera
- 1 13 HP longtail boat (3 years old)

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	158,000
Pla Nin	180,500
Pla Salid	71,000

RESEARCH PROJECTS

1. Biological fishery survey in Kaeng Lerng Charn Irrigation tank.
2. Experiment on growth rate of Pla salid, Trichogaster pectoralis (Regan) in ponds.
3. Preliminary studies on life history of Hampala dispar (H. M. Smith).
4. Evaluation on stocking some fishes in irrigation tanks.
5. Study on fecundity and young produced of various sizes of Tilapia nilotica (Linn.).

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1965; O.K.
2. Truck, dodge; purchased in 1955; poor.
3. Truck, dodge fargo; purchased in 1966; O.K.
4. Truck, dodge power wagon; purchased in 1955; poor.

EQUIPMENT AVAILABLE FOR RESEARCH

- | | |
|--------------------------------------|------------------------------|
| 1. 1 100 m seine | 10. 1 profile projector |
| 2. 2 50 m seines | 11. 1 Kemmerer water sampler |
| 3. 2 25 m seines | 12. 1 centrifuge |
| 4. 3 plankton nets | 13. 1 refrigerator |
| 5. 1 dissecting binocular microscope | 14. 1 analytical balance |
| 6. 2 dissecting apparatus | 15. 2 500 gm balances |
| 7. 10 aquaria | 16. 2 thermometers |
| 8. 1 Ekman dredge | 17. 1 pocket pH meter |
| 9. 1 air pump with filter | 18. 1 water analysis lab kit |
| | 19. 1 30 kg balance |

NAKORN RAJSIMA

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Nakorn Rajsima	Amphur: Muang Province: Nakorn Rajsima	1953

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
24.5 rai - Land 2 rai - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Boonlue Somboonwong	3 years at Vocational School	
Biologists: Mr. Pramot Suwanasart	B.S. Kasetsart Un.	1964
Mr. Veerasak Chueyphat	B.S. Kasetsart Un.	1969
Extension: 3	3 years experience	
Laborers: 10 Permanent 3 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
4	400	10	10
2	800	4	80
1	200		

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- 1 motorcycle, 13 years old
- 1 12 HP water pump
- 1 5 HP water pump

Rice Paddy Fields and Fish Species Used

2 10 rai

Pla Nai	1,000
Pla Salid	4,000

500 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	80,000
Pla Morted	124,500
Pla Nin	100,000
Pla Salid	26,200
Pla Mortan	10,000

RESEARCH PROJECTS

1. Role of sodium cyanide in fish culture.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1964; O.K.
2. Truck, dodge power wagon; purchased in 1955; no good.
3. Truck, dodge; purchased in 1955; no good.
4. Truck, dodge fargo; purchased in 1967; O.K.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 2 50 m seines
2. 1 dissecting microscope
3. 1 compound binocular microscope
4. 12 aquaria
5. 1 Ekman dredge
6. 1 dissecting apparatus
7. 1 thermometer
8. 1 analytical balance
9. 1 pocket pH meter
10. 1 500 gm capacity balance
11. 1 50 kg-100 kg scale

NAKORN SAWAN

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Nakorn Sawan	Amphur: Muang Province: Nakorn Sawan	1927

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
35 rai - Land 17 rai - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Bunlue Luksanabut		
Biologists: Mr. Suchit Bhinyoying	B.S. Kasetsart Un.	1959
Mr. Kumron Potipituk	B.S. Kasetsart Un.	1964
Mr. Khemchat Nimsomboon	B.S. Kasetsart Un.	1968
Mr. Suchin Thongmee	B.S. Kasetsart Un.	1969
Extension: 1	5 years experience	
5	3 years experience	
Laborers: 59 Permanent		
8 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
1	331	1	1,040
1	396	1	680
1	1,400	1	660
1	1,081	1	840
1	1,081	5	396
1	268		
1	576		
1	1,064		

RESERVOIRS

Bung Bora Pet 130,000 rai

EXTENSION AND DEMONSTRATION ACTIVITIESPonds and Fish Species Used

1 earthen 331

Pla Nin 500

2,424 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nin	11,000
Pla Sawai	119,000

COLLECTED - NOT PRODUCED

<u>Species</u>	<u>Number</u>
<u>Morulus chrysophekadion</u>	4,540
<u>Cirrhinus sp.</u>	193
<u>Cyclocheilichthys sp.</u>	10,173
Pla Tapien	1,508
Pla Kaho	805

RESEARCH PROJECTS

1. Artificial breeding of Pla Sawai (Pangasius sutchi) by pituitary hormone injection.
2. Study on stomach contents of some species of fishes in Bung Borapet.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1965; poor.
2. Boat; 7 HP longtail.
3. Boat; 50 HP longtail.
4. Boat; 25 HP outboard motor.
5. Boat; 20 HP inboard motor.

EQUIPMENT AVAILABLE FOR RESEARCH

- | | |
|---------------------------|----------------------------------|
| 1. 1 200 m seine | 10. 1 oven |
| 2. 4 100 m seines | 11. 1 refrigerator |
| 3. 1 50 m seine | 12. 1 current meter |
| 4. 3 plankton nets | 13. 1 5 - 10 gm capacity balance |
| 5. 10 aquaria | 14. 1 12 HP pump |
| 6. 2 Ekman dredges | 15. 1 9 HP pump |
| 7. 3 air pumps | 16. 1 10 KVA generator |
| 8. 3 dissecting apparatus | 17. 1 binocular |
| 9. 1 microscope | |

NONG KHAI

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Nong Khai	Amphur: Srichiengmai Province: Nong Khai	1968

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
125.5 rai - Land 7 rai - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Nid Koochareonpaisal	B. S. Kasetsart Un.	1963
Biologists: Mr. Teinthong Yuovechwatana	B. S. Kasetsart Un.	1968
Mr. Vichian Plengchawee	B. S. Kasetsart Un.	1969
Extension: 2	5 years experience	
5	3 years experience	
Civil Engineers: 2		
Laborers: 8 Permanent		
22 Temporary		

NUMBER AND SIZE OF PONDS

<u>Earthen</u>		<u>Cement</u>	
4	1 rai	6	10 (m ²)
6	0.5 rai		

RESERVOIRS

Nong Rirk - 706 rai

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

1. 3 motorcycles
2. 1 movie projector
3. 1 slide projector

Rice Paddy Fields and Fish Species Used

50 250 rai

Pla Nai 95,000
Pla Nin 2,000

400 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	Brood fish just stocked
Pla Nin	Brood fish just stocked
Pla Salid	Brood fish just stocked

RESEARCH PROJECTS

1. Fish collection in Nong Khai province.
2. Experiment on common carp culture in nylon baskets by using two kinds of fish-food.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1968; O.K.
2. Jeep, land-rover; purchased in 1963; poor.
3. Boat, 100 HP outboard motor.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 2 100 m seines
2. 2 50 m seines
3. 3 25 m seines
4. 3 plankton nets
5. 10 aquaria
6. 1 Kemmerer water sampler
7. 1 airpump with filter
8. 1 Ekman dredge
9. 1 compound microscope
10. 1 dissecting microscope
11. 2 500 gm capacity balances
12. 2 20-30 kg capacity balances
13. 1 current meter
14. 1 underwater thermometer recorder
15. 1 colorimeter
16. 1 electric pH meter

PATTALUNG

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Pattalung	Amphur: Muang Province: Pattalung	1954

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
775 rai - Land 100 rai - Water	

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Pramot Wanichagorn Extension: 2 Laborers: 4 Permanent 10 Temporary	B. S. Kasetsart Un. 3 years experience	1956

NUMBER AND SIZE (m²) OF PONDSEarthen

1	1,600
2	112
2	49
1	232
1	225
2	175
2	70
2	140
1	235

EXTENSION AND DEMONSTRATION ACTIVITIESEarthen Ponds and Fish Species Used

1 247 rai

Pla Nai 247

Rice Paddy Fields and Fish Species Used

2 1/2 rai

Pla Salid 25 pair (brood)

50 pair (brood) stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Salid	114,900
Pla Nai	136,100
Pla Nin	65,300

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1964; O.K.
2. Jeep, willy; no good.
3. Truck, dodge power wagon; purchased in 1955; no good.
4. Truck, chevrolet; no good.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 1 100 m seine
2. 1 50 m seine
3. 2 plankton nets
4. 1 compound microscope
5. 3 dissecting apparatus
6. 10 aquaria
7. 1 airpump with filter
8. 1 analytical balance
9. 2 500 gm capacity balances
10. 1 Kemmerer water sampler

SAKOL NAKORN

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Sakol Nakorn	Amphur: Muang Province: Sakol Nakorn	1942

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
128.75 rai - Land 18.75 rai - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Somjet Julapong	B. S. Kasetsart Un.	1962
Biologists: Mr. Phichit Srimookda	B. S. Kasetsart Un.	1966
Mr. Kiri Koanandakul	B. S. Kasetsart Un.	1968
Extension: 5	5 years experience	
10	3 years experience	
Laborers: 40 Permanent		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>				<u>Cement</u>	
1	338	1	209		
3	268	1	570	5	50
2	260	1	273	6	16.50
1	700	1	5,550	1	28.8
1	529	1	672	1	6.79
1	208	1	540	12	6
1	180	1	1,140	6	8
1	902	1	5,550	2	24.64
1	2,210	1	800		
1	667	1	308		
1	216	1	600		
1	144	1	336		
1	910	2	264		
3	600	2	82.50		
1	966	1	142.50		
1	825	1	198		
1	2,072	1	217		
1	4,410				

RESERVOIRS

Nong Harn Lake	48,000 rai (cage culture)
----------------	---------------------------

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- | | |
|--------------------------------------|---------------------------------|
| 1. 6 motorcycles (4 work; 2 no good) | 7. 1 12 HP water pump |
| 2. 1 land rover jeep | 8. 1 electric water pump |
| 3. 1 jeep | 9. 3 generators |
| 4. 2 movie projectors | 10. 1 25 HP outboard motor boat |
| 5. 1 slide projector | 11. 1 camera |
| 6. 4 3HP water pumps | |

Rice Paddy Fields and Fish Species Used

16 65 rai

Pla Nai 25,800

400 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	753,453
Pla Nin	299,800
Pla Morted	261,690
Pla Salid	500
Pla Mortan	26,000

RESEARCH PROJECTS

1. Cyprinus carpio culture in floating baskets.
2. Biological fishery survey of Nam Pung irrigation tank.
3. Biological fishery survey of Nong Harn Lake.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1965; O.K.
2. Jeep, land-rover; purchased in 1965; O.K.
3. Jeep, pickup; purchased in 1962; poor.
4. Truck, fargo; purchased in 1955; poor.
5. Truck, fargo; purchased in 1966; O.K.
6. Truck, dodge; purchased in 1953; no good.
7. Jeep; purchased in 1953; poor.
8. Jeep, pickup; purchased in 1964; O.K.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 1 100 m seine
2. 2 50 m seines
3. 6 25 m seines
4. 7 plankton nets
5. 15 aquaria
6. 1 Ekman dredge
7. 1 refrigerator
8. 1 500 gm balance
9. 1 analytical balance
10. 1 electric pH meter
11. 1 oxygen meter
12. 1 dissecting microscope

SURIN

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Surin	Amphur: Muang Province: Surin	1962

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
75.45 rai - Land	
19.47 rai - Water	15 rai

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Uthai Prominthra	3 years at Kasetsart Un.	1947
Biologists: Mr. Boonchuey Chaopaknam	B.S. Kasetsart Un.	1964
Mr. Sutchu Sukwibul	B.S. Kasetsart Un.	1968
Extension: 2	3 years experience	
Laborers: 23 Permanent		
3 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
13	200	10	50
5	800	1	6
5	1,600	9	6

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- 1 motorcycle
- 1 12 HP diesel pump
- 1 5 HP diesel pump

Rice Paddy Fields and Fish Species Used

2 8 rai

Pla Nai 3,200

400 stocked per rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	713,480
Pla Nin	198,435
Pla Salid	93,460

RESEARCH PROJECTS

1. Experimental basket culture of common carp aiming at growth rates, stocking rates, and the endurance of basket constructing materials.
2. Comparison of growth rate among three groups of common carp fed on different formulae of feed.
3. Physio-chemical characteristics of inundated waters in and about Surin Province.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1962; fair.
2. Jeep, willy; purchased in 1962; fair.
3. Truck, dodge power wagon; purchased in 1955; no good.
4. Truck; more than 10 years old; no good.
5. Truck, fargo; purchased in 1966; good.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 2 50 m seines
2. 2 25 m seines
3. 3 plankton nets
4. 2 compound microscopes
5. 1 profile projector
6. 1 electrical centrifuge
7. 2 sieves
8. 10 aquaria
9. 1 airpump with filter
10. 1 refrigerator
11. 1 analytical balance
12. 3 spring balances
13. 1 electric pH meter

TAK

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Tak	Amphur: Muang Province: Tak	1963

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
150 rai - Land 50 rai - Water	8.1 rai

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Montri Muangboon	3 years vocational school	
Biologists: Mr. Chareon Panin	B. S. Kasetsart Un.	1962
Mr. Surajit Parianyarut	B. S. Kasetsart Un.	1966
Mr. Prayot Paosas	B. S. Kasetsart Un.	1968
Extension: 2	5 years experience	
5	3 years experience	
Laborers: 18 Permanent		
14 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
3	1,300	10	5
5	800	10	10
10	400		

RESERVOIRS

Bhumipol 250,000 rai

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nin	316,500
Pla Nai	215,000
Pla Salid	118,000
Pla Ret	3,500
<u>C. batrachus</u>	3,000

RESEARCH PROJECTS

1. Study on limnology of the Bhumipol Reservoir.
2. Study on fishing methods in Bhumipol Reservoir.

3. Experiment on pond culture of Sepat siam, Trichogaster pectoralis, applying different formulae of inorganic fertilizer.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, willy; purchased in 1963; fair.
2. Jeep, land-rover; purchased in 1966; O.K.
3. Jeep, nissan; purchased in 1967; O.K.
4. Truck, isuzu; purchased in 1964; O.K.
5. 1 125 HP inboard motor boat.
6. 2 50 HP outboard motor boats.
7. 1 13 HP longtail motor boat.

EQUIPMENT AVAILABLE FOR RESEARCH

- | | |
|-----------------------------|---------------------------------|
| 1. 2 100 m seines | 10. 2 refrigerators |
| 2. 6 25 m seines | 11. 1 analytical balance |
| 3. 3 plankton nets | 12. 5 500 gm capacity balances |
| 4. 35 aquaria | 13. 1 2,000 gm capacity balance |
| 5. 1 compound microscope | 14. 2 secchi disks |
| 6. 2 air pumps with filters | 15. 1 electric pH meter |
| 7. 1 Ekman dredge | 16. 2 sieves |
| 8. 1 electric centrifuge | 17. 1 12 HP pump |
| 9. 1 Kemmerer water sampler | 18. 1 5 HP pump |

UBOL RAJTHANI

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Ubol Rajthani	Amphur: Muang Province: Ubol Rajthani	1954

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
57.25 rai - Land 6 rai - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Vinus Boonyaratplin	B. S. Kasetsart Un.	1962
Biologists: Mr. Amnuay Tanthong	B.S. Kasetsart Un.	1964
Mr. Niphon Siribhand	B. S. Kasetsart Un.	1968
Extension: 3	5 years experience	
8	3 years experience	
Civil Engineers: 3		
Laborers: 27 Permanent		
22 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
1	387.50	13	50
1	343	8	15
1	100.44	40	130
1	136		
1	145.60		
1	171		
1	448.20		
1	304.20		
1	475.20		
1	375		

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

- | | |
|---|-------------------------------|
| 1. 3 motorcycles | 7. 1 16 HP inboard motor boat |
| 2. 1 Bell and Howell projection equipment | 8. 1 generator |
| 3. 1 9 HP water pump | 9. 1 transistor tape recorder |
| 4. 1 7 HP water pump | 10. 1 transistor amplifier |
| 5. 4 5 HP water pumps | 11. 1 binocular microscope |
| 6. 1 13 HP longtail boat | 12. 1 camera (canon) |

Rice Paddy Fields and Fish Species Used

24	120 rai
Pla Nai	500
Pla Salid	2,000

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	790,500
Pla Salid	263,500
Pla Morted	149,300
Pla Nin	341,900

COLLECTED - NOT PRODUCED

<u>Species</u>	<u>Number</u>
Pla Sawai	970
Pla Tapien	59,650 *
<u>Cyclocheilichthys enoples</u>	

*Represents number collected for both Pla Tapien and Cyclocheilichthys enoples.

RESEARCH PROJECTS

1. Termites as food for common carp with emphasis on conversion factor.
2. General survey on fishes and fishing gear in Moon River, Ubol Rajthani Province.
3. A preliminary study on the effect of pollution to fishes by soaking jute in irrigation tanks.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1964; O.K.
2. Jeep, land-rover; purchased in 1965; O.K.
3. Jeep, wagoner; purchased in 1965; O.K.
4. Truck, dodge power wagon; purchased in 1955; poor.
5. Truck, dodge stake; purchased in 1955; poor.
6. Truck, fargo; purchased in 1967; O.K.

EQUIPMENT AVAILABLE FOR RESEARCH

- | | |
|-----------------------------|-----------------------------|
| 1. 2 100 m seines | 7. 1 compound microscope |
| 2. 6 50 m seines | 8. 2 profile projectors |
| 3. 2 25 m seines | 9. 1 dissecting microscope |
| 4. 9 plankton nets | 10. 2 sieves |
| 5. 1 Kemmerer water sampler | 11. 40 aquaria |
| 6. 7 stereo microscopes | 12. 3 air pumps with filter |

13. 1 refrigerator
14. 1 analytical balance
15. 1 500 gm capacity balance
16. 11 thermometers
17. 1 lab kit for water analysis
18. 1 electric pH meter
19. 1 current meter

UDORN THANI

<u>STATION</u>	<u>LOCATION</u>	<u>ESTABLISHED</u>
Udorn Thani	Amphur: Muang Province: Udorn Thani	1954

<u>AREA</u>	<u>AVAILABLE FOR EXPANSION</u>
27.75 - Land 9.50 - Water	None on station

<u>PERSONNEL</u>	<u>TRAINING</u>	<u>YEAR</u>
Head: Mr. Songsilpa Sutjaritkul	3 years Kasetsart Un.	1947
Biologists: Mr. Pipop Kamolrat	B.S. Kasetsart Un.	1964
Mr. Chaichet Laojintanasri	B.S. Kasetsart Un.	1968
Extension: 7	3 years experience	
4	5 years experience	
Civil Engineers: 2		
Laborers: 24 Permanent		
45 Temporary		

NUMBER AND SIZE (m²) OF PONDS

<u>Earthen</u>		<u>Cement</u>	
1	1,350	1	1,230
1	1,092	2	704
2	726	1	946
1	400	1	814
1	360	1	770
1	660	1	1,032
1	528	2	480
1	1,080		
2	102		
2	90		

Rice Paddy Fields

20 160

EXTENSION AND DEMONSTRATION ACTIVITIESEquipment Available

1. 3 motorcycles
2. 16 mm movie projector with screen,
3. 35 mm slide projector

4. 2 transistor tape recorders
5. 2 transistor amplifiers
6. 1 pair of binoculars
7. 1 35 mm camera
8. 2 12 HP water pumps
9. 1 9 HP water pump
10. 1 7 HP water pump
11. 2 5 HP water pumps

Rice Paddy Fields and Fish Species Used

24 84 rai

Pla Nai 53,800

645 stocked per rai. Average production 42 kg/rai.

FISH PRODUCTION

<u>Species</u>	<u>Number</u>
Pla Nai	478,100
Pla Salid	348,200
Pla Nin	113,300

RESEARCH PROJECTS

1. Experiments on common carp culture in rice paddy fields.

TRANSPORTATION FACILITIES AVAILABLE

1. Jeep, land-rover; purchased in 1963; poor.
2. Jeep; purchased in 1965; O.K.
3. Jeep, land-rover; purchased in 1965; O.K.
4. Truck, dodge power wagon; purchased in 1954; no good.
5. Truck, dodge; purchased in 1954; no good.
6. Truck, dodge fargo; purchased in 1967; O.K.

EQUIPMENT AVAILABLE FOR RESEARCH

1. 4 50 m seines
2. 6 25 m seines
3. 9 plankton nets
4. 1 profile projector
5. 20 aquaria
6. 2 airpumps with filter

7. 1 dissecting apparatus
8. 1 refrigerator
9. 1 analytical balance
10. 1 500 gm capacity balance
11. 6 thermometers
12. 1 pocket pH meter
13. 1 water analysis lab kit
14. 1 compound binocular microscope
15. 1 microscope substage lamp
16. 1 7 kg balance

**9.02 List of Equipment and Chemicals Needed
for a Basic Water Chemistry Laboratory**

Materials for Water Chemistry Lab

	<u>I Sampling Equipment</u>	<u>Cost in U. S.</u>
36	BOD bottles 300 ml	\$78.23
2	Sampling device - bottle train sampler	
4-6	Field thermometer 0-50°C	16.50
2	Field reagent box	
	<u>II Laboratory Hardware</u>	
4-6	Ring Stand or Burette Support 60-75 cm high	30.00
4-6	Fisher or Bunsen burner (if gas is available)	35.00
12	Wire gauze, 15 cm x 15 cm, asbestos center	4.20
2	Crucible tongs	7.00
2-3	Burette clamps, double	2.40
6	Clamps, single general utility	13.20
4-6	Ring clamps or support rings or tripods, 125 mm diameter	9.00
3-4	Triangular files - glass cutter	3.60
1	Cork borer	5.00
1	Rack for funnels	15.50
1	Rack for Kjeldahl flasks	6.50
	<u>III Volumetric glassware - pyrex or corex or kimax</u>	
	Volumetric flasks	
10	1 liter	38.00
10	500 ml	35.50
10	200 or 250 ml	27.00

Volumetric pipettes

3-4	5 ml	\$ 9.60
3-4	10 ml	10.40
1-2	25 ml	5.70
1-2	50 ml	6.06
3-4	100 ml	13.20
1-2	200 ml	7.60

Graduated pipettes

5	1 ml in hundredths of ml	7.50
5	2 ml in tenths of ml	8.00
5	5 ml in tenths of ml	8.00
5	10 ml in tenths of ml	9.50

Graduated cylinders

1	50 ml	3.10
3-4	100 ml	13.80
3-4	200 ml	14.40
3-4	100 ml	27.60

Burettes

2	50 ml in tenths of ml	33.00
2	25 ml in tenths of ml	32.00
4	10 ml in tenths of ml, squeeze bottle, self zeroing	80.00

IV Other Glassware - Pyrex, Kimax

Beakers, Griffin low form with lip

5-6	100 ml	2.70
5-6	250 ml	3.75

3-4	600 ml	\$ 5.75
3-4	1,000 ml	8.80
	Flasks (Erlenmeyer, narrow mouth)	
12	125 ml	25.44
24	250 ml	52.32
12	500 ml	27.24
12	1,000 ml	31.20

V Miscellaneous Equipment

6	condensers, 300 mm	27.00
24	Funnels, 5-7.5 cm diameter, long stem	15.36
2	Dessicator, 220-300 mm diameter	26.00
	Rubber stoppers, 1 doz of each size to fit each size flask	37.40
30m	Rubber tubing 5-6 mm inside diameter	54.00
10m	Glass tubing 5-6 mm diameter	16.00
1	pH meter - Photovolt, battery powered for field use ¹	265.00
1	Spare electrode for pH meter	24.00
24	Nessler tubes, graduated at 50 and 100 ml	60.24
1	Rack for Nessler tubes	9.75
1 pr	Asbestos gloves	6.00
1	Oven - for temp. up to 150-200°C	225.00
1	Still, 4 liter/hr., distilled H ₂ O	305.00
1	Storage jug for distilled H ₂ O, 40-50 liter	25.52
6	Wash bottles, 500 ml polyethylene	3.65
1	Analytic balance, sensitivity 0.1 mg, capacity 150-200 gm	795.00

¹or laboratory 220 volt model

1	Set of weights for balance	\$ 15.00
1	Triple beam or torsion balance, sensitivity 0.1 gm, capacity 1-2 kg	185.00
3-4	Reagent bottles, 16 oz or 500 ml	6.92
36	Dropping bottles, 60 ml polyethylene, or glass with pipette	12.60
3 box	Filter paper 15 cm Whatman No. 42	9.36
3 box	Filter paper 15 cm Whatman No. 5	5.58
25	Pipets, ungraduated, with rubber bulb (eyedroppers)	1.65
5-6	Evaporating dish, porcelain, 50 or 100 ml	6.75
1 box	Glazed weighing paper, for use with analytic balance	0.45
12	Kjeldahl flasks, 800 ml	158.00
12	Stoppers for Kjeldahl flasks	2.50
1	Hood or suction manifold to exhaust fumes	295.00
2	Thermometer 0-200°C	7.20
12	Brown bottle, 16 oz or 500 ml, for reagent storage	2.75
12	Spatula, assorted sizes	9.60
1,000	Labels	2.00
1	Powder funnel 10-15 cm inches diameter	0.78
1	Powder funnel 5-7.5 cm inches diameter	1.00
500 gm	Boiling beads	1.50
1	Magnetic Stirrer	37.00
12	Magnetic Stirring bars, 2 to 3 cm	<u>30.00</u>
TOTAL COST =		\$3,458.85

Chemicals for Water Chemistry Laboratory
For Determination of Dissolved O₂, CO₂, Alkalinity
Ammonia, Organic Nitrogen, Total Hardness, and pH

(All reagents are Reagent Grade except where otherwise stated)

O₂Det'n*

6-4Kg bottles	H ₂ SO ₄ , conc. Sp. Gr. 1.84
500 gm	Sulfamic acid (NH ₂ SO ₂ OH)
2 Kg	MnSO ₄
5 Kg	NaOH
2 Kg	KI
500 gm	K ₂ Cr ₂ O ₇
250 gm	Soluble starch powder
2 liter	glycerine
3 - 2.7 Kg bottles	HCL, conc. Sp. Gr. 1.19

CO₂Det'n

10 gm	phenolphthalein indicator
2 liter	ethyl or methyl alcohol, purified grade
1 Kg	Na ₂ CO ₃ , or 2 liters, 1-N std. NaOH

Alkalinity Det'n

10 gm	Xylene cyanole indicator
10 gm	Methyl orange indicator

pH Det'n

1 liter each	pH buffers, pH 5, 7, 9 (liquid or tablets)
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*Det'n = determination

Ammonia Det'n

6 liter	Nessler's reagent or 500 gm HgI ₂
500 gm	ZnSO ₄
1 Kg	Rochelle salt
100 gm	Lead Acetate
500 gm	KH ₂ PO ₄
1 Kg	K ₂ HPO ₄
500 strips	Litmus paper, red
500 gm	NH ₄ Cl

Hardness Det'n

10 gm	Calmagite (or Chrome Black T, Eriochrome Black T, or F241)
100 gm	Hydroxylamine HCl
250 gm	CaCl ₂
500 gm	E. D. T. A. (Versene) *
100 gm	MgCl ₂
1.8 Kg bottle	NH ₄ OH Sp. Gr. 0.90

Kjeldahl Digestion for Organic Nitrogen

2 Kg	Na ₂ SO ₄ or K ₂ SO ₄ (anhydrous)
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Miscellaneous

2 Kg	Anhydrous CaCl ₂ , granular, 4 to 8 mesh, Technical grade
1 Kg	Soda Lime, granular, 4 to 8 mesh, Technical grade

TOTAL COST.....\$ 193.00

*sodium salt of ethylenediaminetetraacetic acid

9.03 Equipment Needed for a Basic Fish Parasite and Disease Laboratory

Equipment Needed to Establish a Fish Parasite and Disease Lab

Parasite Lab

		<u>Est. Price</u>
Microscope- plus case	Compound, phase-contrast with trinocular head (light and dark field objectives)	\$ 1,800.00
Microscope- plus case	Dissecting - cycloptic with camera adaptor 10x and 15x oculars	600.00
Camera lucida-	Unitron	40.00
Lamps-	2 gooseneck desk lamps	20.00
Dissecting kit-	Forceps, scapels, scissors, droppers, probes, needles, bone shearing	30.00
Dissecting pans-	Specimen dishes, petri dishes, embryo dishes, culture dishes	60.00
Aquaria-	40 liter-(about 50 with air; water lines)	1,500.00
Troughs-	6 with running water	600.00
Refrigerator	Freezer unit included	350.00
Microtome-	Plus extra blades, paraffin, etc.	300.00
Heating table for slides-	Plus paraffin oven	350.00
Microscope slides, cover slips, labels, etc.	slide boxes	200.00
Alcohol, permount, Xylene, etc., for slide work		50.00
Glassware-	Beakers, flasks, cylinders	300.00
Storage vials-	Different sizes	150.00
Formalin solution	10 gallons	40.00
Other chemicals-	Bouins, Lugols, Glycerine jelly, Stains (Carmin, Hematoxylin, fast green) Acetone, Acids (HCl, H ₂ SO ₄ , Glac. Acetic). NaOH, etc.	100.00

Drawing materials		\$ 50.00
Camera-	With microscope adaptor (single lens reflex)	300.00
References-	Books, specimens, reprints, etc.	300.00
Seines, dipnets, etc. for collecting fish		200.00
Bacteriological Lab		
Incubator, 30° - 65°C		425.00
Incubator, 0° - 50°C (2)		900.00
Autoclave; costle portable		650.00
Oven, sterilizing		325.00
Demineralizer for purifying water		170.00
Glass distillation apparatus		250.00
Magnetic stirring apparatus with rods		80.00
Hot plate		30.00
Spectronic 20 colorimeter		475.00
Torsion prescription balance		200.00
Triple beam balance		25.00
Centrifuge, Micro-hematocrit		210.00

Bunsen burner; Touch-O-Matic (2)	\$ 32.00
Centrifuge, clinical	150.00
Timer	6.00
pH Meter	230.00
Liqui-nox detergent	20.00
Pipette Washing apparatus	75.00
Mortar and Pestle (6)	15.00
Bacteriological inoculating loop (6)	12.00
Disposable syringes (2.5, 5, and 10 ml)	45.00
Pipette can (6)	32.00
Pipettes (1, 5, and 10 ml)	85.00
Rubber tubing of assorted sizes	50.00
Rubber stoppers of assorted sizes	10.00
Bacteriological media (TSA, BHI, Pseud. F, sulfide, etc.)	75.00
Bacteriological glassware (Tubes, Petri dish)	150.00
Bacteriological stains	50.00
<u>Tissue Culture Laboratory - Virus Research</u>	
Sterile hood, luminar flow	1,000.00
Tissue culture glassware	250.00
Tissue culture media and antibiotics	100.00
Inverted TC microscope	800.00
Vacuum pump	85.00
Large capacity millipore filter with pressure vessel	230.00
Swinny adapter filters (24)	192.00

*If gas is available, otherwise substitute electric hot plates.

Millipore filters of assorted porosity	100.00
Cornwall continuous syringe (2, 5 ml; 2, 10 ml)	<u>75.00</u>
	\$ 14,949.00

**9.04 List of Equipment Needed for a Basic Fish
Feed and Nutrition Laboratory**

Equipment for Fish Nutrition Research Facility

<u>ITEM</u>	<u>QUANTITY</u>	<u>UNIT COST</u>	<u>TOTAL COST</u>
A. <u>Wet Lab:</u>*			
Aquarium, glass, 12 gallon capacity	50	25.00	1250.00
Tanks, fiberglass, 55 gallon capacity, with stand-pipe drain	20	65.00	1300.00
Water pump with pressurized storage tanks, to deliver 900 g.p.m. at 20 ft. elevation	1		235.00
Charcoal	500 lbs.	.50	250.00
Scales, platform type, 10 kg.	1		275.00
Air compressor, to 165 p.s.i., 20 gal. tank or Blower, Sutorbilt 5 HP			155.00
Miscellaneous materials (air stones, tubing, hose, cleaning equipment, containers, etc.)			100.00
B. <u>Feeding in Ponds:</u>			
Hardware cloth for cages 1/4" mesh, 36" wide	300 ft.	42.00	126.00
Scales for field weighing, 10 kg.	1		40.00
Oxygen analyzer, battery operated	1		700.00
C. <u>Feed Preparation Area:</u>			
Scales, 200 kg.	1		150.00
Feed mixer	1		285.00
Pelleting machine with 1/8" die ring	1		3145.00

* The following materials can be fabricated locally: racks and tables for tanks; plumbing for supplying water to tanks and for draining tanks; container for charcoal filtration.

<u>ITEM</u>	<u>QUANTITY</u>	<u>UNIT COST</u>	<u>TOTAL COST</u>
Hobart mixer, 12 qt.	1		476.00
Grinding head with 1/8" extruding plate			24.00
Wiley mill with 1/2 h. p. motor, with 3/32, 1/16, and 1/32 inch screens	1		1,020.00
Forced-air drying oven, 36" x 36" x 60" 45 cu. ft., electric	1		1,500.00
Hammer mill, 66 hammers, 15 inch x 24 inch diameter chamber, with 1/8 inch and 3/32 inch screens, with 15 h. p. elec- tric motor	1		685.00
D. <u>Analysis Lab:**</u>			
Analytical balance, electronic, 160 grams	1		795.00
Kjeldahl digestion and distilling unit, 12 position	1		2,150.00
Fume hood and blower for perchloric acid digestion	1		2,544.00
Magnetic stirrer	1		34.00
Titration lamp	1		30.00
Water bath, thermostatic, 26" x 15" x 16"	1		297.00
Electric heating plate, thermostatic, 12" x 13"	1		77.50
Dissecting kit	1		20.00
Water still, electrically heated, 2 gal. per hr. capacity	1		299.00
Storage freezer, chest type, 17.2 cu. ft.	1		220.00

**Work table, storage cabinets, electricity, gas, and plumbing are assumed to be installed.

<u>ITEM</u>	<u>QUANTITY</u>	<u>UNIT COST</u>	<u>TOTAL COST</u>
Goldfish fat extractor, electric, 6-position	1		585.00
Aspirators, 7-inch	3	6.50	19.50
Muffle furnace with temp. controls and pyrometer, 5 1/2" x 15" x 4 1/2"	1		347.00
Dessicators, with stopcock covers, 250 mm inside diameter	4	46.00	184.00
Spectronic 20 colorimeter with line voltage regulator, moisture-proof model	1		400.00
pH meter, AC-battery powered crude fiber analyzer, 6 position, Labconco model	1		330.00
	1		660.00
Fiber filter with 6 metal screens	1		57.25
Glassware, hardware, and miscellaneous equipment (beakers, flasks, pipettes, burettes, crucibles, stands, extraction thimbles, etc.)			<u>1,000.00</u>
		TOTAL	21,765.25

**9.05 List of Equipment Needed for a Basic
Limnological Research Laboratory**

LIMNOLOGICAL APPARATUSCOST

MAPPING

2 PLANETABLES WITH ALIDADES (LOCAL CONSTRUCTION) (Satisfactory for mapping areas up to 10 acres with reasonable accuracy)	\$ 5.00
1 STEEL TAPE 100 FT OR 50 M	6.10
2 TRANSITS WITH TRIPODS (\$834.50)	1,669.00
2 PROTRACTORS (\$2.60 each)	5.20
1 GRADUATED LINE FOR DEPTHS	1.00
1 STADIA ROD (For use with transit where high degree of accuracy is not required)	69.00
1 POLAR PLANIMETER	54.00

TEMPERATURE

12 MAXIMUM - MINIMUM THERMOMETERS @ \$15.00 each	180.00
1 ELECTRIC - RESISTANCE THERMOMETER. 50 FT CABLE (The thermometer on YSI Oxygen meter may be satisfactory)	175.00

VISIBILITY

1 SECCHI DISK (Local construction)	1.00
------------------------------------	------

CURRENT

1 CURRENT METER	520.00
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BOTTOM MATERIALS SAMPLER

1 EKMAN DREDGE WITH MESSENGER	92.00
1 SIEVE FOR SCREENING (Local construction) (30 mesh/inch)	10.00

LIMNOLOGICAL APPARATUSCOST

WATER SAMPLER

*1 KEMMERER SAMPLER WITH MESSENGER (Can be operated on ordinary rope)	92.00
***1 VAN DORN WATER SAMPLER MESSENGER (Can be obtained with transparent cylinder, which is desirable for seeing stratification of algae. This should be operated on a cable because the clamping mechanism tends to cut rope.)	90.00 12.50
1 BOTTLE TRAIN APPARATUS (Local construction) BOD bottles for train - \$57.27 per 24	30.00 57.27

PLANKTON

*1 PLANKTON NET, WISCONSIN TYPE WITH DETACHABLE "BUCKET," NO. 20 BOLTING CLOTH	80.00
1 EXTRA BUCKET FOR ABOVE	50.00
1 EXTRA BOLTING CLOTH NO. 20 FOR REPLACEMENT At least 1 yard (price approximately \$23 per yd. from PAUL O. ABBE', INC., 139 Center Ave., Little Falls, N. J. 07424)	23.00
**1 PLANKTON CENTRIFUGE	206.00
*1 HENSEN-STEMPLE PIPET 1 ml. x 2 ml.	23.00
1 OVEN, DRYING	200.00
1 FURNACE, MUFFLE - 1400 ^o F	300.00
2 DESICCATORS @\$20.00 each	40.00
1 NEPHELOMETER, COLEMAN MODEL 9	557.00
GENERAL	
1 COMPOUND MICROSCOPE, With substage condenser, objectives 16 mm., 4 mm., and oil imm. and 10X Ocular. Mechanical Stage. about	600.00
1 STAGE MICROMETER 2 mm. 0.1 and 0.01 mm.	27.00

<u>LIMNOLOGICAL APPARATUS</u>	<u>COST</u>
1 OCULAR MICROMETER DISC 5mm. in O. a mm.	10.00
1 OCULAR MICROMETER DISC, WHIPPLE	18.00
1 COUNTING CELL, SEDGWICK-RAFTER, PLANKTON	12.25
1 STEREOSCOPIC MICROSCOPE 10X-70X	600.00
BALANCES	
1 TRIPLE BEAM WITH WEIGHTS TO 2000 GRAM CAPACITY 0.1 gr. DIVISIONS Approximately	30.00
1 DIAL-O-GRAM 310 OHAUS (TYPE) 311 g. by 0.01 g.	60.00
1 ANALYTICAL BALANCE, SENSITIVE TO 0.1 mg.	<u>980.00</u>
Total cost:	\$6,880.32

*WILDLIFE SUPPLY CO., 2200 S. Hamilton St., Saginaw, Mich. 48602

**FOERST MECHANICAL SPECIALTIES CO., 2407 N. St. Louis Ave,
Chicago, Ill.

***HYDRO PRODUCTS, P. O. Box 10766, San Diego, California

LIMNOLOGICAL APPARATUSCOST

REFERENCE BOOKS

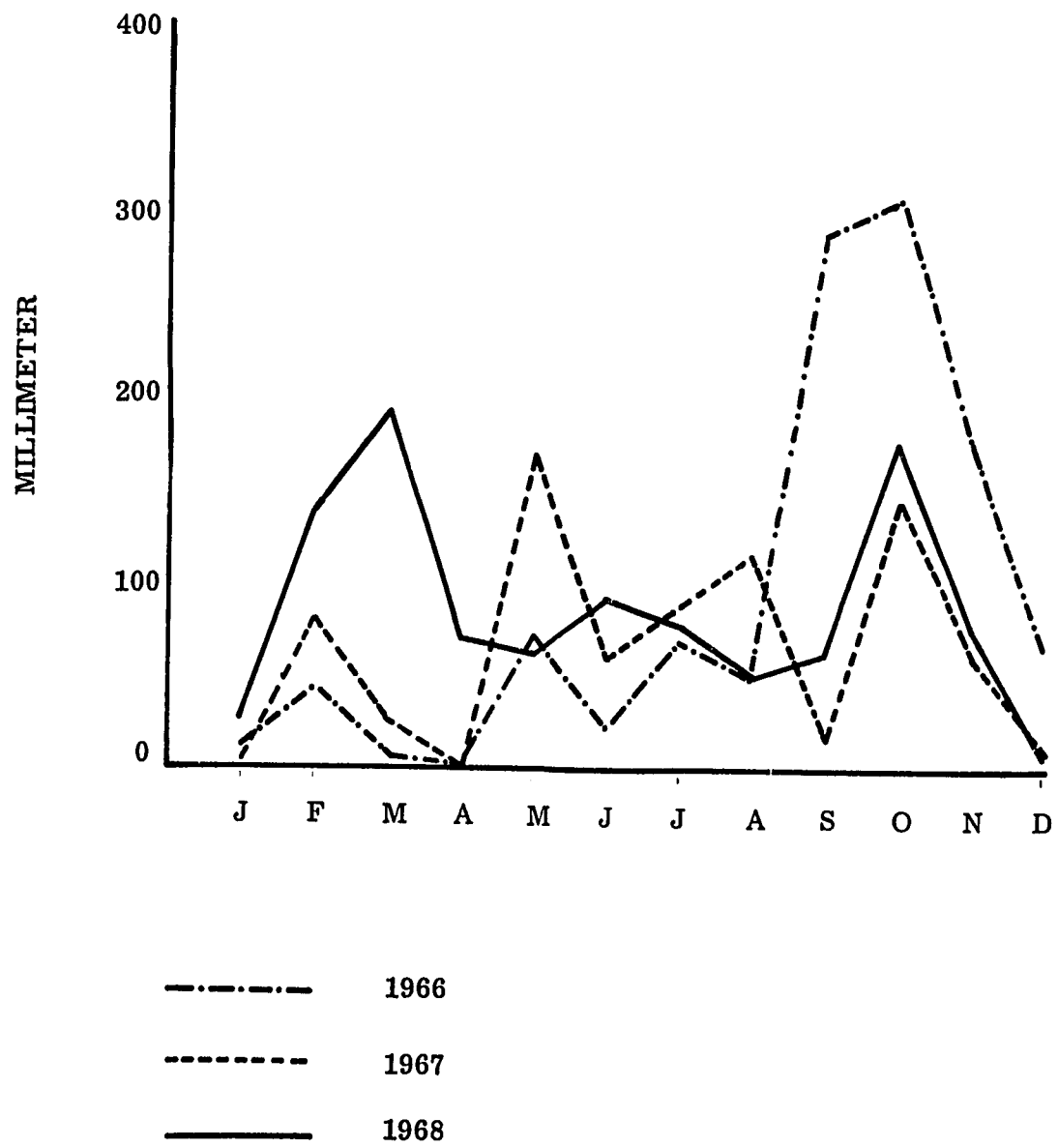
Hutchinson, G. Evelyn. 1957. A Treatise on Limnology Vol. I. Geography, Physics, and Chemistry John Wiley and Sons, Inc. London. 1015 pg.	22.00
_____ 1967. A Treatise on Limnology. Vol. II. Introduction to Lake Biology and the Limnoplankton John Wiley and Sons, Inc. New York, London, Sydney. 115 pg.	39.00
Prescott, G. W. 1964. How to Know the Fresh-water Algae. Wm. C. Brown Company Publishers, Dubuque, Iowa.	4.00
Edmondson, W. T. (Ed.) 1959. Ward and Whipple Fresh-water Biology. 2nd Edition. John Wiley and Sons, Inc. London. 1248 pg.	34.50
Usinger, Robert L. 1963. Aquatic Insects of California. Univ. of Calif. Press, Berkeley and Los Angeles, 508 pg.	10.00
American Public Health Association 1965. Standard Methods for the Examination of Water, Sewage, and Industrial Wastes. American Public Health Association, Inc., 1790 Broadway, New York 19, N.Y. 522 pg.	14.00
Welch, Paul S. 1948. Limnological Methods. Blakiston Co. Philadelphia. 381 pg.	
Lagler, Karl F. 1956. Freshwater Fishery Biology. 2nd ed. Wm. C. Brown Co. Publishers, Dubuque, Iowa.	<u>7.95</u>
Total cost:	\$131.45

9.06 Monthly Rainfall of Coastal and Marine Stations

MONTHLY RAINFALL

1966 - 1968

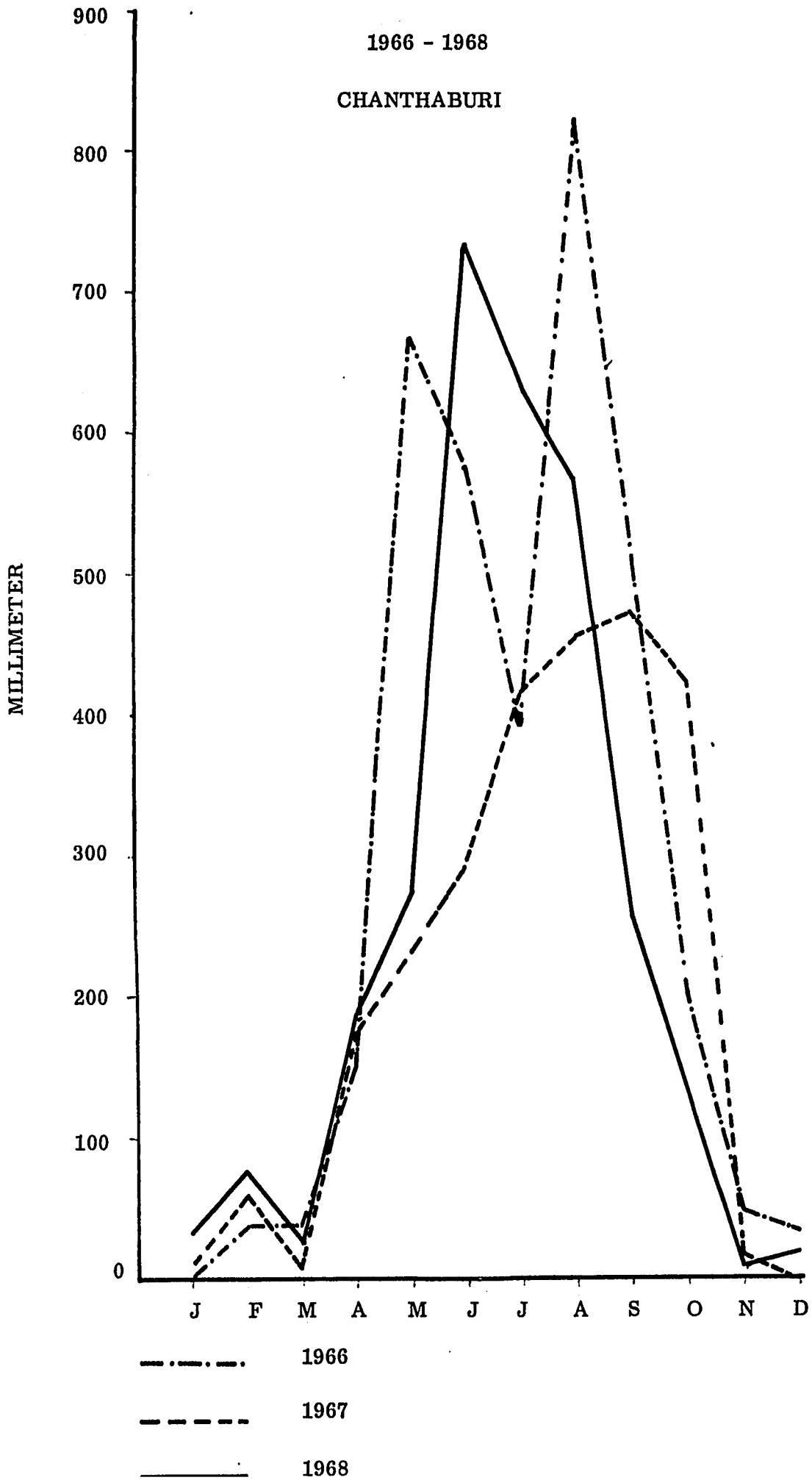
PRACHUAP KHIRI KHAN



MONTHLY RAINFALL

1966 - 1968

CHANTHABURI



9.07 Annual Rainfall (mm)

9.07 Annual Rainfall (mm)

<u>STATION</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>
<u>North</u>			
Chieng Mai	864.9	1354.1	1259.6
Chieng Rai	1833.5	2099.2	1935.4
Tak	1108.1	765.5	835.7
<u>Northeast</u>			
Khon Kaen	1366.2	931.1	1165.9
Maha Sarakham	1527.7	970.8	1319.0
Nakorn Rajsima	1317.8	920.4	1086.0
Nong Khai	1625.5	1644.8	1582.3
Sakol Nakorn	1445.7	1408.0	1494.1
Surin	1627.2	1172.1	1353.5
Ubol Rajthani	2257.6	1297.1	1474.6
Udorn Than	1594.2	1427.7	1514.1
<u>Central</u>			
Bangkhen	1667.6	-----	-----
Chainat	-----	-----	1094.8
Nakhon Sawan	1438.9	1076.2	886.7
<u>South</u>			
Pattalung	3070.2	2515.8	1574.7
Pattani	2626.5	1708.8	1486.5
<u>Marine</u>			
Phuket	2514.9	2279.0	2532.4
Rayong	-----	881.6	1296.9
Prachuap Khiri Khan	1107.3	771.3	1039.1
Chanthaburi	3499.6	2544.2	2932.0
Songkhla	3354.4	2128.7	1553.9

9.08 Analyses of Water

9.08 Analyses of Water

<u>STATION</u>	<u>pH</u>	<u>Total hardness</u>	<u>Alkalinity</u>	<u>Salinity</u>	<u>NaCl</u> ³
<u>Bangkhen</u>					
Well water	8.3	156 ppm	210 ppm		
Acid water ¹	3.5	180 ppm	0 ppm		
<u>Khon Kaen</u>					
Ubol Ratana Reservoir	8.5	40 ppm	62 ppm		
Salt pond ²	8.7	102 ppm	177 ppm	3.1 ppt	
<u>Sakol Nakorn</u>					
Station pond	7.7	120 ppm	156 ppm		27.9 ppm
Nong Harn Reservoir	6.8	18 ppm	30.4 ppm		9.3 ppm
<u>Chieng Rai</u>					
City water	---	52 ppm	32 ppm		
Kwan Payao Reservoir	6.5	36 ppm	51 ppm		
Station pond	6.5	32 ppm	32 ppm		
Station well	6.5	180 ppm	200 ppm		

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1. Sample obtained from a clay soil north of Bangkok when ponds were being constructed.
 2. Sample obtained from a pond on the station. During the dry period of the year, the salinity was 9.7 ppt.
 3. Chloride expressed as NaCl.