2. Conclusions & Recommendation

A. Conclusions

a) The Research period covers the years 1978-1979 (from May 1978 to April 1979). According to the main future beneficial water ecology of Songkla Lake the main objectives of the study were : Water Loading Survey, Water Quality both Physical, Chemical and Bacteriology, Plankton and Benthic fauna Survey, Aquatic Resource and Fishery Situation. Anyway, the summary of this report is covered only assesment of Physical-Chemical Water Quality requirements for the conservation or improve in regard to future water used, fishery, aesthetic and recreation.

b) The Water Quality was facilitated through the Chemistry Laboratory of the Faculty of Sciences, Prince of Songkla niversity and the recessary field equipment and transpartation facilities.

c) The sampling stations were set up 15 stations along the whole lake within 820 km^2. nforjunately, the masking stations (wood pole) were distroyed by the fishermen. But the 15 stations caused not any problems for our and clear land mark.

d) Major Finding :

1) Salinity intrusion into the upper lake. Station 11 which was close to inlet of Thale Noi and very close to the Ranoj Pumping Station which pumps water to feed about 65,000 Rais and want water from thale luang 56.2 million m^3 per year, the annual average of salinity was 2.2 ppt. But in September, October 1978 were high as 4.0 ppt and 6.6 ppt and in March-April were found 3.2 and 3.4 ppt and its is about 2 ppt from December 1978 to April 1979. Salinity in 1965 of the upper part from Ko Yai. The inlet of Thale Noi by average was 1.3 ppt and 0.4, 1.7, 7.2 and 0.6 in 1966, 1967, 1968, 1969 and 1971 respectively.

The mineral content of the lake is therefore changing from year to year. The chemical quality is not salisfactory for water supply and irrigation.

2) 4 klong is playing a major role for conveying of pollutants. These were Klong Lampam, Klong Pakpra, Klong Mangrium and Klong Ranoj. Pollutants come from Demestic waste, agriculture.

B. Recommendation

a) It is recommended to continue the lake survey or the lake monitoring. However the sampling stations and sampling frequencies should be changed because of statistical reasons.

b) The area coverage should be the whole lake incleading, Thale Sap (Outer Lake), Thale Luang (Inner Lake) and Thale Noi. The reasons are that all parameters must be the same for the whole lake at the same time and also never omit any part of the lake

c) Physical-chemical parameters such as Temperature, Transparency, Dissolved Oxygen, Salinity, Alkalinity, pH, Nitrate, Phosphate, Chlorophyll is not sufficient at present and also the analyse and measure of these parameters could be continued until the project is in operation and resumed thereafter to follow up the changes in water quality, The other parameters should be measure the BOD COD, Turbidity, Silica and Total Solids. The pesticide residue analyses is a must in the near future.

d) Sampling Station must be reduced in Inner Lake and be increased in Thale Noi and Thale Sap at least 10 station all together.

e) Implementation the foregoing recommentation, the permanent technicians should be considered urgently in this project. Special research studies will be more and more required in the future in addition to lake monitoring inorder to answers specific questions (e.g. on the wastes assimilations capacity of the lake)

f) NEB and PSU cooperation should be closed and closed than before both policy and assistant ship. Particulary, NEB should have a master plan for the development and research projects in hand already and also PS. respone this policy carefully.

g) The maximum of the Laboratory (Chemistry sector only is enough for today. But the fact is many sub-projects such as Plankton, Benthic fauna, Soil Quality, Project Office, libary, Equipments are in this small room (6x6 m)

h) Staff members promotion should be done in this University. NEB & PSU should understand the situation of the staff very well and willing to deve lope them as soon as possible without any doubt. Workshop or training both in and out state.

i) Experts or Consultants are still necessary. However, it is recommended to send those Expert or Consultand both Thais and Foriengners who understand Thai and willing to help, not to lookdown upon us

j) Budget for the project for each fiscal year should be written by both NEB and PSU and managed by PSU only

3. Introduction

Lake Songkla has an area about 1,040 km^2, produced one of the largest lake in Southeast Asia. The depth in general is about 1-2 meters. Thes lake is divided into 4 parts, namely, outer part (Thale Luang), straits (from Pak Ror to Pak Phayun), Inner part (Thale Noi) and most inner part Thale Noi, respectively. Ecological characteristics of both plants and animals of this lake are different from one part to the others due to hydrological and climatic factors.

Lake Songkla forms a terminal of many canals originating from Tennaserim Mountain on the west and connects with the sea at the end part at Songkla to the Gulf of Thailand. Therefore the upper part of the lake consist exclusively of fresh water. The water becomes more saline in seaward direction. The salinity in the North is 1.8 ppt and gradually increases to 28 $\pm$ 4 ppt at the end part. The penetration of saline water into the lake is due to the tied and rain fall, for instance in January the salinity of the whole lake may range from 0.3 to 0.4 ppt (S S Annual Report 1965-1966). The ecological equilibrium can be therefore easily upaet.

The bottom soil at the northern part of Lake Songkla is clay loam and silty clay loam, at the middle is clay and at the lower part is sanda clay High amount of organic matter causes the low pH of bottom soil at the upper part and decreases to nearly neutral at the lower part where there is less organic matter. Erom the data of phosphorus of bottom soil, it is Justify to say that the lake has rather high potentiality of fertility. Since the lake is shallow and scarcely lack of oxygen at the bottom surface, the phosphorus can hardly be exchanged between the bottom surface and lying over water. This evidence is supported by the low amount of phosphorus which can not be detected (KOBAYASHI 1959). On the contrary, below the bottom surface provided anaerobic condition could increase the dissoving degree of phosphorus. Consequently it enhance the growth of rootting macrovegetation. The nuisance of macrovegatation is one of the important problers, specially in the northern part of the lake.

The mass of the lake water is easily everturned and replaced since there are many inflows, This can be seen from the seasonal fluctuation of salinity. IT is believed that chemical property of water should be seasonally changed but there is no evidence to confirm. Therefore the investigation of

chemical property of lake is one of the essential subjects. This should emphasize on the nutrient cycle since it is a limitting factor of the production capacity of lake. Moreover, the chemical data could provide the awareness of pollution and/Or eutrophication. The drainage into lake, other than nurtients, could be wastes, for instance, oil, chlorinated hydrocarbon and waste from rubber processing.

The survey on biological aspects, as far as appeared in Annual Report of Songkla Marine Fisheries Station (1965-1975), is more or less incomplete both in methodological implication and data presentation. Therefore the survey of biological resources in respect to biological production and biological indication of eutrophication and/or pollution should be carried out. This includes microbiological survey.

Fishery conditions in Lake Songkla is very intensively performed since the production of aquatic animals is rather high. HTS (1974) estimated that 6 metric tons per square kilometer per year is reasonable. In total catch with seine, it contained giant prawn of high purchasing price up to 18.7 per cent (S S 1973). Most of the fishing gears is stationary, e.g. fish stake, bamboo fence, drifting net, long-line hook. But the units of each kind are numerous, sufficiently to understand that the resources in the lake are heavily over-exploited. However there is no evidence to confirm this hypothesis. the survey of fishermen, number of fishing grats and their efficiency, and the amount of aquatic animal harvested is very impertant in the project.

In conclussion, the utilization of aquatic resources and environmental planing of Lake Songkla can be conducted only after we have a complete set of data on biological and chemical properties of lake. It is therefore worth while to carry out first the extensive survey of Lake Songkla to examine what and where the resources are. After that in order to, evaluate the plan of lake utilization, its impact on biological environments should be carried on in a way of intensive research. For extensive research, the designed investigation should emphasize on the aspects of data securing to indicate the present and future problems, e.g. the impacts of deep-sea port planning, drainage of domestic, industrial and agricultural sewages into the lake, and the heavily exploitation of aquatic resources.

4. Project Objectives

To survey the Inner Lake (Thale Luang) for obtaining information (Baseline Data) which are relevance for over all planning of Lake Songkla, for instance environmental planing and Resources.

Aspect of studies :

1. Water Quality (Physic-Chem)
2. Heterotrophic and Coliform Bacteria
3. Pollution Loading Survey
4. Bottom Sediment Quality
5. Plankton Survey
6. Benthic Fauna Survey

5. Background Information on Area

5.1 Location and geography

What is generally known as Lake Songkla actually condidts of five distinguishable areas :

(a) A small (24.4 km^2), isolated Thale Noi to the north

(b) Two large contiguous water bodies, Thale Luang (487 km^2) and Thale Sap (333 km^2) which together comprise 78 % (820 km^2) of the entire Lake system.

(c) Ao Tong Ben and Khlong Luang (28.5 km^2) which are essentially connecting canals to the southern portion,

(d) Thale Sap Songkla (179 km^2) whith its narrow outlet to the Gulf of Thailand at Songkla Town

The total Lake water area is about 1,051 km^2 or only 13.5 % of its entire watershed of 7,797 km^2 which is located in three adjacnet provinces of Southen Thailand as given in Table 1

Table 1

Watershed Area of Lake Songkla Complex

Province	Lake Area		Watershed Area (Land)		Watershed Area (Total)	
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)
Nakhon Si Thammarat	0	0	274	4.1	274	3.5
Phatthalung	426	40.5	2,883	42.7	3,309	42.4
Songkla	625	59.5	3,589	53.2	4,214	54.1
TOTAL	1,051	100.0	6,746	100.0	7,797	100.0

More than 100 streams of all sizes flow into the Lake system but there is only one narrow channel outlet to the sea. The eastern boundary of the Lake is a generally sandy narrow strip with a first class highway along which are located more than 50 villages or "ban"

Thale Noi, the northern isolated portion of the Lake complex, is geogically doomed to be become a marshy and swampy area eventually becoming part of the surrounding alluvial plains. Already the northern and easten boundaries of this Lake are covered with mangrove swamps, which appears to have been part of the Lake seceral millenniums ago. The waters of Thale Noi have salinities comparable to fresh water with less than 50 to 100 ppm of chlorides. At least five identifiable streams feed the Lake which is connected to Thale Luang by two small streams about 2.5 kilometres long.

Thale Luang and Thale Sap form the main Lake water body. They have a salinity ranging from less than 200 ppm in the upper northern reaches to about 18,000 ppm in the lower or southern parts, influenced mainly by rainfall during the monsoon season and the tidal effects of sea (Gulf of Thailand) entering the Lake through the narrow inlet at Songkla. This main water body is shallow, averaging 1 to 2 metres in depth and with a relatively flat bottom. Numerous patches of water plants are already slowly forming sand banks. These areas serve as waterfowl resting, feeding and nesting places.

At the northeastern corner, near Ranot town, there is a staff gauging station with water elevation being read 5 times a day every three hours from 0600 to 1800. Water elevation at this point varies from about 0.4 metres below mean sea level (MSL) during dry season to about 1.4 metres above MSL at flood seasons. At the southern end of this portion of the Lake is located the bird sanctuary at Ban Khukud and the Kohseekoha or "bird cave" islands.

Khlong Luang and Ao Tong Ben connect the main Lake body to the southern portion called Thale Sap Songkla. This part of the Lake complex is a tide-affected body of water with salinities varying from less than 200 ppm during flood flows to more than 32,000 ppm at high tides in the dry season, nearly that of normal sea water, At the southeastern part of this Lake area is located the town of Songkla. The lightly industrialized town of Haadyai to the southwest discharges its effluents-laden streams also into this portion of the Lake.

The entire Lake complex watershed is rectangular in shape tapering to a point south of the Khao Nam Khang mountain range at the boundary of Songkla and the State of Kedah in Malaysia. It measures about 68 kilometres wide in the east-west direction and up to 190 kilometers in length in the northwest-southeast direction.

The west side of the basin generally follows the provincial boundary between Changwat Phatthalung and Changwat Trang. The northern boundary is that between Changwat Phatthalung and Changwat Nakhon Sri Thammarat. The eastern boundary is the Gulf of Thailand to the Port of Songkla and down along the watershed boundary of Khong Na Thap.

5.2 Hydrology

As recorded at stations located in Phatthalung, Khuan Khanun, Haadyai, Rattaphum and Ranot, the 20 year (1952-1971) mean rainfall is 1,950 mm. The average distribution of rainfall per month at these five stations is given in Table 2a below.

Table 2a

Monthly Rainfall and Rainy Days, Lake Songkla Area

	J	F	M	A	M	J	J	A	S	O	N	D
Average rainfall (mm)	121	33	45	88	125	68	82	85	99	288	472	368
Average number of rainy days	6.4	2.5	3.1	5.1	8.1	5.5	6.0	6.8	7.2	14.2	16.2	13.3

The annual rainfall over the watershed is thus a little less than 2 metres annually and on the average there are 94 rainy days a year. It is also of interest to note that there is a marked dry and wet season.

Table 2b

Annual Rainfal and Rainy Day by Season, Lake Songkla Area

	Average Rainfall	Average Rainy Days
February to September	625 mm	44.3
October to January	1,249 mm	50.1

Rainfall in the 4 month period October to January is twice that of the 8 month period February to September, although the numbers of rainy days in the two periods do not differ very much. This is clearly shown in Table 2b. The Netherlands Development Company or NEDECO, a Dutch consulting firm, has estimated that the evaporation of the Lake is between 1,145 to 1,340 mm annually. Annual runoffs into the Lake of 5 khlongs on the west side very from a low of 376 mm, for Khlong Thakae with a catchment of 290 km^2 in 1968, to a high to 1,977 mm. for Khlong HuaMon with a catchment of 240 km^2, in 1965. Total annual run off to the Lake system (except Thale Sap Songkla which is connected directly to the sea) is estimated to be between 2.28 and 2.78 billion cubic metres during the year 1965-1967)

5.3 Demography

The population in the watershed as catchment area of the Lake, as given in the 1970 census data is shown in Table below

Population in the Lake Songkla Watershed Dam
Based on 1970 Census Data

Changwat and Amphoe (Province and District) Inside Watershed	Total Households	Total Population	Approximate Median Age
a. Nakhon Sri Thammarat			
1. Cha-uat	10,110	59,968	14
b. Phatthalung			
1. Muang Phatthalung	19,534	109,285	17
2. Khao Chaison	11,059	60,047	16
3. Khuan Khanun	14,895	83,463	16
4. Pak Phayun	9,644	52,177	16
c. Songkla			
1. Muang Songkla	21,964	118,031	18
2. Ranot	12,620	68,620	17
3. Rattaphum	9,857	54,229	17
4. Sadao	8,325	44,447	17

5. Sathing Phra	7,046	37,654	18
6. Haadyai	31,146	165,456	18
TOTAL	156,200	853,377	17

5.4 Water and Irrigation Systems

Of all the resources in the Lake system, water is without doubt the primary concern. It is renewable and assured by the natural hydrological cycle. Its use and development, however, needs hyman intervention, otherwise, it is either lost into the sea or its quality impaired by tidal effects or by manmade pollution. Water's primary uses in the Lake are public and small agro industrial supplies, irrigation, aquaculture and transport.

Non-living water resources of Songkla Lake watershed include rivers and streams, khlongs and ground water in addition to the Lake water itself. Data on the exact number of stream and rivers and their flows are not available although the RID has gauging records of a few important ones.

Average rainfall is 2000-3000 mm. a year but in the monsoon season heavy rainfalls can occur continuously for 3 to 7 days. Such excessive precipitation may total 200-600 mm. resulting in sudden floods which fortunately do not, except in extremely exceptional cases, inflict serious damage to agricultural lands or existing irrigation systems. However, there is a lack of rain at the beginning and the end of the cultivation season and this implies the necessity of appropriate irrigation and adequate drainage systems.

From the best available map, eleven major rivers may be seen to drain into the Songkla Lake as follows ;

(a) To Thale Noi

1. Khlong Pa Phayom (to the mangrove area north)
2. K. Tha Nae (through Amphoe Khuan Khanun)
3. K. Mae Toei

(b) To Thale Luang

4. K. Yai (through Changwat Phattalung)

5. K. Hua Mon (through Ban Lam Pam)

6. K. Tha Madua (through Amphoe Kaho Chaison)

(c) To Thale Sap

7. K. Pa Bon and K. Loet

8. K. Long

9. K. Phru Pho

(d) To Thale Sap Songkla

10. K. Kao Yai (through Amphoe Rattaphum)

11. K. U. Taphao (through Amphoe Hat Yai)

Principal irrigation activities center on drainage and salinity contril and water distribution in small projects. Currently, nine river irrigation projects are operational, eight of which are diversion dams across medium sized (about 50 meters wide) rivers and one is a pumping station at Ranot, using water from Thale Luang. The total area to be served by these projects is estimated to be 368,000 rai or 59,000 ha. with an average water use of almost 359 million cubic meters a year. In addition four potential impoundment dam sites and one diversion dam location have been studied with a possible irrigable area of at least 142,000 rai or 22,700 hectares. Within the next few months, the first phase of the Ranot Pumping Station is expected to be fully operational and will benefit farmers in an area of more than 115,000 rai or 18,000 hectares.

The total water surface area of the Lake complex is about 1,000 sq.km. at an elevation of 4.5 m. above mean sea level (MSL), but only about 299 sq.km. at an elevation of 2.0 meters above MSL.

5.5 Fisheries and Aquaculture

Fishery is an important sector in Thailand's economy. The country ranks among the top ten fish producing nations of the world with an annual landing catch reported at 1.5 million metric tons, of which 90 % comes from marine fishing in the Gulf of Thailand, Andaman Sea and South China Sea. Total annual inland production is only about 100,000 tons while production from aquaculture has risen to 50,000 tons in 1975. However, there is the constraint in further development of aquaculture and inland fishing development in LS basin the diversion of water for irrigation reduces the area for fishing.

In particular, Songkla has a large stake in fishery, since many fishing boats such as trawlers use the province and port as a home base. It is perhaps partly because of this that the government decided to establish a brackish fishery station in Songkla, now pioneering in modern techniques of aquacul ture and inland fishery development. Authorities now recognise that the production development potential of inland fisheries, particularly aquaculture in Lake Songkla is substantial considering a tropical climate free of typhoons and other natural calamities, favorable geography and apparent natural abundance of nutrients compatible with fishery in the Lake. Such organisms as copepods, cladocerans, lucifer, sagitta and similar benthic biota have been found to be of sufficient abundance in the Lake waters to support much more population of fishery and other living resources than is presently the case. Perhaps, natural fertility of the Lake bottoms and dissolved nutrients may, if identified, ensure better and more extensive aquaculture along the Lake shores. Realizing this Lake potential, the Fourth Five Year National Development Plan will incorporate priority programmes for the acceleration of inland fishery development and the intensification of aquaculture development in fresh water.

Some 36 species of fish have been identified as indigenous to the Lake. The more important ones are the sea bass, grouper (Epinephelus sp.) mullet (Mugil sp) and murell (Ophicephalus sp). In addition, crabs (Scylla serata), oysters (Crassostrea lugubris) and shrimps (Penaous sp) have been caught in fairly large quantities. Aquacultrue of these resources is being encouraged by the Fisheries Department. In a parallel move, backed by formal legislation, trawl, encircling purse seine and use of electric devices and explosives are forbidden as part of the conservation efforts within the Lake complex.

For internal purposes, Thailand distinguishes three types of fisheries - inland, brackish and marine. Obviously, only the first two types would be relevant to Lake Songkla ; and in particular Thale Sap Songkla would involve brackish fishery since it is tide - affected. The administrative and organizational set up of the brackish fishery stations in Songkla is quite func tional. under the present director, the station is pursuing its work rigorously along five major thrusts ;

(a) aquaculture research, including nutrition, disease and parasites and predation

(b) seed production of fin fishes, prawns, shellfish and plankton fish food

(c) selection of aquaculture areas in the Lake including ecological studies, taxonomy and specie preference

(d) conservation, improvement of fish stock in Lake including stock assessment, utilization, pollution studies and evaluation

(e) coastal aquaculture activities including extension services, registration, training and demonstration and fishery cooperations.

The Lake itself is periodically stocked with the brackish tiger shrimp (Penaeus monodon) and fresh water prawn (Macrobrachium rosenbergii). It is reported that about 130,000 kgs. or 130 tons of the latter have been caught and landed in 1976. Sea bass (Lates calcarifer) is intended to be introduced in 1978. Seed for these stocks are now being produced from the three field stations using modern methods. It is quite a tribute to the fishery officials that, in spite of the limited budget, the fishery field stations are doing a great job in producing the needed fish finferlings for stocking of aquaculture ponds.

But much more needs to be done. More extensive inventory and rehebilitation surveys, dissemination of already known techniques of aquaculture through effective extension work, rearing of young seed prior to stocking, enlarged production from the Lake and of caurse establishment of suitable credit facilities and aquaculture area licensing schemes, are obvious needs.

6. History of Project

The project is divided into two pariods. The first period will take three years which can be scoped as following :

1. To survey the resources of Lake Songkla extensively for environ mental planing and resources management. One year period is required.

2. To carry out an intemsive research in particular topics subjected from the data evaluation of the first year. The time requirement is also one year and during this time the routine work of the first year is still carried on.

3. To apply the research results of the first two year for the benefit of sovity. This may also take one year period and the routine work is still carried on.

The second period concerns the routine work in checking the impact of human activities and environmental change on Lake Songkla, and the tackle of immediate problems involved in order to predict the future problems for preventive measures.

During 1976 - 1978, the Project was organized by Dr. Danai Limpadanai and the six sub - projects had been rupported joinly by the Harbour Department, the National Environment Board and the Songkla Fishery Station and the Prince of Songkla niversity, Those sub - projects were Pollution Loading Survey (Thale Sap Songkla by Narong Nachiangmai, Heterotrophic and Coliform Bacteria by Niti Rithpornpan, Water Quality by Chatchanok Kalari, Plankton and Larvae of Aquatic Animals by Danai Limpadanai, Aquatic Resources and Fishery Situation by Yudh Hansopa and Benthic Fauna Survey by Apichart Thammarak. All project proposals covered only the (Thale Sap Songkla)

In May 1978, the Songkla Lake Project was organized by Narong Nachiangmai as Project Director. The proposed project was similar to that carried out by 1976 - 1978 but a new project was carried out under the PSU staff that was Bottom Sediment Quality. Also, this research project has been supported jointly by the Songkla Fisheries Station, NEB and PSU

The project has begun since May 1978 - April 1979. The survey was carried out by selling 15 stations around Inner Lake (Thale Luang) with an ares 800 sq. Kilometers.

7. Project Work Plan and Activities

7.1 Aspect of Studies

7.1.1 Physical properties

(a) Depth Survey is emphasized on the depth of the lake at various points for construction of bathy-metric map for interpretation with other data.

(b) Sedimentation Sedimentation, other than causing lake become shallow, can damage the spawning and feeding ground of some certain aquatic animals.

(c) Transparency Light intensity into lake can be estimated from a transparency. It is one of the indicators for turbidity of for productivity of waters. In interpretation with other data it may provide some informations of water quality.

(d) Temperature Temperature is a limitting factor of many process/ of activities of lake both biota and chemical reactions. The data of vartical fluctuation of temperature may provide some necessary informations.

(e) Conductivity Conductivity can provide total dissolved solid in water and this has an effect on various aspects of biota in lake ecosystem.

(f) Hydrological Survey This includes inflow, outflow and water circulation in lake. It is, when using with other data, very essential for environmental planing.

7.1.2 Chemical & Biochemical Studies

(a) pH pH in water can indicate degree of water quality.

(b) Salinity Salinity in Lake Songkla fluctuate seasonally, i.e. Lake Songkla is mixohaline. When salinity is used with other data, its influences on biota can be examined

(c) Dissolved Gases Dissolved gases such as oxygen, carbon dioxide and amonia etc. can express the degree of productivity and/or decomposition in waters

(d) COD COD shows the amount of organic matter to be oxidided and unsaturated organic compounds in term of oxygen consumption

(e) Dissolved Solids Dissolved solids such as nitrate, phosphate, silicate, calcium and iron etc. are nutrients of plants both micro- and macrovegetations. Furthermore, some of them shows the degree of eutrophication.

(f) Oil & Pesticide Both cause the pollution of water while the first is unknown for its potential breakdown or the biodegradative capacity, and the latter is toxigenic.

(g) Chemical Properties of Bottom Soil This contains the potentiality of soil fertility and when the conditions are enhanced the exchange of ion between soil surface and water lying above will take place. Eurthermore, they provide good conditions for rootting plants. The emphasis of this survey should be placed on the nutrient content and exchanged potentiality

(h) Biochemical Studies This is to study the biochemistry of macrovegetation and algae, specially the macrovegetation which are very densely in the northern part of the lake

7.1.3 Biological Studies.

(a) Plankton Both phyto- and zooplankton are indicator of enrichment of lake since they react directly to the amount of nutrient supply Furthermore, they are diet of aquatic macro-animals. Some of them are indicator of degree of eutrophication and pollution. Therefore their quality and quantity including production capacity should be determined

(b) Aquatic macro-vegetation Macrovegetations are not only useful in asense of refuge of many aquatic animals but in some case they are also accumulation place for pect. In many cases they cause the waters become shallow. Their abundance and vicinity should be investigated.

(c) Aquatic animals There is no complete list of aquatic animals in Lake Songkla. Only some particular kind has been compiled, but the majority has not. Consequently, the impact of environmental change to them is unknown. Therefore, the list of fauna should

collected and continuous observation should be carried on. This covers nektic, aufwuchs and benthic fauna including their parasites.

(d) Microbiological Studies. Microbs are important as they are decomposer of organic matter in lake and some particular kinds are diseases. The investigation of heterotrophic and coliformic

7.1.4 Fishery Survey

(a) Fishery Resources. Lake Songkla gas been very rich with crustaceans and fishes. Giant prawn, Macrobachium rosenbergi, has been found in all part of the lake. The upper part is covered with macrovegetation. The first stage of this study is to survey the removal amount of the said resources to evaluate whether they have been reasonably expoited.

(b) Fisheries. The mean of removal and exploitation of aquatic resources may be called "fishing". This is to survey the fishing conditions of Lake Songkla including efficiency of some important fishing gears.

7.1.5 Sources of Water Pollution. Pollution of Lake Songkla, which is going on now or may exist in the future, can happen from various sources, e.g. domestic sewage, rubber processing waste, and/or other industrial and agricultural wastes, The survey of sources of pollution may be one of the tools for corrective and preventive measures.

7.2 Work Plan and Activities (May 1978 - April 1979)

Six Sub-projects concentrated in the Inner Lake are

(a) Pollution Loading Survey

a survey of Quantity and Sources of Waste Materials emptying into the lake included, Community Waste, Industrial Waste, Agricultural Waste from catchment area and also analysis of water Sample from tributaries

(b) Water Quality

Analysis of water sample from various stations to determine Temperature, DO, B.O.D, Nitrite, Phosphorus, Salinity, alkalinity, Chlorophyll etc.

(c) Plankton Survey

Survey and Collection of Samples by the I.B.P. method. Analysis as to type and quantity in various areas with respect to time of year.

(d) Benthic Fauna Survey

Collection Samples using a type of fishnet. Analysis as to type and quantity with respect to time of year.

(e) Heterotrophic and Coliform bacterial

Survey and analysis of water samples at various stations to determine type and quantity of bacteria

(g) Bottom Sediment Quality

Survey and Coolection of Bottom Sediment samples and analysis to determine total and Soluble components of N, P, K and Fe. Also, determination of Heavy Metal

8. Project Schedule

No.	Sub-project / Description	1978 May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1979 Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1980 Jan.	Feb.	March	April
1.	Pollution Loading Survey																								
2.	Water Quality																								
3.	Heterotrophic and Coliform Bacteria																								
4.	Plankton Survey																								
5.	Benthic Fauna Survey																								
6.	Bottom Sediment Quality																								
7.	Report Preparation																								
8.	Editing and Printing of Final Report																								

Start of Project

First Reviex Session

Second Review Session

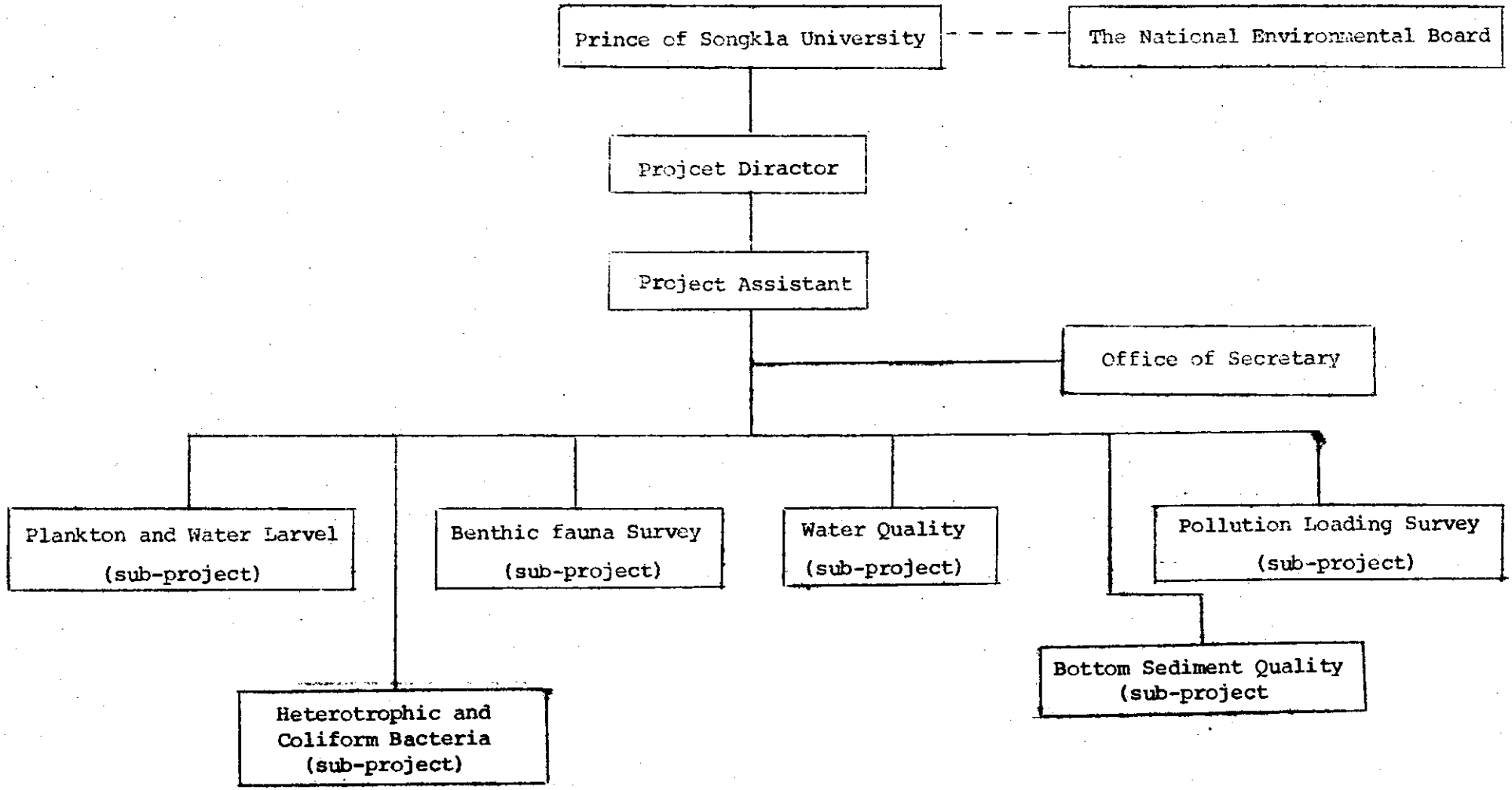
Third Rewiew Session and review of rough draff for final report

Start of Final Report

Submittal of printed report

9. Songkla Lake Research Project

(May 1978 - April 1979)



10. Study Team.

1. Project Director
   Narong Nachiangmai
   B.Sc (Sanitation),
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   Faculty of Medicine
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2. Deputy Project Director
   Somsak Bhoromthanaratana (Leader)
   B,Sc (Fisheries)
   M.Sc (Biology)
   Faculty of Natural Resources
   Prince of Songkla University

3. Water Quality Assessment (Sub-project)
   Narong Nachiangmai (Leader)
   B.Sc (Sanitation)
   M.Sc (Environmental Health)
   Faculty of Medicine
   Prince of Songkla University
   Kanika itsupakhorn
   B.Sc (Sanitation),
   Faculty of Medicine

4. Benthic Fauna Survey (Sub-project)
   Somsak Bhoromthanaratana (Leader)
   B.Sc (Fisheries)
   M.Sc (Biology)
   Faculty of Natural Resources

5. Plankton Survey
   Somsak Bhoromthanaratana
   B.Sc (Fisheries)
   M.Sc (Biology)
   Faculty of Natural Resources

6. Heterotrophic and Coliform Bacteria (Sub-project)

Sineenart Kamolmattayakul (Leader)

M.D. Board of Clinical Pathology

Faculty of Medicine

rirat Kongmuang

B.Sc, M.Sc (Clinical Pathology)

Faculty of Medicine

Compee Jitjai

B.Sc, M.Sc (Microbiology)

Faculty of Medicine

7. Bottom Sediment Quality (Sub-project)

Somchai Ongprasert (Leader)

B.Sc, M.S (Agricuture)

Faculty of Natural Resources

Athijit taweteekul

M.S. (Agriculture)

Faculty of Natural Resources

8. Pollution Loading Survey (Sub-project)

Kwanchai Suwan-samrith (Leader)

B.Eng (K.U), M.Eng (C.U), Chemistry

Faculty of Engineering

Pipat Pooripanyakun

B.Eng (K.U), M.Eng (Sanitation), C.U.

Faculty of Medicine

Compee Jitjai

M.Sc (Microbiology)

Faculty of Medicine

9. Research Assistants

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B.Sc (Chemistry), PSU

Domol Suwannang

B.Sc (Chemistry), PSU

Thakan Theinthong

B.Sc (Biology), PSU

Pen Nithiwedruangcharat

B.Sc (Chemistry), PSU

Maka Thipkeeree

B.Sc (Chemistry), PSU

Aunnop Sakolprakaikit

B.Sc (Chemistry), PSU

10. Office of Scretary

Wirasinee Somwathee

B.A.

Ampai Sirikatitume

B.A.

Surapol Jeimsakul

Typist

11. Expert Staff

Dr. A.H.V. Sarma

Dr. H.F. Ludwig