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THE INLAND FISHERIES PROGRESS

IN THAILAND

1970

by
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by Improved Fishcultures

ITINERARY FOR THAILAND, NOVEMBER 8 - DECEMBER 4, 1970

November 8	Arrived Thailand
November 9	Conferences with officials of USOM/Thailand and Regional Economic Development, U.S.A.I. D.
November 10	Conferences with officials of the Department of Fisheries
	Bangkhen Fisheries Station
November 11-13	Malacca Tropical Fish Culture Research Institute, Malaysia
November 14-15	Chaing Rai Fisheries Station
November 16-17	Chiang Mai Fisheries Station. Discussions with personnel of Tak and Chainat Fisheries Stations in the North.
November 18-24	Bangkhen Fisheries Station
	IPFC Symposium on Coastal Aquacultures
November 25-26	Sakon Nakhon and Udorn Thani Fisheries Stations in the Northeast
November 27	Nong Khai Fisheries Station
November 28-30	Ubon Ratana and Khon Kaen Fisheries Stations
December 1-4	Final conferences with officials of USOM/Thailand, U.S.A.I.D., and Department of Fisheries

FISH SPECIES CAPTURED OR CULTURED IN THAILAND

Scientific name	Common name	Thai name
Anabas testudineus	Climbing perch	Pla Mor
Aristichthys nobilis	Bighead carp	Pla Soong-Hue
Betta splendens	Fighting fish	
Catlocarpio siamensis		Pla Kaho
Chanos chanos	Milkfish	
Cirrhinus jullieni		
C. microlepis		Pla Nuan Chan
Clarias batrachus	Walking catfish	Pla Duk Dam
C. macrocephalus		Pla Duk Uey
Ctenopharyngodon idellus	Grass carp	Pla Choa-Hue
Cyclocheilichthys apogon		Pla Sai Tan
C. enoplos		Pla Takok
Cyprinus carpio	Common carp	Pla Nai
Dangila sp.		Pla Sa
Datnioides microlepis	Tiger fish	Pla Seua Taw
Hampala dispar		Pla Soot
H. macrolepidota		Pla Kasoop
Heleostoma temminckii	Kissing goramy	Pla Mortan
Hypophthalmichthys molitrix	Silver carp	Pla Lin-Hue
Kryptopterus sp.		Pla Neua On
Lates calcarifer	Sea bass	Pla Kapong
Moina macrocopa		
Morulius chrysophekadion	Crow fish	Pla Ka
Mystus sp.		Pla Kayeng
Notopterus chitala		Pla Krai
N. notopterus		Pla Chalat
Ompok bimaculatus		Pla Cha Oan
Ophicephalus gachua		Pla Kang
O. micropeltes		Pla Chado
O. striatus	Snakehead	Pla Chon
Osphronemus goramy	Giant goramy	Pla Ret
Osteochilus hasselti	Nilem	Pla Prom
Pangasianodon gigas	Royal fish	Pla Buk
Pangasius larnaudii		Pla Tepo
P. sutchi		Pla Sawai
Pristolepis fasciatus		Pla Mor Chang
Probarbus jullieni		Pla Eesok
P. leptobarbus		
Prophagorus niuhofii		
Puntius daruphani		Pla Tapak
P. gonionotus	Puntius	Pla Tapien
P. proctozysion		Pla Mang
Rasbora sp.		Pla Siew
Tilapia melanopleura	Congo tilapia	Pla Khang Lai

Scientific name	Common name	Thai name
Tilapia mossambica	Java tilapia	Pla Morted
T. nilotica	Nile tilapia	Pla Nin
Trichogaster pectoralis	Sepat Siam	Pla Salid
Wallagonia attu		Pla Khao

MONETARY UNITS OF THAILAND

100 satangs = 1 baht ($0.5 U.S.)
20 baht = $1.00 U.S.

UNITS OF AREA IN THAILAND

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

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1.0 RECOMMENDATIONS

1.01 The following recommendations for more rapid progress in development of fisheries in Thailand are based on the present level of research knowledge; upon discussion with personnel of the Thai Department of Fisheries and USOM/Thailand; and from past and current observations of the problems. Certain previous recommendations considered pertinent and not yet implemented are repeated.

1.02 For development of highly productive fish cultures, some of the most important ingredients are efficient species and efficient combinations of fish. Research has begun, but is proceeding slowly because relativel few ponds are available for research on this problem. Preliminary research indicates the Chinese carps, Tilapia nilotica, and the common carp are among the efficient species, whereas Trichogaster pectoralis and Puntius gonionotus appear less efficient. Research must be continued to determine the most efficient species that feed on plankton, higher plants, periphyton, insects, decaying organic matter, molluscs, and other groups of fish-food organisms, so that suitable combinations may be selected for different environments. It is recommended that an additional 100 ponds be constructed at the stations where land and adequate water are available, so that the development of fishcultures can proceed more rapidly.

1.03 Other important ingredients for highly productive fishcultures are feeds. Some feeds are suitable only as pond supplements, whereas others that are nutritionally complete are suitable for use in cage culture and other cultures where natural foods are absent or present in insufficient amounts.

The total protein and amino acid composition of various locally abundant potential feed materials should be compiled, ordetermined where analyses are not presently available. Sources of essential vitamins must also be determined. It is recommended that the fishery biologist responsible for development of fish feeds at the Bangkhen Station be sent to Auburn for a 3-month period to learn techniques in feed formulation, testing and analysis, and that an additional biologist specialize in this field for a 2-year period of study abroad.

1.04 During the past survey, fish parasites were found to be causing high mortality on fish farms culturing the catfish Clarias. Extension personnel listed this as their single most important problem. One student is at Auburn University for a 2-year period of training in fish parasites and diseases. Additionally, two more personnel should be sent for intensive training. Research on fish disease control should be conducted at the Bangkhen Station, with periodic training courses for personnel in extension and research at the other stations.

1.05 One of the best programs carried on by the fisheries research stations that affects large numbers of people in the Northeast is construction of village water reservoirs. This program was described in the previous reported dated January 1, 1970. The Fisheries Department engineers locate suitable areas for the reservoirs, and through A.R.D., grant money is allocated for cement and other necessary supplies. The village donates the labor for construction of the dam. Many of the stations have surveyed sites ranging in number from a few dozen up to over 100

reservoirs in their respective provinces, but the rate of construction is very slow -- 2 to 3 reservoirs per station per year. It is recommended that this program be assisted by the allocation of war-surplus construction machinery to speed up the rate of construction.

1.06 The new program in the Fisheries Department for assisting villages in managing their reservoirs for high fish production has been very successful. This consists of stocking combinations of species that utilize the various natural fish-food organisms, plus the use of phosphate fertilizers. This has increased production from 100 to over 500 per cent. A project to extend this program to other areas has been prepared by the Fisheries Department and submitted to USOM for support. It is entitled, "Fishery Development in Five Irrigation Tanks". This is a good project, worthy of support.

1.07 A new project is being formulated to test methods of culturing fish in bamboo-fenced pens extending from the margins of a reservoir out to water depths of 1 to 2 meters. This is described in Section 3.06 of this report. This method of culture appears promising for use where land holdings are too small and incomes too low for construction of fish ponds by individual farmers. Where reservoirs exist, intensive culture of fish in penned sections appears quite feasible. Research on this method of culture is proposed for 2 sites as described in this report. Intensive and expanded research for its rapid evaluation should be quite important and its support is recommended.

1.08 The Fisheries Survey Unit of the Fisheries Department works out of Bangkok making the fish populations surveys necessary for preimpoundment studies for evaluation of the effects of reservoir construction. It also collects data that makes possible evaluation of the effects on fish populations of reservoir management procedures. It is necessary for this unit to have adequate portable aluminum boats, trailers and motors as these surveys cannot be conducted in a suitable manner by wading in the shallow waters of a reservoir. It is necessary to sample fish in water to depths of 8 to 10 meters. It is recommended that requests for such equipment be approved.

1.09 It is recommended that the Fisheries Department set up a system of surveys to more accurately measure the total catch of fish from inland waters. Statistics on the most important fisheries are very inadequate, and do not accurately measure trends in the annual catch.

1.10 In response to recent success in spawning of various species of shrimps and their culture to the juvenile stage, research should be intensified upon development of intensive shrimp cultures in the coastal and inland waters, both alone and in combination with fishculture.

1.11 Plans have been made to acquire the preliminary information necessary for experimental management of large impoundments up to 48,000 rai in area. It is recommended that preliminary research be carried on to evaluate the present standing crop, catch and composition of each in each of the impoundments. This will be followed by various management procedures; the effects of which will be measured by changes in standing crop,

catch, rates of growth, water quality and other parameters.

1.12 It is recommended that length-weight data on fishes from Thai rivers and impoundments, which have been accumulated by the Fisheries Department over the past 10 years or more, be computerized and consolidated to provide a handbook for use by biologists in evaluating relative conditions of fishes under various systems of management.

1.13 It is recommended that completed data on life histories and food habits of Thai fishes be published as soon as possible so that this information will be available for management of fish populations.

1.14 It is recommended that a handbook be prepared giving descriptions and pictures of Thai fishes. This is needed wherever fisheries surveys are being conducted in Thailand or in neighboring countries.

1.15 Drawings have been made of many species of algae occurring in Thai waters. Plans should proceed to check the identification with qualified authorities and to prepare an illustrated handbook for their identification.

1.16 The Fisheries Department must investigate the magnitude of the pollution problem in river systems emptying into the Gulf of Thailand. The estuarine areas are the breeding grounds for Macrobrachium shrimps and the nursery grounds for marine shrimp. The rich Gulf of Thailand fisheries furnishes most of the marine fisheries catch. The 5-year plan for fisheries and agriculture development includes establishment of extensive commercial shrimp farms along the coast. All of this can be jeopardized by pollution from heavy metal wastes from industry, and by excessive organic pollution. It is recommended that the Fisheries

Department determine the government agencies presently engaged in pollution monitoring and abatement. If these are considered inadequate for protection of the fisheries, then the Fisheries Department should arrange for a cooperative survey to determine the magnitude of the problem, and subsequently develop plans for pollution abatement and control.

2.0 HIGHLIGHTS OF RESEARCH RESULTS - 1970

2.01 Management of Village Reservoirs

Two village reservoirs were managed in 1969 - 1970 using hatchery-produced fingerling fish for stocking and by applying phosphate fertilization. One reservoir was in the North, near Chiang Mai, and the other was in the Northeast, near Udorn Thani. The results are given below.

2.011 Nong Bua Reservoir - average area 56 rai

Species			Number stocked*	Survival in catch (%)
Thai name	Common name	Scientific name		
Pla Tapien	Puntius	Puntius gonionotus	15,000	12.9
Pla Nai	Common carp	Cyprinus carpio	1,500	2.0
Pla Nin	Nile tilapia	Tilapia nilotica	12,000	10.0
Pla Khang Lai	Congo tilapia	Tilapia melanopleura	6,000	7.3
Pla Soong-Hue	Bighead carp	Aristhichys nobilis	1,500	14.9
Pla Lin-Hue	Silver carp	Hypophthalmichthys molitrix	3,000	47.4
Pla Duk Dam	Walking catfish	Clarias batrachus	6,000	29.2

*Stocked October, 1969

Mixed species stocking was used to insure the presence of species that would consume all types of fish-food organisms produced.

Fertilization was at the rate of 4 kg superphosphate per rai per month. The reservoir was fished out by villagers in April, 1970. The total catch was 25.6 kg/rai (160 kg/ha) whereas the standing crop in former years averaged 9.6 kg/rai, an increase of 166 per cent. The species stocked made up 74.3 per

cent of the total catch. Ranked in order of their contribution to the catch are the following principal species:

Species			Catch (%)
Thai name	Common name	Scientific name	
Pla Lin-Hue	Silver carp	Hypophthalmichthys molitrix	18.6
Pla Tapien	Puntius	Puntius gonionotus	14.9
Pla Chon	Snakehead	Ophicelphalus striatus	13.7
Pla Soong-Hue	Bighead carp	Aristhichys nobilis	12.3
Pla Duk Dam	Walking catfish	Clarias batrachus	11.7
Pla Nin	Nile tilapia	Tilapia nilotica	8.8

Survival of fish stocked, assuming all survivors were caught, was highest for silver carp. The average size stocked was 27 cm and the smallest was 21 cm. The common carp, the poorest in survival, ranged in size from 11 to 28 cm, with 40 per cent being 26 cm. These were larger fish than are normally available for stocking and survival should have been high. This appears to indicate heavy poaching before the reservoir was opened to fishing. The silver carp, being a plankton feeder, would be least vulnerable to poaching.

2.012 Nang Sang Kam Reservoir - average area 25 rai

Species			Stocked*		Survival
Thai name	Common name	Scientific name	Number	Size	in catch (%)
Pla Nai	Common carp	Cyprinus carpio	1,000	5 cm	60.8
Pla Nin	Nile tilapia	Tilapia nilotica	1,000	5 cm	1.8

*Stocked October, 1969

The reservoir was fertilized with one application of 12-24-12 followed by monthly applications of 20 per cent superphosphate at 4 kg/rai/month. Total cost of fertilization was 760 baht ($38.00). It was fished out at low water level, March, 1970, after six months growing period. The catch was 68 kg/rai (425 kg/ha), a 580 per cent increase over the average standing crop of 10 kg/rai before management.

Despite the small size of carp stocked, 60 per cent survived to harvest and contributed over 55 per cent of the catch. Tilapia nilotica, probably because of the small size stocked and the presence of predatory snakehead and catfishes, had low survival and contributed only 1 per cent of the catch. Wild fishes, inclduing principally Ophicephalus striatus (snakehead), Clarias batrachus (walking catfish), Mystus sp., Anabas testudineus, and Trichogaster pectoralis (Sepat Siam) made up the rest of the catch.

Fees were charged villagers for fishing the reservoir. Total fees collected were 4,000 baht ($200.00), giving a return, above fertilizer costs, of 3,240 baht ($162.00). The villagers were very enthusiastic about the results and consequently both the upper and lower reservoirs (total 62 rai) were restocked in April - July, 1970, using three species of fish.

Species				
Thai name	Common name	Scientific name	Total number stocked	Size (cm)
Pla Nai	Common carp	Cyprinus carpio	5,700	3.8-8.2
Pla Nin	Nile tilapia	Tilapia nilotica	6,400	6.2-9.9
Pla Morted	Java tilapia	Tilapia mossambica	7,400	5.1-8.9

When the reservoir was visited on November 26, 1970, carp were in excess of 1 kg and tilapias were 0.5 to 0.7 kg. This indicated that higher stocking rates (at least double) should be used.

The excellent results from these two reservoirs have demonstrated to the villagers that the Fisheries Department biologists can help them manage their reservoirs for high fish production. With further refinements in the size, number, and species of fish stocked, the highest production obtained in these tests can easily be doubled. As a result of these successes, the Fisheries Department has planned to assist villagers in management of an additional 10 reservoirs in 1971.

2.02 Efficiency of Different Species and Fertilizers for Fishculture

2.021 Chinese carps

At Chiang Rai Station, stocking a combination of the Chinese carps, including the grass carp (Ctenopharyngodon idellus), common carp (Cyprinus carpio), silver carp (Hypophthalmichthys molitrix), and the bighead carp (Aristhichys nobilis), was tested in ponds for a 6-months period at a 4-4-1-1-ratio, totalling 500 fish per rai. Manure was applied at the rate of 110 pounds per rai per month. In both tests the fish were fed daily 1.5 kg dry weight of aquatic plants per each 100 kg total weight of fish (1.5 per cent rate). Production per rai was 145 kg/rai (906 kg/ha) without manure and 170 kg/rai (1,062.5 kg/ha) with manure. This is relative high production for such treatments.

2.022 Puntius gonionotus (Pla Tapien)

A mixed feed with 25 per cent protein was used at the following percentages of body weight for different sizes of fish.

Size (grams)	Rate of feed (%)
35 - 150	3.0
150 - 230	2.5
230 - 280	2.25
280 - 360	2.0
360 - 460	1.5

After 5 months of feeding, the results were as follows:

Number stocked	1,000 per rai	1,500 per rai
Produced, kg/rai	110.5	99.0
Produced, kg/ha	690.3	618.8
Survival, (%)	87.7	54.0
Feed conversion (S)*	0.76 - 0.99	0.67 - 1.67

*S = pounds of feed to produce 1.0 pound of fish where fish are also consuming natural foods.

With this species, production was low, but feed conversion was very good. Further testing will be needed to see if higher production can be obtained.

2.023 Trichogaster pectoralis (Pla Salid)

Tests in ponds stocked at 3 fish/m^2 (4,800/rai) were conducted for a 6-months period at the Tak Station, with and without fertilization. The average results were as follows:

Treatment	Kg/rai	Kg/ha	Survival (%)
Unfertilized	50.4	315	43.4
Phosphate only	105.5	659	63.3
8-8-4	96.0	600	29.4

Size of fish used in the tests was 2.5 cm; higher survival could have been obtained by stocking larger fish (6 to 8 cm). Results appear to indicate that phosphate fertilizer only is as good as the higher priced 8-8-4 fertilizer. A total of 30 kg superphosphate costing 36 baht ($1.80) increased production by 55 kg of fish, at a cost of 66 baht ($3.30) per kg. Production of this species with phosphate fertilizer was about as high as that of Puntius gonionotus with feeding (Section 2.022)

2.024 Relative Efficiency of Cyprinus carpio (Pla Nai), Tilapia nilotica (Pla Nin) and Trichogaster pectoralis (Pla Salid)

Chicken manure was used at the rate of 320 kg/rai/month in an experiment that lasted 6 months.

Species			Number	Production	
Thai name	Common name	Scientific name	per rai	kg/rai	kg/ha
Pla Nai	Common carp	Cyprinus carpio	1,000	161.6	1,010.0
Pla Nin	Nile tilapia	Tilapia nilotica	1,000	224.8	1,405.0
Pla Salid	Sepat Siam	Trichogaster pectoralis	1,000	59.3	370.6

In this test, Tilapia nilotica was most efficient, the Cyprinus carpio next and Trichogaster pectoralis was third. In the experiments with Trichogaster pectoralis reported in Section 2.023, the production of 105.5 kg/rai with phosphate fertilization was approximately twice as high as that reported above with chicken manure, and that without any fertilization (50.4 kg/rai) was almost as high. However, the rates of stocking were different - 1,000 per rai above compared with 4,800 per rai in the previous section. It would appear that too few Trichogaster pectoralis were used in the above test to evaluate the relative effectivenss of chicken manure.

2.03 Effects of Rates of Feeding on Conversion (S) by Cyprinus carpio (Pla Nai) in Cages

In an experiment which lasted 3 months, 200 carp were stocked per m^2 of cage. Sizes of fish stocked were: small - 3 to 5 cm, averaging 2.6 g; medium - 5 to 10 cm, averaging 9.84 g; and large - 10 to 15 cm, averaging 47.05 g. The following table gives the feeding rate and conversions.

Feeding rate (%)	Conversion		
	Small	Medium	Large
1	0.6	1.0	1.6
2	1.1	1.6	2.6
3	1.6	2.9	5.0
4	2.4	4.2	10.3

The composition of the feed used was as follows:

Ingredient	Per cent
Soybean meal	24
Fish meal	16
Malt	15
Broken rice	25
Rice bran	20

Pellets were suspended in a cloth bag of 3-mm mesh to prevent loss. This was an excellent study, showing effect of size and rate of feeding on conversion. The feed used was not a complete feed.

2.04 Feeding Habits and Spawning of Fishes in Rivers and Reservoirs

In order to plan most effective stocking of reservoirs, it is necessary to know the feeds eaten by various species. For highest production, the fish stocked should consume all types of fish-food organisms produced in the

reservoirs. This includes zooplankton, phytoplankton, periphyton, higher plants, decaying organic matter, crustacea, snails, insects, small fish and other aquatic animals. The following lists were compiled from the combined research of all biologists in the research units and research stations, but must be considered tentative and subject to periodic revision. The species and feeding habits are given under two headings.

2.041 Fish Species That Spawn in Reservoirs

Thai name	Common name	Scientific name	Food habits
Pla Mor	Climbing perch	Anabas testudineus	Insects
	Fighting fish	Betta splendens	Insects
Pla Duk Dam	Walking catfish	Clarias batrachus	Decaying organic matter
Pla Duk Uey		C. macrocephalus	Decaying organic matter
Pla Sai Tan		Cyclocheilichthys apogon*	Plankton
Pla Sa		Dangila sp.	Algae
Pla Soot		Hampala dispar*	Carnivore
Pla Kasoop		H. macrolepidota*	Carnivore
Pla Mortan	Kissing goramy	Heleostoma temmincki	Plankton
		Morulius sp.	Carnivore
Pla Kayeng		Mystus sp.	Carnivore
Pla Krai		Notopterus chitala*	Carnivore
Pla Chalat		N. notopterus*	Carnivore
Pla Cha Oan		Ompok bimaculatus	Carnivore
Pla Kang		Ophicephalus gachua	Carnivore
Pla Chado		O. micropeltes*	Carnivore
Pla Chon	Snakehead	O. striatus*	Carnivore
Pla Ret	Giant goramy	Osphronemus goramy*	Aquatic weeds
Pla Prom	Nilem	Osteochilus hasselti*	Plankton
Pla Mor Chang		Pristolepis fasciatus*	Aquatic insects
Pla Eesok		Probarbus jullieni	Aquatic weeds, snails and molluscs
Pla Tapien	Puntius	Puntius gonionotus*	Aquatic weeds
Pla Siew		Rasbora sp.	Periphyton
Pla Salid	Sepat Siam	Trichogaster pectoralis	Plankton

*Most important in reservoirs

2.042 Fish Species That Do Not Spawn in Reservoirs

Thai name	Common name	Scientific name	Food habits
Pla Soong-Hue	Bighead carp	Aristichthys nobilis	Decaying matter and zooplankton
Pla Kaho		Catlocarpio siamensis	Omnivore
Pla Nuan Chan		Cirrhinus microlepis	Plankton
Pla Choa-Hue	Grass carp	Ctenopharyngodon idellus	Aquatic weeds
Pla Takok		Cyclocheilichthys enoplos	Snails
Pla Neua On		Kryptopterus sp.	Carnivore
Pla Tepo		Pangasius larnaudii	Carnivore
Pla Sawai		P. sutchi	Omnivore
Pla Eesok		Probarbus jullieni**	Molluscs, snails and aquatic weeds
		P. leptobarbus	Aquatic weeds
Pla Khao		Wallagonia attu	Carnivore

**Listed in both groups

2.05 Biology of Species of Fishes

2.051 Biological Studies on the Life Histories of Various Fish Species

Biological studies are necessary in order to evaluate the usefulness of various species in different environments. Such studies have been completed on the following species:

Thai name	Common name	Scientific name
Pla Soong-Hue	Bighead carp	Aristichthys nobilis
Pla Duk Dam	Walking catfish	Clarias batrachus
Pla Choa-Hue	Grass carp	Ctenopharyngodon idellus
Pla Nai	Common carp	Cyprinus carpio
Pla Lin-Hue	Silver carp	Hypophthalmichthys molitrix
Pla Ka	Crow fish	Morulius chrysophekadion
Pla Krai		Notopterus chitala
Pla Sawai	Catfish	Pangasius sutchi

Table continued

Thai name	Common name	Scientific name
Pla Mor Chang		Pristolepis fasciatus
Pla Eesok		Probarbus jullieni
Pla Nin	Nile tilapia	Tilapia nilotica
Pla Salid	Sepat Siam	Trichogaster pectoralis

2.052 List of Fish Species on Which Research is in Progress

Thai name	Common name	Scientific name
Pla Mor	Climbing perch	Anabas testudineus
Pla Kaho		Catlocarpio siamensis
		Cirrhinus jullieni
Pla Sai Tan		Cyclocheilichthys apogon
		Datnioides microlepis
Pla Soot		Hampala dispar
Pla Chalat		Notopterus notopterus
Pla Prom	Nilem	Osteochilus hasselti
		Prophagorus niuhofii
Pla Tapak		Puntius daruphani
Pla Tapien	Puntius	P. gonionotus
Pla Mang		P. proctozysion

It is hoped that the biology of these species will be published as soon as possible to make the information usable in planning management of reservoirs and ponds.

2.06 Spawning and Rearing Postlarval Macrobrachium rosenbergii Prawns for Culture

Two groups in Thailand have succeeded in working out commercial methods of producing juvenile prawns for stocking. These are Snit Tongsanga

and assistants of Kasetsart University at Bangkok and the staff of the Songkhla Fisheries Station in South Thailand. This makes possible for the first time the development of a commercial culture of this species, either alone or in combination with fishculture in ponds or in paddy fields. Also, it may make feasible the restocking of this species above dams that prevent upstream migration of the juvenile prawns from the spawning grounds in the estuaries.

2.07 Cage Culture of Fish

In general, practically all attempts to produce fish in cages suspended in the top waters of ponds or raceways failed because a complete pelleted feed was not available. The pelleted feeds tried were nutritionally incomplete and fish growth ceased after 1 or 2 months of feeding.

At Chainat, culture in floating cages of Pla Sawai (Pangasius sutchi) yielded 29.8 kg/m^3 of cage stocked with 50 fish and 84 kg/m^3 where stocked with 100 fish/m^3. Conversion was 2.96 and 2.58, respectively. Length of experiment was 10 months.

3.0 ADDITIONAL EXPERIMENTS PLANNED FOR 1971

3.01 Management of Village Reservoirs

Plans are prepared for management of 10 additional village reservoirs by use of stocking and fertilization. A project has been submitted by the Fisheries Department to A.I.D. for approval. This is a good project that will benefit many people in local areas.

3.02 Management of Large Reservoirs

Plans are being developed for management of Kwan Payao, a 10,400-rai reservoir at Payao in North Thailand; Kaeng Lerng Charn, a 2,000-rai reservoir at Maha Sarakham; and Nong Harn, a 48,000-rai reservoir at Sakon Nakhon. Surveys are in progress to determine standing crop, species composition, composition of catch, and condition of fish in these reservoirs. Surveys of the extent of weed beds are being made on some lakes to evaluate the effect of herbivorous fishes that are to be added at a later date.

3.03 Pond Cultures

Plans were made for research dealing with species efficiency, effect of fertilizers and feeds on production, and control of fish parasites. Feeds used for testing at all fisheries stations will be formulated and pelleted at the Central Bangkhen Station.

3.04 Cage Cultures

The success of cage culture depends upon development of nutritionally complete feeds that include adequate amounts of vitamins. Formulations, using locally available materials, are being prepared for testing at selected stations.

3.05 Tests of the Grass Carp for Control of Grasses Infesting Kud Ling Ngor Reservoir

This 1,630-rai reservoir is near Udorn Thani and the shallow waters from the shoreline out to 2 meters deep are infested with an unidentified species of grass that extends 20 to 50 cm above the water surface. Plans were prepared to fence off areas to be stocked with 10 to 40 grass carp per rai to determine their effectiveness in controlling this weed.

3.06 Pen Culture of Fish in the Marginal Waters of Reservoirs

The possibility of raising fish in shallow waters of reservoirs by fencing in areas extending from the bank out to areas where the water is approximately 1 to 1.5 meters deep is to be investigated at Huey Sithon Reservoir at Maha Sarakham, and possibly at Ubon Ratana Reservoir. Back-up research will also be conducted at Auburn University experimental ponds.

This method shows promise for intensive fish culture in areas where village or irrigation reservoirs are made available for this usage. The penned fish will obtain food organisms brought into the pens by water circulation from the deeper waters of the reservoir, from feeds produced in the pens, and from

feeds supplied directly by the fish farmer to the fish in the form of aquatic plants or agricultural wastes.

In many locations, farms are too small and income too low for construction of individual farm ponds. In some areas, pen culture in communal-held reservoirs appears more feasible.

3.07 Preparation of Length-Weight Tables for Thai Fishes

The Fisheries Survey Unit and research stations have made many measurements of lengths and weights of Thai fishes, but these are seldom available for usage in fisheries management. It is proposed to consolidate all suitable measurements by computer to develop average weights for different lengths of fishes from rivers, swamps and reservoirs. This will give a national average figure than can be used to evaluate relative conditions of fishes, which is in turn related to rate of growth. Such tables are necessary for usage in management of fish populations in reservoirs. The development of the computer program and processing of the data can be done at the Auburn University International Center for Aquaculture.

3.08 Manual of Thai Fishes

The Taxonomy Unit of the Fisheries Department has prepared a list of Thai fishes, with photographs of 200 species. This should be prepared for publication as soon as possible as it will have usage in Thailand and neighboring countries.

3.09 Tests with Leptobarbus hoeveni for Aquatic Weed Control

This species appears similar in herbivorous habits to the Chinese grass carp. Since it is a desirable indigenous species, it is to be tested for its effectiveness in controlling submersed, rooted, aquatic plants and for floating aquatics.

3.10 Spawning and Biology of Species Threatened by Impoundment of the Mekong River

Pangasianodon gigas, the largest catfish in the world, spawns in areas of the river soon to be impounded. Also, certain species of Leptobarbus, Pangasius, Mystus, Vittalus, Probarbus, and Puntius occur abundantly only in the Mekong. Some of these have practically disappeared in other parts of Thailand, and may disappear in the Mekong River after it is impounded. It is desirable to study the ecological requirements, spawning and possible uses of these fishes.

3.11 Kenaf and Cassava Leaves and Cassava Wastes for Fish Feed

Kenaf leaves have been found to contain 25% protein, thus making them a potential source of protein for fish feeds. Cassava leaves have a similar protein content. Preliminary experiments have shown that cassava root meal can be utilized in mixed feeds. These and other locally available materials will be tested in feed formulations.

4.0 SUMMARY OF FISHERIES RESEARCH PROJECTS ACTIVE IN 1968, 1969 and 1970

These fisheries research projects dealt with the following problems:

4.01 Culture of Following Fishes in Cages

Clarias
Pangasius
Cyprinus carpio

4.02 Culture of Following Fishes in Ponds

Pangasius sp.
Tilapia nilotica
Clarias batrachus
C. macrocephalus
Puntius gonionotus
Trichogaster pectoralis
Osteochilus hasselti
Cyprinus carpio
Chinese carps
Probarbus jullieni

4.03 Culture of Following Marine Fishes

Sea bass
Milkfish
Mullet

4.04 Culture of Fishes in Rice Paddies

4.05 Crab and Oyster Culture

Native osyters and Japanese blue crab cultures

4.06 Shrimp Culture in Ponds

Macrobrachium - giant prawn
Penaeus spp. - saltwater shrimps

4.07 Diseases and Parasites of Fish

4.08 Fish Feeds and Feeding

Formulation of complete feeds
Evaluation of supplemental feeds

4.09 Life Histories of Fishes

Trichogaster pectoralis
Anabas testudineus
Cyprinus carpio
Probarbus jullieni
s gonionotus
lepis fasciatus
erus chitala
la dispar
Dalmoides microlepis
Puntius daruphani

4.10 Pollution

Kenaf
Insecticides

4.11 Spawning of Fishes

Work with 7 species

4.12 Surveys of Impoundments and Streams

22 Reservoirs
4 Rivers

4.13 Taxonomy of Thai Fishes

The stations at which the research is being conducted and titles of the approved projects are given in the Appendix under Section 9.0.

5.0 PARASITES AFFECTING FISH AND MAN

5.01 Parasites of Catfish

There are approximately 200 fish farms in the vicinity of Bangkok that produce Clarias batrachus for the commercial market. One farm, where parasite studies were made, consisted of 30 ponds, each of which were 0.25 rai in size. These ponds were stocked with 50,000 fingerlings per pond (20,000/ rai). The fingerlings were obtained from commercial dealers who collected the fry from natural waters during the spawning season of this species. They were held in small ponds or nylon baskets suspended in canals.

The fingerlings were 3 to 5 inches in size when stocked into the production ponds. The production period was approximately 6 months and 2 crops per year were obtained. The fish were fed a mixture of ground trash fish and broken rice cooked together. Survival of the stocked fingerlings varied from 30 to 50 per cent and most of the loss occurred during the first month after stocking. During this period, the ponds developed a dense bloom of yellow-green algae identified as Polycystis sp. The fingerlings developed small, red pustules on the body that ruptured and spread into lesions 3 to 5 cm in size. An abundant bacterial fauna was associated with these lesions but it appeared to be decay bacteria rather than a specific pathogen. The surviving fish recovered and no significant losses were reported during the remainder of the production period.

Fingerlings from one commercial dealer were examined and found to be heavily parasitized with Trichodina sp. and Gyrodactylus sp. No treatment

was practiced prior to the sale and stocking of these fingerlings into the production ponds. Based on limited examination and observation, it was believed that the losses sustained in the production ponds were due to this parasitic infestation. These external parasites broke the mucous and skin of the host and permitted the invasion of non-specific bacterial infections. As the production ponds became heavily polluted with organic decay, the prasite fauna could no longer survive. This accounted for the absence of significant parasitism in the production ponds. However, injury to the body covering caused by parasites became infected with bacteria.

Several specimens of Clarias weighing 0.1 to 0.3 lb were taken from a production pond and examined for parasites. These specimens were free of significant parasitism. These ponds had no dissolved oxygen and had free CO_2 in excess of 100 ppm. Such an environment would be unsuitable for certain common parasites such as Ichthyophthirius and would probably limit populations of Trichodina and Gyrodactylus.

The Clarias culture in this area was developed by local farmers and is not based upon sound research data. The extremely high stocking densities are practiced to compensate for the expected high mortality during the first month. The stocking rate could be reduced considerably and survival increased by treating the fingerlings with parasiticides prior to stocking in the production ponds. In addition, most farmers probably over-feed which is not only uneconomical, but also leads to greater pond contamination.

5.02 Survey of Parasites of Other Fishes

At the Sakon Nakhon Station there was a research project on cage culture of Cyprinus carpio (Pla Nai) in a bay of the Nang Harn Reservoir. The reported survival of Pla Nai in cages was 99 per cent during the course of the experiment on feeding. After the experiment terminated, the fish were left in the cages and heavier mortalities developed. These fish were examined for parasites and found to be heavily parasitized with the larvae of anchor parasites (Lernaea sp.). Several cyprinid species from the reservoir were examined and found to have from 10 to 25 adult anchor worms per fish. Larval production is probably seasonal and during the season of greatest larval production, the gills of small fish became heavily parasitized resulting in increased mortality.

5.03 Liver Fluke Affecting Man

This area of Thailand is known to have a high incidence of liver fluke (Opisthorchis viverrini) infestation in the human population. Some of the fisheries biologists were under the impression that the large snail, Vivapara sp., was the vector of this parasite. This large snail is very abundant and is used as human food as well as food for animals. It is not, however, involved with the human liver fluke infestations. The snail hosts for the liver fluke are of the family Amnicolidae and three of the most important species are Parafossarulus straitulus, Bulimus fuchians and B. longicornis. Forty species of cyprinid fishes are reported to be second intermediate hosts of this parasite. Human

infections result from the practice of eating these fish without sufficient cooking to kill the infective metacercariae. Two recent studies[1] document the status of this health problem in Thailand. The essential epidemiological factors in the dissemination of this parasite are: 1) the presence of adult flukes in man or reservoir hosts (dogs and cats); 2) contamination of water with sewage containing the infective eggs; 3) the presence of sewage-feeding snails of certain species; 4) the presence of suitable host fish species, and, 5) the practice of eating uncooked fish containing the infective metacercariae. It would appear that control or prevention could be attained by cooking fish before eating or preventing sewage from entering waterways of fisheries. Simple as these measures appear, they may be difficult to practice. Cooking fish would require a change in the diet of local segments of the rural population. Sanitation might appear to be a better method of control than changing the food habits of a people, if dogs and cats were not also reservoirs for the parasitic worms. A third alternative would be snail control which might be feasible if more facts were known concerning the bionomics of this host.

Another aspect of this national health problem in Thailand involves the changing ecology in the Northeast which is the endemic center of the disease. With the impoundment of the major rivers, the swampland fisheries may be greatly modified or eliminated. These are the areas which serve as epidemic

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[1] Harinasuta, C., and S. Vajrasthira, "Opisthorchiasis in Thailand", Ann. Trop. Med. Prasitol., 54:100-105, 1960, and Sadum, E. H., "Studies on Opisthorchis viverrini in Thailand", Am. J. Hyg., 62:81-115, 1955.

focci for the parasite, for as the flood waters recede, isolated lakes and ponds are left over a wide area. The fish populations in these natural impoundments become heavily parasitized as a result of improper sanitation. To replace the loss of the swampland fishery many upland ponds will probably be constructed and fish culture will become even more concentrated. If adequate measures are not taken with regard to sanitation, pond weed control, and snail control in these ponds, they may become serious epidemic centers. Biological control of snails is feasible by use of fishes that feed upon snails and by use of herbivorous fishes that eliminate pond weeds.

6.0 HATCHERY PRODUCTION AND FISH DISTRIBUTION

Use of improved techniques for production of fingerling fishes developed in the past several years by the fisheries stations enabled all stations to meet the local demand for fish needed for stocking in the provinces that each served. By raising yearly 3 or more crops of fry, plus the use of feeding and fertilization, they produced the required number of fish using a smaller number of ponds than was formerly required. The ponds freed by these procedures were used to develop methods of fish farming, including efficient rates of stocking, fertilization and feeding.

6.01 Need for Larger Fingerling Fishes

Up to the present, small fish only were produced for sale to fish farmers or for stocking natural waters. These were usually 2 to 3 cm in length. However, since the Fisheries Department has become involved in management of village

reservoirs, it has become evident that the stocking of small fish results in very low survival, and that larger sizes must be produced for stocking into natural waters and reservoirs.

The sizes needed are a minimum of 7 to 10 cm in length, as these larger fishes would be less vulnerable to predation when stocked into waters that already contained wild fish. In experiments on pond management conducted by the stations, it is evident also that larger fishes should be used in stocking ponds that previously contained no fish if high production is to be obtained. Use of larger fish in stocking would result in higher survival and would reduce the time needed to reach harvestable size.

The need for producing larger fingerlings for management of reservoirs will require more pond space than is presently available at most of the stations. There are a number of procedures that may held solve this problem.

The extension specialists are teaching interested farmers how to produce fish fry and fingerlings for sale to other farmers. This is having the effect that less fish will be required from the stations to satisfy private demand. It also is making the fish for stocking available locally in many areas, thus reducing the cost of transport and increasing the percentage of survival. Either the local producers or the fish farmers can raise the 2-cm fish to 7 cm or more by stocking these into rice paddies. Upon reaching a suitable size, they can then be stocked into ponds or into other paddy fields.

The stations may raise the small fish to larger size by feeding them in cages suspended in the reservoirs, by pen culture in marginal waters, or they

may contract with farmers to raise them to the necessary size in paddy fields. It would be desirable to increase the pond acreage at selected stations.

6.02 Summary of Production and Distribution of Fishes for Stocking in 1970

Detailed figures on production of each species is given under Section 10.0 for each of the stations. The following table summarizes this information.

Station	Fingerlings produced	Fingerlings distributed
North		
Chiang Mai	1,292,000	371,000
Chiang Rai	1,500,000	1,012,393
Tak	805,000	320,000
Northeast		
Khon Kaen	1,610,000	824,970
Maha Sarakham	680,000	500,000
Nakhon Rajsima	340,700	270,000
Nong Khai	435,100	305,700
Sakon Nakhon	1,342,650	1,371,240*
Surin	1,005,375	219,000
Ubon Rajthani	1,500,000	800,000
Central		
Bangkhen	4,019,700	2,000,000
Chainat	1,000,000	600,000
Nakhon Sawan	130,000	30,000
South		
Pattalung**	---------	----------
Pattani**	---------	----------
TOTAL	16,300,525	8,843,303

* Carry over from last year included in distribution.
** Operations interfered with by communist harrassment in this area.

6.03 Specialization of Stations for Certain Species

Species and stations involved in spawning operations are: 1) Chinese carps (silver, bighead and grass carps) - Chiang Rai; 2) Pangasius - Nakhon Sawan and Bangkhen; 3) Tilapia melanopleura - Chiang Rai; 4) Tilapia nilotica - all stations; 5) Trichogaster pectoralis and Osteochilus hasselti - Khon Kaen.

7.0 STATUS OF FISHERIES EXTENSION PROGRAM

Year by year, the program is being improved. The vehicles made available for transportation have made distribution of fish and dissemination of information possible in areas distant from the stations. In past years, only farmers within easy walking distance could obtain fish from the stations and safely transport them back to their ponds or paddies.

One of the promising aspects of the progress in extension is that of teaching farmers in remote areas to raise small fish for sale to other farmers. This has served the double purpose of making fish for stocking more readily available and of providing a cash crop for the farmer that specializes in production of fingerlings.

The program for production of fish in rice fields has in general been successful - except in areas where the fields were flooded by rivers and in areas where the paddy fields dried up for lack of rain. Most extension workers thought pond culture would be more attractive to farmers because there would be less danger of the pond flooding or drying up, and ponds produce much higher crops of fish. Where floods and droughts were not involved, the extension specialists

estimated that less than 10 per cent of the paddies stocked failed to produce satisfactory numbers of fish. They considered the common carp the best fish for stocking into paddy fields. Production ranged from 30 to 65 kg/rai, the latter when feeding was added.

In the Bangkok area, where intensive culture of the walking catfish, Clarias batrachus, is practiced, losses from 40 to 70 per cent of the fish stocked were due to parasites and/or bacterial disease. The extension specialists listed this as their primary unsolved problem.

Through their excellent system of record keeping, the extension specialists are accumulating much needed information on the number of rai in paddy-fish and pond cultures and relatively reliable records on production. This information should be summarized yearly and attempts made to get more accurate yield records. With a statistically devised plan of sampling, they could get estimates on the catch and consumption of fish in local communities that are urgently needed by the Fisheries Department in planning and evaluating regulations.

Most of the extension personnel stressed their need for more training in the various fields of fish culture. The Chiang Rai Station is conducting frequent seminars for their extension personnel and others interested in fisheries.

A problem brought up by extension workers was that where waters were too acid to produce fish, there was a need for testing the waters and soils prior to encouraging farmers to construct and operate fish ponds. Such waters must be limed in order to get good production and in many areas no liming material is available. It was suggested that samples of waters and soils be brought to the stations for determinations of acidity, hardness and alkalinity by the biologists.

The principal need of the extension specialists was more research-proven methods of aquaculture to demonstrate.

APPENDIX

8.0 THE DEPARTMENT OF FISHERIES

The Department of Fisheries is under the direction of Prida Karnasut, Director-General, and is one of the departments in the Ministry of Agriculture, located in Bangkok.

The Inland Fisheries Division, under its director, Chertchai Amatyakul, is one of the four divisions in the Department of Fisheries. In the Inland Fisheries Division are the Aquacultures, Extension, Design and Construction and the Experimental Stations and Units. Extension specialists and engineers for design and construction of stations, ponds, and reservoirs are located at the Experimental Stations. These and the research units will be described in the following pages.

8.01 The Five-Year Agriculture and Fisheries Development Plan

The Agricultural Development Strategy for Thailand[1] includes plans for the more rapid development of both inland and marine fisheries, with considerable emphasis on aquaculture in coastal and inland waters.

Statistics on the catch from inland and marine areas from 1961 - 1968 are given in Section 11.0 of this report. The inland fisheries statistics are very incomplete because of the large amount of fishery products consumed by "subsistence" or the occasional fishermen. Since these do not find their way to markets, accumulation of these date would be very difficult. Even local market

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[1] Agricultural Development Strategy for Thailand. A Report by the Agricultural Development Strategy Sub-Committee. Published by the Office of the National Economic Development Board. December, 1969.

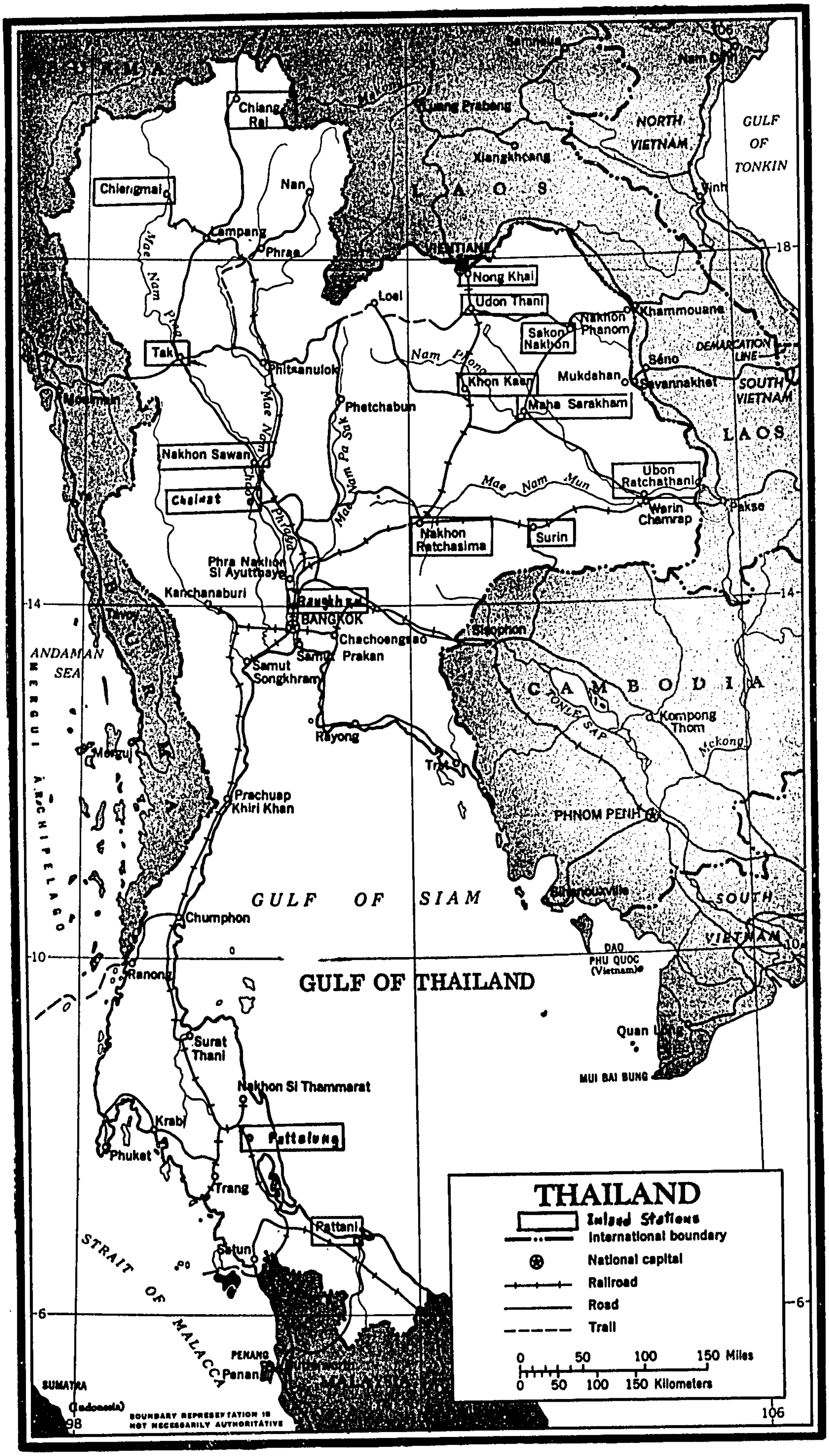
data are very inadequate because of their dispersed nature. Freshwater fisheries products are normally caught, sold and consumed within a 24-hour period. In the statistics given for 1968, the catch of freshwater fish makes up 8 per cent of the total catch. FAO has estimated that the actual catch is at least twice the reported figures. This emphasizes the necessity for accumulation of catch statistics from the inland water areas for fish and shrimp are the principal sources of high-quality protein.

8.02 The Inland Fisheries Research Facilities

Locations of the inland fisheries stations of the Department of Fisheries are shown on the following map. Chiang Mai, Chiang Rai and Tak are located in North Thailand; Khon Kaen, Maha Sarakham, Nakhon Rajsima, Nong Khai, Sakon Nakhon, Surin, Ubon Ratana Reservoir, Udon 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. These stations will be discussed in Section 10.0.

Most of the fisheries research in Thailand is conducted at the various fisheries stations of the Fisheries Department. Fisheries research is also conducted at Kasetsart University, which is located approximately 20 miles north of Bangkok and immediately adjacent to the Bangkhen 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 Biologist Survey Unit at Bangkok.


THAILAND
Inland Stations
International boundary
National capital
Railroad
Road
Trail
0 50 100 150 Miles
0 50 100 150 Kilometers
Chiang Rai
Chiengmai
Nan
Lampang
Phrae
Tak
Phitsanulok
Phetchabun
Nakhon Sawan
Chainat
Loei
Nong Khai
Udon Thani
Sakon Nakhon
Nakhon Phanom
Khon Kaen
Maha Sarakham
Mukdahan
Ubon Ratchathani
Warin Chamrap
Nakhon Ratchasima
Surin
Phra Nakhon Si Ayutthaya
Kanchanaburi
BANGKOK
Chachoengsao
Samut Prakan
Samut Songkhram
Rayong
Trat
Prachuap Khiri Khan
Chumphon
Ranong
Surat Thani
Nakhon Si Thammarat
Krabi
Phuket
Pattalung
Trang
Pattani
Satun
PENANG
Penang
SUMATRA (Indonesia)
VIENTIANE
Luang Prabang
Xiangkhoang
Khammouane
Savannakhet
Séno
Pakse
NORTH VIETNAM
SOUTH VIETNAM
DEMARCATION LINE
LAOS
CAMBODIA
Kompong Thom
TONLE SAP
Mekong
PHNOM PENH
Sihanoukville
SOUTH VIETNAM
PHU QUOC (Vietnam)
Quan Long
MUI BAI BUNG
GULF OF TONKIN
Vinh
ANDAMAN SEA
MERGUI ARCHIPELAGO
Mergui
Tavoy
Moulmein
Mae Nam Ping
Mae Nam Nan
Mae Nam Pa Sak
Mae Nam Mun
Nam Phong
Mae Nam Chao Phraya
GULF OF SIAM
GULF OF THAILAND
STRAIT OF MALACCA
MALAYSIA
BOUNDARY REPRESENTATION IS NOT NECESSARILY AUTHORITATIVE
18
14
10
6
98
106

9.0 TITLES OF CURRENT FISHERIES RESEARCH PROJECTS AND THOSE RECENTLY COMPLETED

9.01 Culture of Fishes in Cages

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	The experiment on culture of Clarias batrachus in cages.			*
Chainat	Pangasius sutchi culture in nylon net floating cages.	*	*	*
Chiang Rai	Cage culture of Cyprinus carpio, Tilapia nilotica and T. melanopleura.			*
Khon Kaen	Pangasius sutchi, cage culture in running water.			*
Maha Sarakham	Growth rate of C. carpio in cages.	*	*	
Nakhon Sawan	Cage culture of Pangasius sutchi.			*
Nong Khai	C. carpio in nylon cages.		*	
Sakoh Nakhon	C. carpio culture in floating cages.	*	*	*
Surin	C. carpio growth rates.		*	

9.02 Culture of Fishes in Ponds

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Growth rate of Pangasius sutchi.	*		
"	Effect of pH on fingerling pond fishes.		*	
"	T. nilotica fry production with various ratios of ♂ to ♀ brood fish.		*	
"	Clarias batrachus, with trash fish or Auburn No. 2 pellets, with various rates of stocking.		*	

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Clarias macrocephalus culture.			*
Chainat	Production of T. nilotica in ponds with different rates of stocking.			*
"	C. carpio culture in ponds with different rates of stocking.			*
Chaing Mai	Production of Puntius gonionotus.			*
Chiang Rai	A comparison on yields with and without manure in culture of Chinese carps.			*
"	Production of C. carpio and T. nilotica with the application of manure.			*
"	Culture of Notopterus chitala.			*
Ditch & Dike	T. nilotica in combinations with C. carpio.			*
Khon Kaen	Growth rate of Osteochilus hasselti.	*		
Surin	Production of pond-cultured carp, C. carpio.			*
Tak	Pond culture of Trichogaster pectoralis with inorganic fertilizers.			*
"	Production of T. nilotica in fertilized and unfertilized ponds with periodic harvests.		*	*
Ubon Rajthani	Growth rate of Pangasius sanitwongsei.			*
"	Probarbus jullieni culture.			*

9.03 Culture of Marine and Brackishwater Fishes

Station or Unit	Project Title	Year Active 1968	1969	1970
Chantaburi	Pond culture of sea bass, Lates calcarifer.			

Station or Unit	Project Title	Year Active 1968	1969	1970
Prachuap Khiri Khan	Milkfish culture in ponds and abundance of fry in coastal waters.		*	
"	Lates calcarifer and T. mossambica in brackishwater ponds.			*
"	Species and abundance of fry of brackishwater fish in Klong Wan Bay.			*
"	Life history of mullets.			

9.04 Culture of Fishes in Rice Paddies

Station or Unit	Project Title	Year Active 1968	1969	1970
Chiang Mai	Fish culture in paddy fields	*		
Ditch & Dike	C. carpio culture in rice fields using animal manure and inorganic fertilizers.	*		
"	C. carpio culture in fields with different spacing of rice.			
Khon Kaen	C. carpio, T. nilotica and Trichogaster pectoralis culture in paddy fields.			
N.E. Center	Trichogaster pectoralis culture in rice fields.			
"	C. carpio culture in rice fields.	*		
Sakon Nakhon	C. carpio production.			
Udorn Thani	Evaluation of success of rice field culture of C. carpio in Udorn Thani and Nong Khai Provinces.	*		
"	C. carpio culture in rice paddy fields.			

9.05 Culture of Crabs and Mollusks

Station or Unit	Project Title	Year Active 1968	1969	1970
Chantaburi	Raft method of culture for the oyster, Pycnodonta numisma.		*	
"	Pond culture of blue crab, Scylla serrata.	*	*	*
"	Comparison of 3 methods of oyster culture.			*
Prachuap Khiri Khan	Culture of Japanese oyster, Crassostrea gigas.		*	*
"	Culture of native oysters.	*	*	*

9.06 Culture of Shrimps in Ponds

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Culture of giant freshwater prawn, Macrobrachium rosenbergii.			*
Chainat	Growth rate of the giant freshwater prawn, M. rosenbergii.	*	*	
"	M. rosenbergii culture in combination with Puntius gonionotus.			*
Chantaburi	Production of shrimp (Penaeus sp.) in brackishwater ponds with and without phosphate fertilization.	*		

9.07 Diseases of Fishes

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Parasites and diseases of pond fishes.			

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Parasites of Clarias sp. in ponds.			*

9.08 Feeds and Feeding

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Feeding C. carpio with different formulae of pelleted feeds.		*	*
"	Pond conversion value "S" of various supplementary diets.			*
"	Supplementary diets for feeding C. carpio fry.			*
Chainat	Termites as food for C. carpio with emphasis on conversion factor.		*	
Surin	Comparison of growth rate among 3 sizes of C. carpio fed on different formulae of feed.	*	*	
"	Rearing C. carpio from fry to fingerlings, feeding with Moina sp. and artificial feed.			*
Ubon Rajthani	Termites as food for C. carpio.	*	*	

9.09 Life History

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Morphological development of Trichoaster pectoralis.	*		
"	Primary study on biology of Anabas testudineus.			
"	Embryological and morphological development of C. carpio and Clarias batrachus.			

Station or Unit	Project Title	Year Active 1968	1969	1970
Biological Survey Unit	Life history of Probarbus jullieni.	*		
Chiang Mai	Biology of Puntius gonionotus: propagation and embryonic development.		*	*
Chainat	Food habits of Catlocarpio siamensis.		*	*
Chiang Rai	Life history of Pristolepis fasciatus in Kwan Payao Reservoir.	*		
"	Life history of Notopterus chitala.			
Khon Kaen	Food habit of Morulius chrysophekadion in the Ubon Ratana Reservoir.		*	*
Maha Sarakham	Life history of Hampala dispar.		*	*
Nakhon Sawan	Life history of Datnioides microlepis.			*
"	Stomach and intestine contents of some species of fishes in Bung Bora Pet.		*	*
N.E. Center	Stomach contents and state of gonad development in fishes of Northeast Thailand.			*
Pattalung	Life history of Prophagorus niuhofii.			*
Tak	Life history of Puntius daruphani.		*	*
Ubon Ratana Reservoir	Life history of Cyclocheilichthys apogon.			*

9.10 Pollution

Station or Unit	Project Title	Year Active 1968	1969	1970
Ditch & Dike	Toxicity of herbicides to C. carpio.			*
N.E. Center	Toxicity of kenaf retting water to fishes.			*

Station or Unit	Project Title	Year Active 1968	1969	1970
Ubon Rajthani	Effect of pollution from kenaf retting to fish in irrigation tanks.	*	*	

9.11 Spawning of Fishes

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Selective breeding of C. carpio.	*	*	*
"	Ovarian development of silver carp.		*	*
"	Induced spawning of Cirrhinus microlepis.			*
"	Production of Clarias batrachus fry.			*
"	Induced spawning of Chinese carps.	*	*	
Chiang Rai	Artificial breeding of Chinese carps.	*	*	
"	Featherback fish (Notopterus chitala) breeding.		*	
Khon Kaen	Spawning of Osteochilus hasselti.		*	*
Maha Sarakham	Fecundity of various sizes of T. nilotica.		*	
Nakhon Sawan	Artificial breeding of Pangasius sutchi by pituitary injection.	*	*	

9.12 Surveys of Impoundments and Streams

Station or Unit	Project Title	Year Active 1968	1969	1970
	Fisheries Surveys on Reservoirs:			
Biological Survey Unit	Ubon Ratana	*	*	
"	Kaeng Kra Jan	*	*	*
"	Lam Pao		*	*
	Lam Ta Kong		*	
	Bung Si Fi		*	*
	Lam Pra Perng		*	
	Nong Bua	*		*

Station or Unit	Project Title	Year Active 1968	1969	1970
	Fisheries Surveys on Rivers:			
Biological Survey Unit	Mekong			
"	Kwae			
"	Nan			
"	Oon			
	Fisheries Surveys on Irrigation Tanks and Village Ponds:			
Chiang Mai	Study on production of fish in Nong Bua Reservoir.			
Chainat	Fisheries biology around Chaophya Dam.			
Chiang Rai	Hydrobiological and fisheries surveys in Kwan Payao.			
Maha Sarakham	Evaluation of stocking program in Kaeng Lerng Charn Irrigation Tank.			
"	Biological survey in Egasatayasuntorn Irrigation Tank.			
Nakhon Sawan	Fishery survey of Bung Bora Pet.			
"	Fishery survey in flood area of Nakhon Sawan.			
N.E. Center	Fisheries surveys in Huey Syo, Huey Yang, Huey Tuey, Kok Muang, Ta Pra, Non Taevaraj, Nong Pa Ko, Sok Ruak.			
"	Experiment management of small irrigation tanks in the Northeast.			
Nong Khai	Fish collection in Mekong River, Nong Khai Province.			
Sakon Nakhon	Fishery survey of Nong Harn Lake.			

Station or Unit	Project Title	Year Active 1968	1969	1970
Tak	Fisheries surveys of Nong Luang Irrigation Tank.			
	Limnology of the Bhumipol Reservoir.			
	Fishing methods and fishing areas of Bhumipol Reservoir.			
Ubon Rajthani	General survey on fishes and fishing gear of Moon River, Ubon Rajthani Province.			
Ubon Ratana Reservoir	A study on fish population in Ubon Ratana Reservoir.			

9.13 Taxonomy

Station or Unit,	Project Title	Year Active 1968	1969	1970
Taxonomy Unit	Taxonomy of freshwater fishes of Thailand.			
	Taxonomy of fish Genus Pangasius.			
	Characteristics of the Genus Clarias.			
	Morphological description of Genus Labiobarbus.			
Ubon Rajthani	Taxonomy of fish in Lam Nam Moon.			

9.14 Miscellaneous

Station or Unit	Project Title	Year Active 1968	1969	1970
Bangkhen	Transportation of live fish in polyethylene bags with oxygen.			

Station or Unit	Project Title	Year Active 1968	1969	1970
Khon Kaen	Culture of Daphnia carinata in ponds.			
Nakhon Rajsima	Role of sodium cyanide in fish culture.			
Prachuap Khiri Khan	Efficiency of various gears for collecting milkfish fry.			
Surin	Physio-chemical characteristics of flood waters in Surin Province.			
"	Materials suitable for fish egg receivers.			
Ubon Rajthani	Evaluation of fish culture under the supervision of Ubon Rajthani Station.			
Ubon Ratana Reservoir	Comparison of efficiencies of stationary fishing gears in Ubon Ratana Reservoir.			

10.0 SYNOPSIS OF PHYSICAL AND BIOLOGICAL DATA FOR THE FISHERIES UNITS AND THE INLAND FISHERIES STATIONS

10.01 The Units Located at Bangkok

10.011 Fisheries Survey Unit

This unit conducts fisheries surveys on rivers and reservoirs throughout the country. They have accumulated more information on the composition of riverine and reservoir fish populations than is available anywhere else in Asia. Estimates of standing crops have been made by rotenone sampling and seining techniques. Preimpoundment surveys on rivers and creeks have been made before dam construction was begun, and subsequent surveys recorded the changes occurring after impoundment. Much of this information has not been published, or published only in Thai. A recent excellent report entitled, "A Report on the Fisheries Surveys of the Mekong River in the Vicinity of the Pa Mong Dam Site" was published both in Thai and in English, and is typical of the unpublished information available on other rivers and reservoirs. Included in the report is a list of species of fishes found in the Mekong River System, and pictures of the more important species.

Measurements of length-weight relationships in various species should be compiled into a handbook for usage throughout the region.

Personnel in this unit are as follows:

Ariya Sidthimunka, Chief	B.S.
Oopathum Pawaputanon, Biologist	B.S.
Chiamchit Boonsom, Biologist	B.S.
Boonchuey Waew-Ngarm, Biologist	B.S.
Sompong Hiranvat, Biologist	B.S.
Tiraphan Pookaswan, Biologist	M.S. candidate
Miss Santana Sangkhakul, Biologist	B.S.
Vijai Srisuwanatach, Biologist	B.S.
Miss Vanpen Kulvijitrangse, Biologist	B.S.

Laboratory facilities for the unit are at the Bangkhen Fisheries Station.

The unit also cooperates with the Stations in conducting experimental management of reservoirs.

A list of its projects is given in Section 9.12.

10.012 Inland Fisheries Stations Section

Personnel at the Bangkok Station responsible for planning research and the details of Station management are:

Vanich Varikul, Chief, Research	M.S.
Preecha Teinehareon	B.S.
Miss Sopa Areeratana	B.S.
Miss Vanida Koonsongnern	B.S.

10.013 Taxonomic Unit

This unit serves all other units and stations in identification of fish, prawns, other aquatic animals and aquatic plants.

Descriptions and pictures have been prepared for a publication on the fishes of Thailand. This would be quite a valuable contribution. The list contains a number of new undescribed species.

A large series of drawings have been made of the algae found in waters throughout Thailand. The biologist involved should be sent to museums or research stations where the identification and descriptions can be checked. A publication in this field would be very useful.

The personnel in this unit are as follows:

Vanich Varikul, Chief	M.S.
Miss Mali Srirungroj, Biologist	B.S.
Sidthi Bunyarutpalin, Biologist	B.S.
Sombhong Suwunnatod, Biologist	B.S.

The laboratory facilities for this group are also at the Bangkhen Station.

It is also working on the taxonomy of the genera Pangasius, Clarias and Labiobarbus.

10.014 Inland Fisheries Mobile Unit

Personnel of this unit are as follows:

Wiset Chomdej, Chief	B.S.
Sompote Jiebna, Biologist	B.S.
Narong Sukomol, Biologist	B.S.
Itsaro Wearakawoot, Biologist	B.S.

10.02 Fisheries Stations in North Thailand

10.021 Chiang Mai Station

Location

Amphur: San Sai
Province: Chiang Mai

Established

1953

Area

53 rai - Land
13 rai - Water

Available for Expansion

None on station
Land is available nearby for expansion

Personnel

		Training	Year
Head:	Mr. Boonhai Thongsamui	B.S. Kasetsart Univ.	1959
Biologists:	Mr. Samrong Powhawm	B.S. Kasetsart Univ.	1964
	Mr. Rewat Rithaporn	B.S. Kasetsart Univ.	1969
Extension:	4		
Laborers:	14 Permanent		
	8 Temporary		

Number and Size (m^2) of Ponds

Earthen		Cement		
1	3,900	1	24	
1	3,300	2	20	
1	1,672	1	12	
2	1,260	30	10	
1	1,215	3	3	
4	800	2	1.5	
3	405	10	10	
4	400	10	200	(to be added)
4	375			
1	324			
4	180			

Water supply is from irrigation canals.

Rice Paddy Fields

15 400 (m^2)

Reservoirs in Province

Nong Bua 90,000 (m^2) Min. 30,000

Fish Production

Species	1970 Number produced	distributed
Pla Tapien	708,000	95,000
Pla Khang Lai	46,000	38,000
Pla Nin	99,000	79,000
Pla Nai	439,000	159,000
	1,292,000	371,000

Research Projects

1. Biology of Puntius gonionotus, method of propagation and its embryonic development.
2. A study on fish population survey in Nong Bua 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.

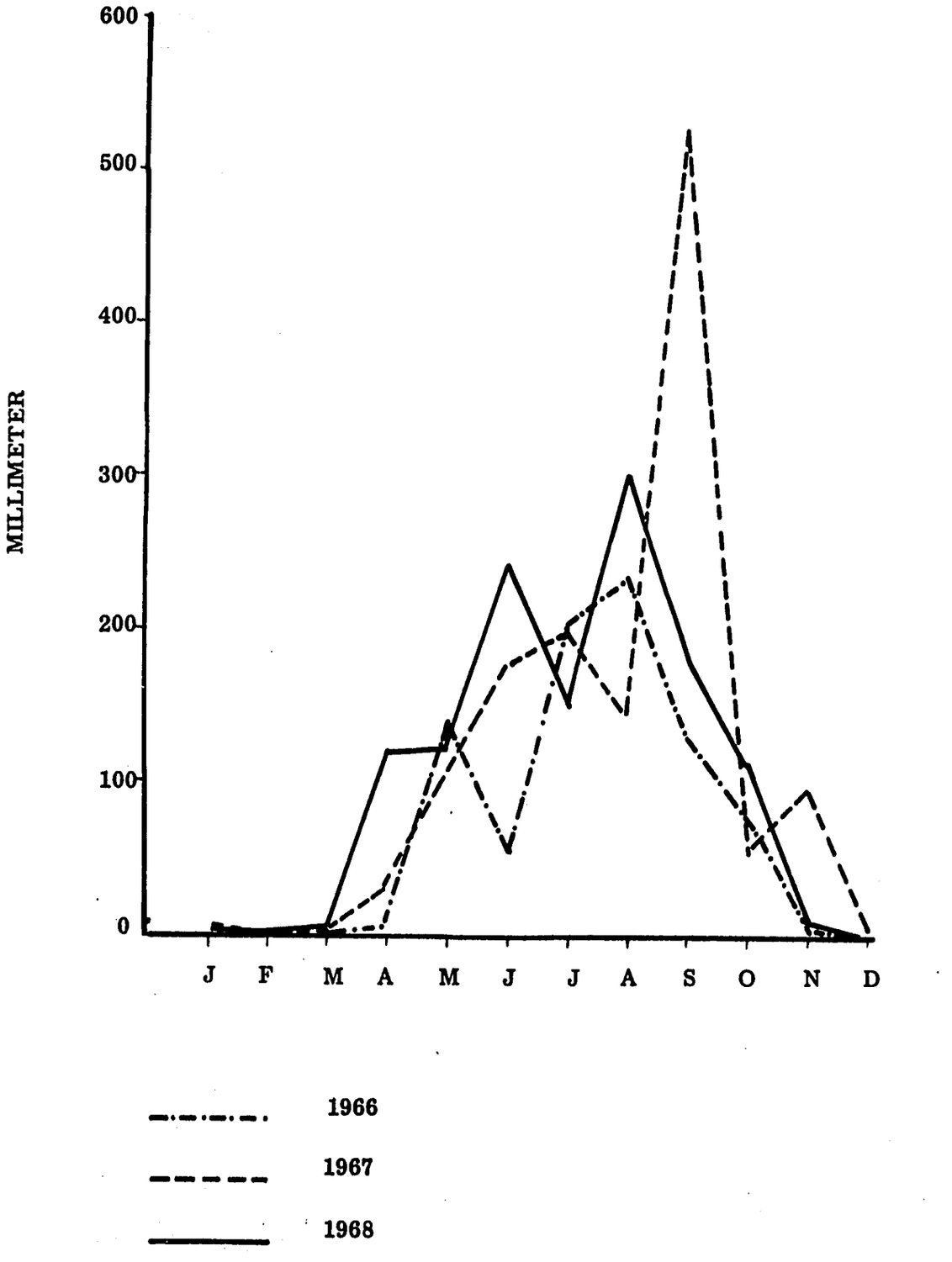
Equipment Available

1. 1 100 m seine
2. 2 50 m seines
3. 2 plankton nets
4. 2 compound microscopes
5. 2 dissecting apparatus
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

MONTHLY RAINFALL

1966 - 1968

CHIANG MAI



10.022 Chiang Rai Station

Location

Amphur: Payao
Province: Chiang Rai

Established

1941

Area

64.5 rai - Land
20 rai - Water

Available for Expansion

None on station
Privately owned land can be purchased

Personnel

		Training	Year
Head:	Mr. Damrong Silapachai	M.A. Missouri Univ. (U.S.)	1968
Biologists:	Mr. Chanintorn Sritongsuk	B.S. Kasetsart Univ.	1964
	Mr. Panu Ravaratmaneegul	B.S. Kasetsart Univ.	1968
	Mr. Samruey Sipkhe	B.S. Kasetsart Univ.	1969
Extension:	5		
Laborers:	33 Permanent		
	3 Temporary		

Number and Size (m^2) of Ponds

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

Ponds are drained and filled by gravity.

Reservoirs

Kwan Payao 10,600 rai (source of water for the Station)

Fish Production

Species	1970 Number produced	distributed
Pla Nai		
Pla Lin-Hue		
Pla Khang Lai		
Pla Nin		
Pla Salid		
	1,500,000	1,012,393

Research Projects

1. Artificial breeding of chinese carps.
2. Breeding of featherback fish (Notopterus chitala)
3. Cage culture of chinese carps.

Transportation Facilities Available

1. Jeep, land-rover; purchased in 1964; O.K.
2. Truck, dodge fargo; purchased in 1966; O.K.
3. Boat, longtail; 10 HP; fair.
4. Boat, outboard motor; 25 HP; O.K.

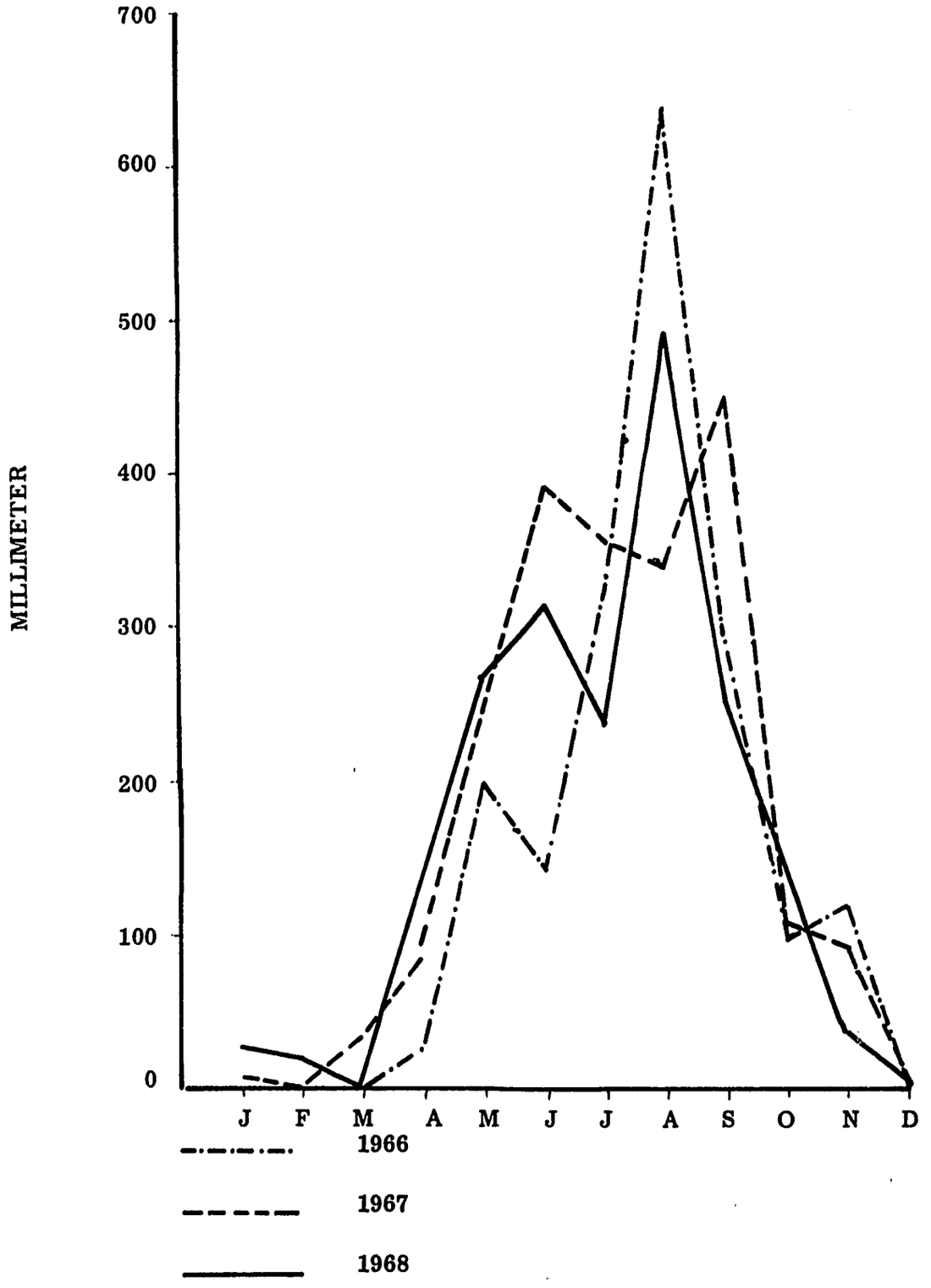
Equipment Available

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

MONTHLY RAINFALL

1966 - 1968

CHIANG RAI



10.023 Tak Station

Location

Amphur: Muang
Province: Tak

Established

1963

Area

150 rai - Land
50 rai - Water

Available for Expansion

8.1 rai

Personnel

		Training	Year
Head:	Mr. Suchit Bhinyoying	B.S. Kasetsart Univ.	1959
Biologists:	Mr. Chareon Panin	B.S. Kasetsart Univ.	1962
	Mr. Surajit Parianyarut	B.S. Kasetsart Univ.	1966
	Mr. Prayot Paosas	B.S. Kasetsart Univ.	1968
Extension:	7		
Laborers:	18 Permanent		
	14 Temporary		

Number and Size (m^2) of Ponds

Earthen		Cement	
3	1,300	10	5
5	800	10	10
10	400		

Reservoirs

Bhumipol 182,000 rai

Fish Production

	1970 Number	
Species	produced	distributed
Pla Nin	400,000	200,000
Pla Nai	250,000	100,000
Pla Salid	150,000	20,000
Pla Ret	-------	-------
Pla Duk Dam	5,000	-------
	805,000	320,000

Research Projects

1. Limnology of the Bhumipol Reservoir
2. Fishing methods in Bhumipol Reservoir.
3. Pond culture of Sepat Siam, Trichogaster pectoralis, applying different inorganic fertilizers.
4. Life history of Puntius daruphani.

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.

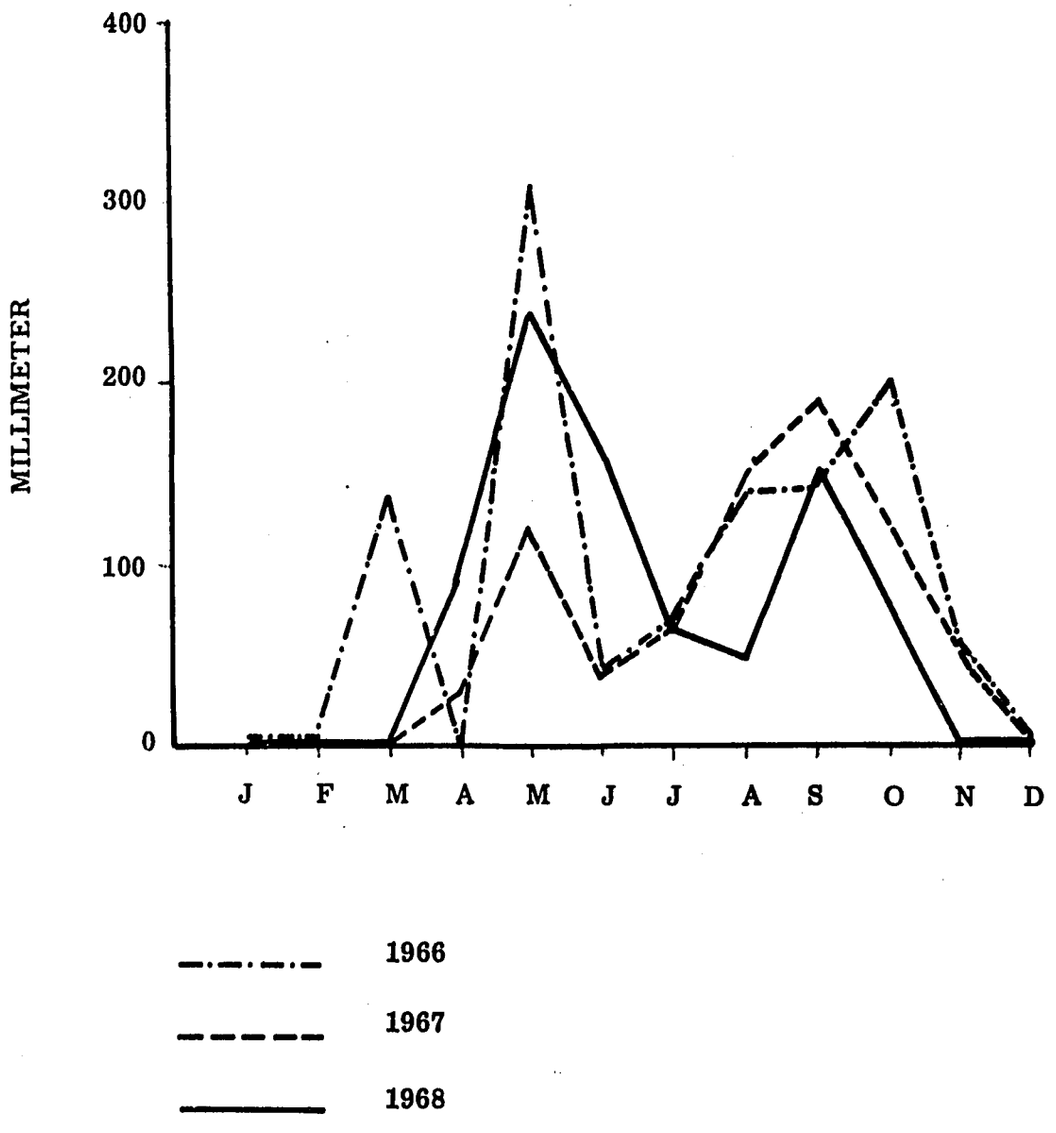
Equipment Available

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

MONTHLY RAINFALL

1966 - 1968

TAK



10.03 Fisheries Stations in Northeast Thailand

10.031 Khon Kaen Station

Location

Amphur: Muang
Province: Khon Kaen

Established

1953

Area

81.75 rai - Land
30.4 rai - Water

Available for Expansion

None on station
Soils contain salt deposits. Some ponds have salinity of 10 ppt in dry weather.

Personnel

		Training	Year
Head:	Mr. Pratom Taweesak	B.S. Kasetsart Univ.	1961
Biologists:	Mr. Somprasong Mobhundit	B.S. Kasetsart Univ.	1966
	Mrs. Paob Jaiyen	B.S. Kasetsart Univ.	
Extension:	4		
Laborers:	21 Permanent		

Number and Size (m^2) of Ponds

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

Water supply pumped from Tung Srang Reservoir. Ponds drained by pumping.

Reservoirs

Tung Srang 2,000 rai

Fish Production

	1970 Number	
Species	produced	distributed
Pla Nai	740,000	
Pla Salid	210,000	
Pla Nin	610,000	
Pla Morted	-------	
	1,610,000	824,970

Research Projects

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

Transportation Facilities Available

1. Jeep, wagoneer; purchased in 1970; good.
2. Jeep, wagoneer; purchased in 1965; O.K.
3. Jeep, land-rover; purchased in 1965; poor.
4. Jeep, international scout; purchased in 1963; poor.
5. Truck, dodge fargo; purchased in 1967; O.K.

Equipment Available

1. 1 100 m seine
2. 2 50 m seines
3. 4 plankton nets
4. 1 Kemmerer water sampler
5. 1 Ekman dredge
6. 1 binocular microscope
7. 1 electric thermometer
8. 1 electric pH meter
9. 2 water analysis lab kits
10. movie screen
11. 1 scale imprint press
12. projector
13. 1 dissecting microscope
14. 20 aquaria
15. 1 centrifuge
16. 1 refrigerator
17. 1 barometer
18. 1 max - min thermometer
19. 1 analytical balance
20. 2 water analysis lab kits
21. 1 7-kg capacity scale
22. 1 generator, 3,500 watt
23. 1 12 HP diesel water pump
24. 1 16 HP diesel water pump (old)
25. 1 13 HP diesel water pump

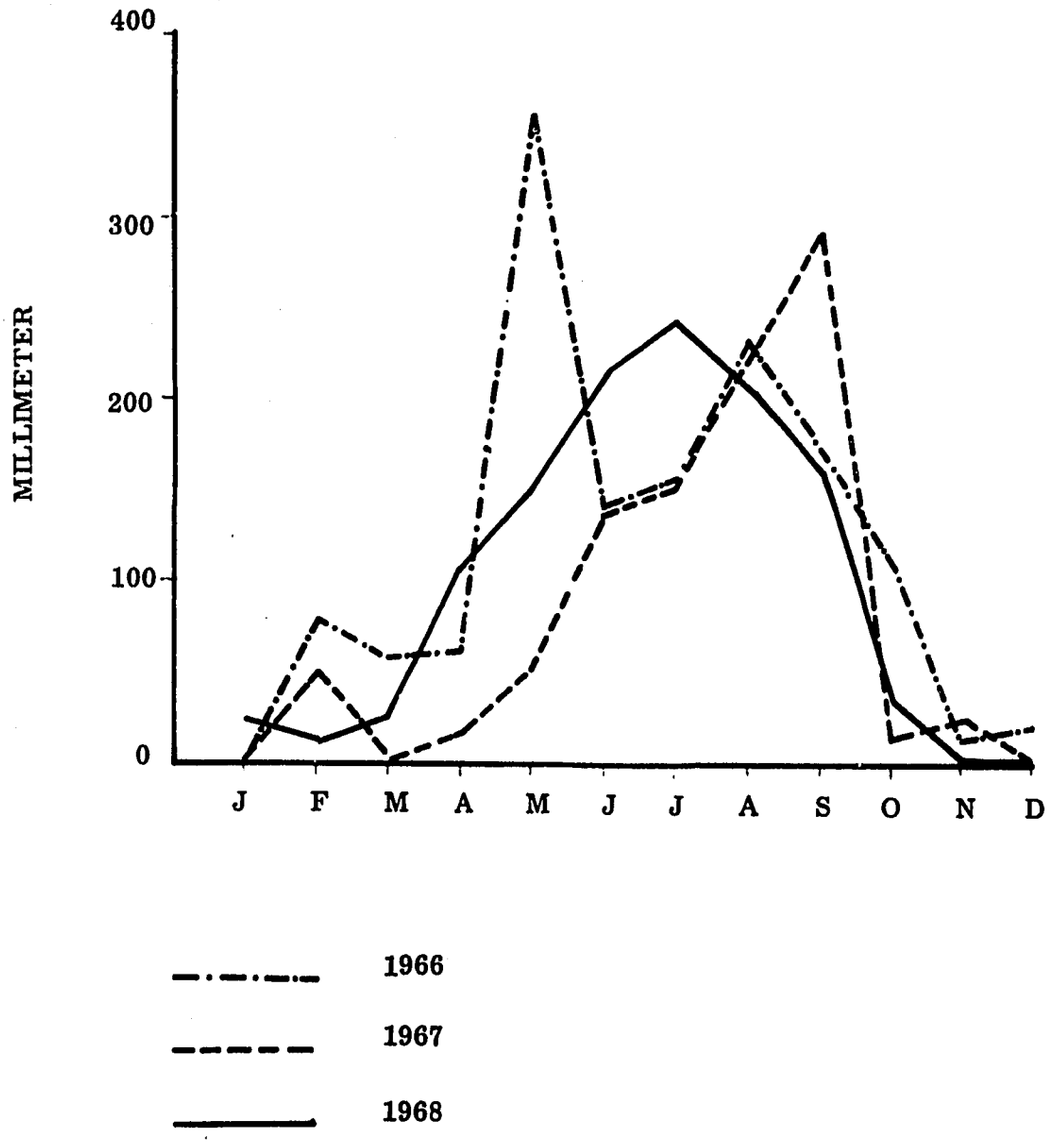
Equipment Needed

1. 1 15 HP diesel water pump

MONTHLY RAINFALL

1966 - 1968

KHON KAEN



10.032 Maha Sarakham Station

Location

Amphur: Muang
Province: Maha Sarakham

Established

1953

Area

20 rai - Land
4 rai - Water

Available for Expansion

10 rai - belongs to Irrigation Department

Personnel

		Training	Year
Head:	Mr. Wai Pinyo	3 years at Kasetsart Univ.	1947
Biologists:	Mr. Manus Chantasut	B.S. Kasetsart Univ.	1966
	Mr. Krisna Thitikulrat	B.S. Kasetsart Univ.	1969
Extension:	3		
Laborers:	14 Permanent		
	6 Temporary		

Number and Size (m^2) of Ponds

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

Ponds are drained and filled by pumping.

Reservoirs

Kaeng Lerng Charn 2,000 rai (source of water for the station)

Fish Production

Species	Total fish production 1970
Pla Nai	
Pla Nin	
Pla Salid	
	680,000

Research Projects

1. Evaluation on stocking some fishes in irrigation tanks.
2. Pen culture in a reservoir.

Transportation Facilities Available

1. Jeep, wagoneer; purchased in 1970; good.
2. Jeep, land-rover; purchased in 1965; O.K.
3. Truck, dodge fargo; purchased in 1966; O.K.

Equipment Available

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

Equipment Needed

1. 1 electric glass electrode pH meter, laboratory model
2. 1 slide projector

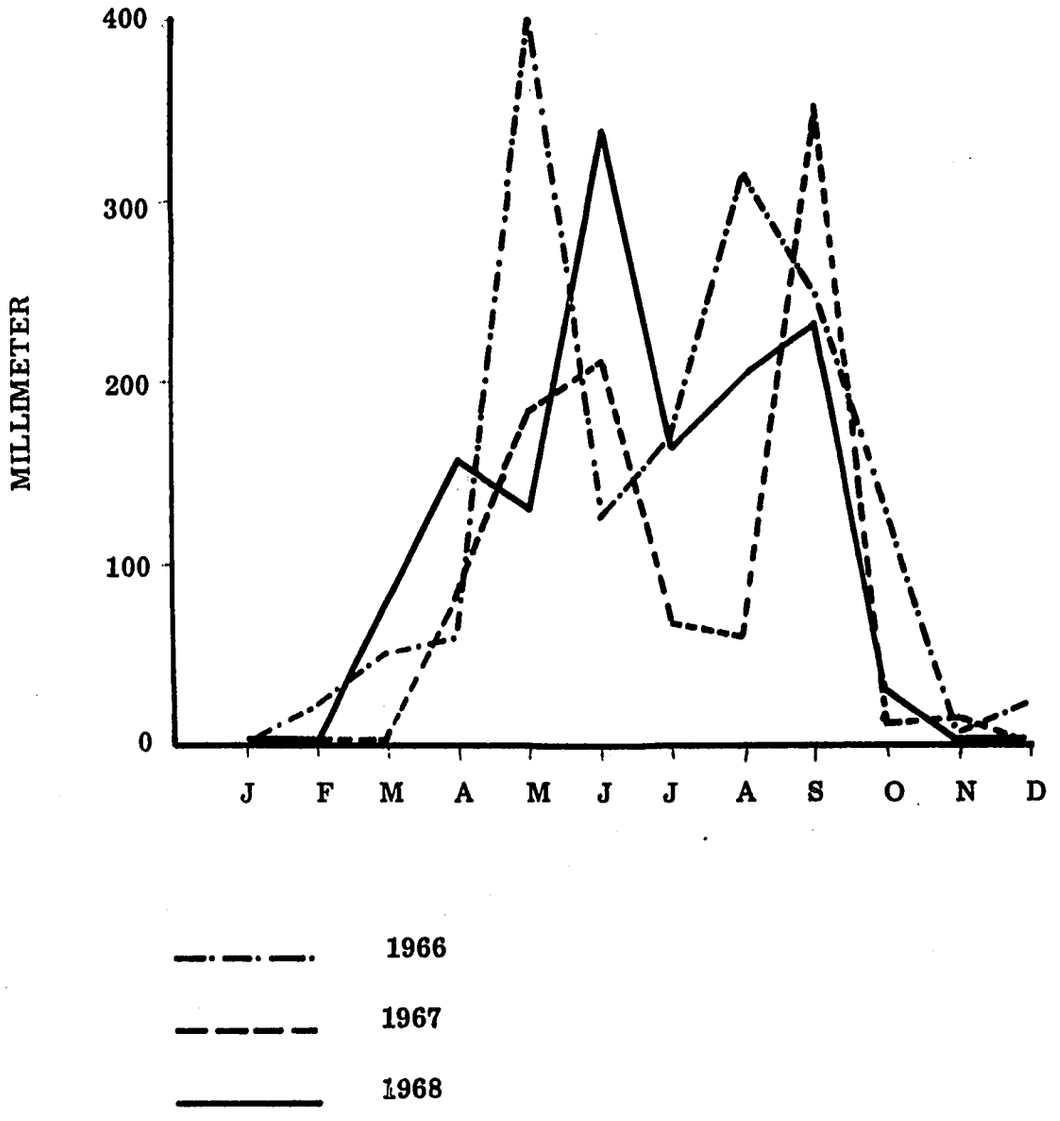
Equipment Available for Extension and Demonstration Activities

1. 1 12 HP water pump
2. 1 5 HP water pump
3. 1 35 mm camera
4. 1 13 HP longtail boat (4 years old)

MONTHLY RAINFALL

1966 - 1968

MAHA SARAKHAM



10.033 Nakhon Rajsima (Korat) Station

Location	Established
Amphur: Muang Province: Nakhon Rajsima	1953

Area	Available for Expansion
24.5 rai - Land 2 rai - Water	None on station

Personnel		Training	Year
Head:	Mr. Boonlue Somboonwong	3 years at Vocational School	
Biologists:	Mr. Pramot Suwanasart	B.S. Kasetsart Univ.	1964
	Mr. Veerasak Chueyphat	B.S. Kasetsart Univ.	1969
Extension:	3		
Laborers:	10 Permanent		
	3 Temporary		

Number and Size (m^2) of Ponds

Earthen		Cement	
4	400	10	10
2	800	4	80
1	200		

Water supply from moat (17 rai) surrounding the station. Ponds are filled and drained by pumping.

Fish Production

Species	Total fish production 1970
Pla Nai	
Pla Morted	
Pla Nin	
Pla Salid	
Pla Mortan	
	340,700

Research Projects

1. Use of sodium cyanide in fish culture.

Transportation Facilities Available

1. Jeep, land-rover; purchased in 1964; O.K.
2. Truck, dodge fargo; purchased in 1967; O.K.

Equipment Available

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. 1 500 gm capacity balance
10. 1 50 kg-100 kg scale

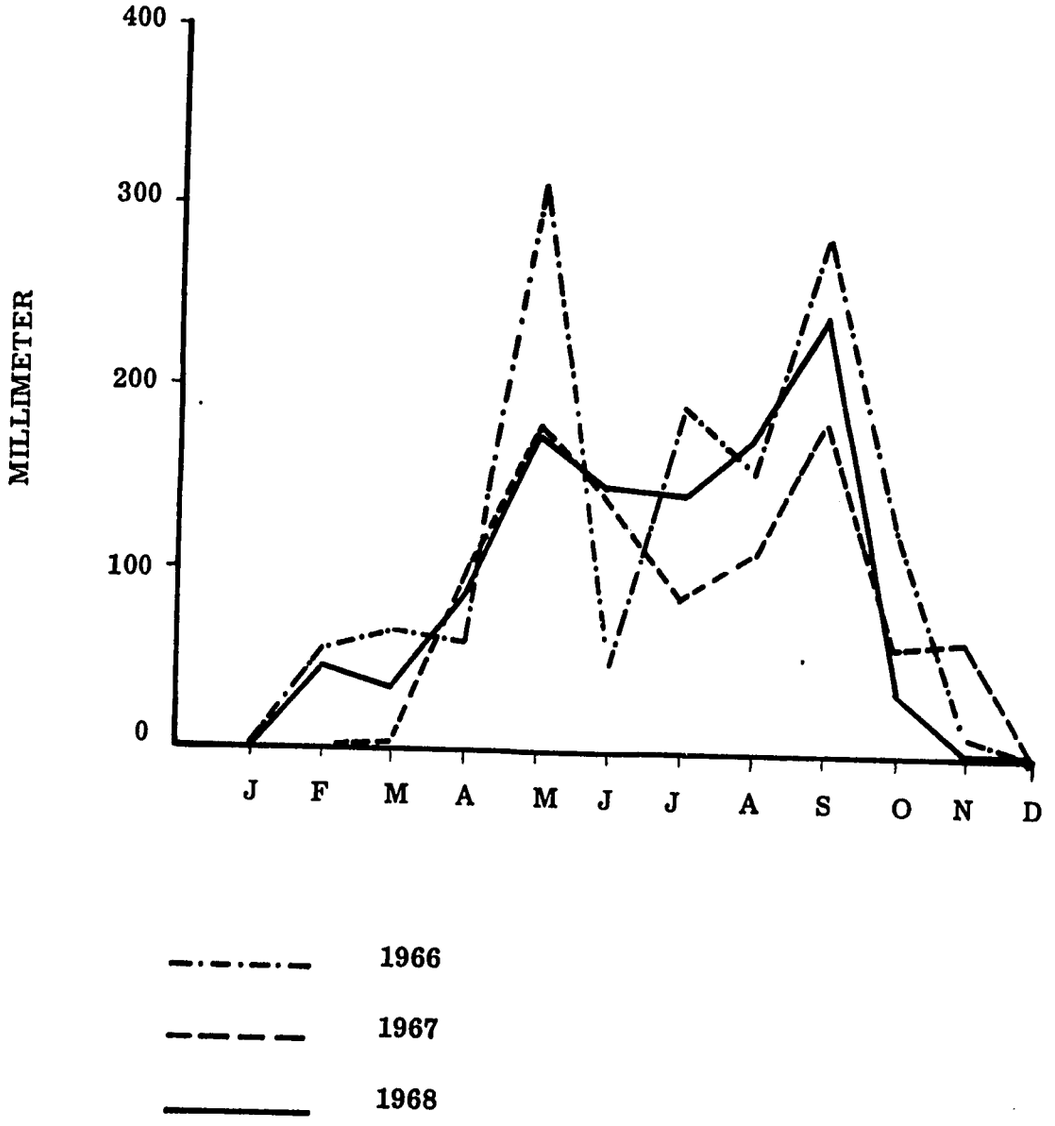
Equipment Needed

1. 1 electronic pH meter, laboratory model

MONTHLY RAINFALL

1966 - 1968

NAKHON RAJSIMA



10.034 Nong Khai Station

Location

Amphur: Srichiengmai
Province: Nong Khai

Established

1968

Area

130 rai - Land
7 rai - Water

Available for Expansion

None on station

Personnel

		Training	Year
Head:	Mr. Nid Koochareonpaisal	B.S. Kasetsart Univ.	1963
Biologists:	Mr. Teinthong Yuovechwatana	B.S. Kasetsart Univ.	1968
	Mr. Vichian Plengchawee	B.S. Kasetsart Univ.	1969
Extension:	8		
Civi Engineers:	2		
Laborers:	8 Permanent		
	22 Temporary		

Number and Size of Ponds

Earthen

8	1 rai
14	0.5 raj
10	200 m^2

Cement

20	10 m^2

Reservoirs

Nong Kirk 706 rai (water supply for station, ponds are filled and drained by pumping).

Fish Production

Species	1970 Number produced	distributed
Pla Nai	269,000	218,000
Pla Nin	157,000	81,700
Pla Salid	9,100	6,000
	435,100	305,700

Research Projects

1. Fish collection in Nong Khai Province.

Transportation Facilities Available

1. Jeep, wagoneer; purchased in 1970; good.
2. Truck, dodge fargo; purchased in 1969; O.K.
3. Jeep, land-rover; purchased in 1968; O.K.

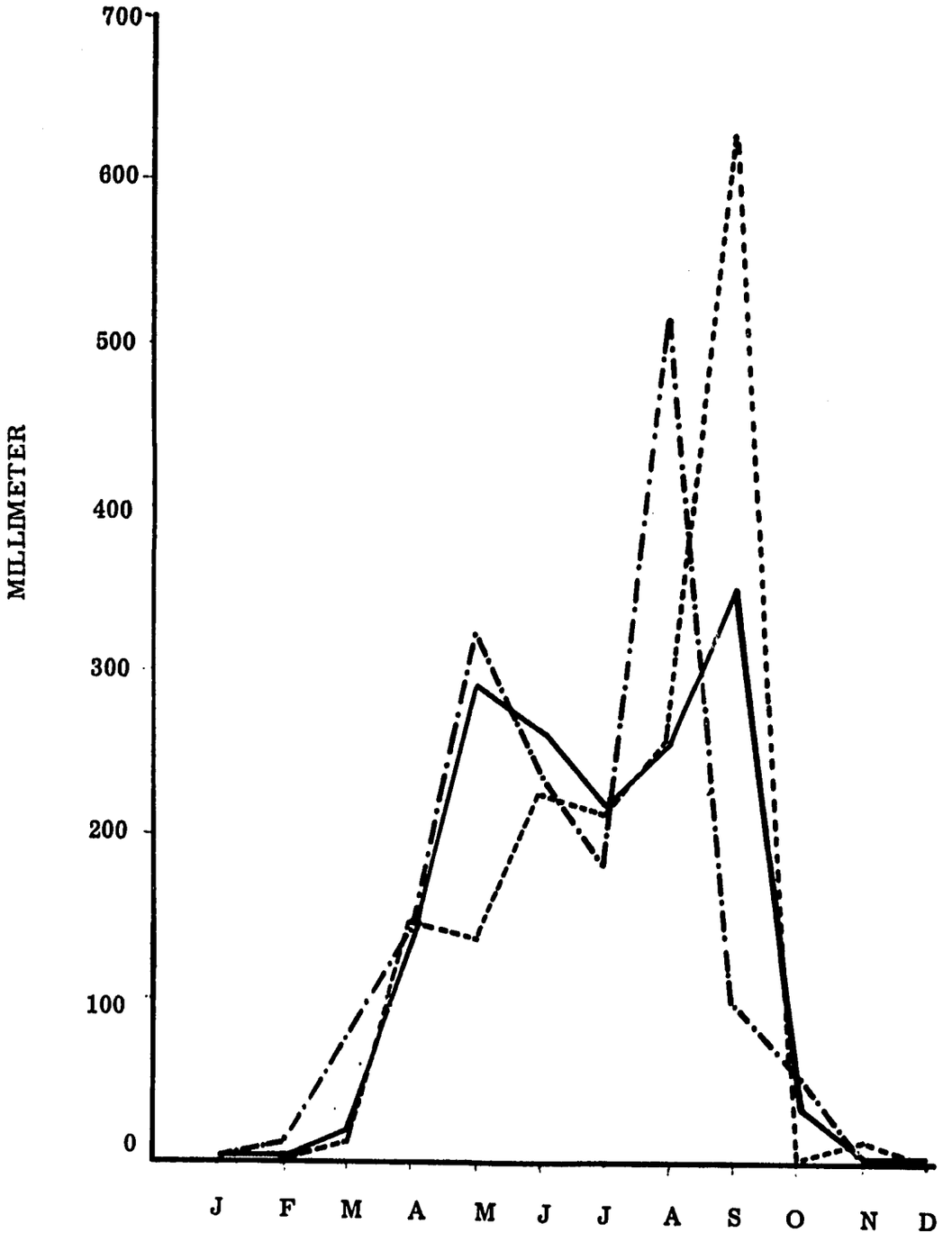
Equipment Available

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

MONTHLY RAINFALL

1966 - 1968

NONG KHAI



10.035 Sakon Nakhon Station

Location

Amphur: Muang
Province: Sakon Nakhon

Established

1942

Area

128.75 rai - Land
18.75 rai - Water

Available for Expansion

None on station, but large area below dam is controlled by the Fisheries Dept.

Personnel

		Training	Year
Head:	Mr. Somjet Julapong	B.S. Kasetsart Univ.	1962
Biologists:	Mr. Phichit Srimookda	B.S. Kasetsart Univ.	1966
	Mr. Kiri Koanandakul	B.S. Kasetsart Univ.	1968
	Mr. Somdej Srikomut	B.S. Kasetsart Univ.	
Extension:	15		
Laborers:	40 Permanent		

Number and Size (m^2) of Ponds

Earthen

1	338	1	209
3	268	1	570
2	260	1	273
1	700	1	5,550
1	529	1	672
1	208	1	540
1	180	1	1,140
1	902	1	5,550
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		

Cement

5	50
6	16.50
1	28.8
1	6.79
12	6
6	8
2	24.64
10	10

Ponds filled by pumping from Nong Harn Lake, and drained by gravity and pumping.

Reservoirs

Nong Harn Lake 48,000 rai

Extensive area available for cage culture in this lake.

Fish Production

	1970 Number	
Species	produced	distributed
Pla Nai	851,100	
Pla Nin	331,050	
Pla Morted	160,500	
Pla Salid	-------	
Pla Mortan	-------	
	1,342,650	1,371,240

Research Projects

1. Cyprinus carpio culture in floating cages.

Transportation Facilities Available

1. Jeep, station wagon; purchased in 1970; good.
2. Jeep, land-rover; purchased in 1965; O.K.
3. Jeep, land-rover; purchased in 1965; O.K.
4. Jeep, pickup; purchased in 1964; O.K.

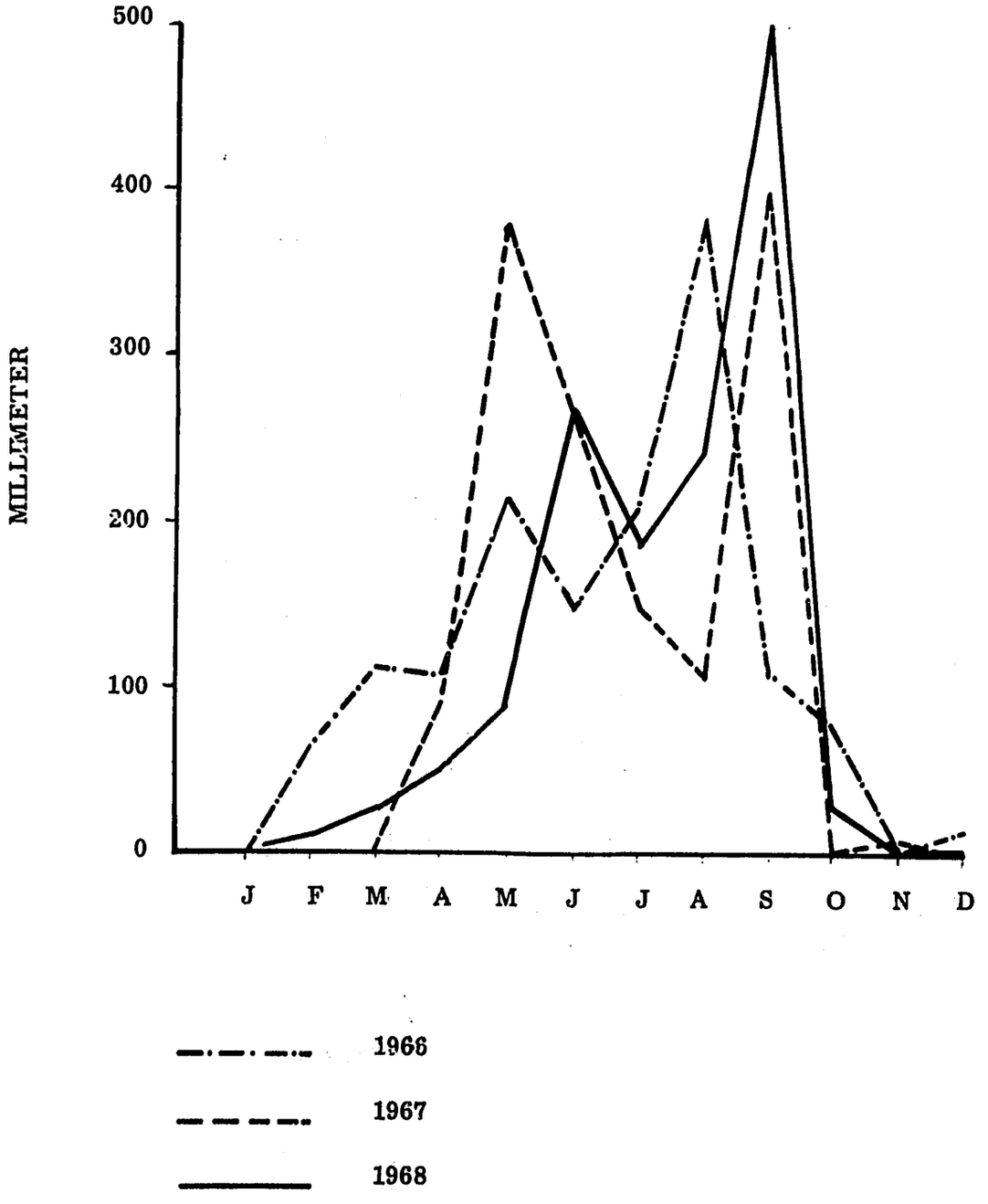
Equipment Available

1. 3 generators
2. 2 cameras, 35 mm
3. 1 50 m seine
4. 3 25 m seines
5. 7 plankton nets
6. 10 aquaria
7. 1 Ekman dredge
8. 1 compound microscope with camera
9. 1 25 HP outboard motor and boat
10. 2 movie projectors
11. 1 refrigerator
12. 1 500 gm capacity balance
13. 1 analytical balance
14. 1 electric pH meter
15. 1 dissecting microscope

MONTHLY RAINFALL

1966 - 1968

SAKON NAKHON



10.036 Surin Station

Location

Amphur: Muang
Province: Surin

Established

1962

Area

75.45 rai - Land
19.47 rai - Water

Available for Expansion

15 rai

Personnel		Training	Year
Head:	Mr. Suin Ritcharung	B.S. Auburn Univ. (U.S.)	1968
Biologists:	Mr. Vattama Leelapat	B.S. Kasetsart Univ.	1970
Extension:	2		
Laborers:	23 Permanent		
	3 Temporary		

Number and Size (m^2) of Ponds

Earthen		Cement	
13	200	10	50
5	800	1	6
5	1,600	9	6

Water supply from a small reservoir suppled by an irrigation canal. Ponds are filled and drained by gravity.

Fish Production

Species	Number
Pla Nai	713,480
Pla Nin	198,435
Pla Salid	93,460
	1,005,375

Research Projects

1. Comparison of growth rate among three groups of common carp fed on different formulae of feed.

Transportation Facilities Available

1. Jeep, land-rover; purchased in 1962; fair.
2. Jeep, willy; purchased in 1962; fair.
3. Truck, fargo; purchased in 1966; good.

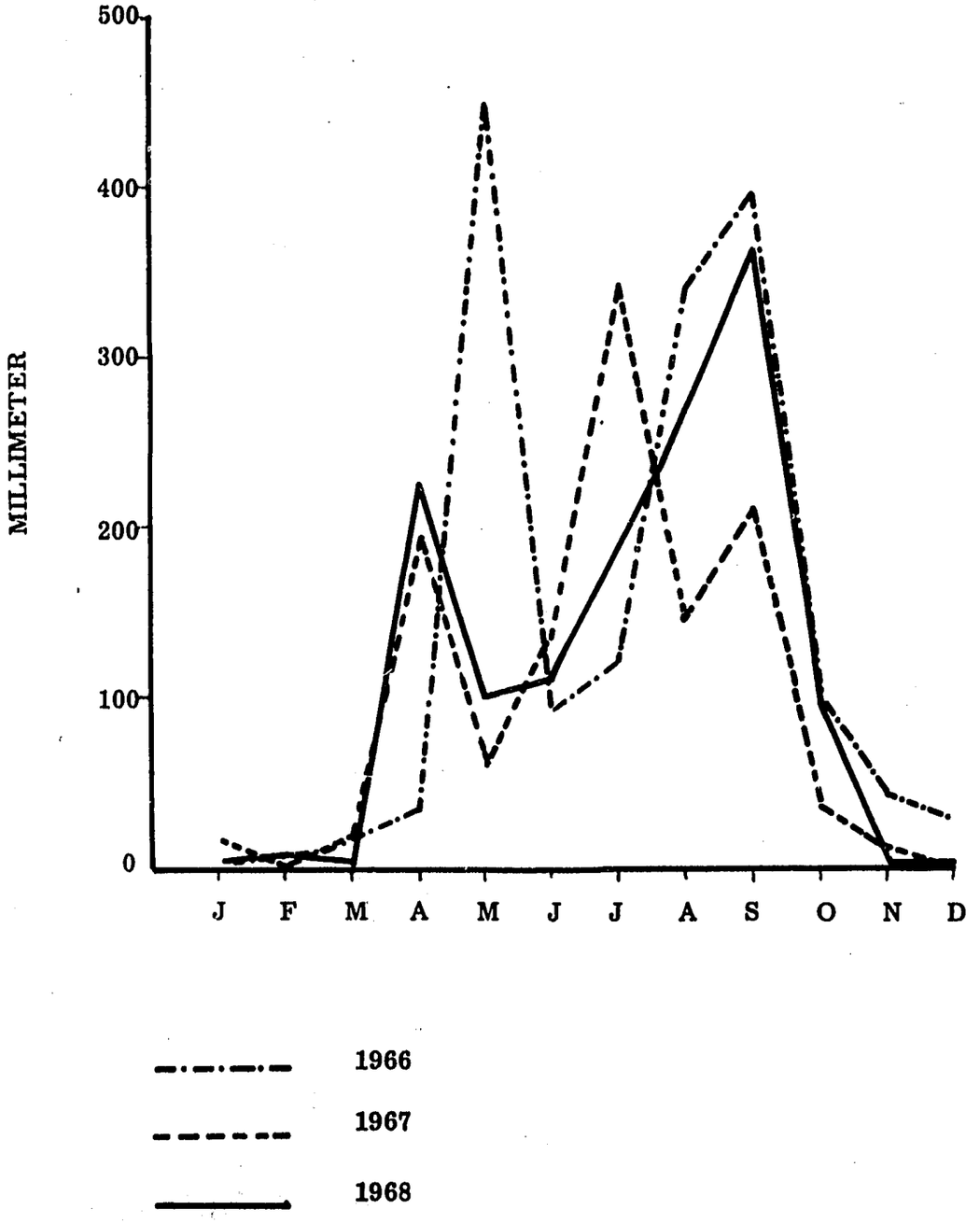
Equipment Available

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

MONTHLY RAINFALL

1966 - 1968

SURIN



10.037 Ubon Ratana Reservoir Station

Location	Established
Amphur: Nam Pong Province: Khon Kaen	1970

Area	Available for Expansion
134 rai - Land	Belongs to Electricity Generating Authority of Thailand

Personnel		Training	Year
Head:	Mr. Sanay Pholprasith	B.S. Kasetsart Univ.	1964
Biologists:	Mr. Manote Hongpromyart	B.S. Kasetsart Univ.	1967
	Mr. Somsak Janesirisak	B.S. Kasetsart Univ.	1970
Extension:	2		
Laborers:	10 Permanent		
	47 Temporary		

Reservoirs

Ubon Ratana	256,250 rai

Fish Species Stocked

Species	Number
Pla Choa-Hue	3,397
Pla Lin-Hue	10,303

Research Projects

1. Fish population in Ubon Ratana Reservoir.
2. Fish stocking in Ubon Ratana Reservoir.
3. Limnological survey.
4. An experiment on selecting the most efficient tagging method for fishes.
5. A study on life history of Notopterus notopterus, Puntioplites proctozysron, Cirrhinus jullieni.

Transportation Facilities Available

1. Jeep, willy; purchased in 1969; O.K.
2. Truck, international; purchased in 1970; O.K.
3. Boat, outboard motor; 9 HP; O.K. (unsafe in rough waters)

Equipment Available

1. 8 50 m seines
2. 8 100 m seines
3. 8 plankton nets
4. 5 aquaria
5. 1 electric pH meter
6. 1 analytical balance
7. 1 microprojector
8. 2 microscopes
9. 1 vacuum pump
10. 1 aqua analyzer
11. 1 centrifuge
12. 1 tele - thermometer
13. 1 recording thermometer
14. 1 water bath
15. 1 spectrophotometer
16. 1 air compressor
17. 1 electrically-heated still
18. 1 drying oven
19. 1 automatic titrator
20. 1 refrigerator

Equipment Needed

1. Motorized boat - safe for rough waters on a large reservoir.

10.038 Ubon Rajthani Station

Location

Amphur: Muang
Province: Ubon Rajthani

Established

1954

Area

57.25 rai - Land
6 rai - Water

Available for Expansion

None on station

Personnel

		Training	Year
Head:	Mr. Montri Muangboon	3 years vocational school	
Biologists:	Mr. Sanchai Sujaritvongsanondh	B.S. Kasetsart Univ.	1970
Extension:	11		
Civil Engineers:	3		
Laborers:	27 Permanent		
	22 Temporary		

Number and Size (m^2) of Ponds

Earthen		Cement	
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		

Earthen ponds will not hold water because of sandy nature of soils.

Fish Production

Species	Number
Pla Nai	
Pla Salid	
Pla Morted	
Pla Nin	
	1,500,000

All fish produced in floating cages on Huey Muang Reservoir beside the Station. This belongs to the Irrigation Department and furnishes water by pumping to the Station.

Research Projects

1. General survey on fishes and fishing gear in Moon River, Ubon Rajthani Province.

Transportation Facilities Available

1. Jeep, land-rover; purchased in 1964; O.K.
2. Jeep, land-rover; purchased in 1965; O.K.
3. Jeep, wagoneer; purchased in 1965; O.K.
4. Truck, dodge fargo; purchased in 1967; O.K.

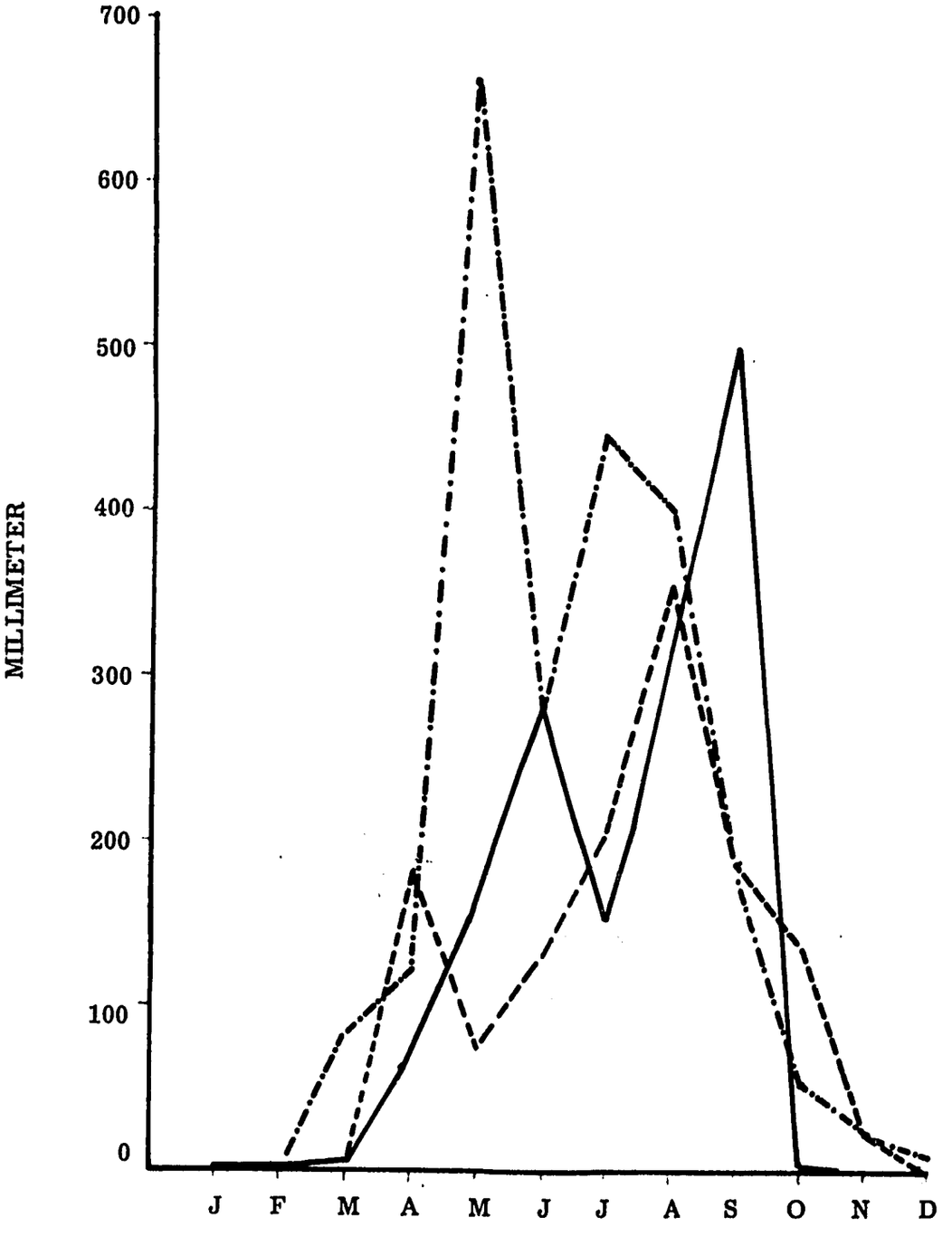
Equipment Available

1. 2 100 m seines
2. 6 50 m seines
3. 2 25 m seines
4. 9 plankton nets
5. 1 Kemmerer water sampler
6. 7 stereo microscopes
7. 3 motorcycles
8. Projection equipment
9. 1 9 HP water pump
10. 1 7 HP water pump
11. 4 5 HP water pumps
12. 1 13 HP longtail boat
13. 1 analytical balance
14. 11 thermometers
15. 1 electric pH meter
16. 1 compound microscope
17. 2 profile projectors
18. 1 dissecting microscope
19. 40 aquaria
20. 3 air pumps with filter
21. 1 16 HP inboard motor boat
22. 1 generator
23. 1 transistor tape recorder
24. 1 transistor amplifier
25. 1 binocular microscope
26. 1 camera (canon)
27. 1 refrigerator
28. 1 500 gm capacity balance
29. 1 lab kit for water analysis
30. 1 current meter

MONTHLY RAINFALL

1966 - 1968

UBON RAJTHANI



10.039 Udorn Thani Station

Location

Amphur: Muang
Province: Udorn Thani

Established

1954

Area

27.75 rai - Land
9.50 rai - Water

Available for Expansion

None on station

Personnel

		Training	Year
Head:	Mr. Songsilpa Sutjaritkul	3 years Kasetsart Univ.	1947
Biologists:	Mr. Pipop Kamolrat	B.S. Kasetsart Univ.	1964
	Mr. Chaichet Laojintanasri	B.S. Kasetsart Univ.	1968
Extension:	11		
Civil Engineers:	2		
Laborers:	24 Permanent		
	45 Temporary		

Number and Size (m^2) of Ponds

Earthen				Cement	
1	1,350	10	200	42	10
1	1,092	1	1,230	10	10
2	726	1	814		
1	400	2	704		
1	360	1	946		
1	660	1	770		
1	528	2	1,032		
1	1,080	2	480		
2	102	2	800		
2	90	6	400		

Rice Paddy Fields

20	160

Fish Production

	1970 Number	
Species	produced	distributed
Pla Nai	248,000	140,000
Pla Nin	257,000	79,000
Pla Morted	133,000	-------
	640,000	219,000

Research Projects

1. Experiments on common carp culture in rice paddy fields. (Floods ruined experiment in 1970. It will be repeated.)

Transportation Facilities Available

1. Jeep, land-rover; purchased in 1963; poor.
2. Jeep, land-rover; purchased in 1965; O.K.
3. Jeep; purchased in 1965; O.K.
4. Truck, dodge fargo; purchased in 1967; O.K.

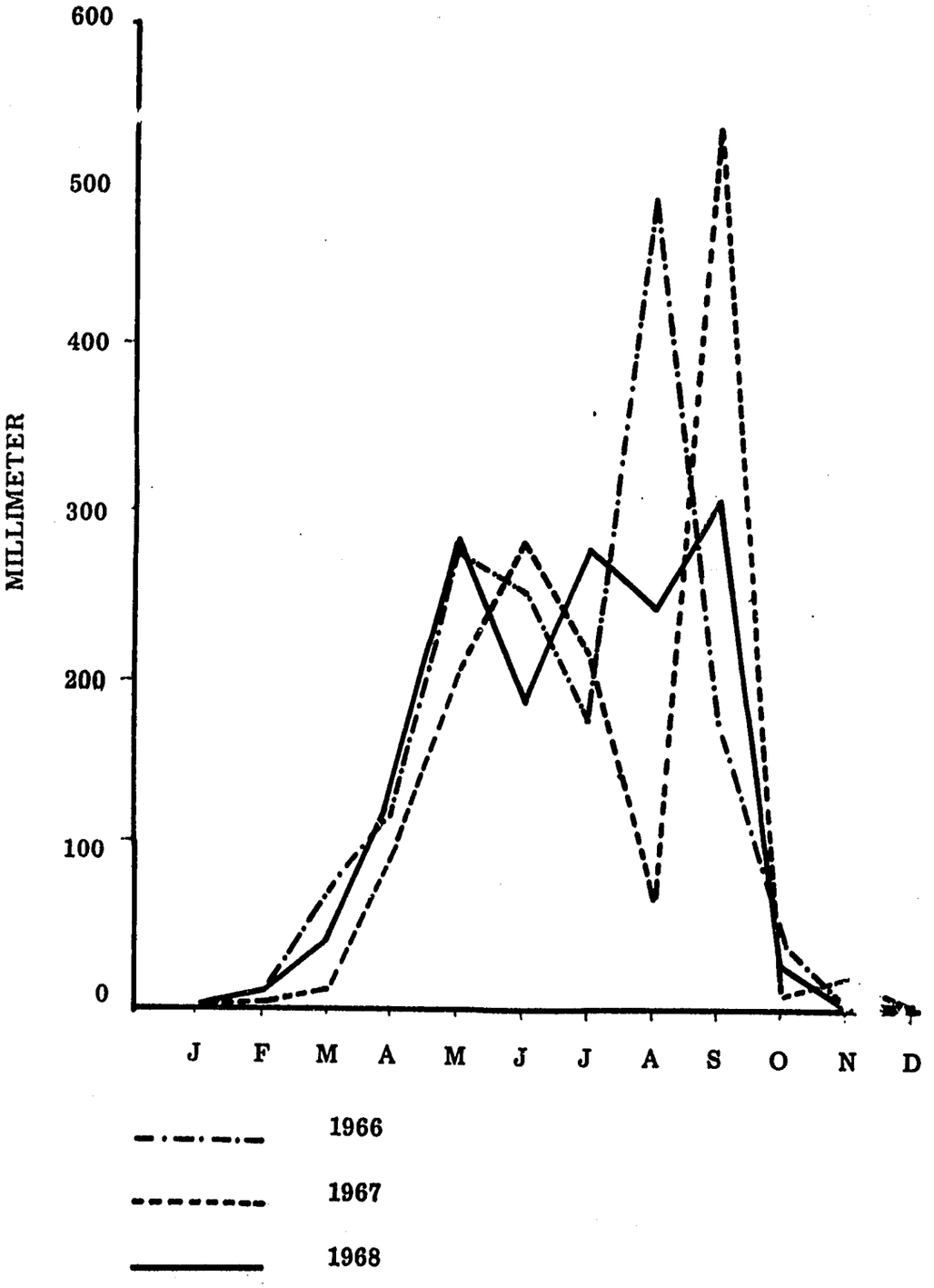
Equipment Available

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. 1 dissecting apparatus
9. 1 refrigerator
10. 1 analytical balance
11. 1 500 gm capacity balance
12. 6 thermometers
13. 1 pocket pH meter
14. 1 7 kg balance
15. 4 50 m seines
16. 6 25 m seines
17. 9 plankton nets
18. 1 profile projector
19. 20 aquaria
20. 2 air pumps with filters
21. 1 9 HP water pump
22. 2 12 HP water pumps
23. 1 7 HP water pump
24. 2 5 HP water pumps
25. 1 water analysis lab kit
26. 1 compound binocular microscope
27. 1 microscope substage lamp

MONTHLY RAINFALL

1966 - 1968

UDORN THANI



10.04 Fisheries Stations in Central Thailand

10.041 Bangkhen Station

Location

Amphur: Bangkhen
Province: Bangkok

Established

1937

Area

38 rai - Land
14.64 rai - Water

Available for Expansion

None on station

Personnel

		Training	Year
Head:	Mr. Samran Dhamrongrut	B.S. Kasetsart Univ.	1961
Biologists:	Mr. Manu Potaros	M.S. Auburn Univ. (U.S.)	1965
	Mr. Prasit Ketsunchai	B.S. Kasetsart Univ.	1961
	Miss Kamolporn Thonguthai	B.S. Kasetsart Univ.	1965
	Mr. Prasert Sitasit	B.S. Kasetsart Univ.	1966
	Mr. Kamthorn Pothongkum	B.S. Kasetsart Univ.	1967
	Mr. Pithaya Pennapaporn	B.S. Kasetsart Univ.	1967
	Miss Wirutadaisamukrasewee	B.S. Kasetsart Univ.	1968
	Miss Supranee Bumrungsuk	B.S. Kasetsart Univ.	1969
Extension:	1		
Laborers:	54 Permanent		
	9 Temporary		

Number and Size (m^2) of Ponds

Earthen*

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

Cement

32	4.5
24	6.0
80	50.0

*concrete side-earthen bottom

Fish Production

Species	Number
Pla Nai	1,612,000
Pla Salid	496,000
Pla Morted	142,000
Pla Mortan	91,000
Pla Ret	43,000
Pla Nin	1,363,000
Pla Lin-Hue	125,700
Pla Soong Hue	122,000
Pla Sawaii	25,000
	4,019,700

Research Projects

1. Induced spawning of Cirrinhus microlepis.
2. Feeding Clarias batrachus with trash fish and Auburn No. 2 pellets and with various rates of stocking.
3. Parasites and disease of pond fishes.
4. Selectrive breeding of C. carpio.
5. Composition of supplementary feeds for fingerling common carp.

Transportation Facilities Available

1. Jeep, willy; purchased in 1958; fair.
2. Volkswagen; 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

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 ba
8. 6 600 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 drying oven (max. 65 C)
14. 1 temperature recorder
15. 1 oxygen meter
16. 1 magnetic stirrer
17. 1 lab pH meter
18. 2 autoclaves
19. 2 calorimeters
20. 1 electric calculator
21. 1 barometer
22. 2 1 HP electric pump
23. 2 3 HP gasoline pump
24. 1 4-5 HP diesel pump

Equipment Available --continued

25. 1 50 kg scale sensitive to 500 gm
26. 25 aquaria
27. 1 10 cu. ft. refrigerator
28. 5 plankton nets
29. 1 shadow graph
30. 1 current meter
31. 1 water distillation machine
32. 1 turbidity machine
33. 1 centrifuge
34. 1 5 HP gasoline pump
35. 1 5 HP gasoline pump
36. 1 6 HP gasoline pump
37. 1 9-12 HP diesel pump
38. 1 air pump (3-5 aquaria)
39. 2 pellet machines
40. 1 mixer
41. 1 grinder
42. 1 cutting machine (for feeds)

10.042 Chainat Station

Location	Established
Amphur: Sunphaya Province: Chainat	1959

Area	Available for Expansion
48 rai - Land 17 rai - Water	51 rai

Personnel		Training	Year
Head:	Mr. Prasit Aguru	M.S. Auburn Univ. (U.S.)	1966
Biologists:	Mr. Pisan Choangpanich	B.S. Kasetsart Univ.	1966
	Mr. Manop Tungtrongpiroj	B.S. Kasetsart Univ.	1968
Extension:	3		
Laborers:	23 Permanent 2 Temporary		

Number and Size (m^2) of Ponds

Earthen		Cement	
2	1 rai	10	50
29	200	10	5
14	400		
10	800		

Fish Production

	1970 Number	
Species	produced	distributed
Pla Nai		
Pla Nin		
Pla Salid		
	1,000,000	600,000

Research Projects

1. Pangasius sutchi culture in floating cages.

Transportation Facilities Available

1. Jeep, land-rover; purchased in 1964; fair

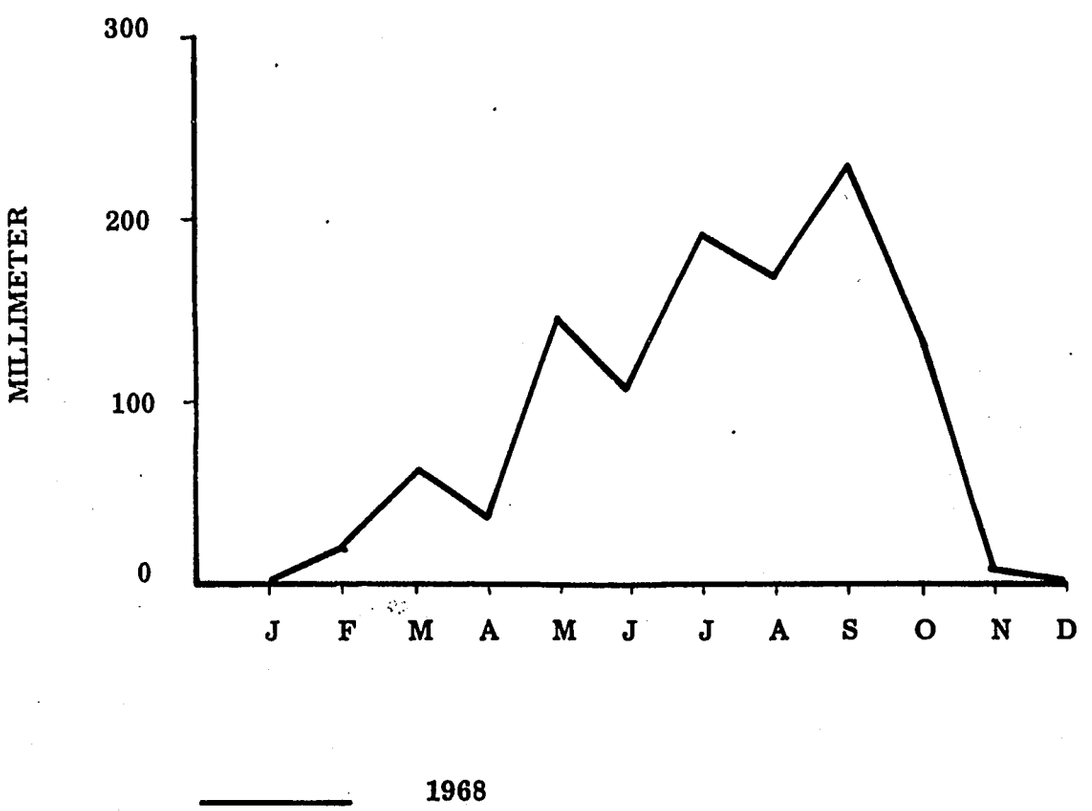
Equipment Available

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. 1 Ekman dredge
7. 1 Kemmerer water sampler
8. 1 compound microscope
9. 1 dissecting microscope
10. 10 aquaria
11. 1 analytical balance
12. 1 current meter
13. 1 500 gm capacity balance
14. 1 200 gm capacity balance

MONTHLY RAINFALL

1968

CHAINAT



10.043 Nakhon Sawan Station

Location

Amphur: Muang
Province: Nakhon Sawan

Established

1927

Area

35 rai - Land
17 rai - Water

Available for Expansion

None on station

Personnel:

		Training	Year
Head:	Mr. Vinus Boonyaratplin	B.S. Kasetsart Univ.	1962
Biologists:	Mr. Kumron Potipituk	B.S. Kasetsart Univ.	1968
	Mr. Khemchat Nimsomboon	B.S. Kasetsart Univ.	1964
	Mr. Suchin Thongmee	B.S. Kasetsart Univ.	1969
Extension:	6		
Laborers:	59 Permanent		
	8 Temporary		

Number and Size (m^2) of Ponds

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

Ponds filled and drained by pumping.

Reservoirs

Bung Bora Pet — 130,000 rai (water supply for Station)

Fish Production

Species	Number
Pla Nin	11,000
Pla Sawai	119,000
	130,000

Research Projects

1. Artificial breeding of Pla Sawai by pituitary hormone injection.
2. Study on stomach contents of some species of fishes in Bung Bora Pet.

Transportation Facilities Available

1. Jeep, land-rover; purchased in 1965; poor.

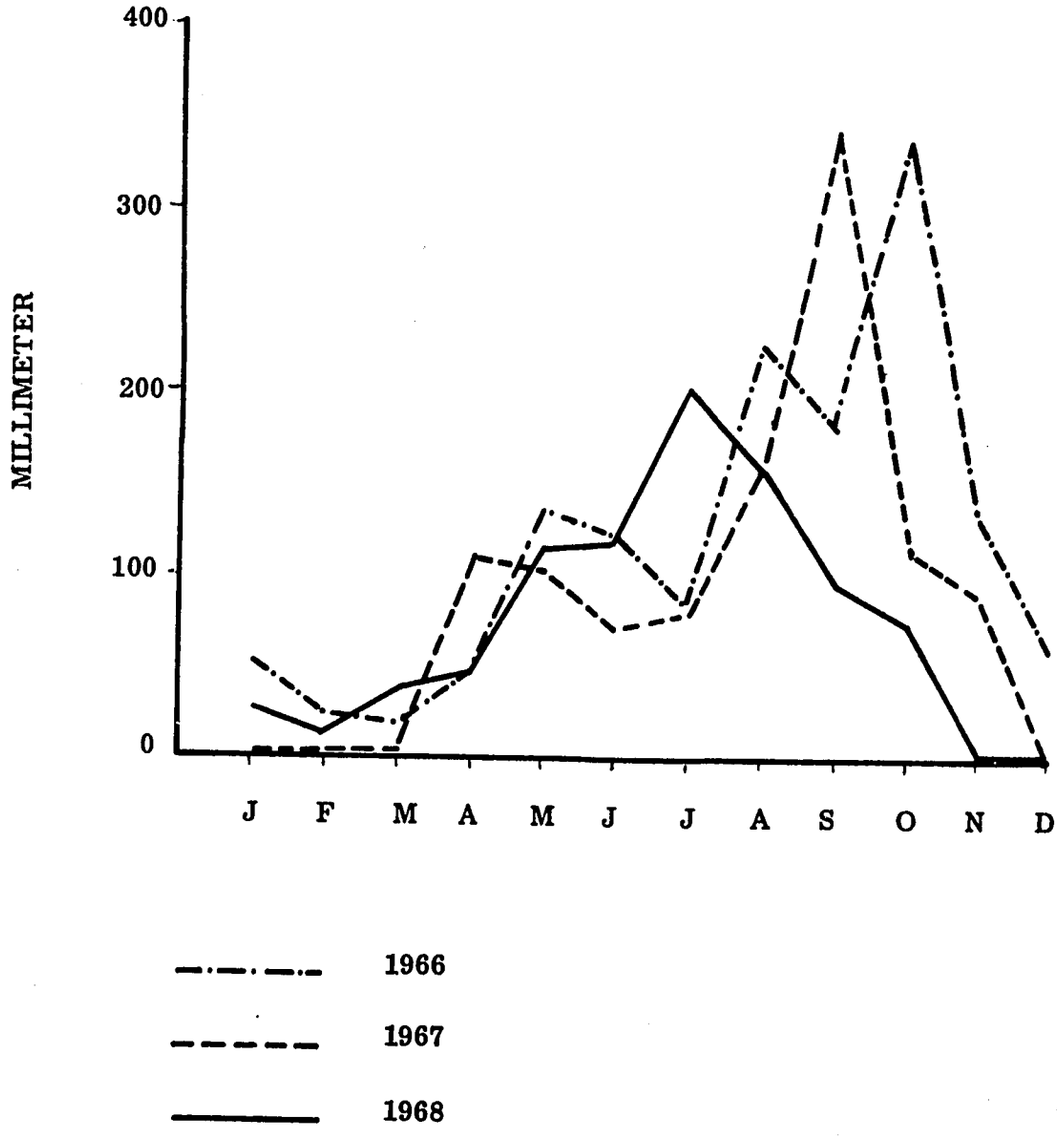
Equipment Available

1. 1 7 HP longtail boat
2. 1 50 HP longtail boat
3. 1 25 HP outboard motor
4. 1 20 HP inboard motor
5. 1 200 m seine
6. 4 100 m seines
7. 1 50 m seine
8. 3 plankton nets
9. 10 aquaria
10. 2 Ekman dredges
11. 3 air pumps
12. 3 dissecting apparatus
13. 1 microscope
14. 1 oven
15. 1 refrigerator
16. 1 current meter
17. 1 5-10 gm capacity balance
18. 1 12 HP pump
19. 1 9 HP pump
20. 1 10 KVA generator
21. 1 binocular

MONTHLY RAINFALL

1966 - 1968

NAKHON SAWAN
(Bung Bora Pet)



10.05 Fisheries Stations in South Thailand

10.051 Pattalung Station

Location	Established
Amphur: Muang Province: Pattalung	1954

Area	Available for Expansion
775 rai - Land 100 rai - Water	

Personnel		Training	Year
Head:	Mr. Pramot Wanichagorn	B.S. Kasetsart Univ.	1956
Biologists:			
Extension:	2		
Laborers:	4 Permanent 10 Temporary		

Number and Size (m^2) of Ponds

Earthen

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

Fish Production

Species	Number
Pla Salid	114,900
Pla Nai	136,100
Pla Nin	65,300
	316,300

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.

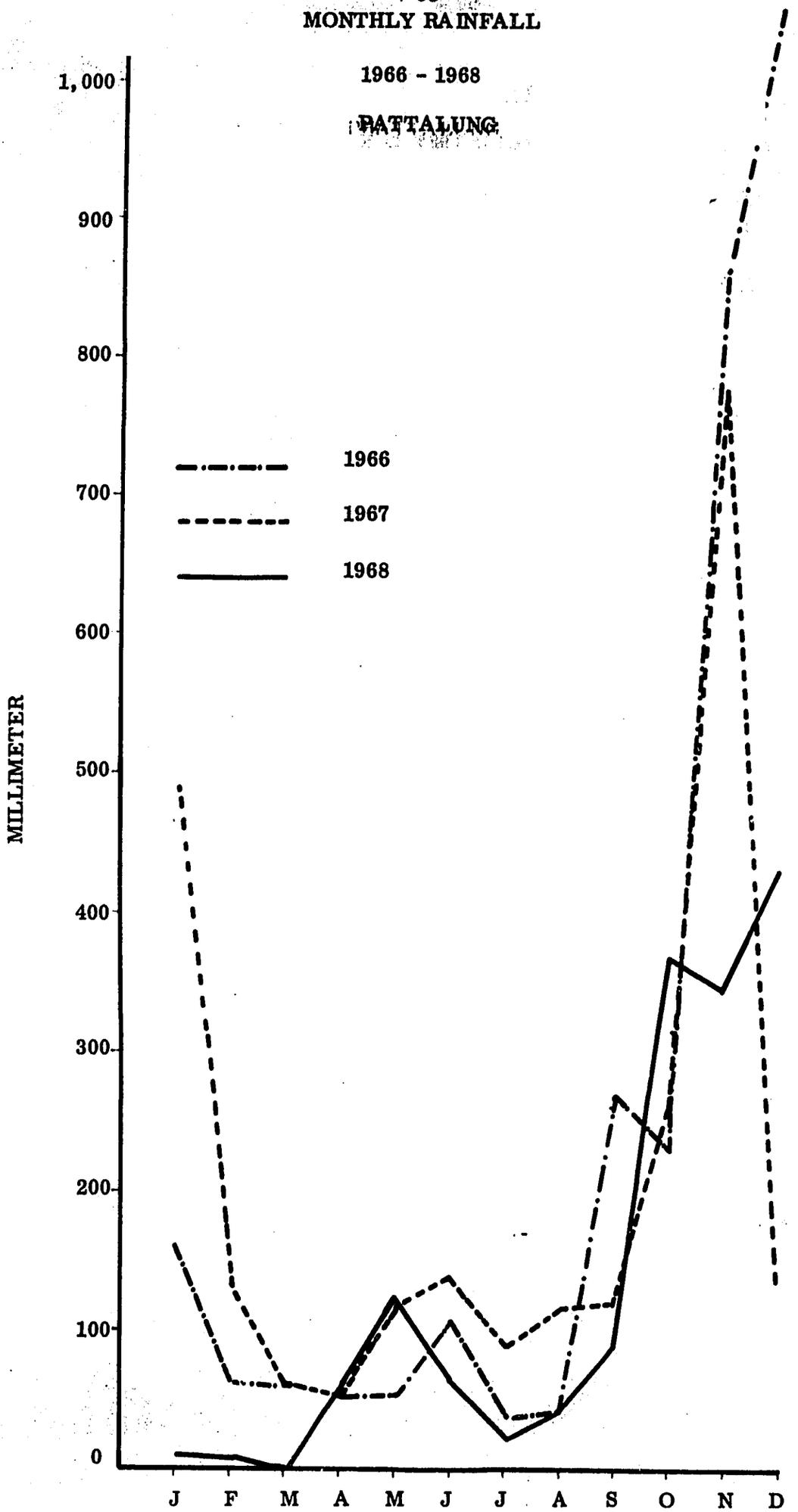
Equipment Available

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 air pump with filter
8. 1 analytical balance
9. 2 500 gm capacity balances
10. 1 Kemmerer water sampler

MONTHLY RAINFALL

1966 - 1968

PATTALUNG



10.052 Pattani Station

This Station is not in full operation.

11.0 FISHERIES STATISTICS

11.01 Catch of fish in tons, 1961 - 1968

Year	Marine	Freshwater	Total
1961	233,275	72,475	305,750
1962	269,709	70,079	339,788
1963	323,374	70,481	393,855
1964	494,196	82,790	576,986
1965	529,493	85,637	615,120
1966	635,165	85,117	720,282
1967	762,187	85,256	847,443
1968	1,004,058	85,245	1,089,393

11.02 Sale price (baht/kg) of freshwater fish at Bangkok Auction, 1964 - 1968

Fish	1964	1965	1966	1967	1968
Anabas testudineus	5.8	4.8	7.8	3.4	5.4
Carps	4.0	3.8	4.3	4.2	4.7
Clarias sp.	9.5	10.0	11.5	8.8	8.7
Fluta sp.	8.5	9.5	7.8	3.4	7.9
Notopterus chitala	6.3	7.3	8.0	7.8	8.9
N. notopterus	4.3	5.5	6.0	6.2	7.9
Ophicephalus micropeltes	6.0	5.5	5.0	6.3	7.7
O. striatus	9.5	10.0	10.5	9.0	11.3
Pangasius sp.	5.3	5.3	6.0	6.7	6.5

11.03 Freshwater fish and prawn catch in 1967 and 1968 (in tons)

Fish	1967	1968
Anabas testudineus	7,584	9,965
Chinese carps	------	378
Clarias sp.	14,117	13,897
Cyprinus carpio	------	7,354
Fluta sp.	------	1,123
Macrobrachium sp. (prawns)	3,738	4,008
Ophicephalus striatus	17,881	17,176
Pangasius sp.	767	955
Trichogaster pectoralis	4,652	5,677

11.04 Uses of freshwater fishes and shrimps

Uses	Tons
Fresh	49,398
Fermented	19,253
Dry-salted	9,157
Smoked	4,594
Fish sauce	1,707
Shrimp paste	296
Fish meal	178
Dried shrimp	77
Fertilizer	26
Other	623

11.05 Shrimp Culture in Thailand (Summary)

A total of 1,003 farmers operate 46,259 rai (18,500 acres) of coastal shrimp farms. Yield average is 54.2 kg/rai/year for a total yield of 2,500,000 kg of cultured shrimp per year. At 25 baht/kg, value for this production is 62,500,000 baht. Area available for expansion is about 3,000,000 rai.

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[1] From Banchong Tiensongrusmee: 1970. The present status of shrimp farming in Thailand, Invertebrate Fisheries Investigations, Department of Fisheries Contribution, No. 18. 34 pages, June, 1970.

12.0 RAINFALL DATA FOR THAILAND

12.01 Annual Rainfall (mm)

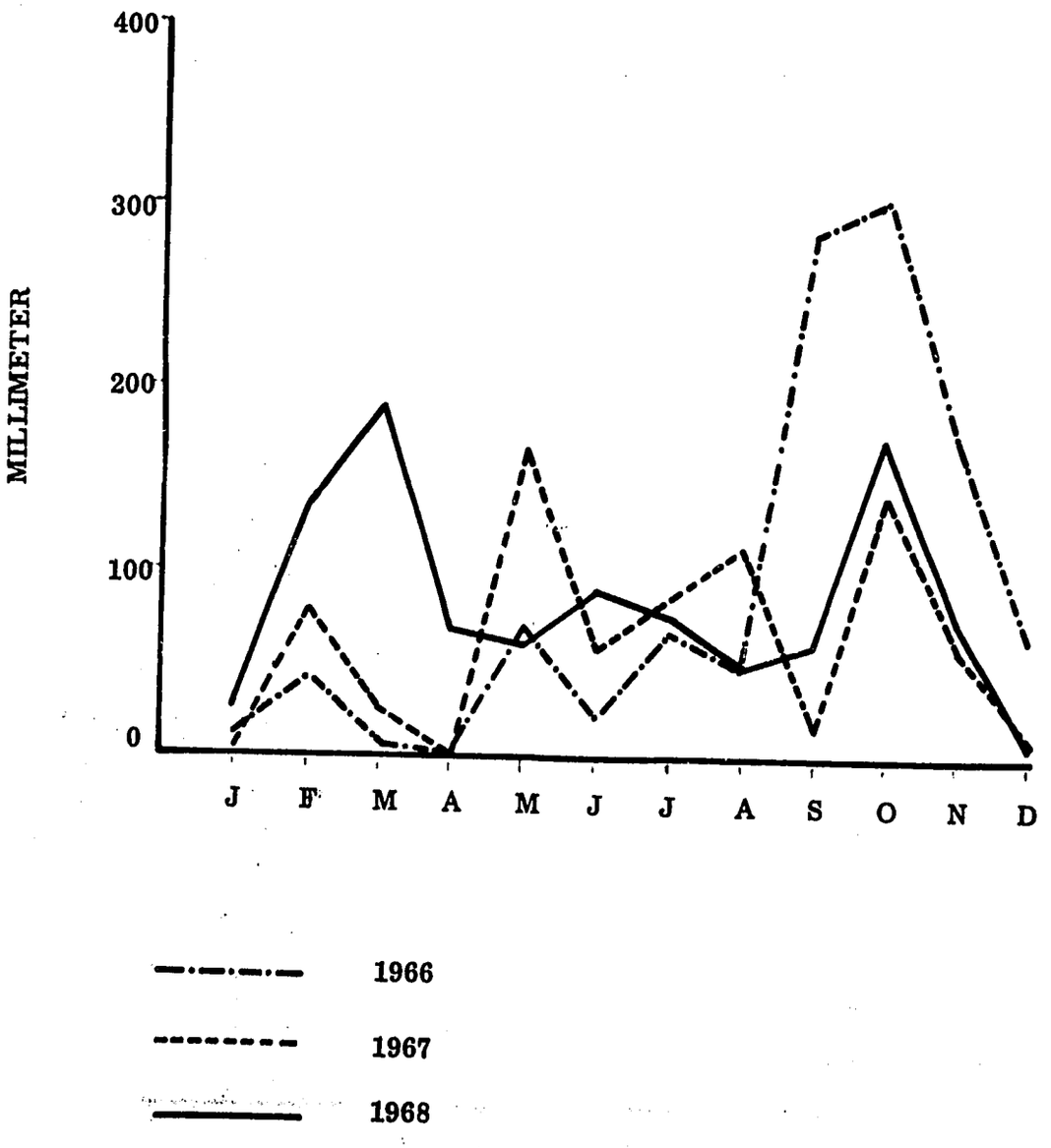
STATION	1966	1967	1968
North			
Chiang Mai	864.9	1354.1	1259.6
Chiang Rai	1833.5	2099.2	1935.4
Tak	1108.1	765.5	835.7
Northeast			
Khon Kaen	1366.2	931.1	1165.9
Maha Sarakham	1527.7	970.8	1319.0
Nakhon Rajsima	1317.8	920.4	1086.0
Nong Khai	1625.5	1644.8	1582.3
Sakon Nakhon	1445.7	1408.0	1494.1
Surin	1627.2	1172.1	1353.5
Ubon Rajthani	2257.6	1297.1	1474.6
Udorn Thani	1594.2	1427.7	1514.1
Central			
Bangkhen	1667.6	------	------
Chainat	------	------	1094.8
Nakhon Sawan	1438.9	1076.2	886.7
South			
Pattalung	3070.2	2515.8	1574.7
Pattani	2626.5	1708.8	1486.5
Marine			
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

12.02 Monthly Rainfall of Coastal and Marine Stations

MONTHLY RAINFALL

1966 - 1968

PRACHUAP KHIRI KHAN



MONTHLY RAINFALL

1966 - 1968

CHANTHABURI