APPENDICES

Appendix 1 — A

Comparison of Single and Series Development

Appendix 1-A Comparison of Single and Series Development

As for the development form, the Interim Report makes a comparative study of the alternative of single development at the upper dam site and lower dam site independently and the alternative of series development of the two dam sites. It concludes that the series development alternative is more advantageous. The study has been revised based on results of detailed site investigation and the conclusion obtained is the same as that of the Interim Report, i.e., series development of the upper and lower dam sites is the most advantageous. Also, the scale of development is partially modified for the upper and lower dam sites.

General

A single (one dam) development scheme at the respective upper and lower sites, and a series (two dams) development scheme should be considered.

In determining the optimum scale of the single (one dam) development scheme, studies were made of the height of the dam, operation hours of the power plant, maximum turbine discharge, drawdown of the reservoir (effective depth), annual energy generation, installed capacity and economic analysis in terms of the benefit/cost ratio and according to the formula of benefit-cost.

The optimum scale involved in the series (two dams) development scheme has been determined on the assumption that the normal water level of the lower dam is to be in the same as the tailrace water level of the upper dam upon settlement of the optimum scale of the upper single (one dam) plan which will produce a larger quantity of energy, making studies of the operation hours of the power plant, drawdown of the reservoir (effective depth) and annual energy generation, installed capacity and analysis of benefit/cost and benefit-cost.

As the Tekai River basin has a very small catchment area, when compared with the entire Pahang River Basin, flood control effect of the Project cannot be substantial. As a result, flood mitigation was not included in the calculation of benefits.

In the same way, though its potential effect on water utilization may be great, this was not included in the calculation of benefits.

Consequently, benefit (B) represents only that derived from power generation.

Loss of forest area resulting from submersion was excluded from the cost calculation.

Comparative studies are shown in Tables A-1.

Single (One Dam) Development

(1) Upper Site

Calculation of power generation was carried out with a 101.00 dam height, 3.6 hours peak operation and 235 m^3/sec. maximum turbine discharge for effective water depths of 5.0 m, 10.00 m and 20.00 m. As a result of this comparison, 10 m was judged to be most advantageous.

In this case, the maximum output will be 150 MW.

(2) Lower Site

Calculation of power generation was carried out with a 50.00 m dam height, 12 hours peak operation and 80 m^3/sec. maximum turbine discharge for effective water depths of 10.00 m, 18.00 m and 25.00 m. As a result of this comparison, 10 m was judged to be most advantageous.

In this case, the maximum output will be 20.00 MW.

Series (Two Dams) Development

(1) Upper Site

Optimum scale of upper single (one dam) development; maximum output 150 MW.

(2) Lower Site

The high water level of the lower dam will be the same level as the tailrace water level (EL. 75.00 m) of the upper power station and the effective storage capacity for power generation will be 21.5 x 10^6 m^3.

In this case the height of the dam becomes 38 m. The optimum scale of series (two dams) development has been determined according to B/C and B-C obtained from the effective depth of the lower dam, plant operation time (hrs) for peak duration, maximum turbine discharge, annual energy generation and maximum output.

Maximum output under series (two dams) development becomes 5.8 MW for the lower site.

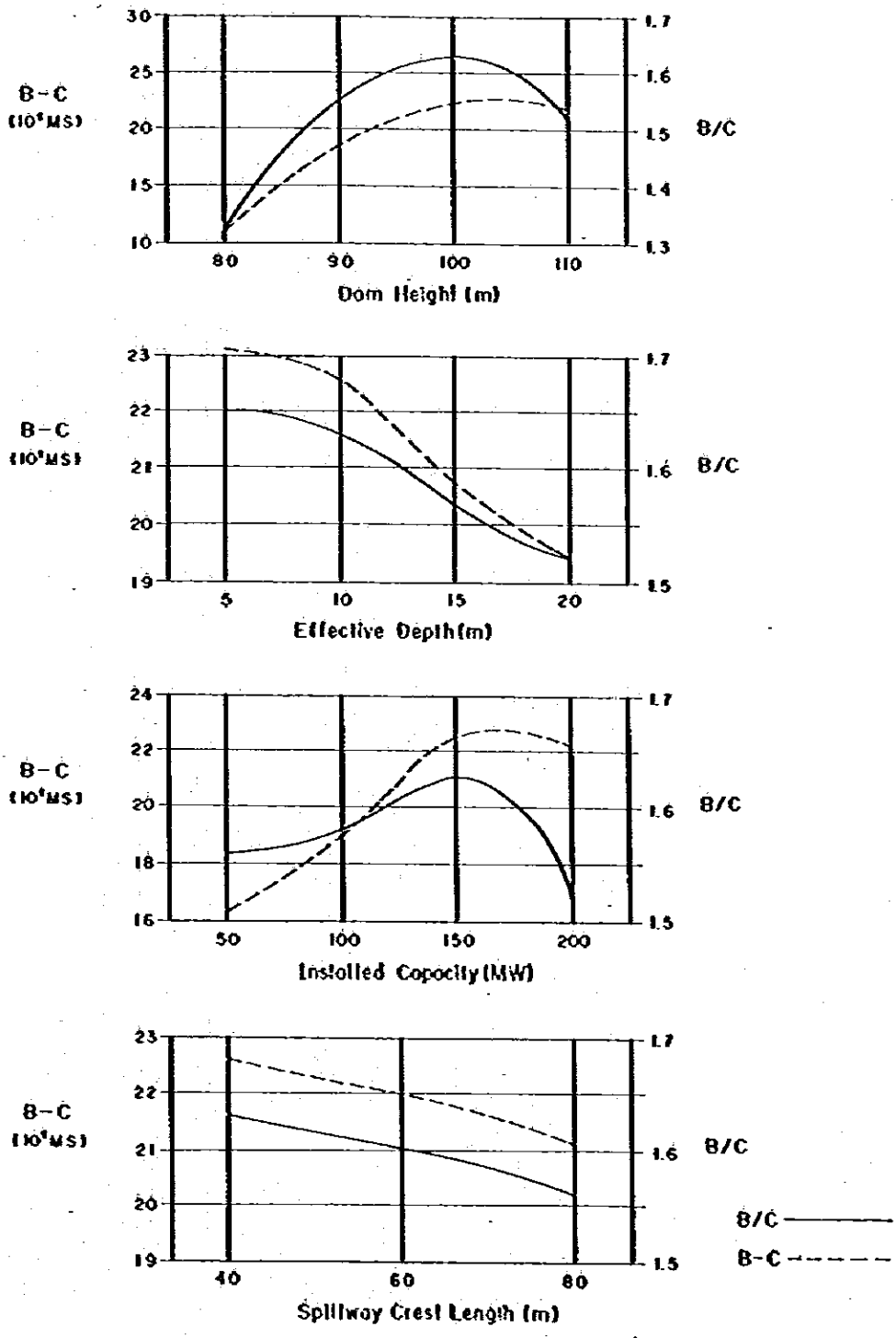
Total maximum output under series (two dams) development becomes 155.8 MW.

Table A-1 Optimum Scale of Developments

Item		Single (One Dam) Development		Series (Two Dams) Development	
Power Site		Upper Dam	Lower Dam	Upper Dam	Lower Dam
Dam Type		Rockfill	Gravity	Rockfill	Gravity
Dam Height	(m)	101	55	101	38
Full Supply Level	(m)	EL 157.00	EL 90.00	EL 157.00	EL 75.00
Minimum Operating Level	(m)	EL 147.00	EL 80.00	EL 147.00	EL 70.50
Effective Depth	(m)	10.0	10.0	10.0	4.5
Plant Operation Hours	(hr/day)	3.6	12	3.6	24
Maximum Turbine Discharge	(m^3/s)	235.00	80.00	235.00	40.00
Installed Capacity	(kW)	150,000	20,000	155,800	
Annual Energy Generation	(MWH)	194,800	89,900	235,100	
Construction Cost	(10^6M$)	289	123	351	
Annual Benefit	(10^6M$)	58.42	19.94	66.91	
Annual Cost	(10^6M$)	35.83	14.88	43.81	
B/C	(10^6M$)	1.63	1.34	1.53	
B-C	(10^6M$)	22.59	5.06	23.10	

Fig. A-1

Upper Dam (Firm-Q=34.84m/s)



Appendix I – B

Pumped–storage scheme

Appendix 1-B Pumped-storage scheme

The characteristics of the Tekai River has a very gentle gradient with an

A favorable storage efficiency of a reservoir (ratio of reservoir storage over dam volume) can be expected if a reservoir is constructed at the gorge construction of a canyon of which geological conditions seem to be favorable.

In view of the above conditions, it will be possible for a large quantity of storage to be obtained if damming up is made to some extent.

Accordingly, a shallow effective depth will ensure a reservoir storage capacity only for pumped-storage purposes. Since there are few fluctuations in the head, the area will be suitable for a mixed pumped-storaged power scheme.

It is proposed that necessary studies be made on a mixed pumped-storaged scheme to be implemented together with the series (two dams) development scheme, one of the components included in the Tekai Hydro-electric Power Development Project, described in this report.

(a) Storage Capacity for Pumped-storage

The effective reservoir storage of the upper reservoir and the lower reservoir involved in the series (two dams) development scheme is 680×10^6 m^3 and 21.5×10^6 m^3, respectively.

The available storage capacity of the upper reservoir will not need a reservoir storage capacity merely for pumped-storage purposes as the effective reservoir storage of the above mentioned reservoir is sufficiently large.

In the event that the full supply level of the lower reservoir under the present scheme should be dammed up by 1.0 m, it will be possible to ensure a reservoir storage capacity of approximately $7.0 \times 10^6 m^3$ only for the pumped-storage purpose.

(b) Scale of Pumped-storage Power Generation

If the above-mentioned reservoir storage capacity is used for six hours of peak duration identical with the operation hours for peak duration for a power plant in the upstream, the following formula can be expressed in order to obtain a scale of 300,000 kW as a maximum output of the said power plant.

$$\frac{7{,}000{,}000\ m^3}{4\ hr \times 3{,}600\ sec/hr} = 486\ m^3/sec \text{ (Maximum Turbine Discharge)}$$

$$9.8 \times 0.87 \times 486\ m^3/sec \times 75\ m \fallingdotseq 300{,}000\ kW$$

(c) Time of Addition of Plant Units for Pumped-storage Power Plant

The time of addition of plant unit(s) for a pumped-storage power plant will be dependent upon a general trend of power demand, configuration of load curve, availability of surplus electric power during the midnight.

Now that the subjects are yet to be studied, it is, of course, impossible to decide on such time of installing additional units.

It is suggested that the same portions of work be carried out in making advance investments beforehand on the occasion of undertaking required works involved in the series (two dams) development scheme in anticipation of addition of units to a pumped-storage power plant in the future.

(d) Desirable Works to Be Undertaken by Advance Investments

Structures of which addition will not be possible or will require an enormous amount of costs at the time of additing plant units to a pumped-storage power plant will be;

(1) Portions to be dammed up for lower dam
(2) Screen and gate of intake for pumped-storage power plant
(3) Foundation for power plant
(4) Draft cube and draft gate

Appendix 2

Environmental Issues

CONTENTS

Appendix 2 Environmental Issues

2.1 Introduction

In developing the project, it is necessary to predict the effects of development activities on the environment, and to thoroughly examine the plans beforehand. Achieving a clear grasp of the present status of the natural environment existing at the proposed sites, therefore, forms a vital initial requisite in order to foresee the effects of development upon the environment and possible changes in future.

In relation to the development project, however, detailed scientific studies on the natural and social environments have not been made up to the present time. In preparing the report, field investigation, visits to related organizations and hearings were made to collect data. Hearings were held for the following organizations, and related data were provided by them.

Item	Name of Office/Visited
Environmental Aspects	Ministry of Science, Technology and Environment, Division of Environment
Fisheries	Agriculture Ministry, Training Division
Archaeology	National Museum
Wildlife	Dept. of Wildlife and National Parks
Forestry	Forestry Research Institute
Forestry	Federal Dept. of Forestry
Zoology	Zoological Dept. University of Malaya
Public Health	Institute of Medical Research
Regional Planning	Pahang State Planning Unit
Forestry	Pahang State Forestry Dept.
Fisheries	Pahang State Fishery Dept.
Public Health	Pahang State Medical Dept.
Agriculture	Pahang State Agriculture Dept.
Hydrology, Meteorology	National Water Resources Study Team

The site under this project (annual rainfall 2,200 mm) is classified as a tropical rain belt, according to the meteorological classification of *Troll, C. West Malaysia shows ranging characteristics in annual and monthly rainfalls for different areas due to the effects of mountains located both at the east and west of the Peninsular Malaysia, as shown in Fig. 1. Characteristics of the site, as seen from the figure, indicate that the rainfall at this site is greater than that at the south of the Peninsular Malaysia. Nevertheless, rainfall is not markedly heavy as in the case in a typical mountain area. Fig. 2, on the other hand, shows monthly rainfall at Kuala Tahan, located approximately 30 km north of the project site. The distribution of monthly rainfall does not exhibit significant monsoon-type seasonal changes between the rainy season and dry season, as observed in coastal areas such as Kuantan, Pekan, etc., measuring locations intended for this project, shown in Fig. 1, but the same tendency as in the cases of K. Lipis, Ipoh, etc. is observed. Thus, it may be said that weather conditions around the project site will show relatively even monthly rainfalls, for a tropical rain area.

The flora at the project site falls into the category of tropical rain forest. The characteristic features of the forest include the most complex structure among plant communities in the world, with an extreme variety in composition of botanic species, and very high biomass productivity. Animals living in this rich forest are, therefore, also varied, and the protection of wild animals living in tropical rain forest has begun to draw increased attention both in Malaysia and internationally.

Most of the fresh water fish species living in the Pahang State waters are edible, and hence fish markets exist in key locations such as Jerantut. The Tembeling River is said to have been one of the pre-historic routes for migrations from elsewhere in SE Asia and recent archaelogical remains have confirmed this fact.

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*Troll, C.: Seasonal Climate of the Earth (1966)
World Map of Climatology, Springer

Examination of present land utilization shows that a certain degree of agriculture has been established along the Tembeling River. The project area is a Forest Reserve administered by the Pahang State Forest Department which has not logged and is still primeval forests. As for forestry, useful merchantable trees are being logged, with emphasis placed on processing for lumber.

Generally, it may be said that the Tekai region is rich in natural resources which are not being fully used.

Under the Proposed Tekai hydroelectric development project, dams, power plants, spillways and roads will be constructed. Through the construction of the dams, lakes will be formed upstream, while variation in river discharge will occur downstream. Additionally, due to the construction of project and roads, substantial changes will occur as trees plants are removed and the ground excavated, banked, etc.

With the project, both upper and lower dams (upper dam height 101 m, lower dam height 38 m) will have large-scale lakes (upper dam: approx. 7,600 ha; lower dam: approx. 610 ha.).

In this appendix, basic predictions and studies on the effects of the construction plans upon hydrological conditions, biota, public health and other socio-economic factors are presented. Reference to some other environmental factors are included in the main report, as follows:

- Porestry - Section 5.3
- Flooding and Flood Mitigation - Section 5.4
- Tourism - Section 5.6
- Inundation of Settlements - Section 5.7.2
- Mineral Resources - Section 5.7.3

2.2 Effects on Water Resources

2.2.1 Flow Conditions

1) Present status

Terrestrial waters in the proposed project sites and surrounding areas consist entirely of rivers. No lakes, swamps, mining pools, paddy fields or other stationary water areas have been found in the course of field surveys and topographical explorations.

As for discharges, the mean discharge of Sg. Tekai is about 3.5 x 10^6 m^3/day at S. Penut (Basin area 1,380 km^2) located downstream of the lower dam. Water level fluctuation between flood conditions and minimum flow (low water) was approximately 7 m at the same location during the observation period.

2) Predicted effects

It is predicted that certain changes will occur in downstream flow conditions depending on the duration of construction and operation. The present plan is as follows: total storage will be 2,040 x 10^6 m^3 for the upper reservoir, and 41.5 x 10^6 m^3 for the lower reservoir. The annual discharge at the lower damsite is expected to be 1,260 x 10^6 m^3. Storage equivalent to the total discharge of 1.6 years will be held in the proposed dams. It is thus probable that downstream aquatic animals and water plants will be subject to certain effects by the above. Namely, due to the lowering of the water level, spawning fish species and amphibians making use of the waterside for breeding and vegetation at the waterside will be changed both in population and distribution in the long term. Because of the dams, river sand and other sediments will be restrained, resulting in changes in sedimentation rates downstream of the project.

As regards the effects of dam lakes after the storage of water, such effects may be roughly classified into those related to the emergence of dam lakes and those related to changes in downstream river discharge. Due to the emergence of dam lakes, the area will change from river(s) to that at a large lake. Because of this transfer into lake environment, hydrological changes will occur. Other effects on local environments will include effects on soil, geological characteristics or groundwater hydrological properties. In addition, related changes will occur in the soil and water conditions of areas near the reservoir caused by fluctuations in underground water levels, and landslides. It is also predicted that shore land erosion will occur around the lakes, and practical safeguards such as retaining trees on shorelands will be necessary to prevent soil erosion and landslides.

As for changes in river discharge downstream due to the construction of the lakes, downstream flow conditions may be stabilized through reservoir discharge adjustment, but this is generally not practical with hydroelectric projects.

2.2.2 Water Properties

1) Present status

In order to predict changes in water properties that may be affected by the dam construction, the present status of water quality was investigated at both damsites and at five points downstream (see Fig. 3 and Table 1). According to the results of water quality tests, no significant characteristics are observed. It may be said that the content of nitrogen compounds is somewhat high, but this is not a notable characteristic. As compared with observation results obtained at a location further downstream of the Pahang Basin, however, it should be noted that a mild alkaline tendency was consistently found downstream during tests repeated four times (July, twice in September and October), in comparison

to the mild acidity that had been found in June (see Fig. 4 and Table 2).

2) Predicted effects

Occurrence of turbid water is predicted for the dam construction period and the period between the completion of dam construction and the stabilization of the reservoir. Turbid water will temporarily affect aquatic or water-utilizing animals and aquatic plants. It will only constitute minor adverse factor for the human utilization of the water system and scenic aspects.

Due to the construction of the dams, flooded areas will change from river systems to lake systems, and it is predicted that the water properties in the water areas will go through drastic changes beginning from the initiation of filling and continuing for the subsequent few years. Although the reservoirs will stabilize gradually, several points should be noted in relation to environmental effects, the lakes will be large and water depths great.

As for changes in water properties during the stabilization period, plants located in areas at the bottoms of the dams will rot and generate hydrogen sulfide through the consumption of dissolved oxygen. In addition, chemical water properties such as carbon, iron and manganese levels may change considerably compared with those of floating waters, primarily due to the earth and sand carried in as sediments. While such changes in water properties will affect the biota in dam lakes and in downstream areas, it will stabilize gradually, possibly in 3-4 years for the lower dam and 5-7 years for the upper dam.

2.3 Effects on Biota

2.3.1 Plants (Trees)

1) Present status

The proposed reservoirs and surrounding area are part of the Tekai - Tembeling Forest Reserve. At present, this area is under the control of the Pahang State Forest Department and rights to timber in the area have been allocated to JENGKA, a private logging company.

This forest area falls into the category of tropical rain forest, generally characterized by varied and abundant plant life as well as complicated structure.

The survey started with the compilation of existing results of academic research and surveys on the Tekai area. However, there has been no previous survey made on the ecological aspect of the forest. The National Forestry Inventory of West Malaysia 1970 - 1972 proved helpful in understanding the nature of the forest types.

After data had been compiled, a field survey was made in selected areas of the proposed upper reservoir.

(1) Survey method and components

A survey was carried out utilizing the fixed plot method which is the most widely used for a forest stock survey (See Attachment A). Two plots were selected in the proposed upper filling area. Forests considered most representative in the region were selected. A compartment (50mx50m or 50m x30m) was designated by drawing reference lines parallel or normal to the slope from a reference point set arbitrarily. Figs. 5 shows the position of each sample plot and Figs. 6 and 7 the general geographical features around the sample plot. A helicopter survey was also made over a wide area encompassing the neighboring Taman Negara as well as the Tekai basin.

Attachment A

Field survey methods and data collected

a) Apparent species
Species appearing in the sample plot were identified and recorded for each height.

b) Diameter at breast height (DBH)
Diameter of plants with a diameter of more than 10 cm at breast height (1.3 m) were measured using a tape measure.

c) Height
Height was measured three times from a point with a unobstructed view of the tree top using a Blume-Reis height gauge. Average value of the measurements was recorded.

d) Height of the first large branch
The height from the ground to the first large branch was measured using the same method as for the measurement of height.

e) Tree position map
Position of trees with 5 cm or more DBH was plotted on the map.

f) Crown projection map
Projection map of the crown (canopy) of trees with 10 cm or more DBH was prepared.

g) Horizontal profile of forest stand
A map plotting the forest stand from the side was prepared.

h) Number of saplings
The number of saplings with 50 cm or less height or with 50 cm or more height and less than 5 cm DBH was recorded. For saplings of giant trees and emergent trees (20 m or more height), the number was recorded by species.

j) Diameter and height measurement for small size trees
Small size trees (40 trees) with 10 cm or less DBH were cut down for examination.

(2) Survey results

a) Apparent species

Species appearing in two the sample plots are shown in Table 3 and show that the forest stand is comprised of low-land dipterocarp forests, with no substantial difference from that of the neighboring Taman Negara area in terms of composition according to study team's observation.

b) Forest structures and characteristics

The diameter distribution shows an L-shaped distribution indicating a large number of small diameter trees and a rapidly decreasing number of larger diameter trees (Figs. 8 and 9). This type of distribution is widely apparent in primary forests, except in some cases of extraordinary stressful environmental conditions.

Height distribution indicates many examples with 10 - 20 m height (Figs. 10 and 11).

Fig. 12 shows the relationship between the diameter at breast height (DBH) and height in Plot 1. From this figure, it may be inferred that 10 - 20 m high examples have a DBH mostly ranging from 10 - 20 cm. This indicates that the forest contains trees rather tall in relation of their diameter.

In Plot 1, the number of saplings 0.5 m or less in height is about 57,000/ha, and the total plant density is about 81,000/ha including trees 50 cm or more height and 5 cm or less diameter. This means that the forest is very dense, has a high biomass and is typical of undisturbed lowland rainforest in SE Asia (Table 4).

Fig. 13 to 16 show the position of every tree with a diameter of 10 cm or more and the crown projection line. The crown projection map of Plot 1 (Fig. 13) shows that there are two giant trees taking superior position in the emergent

layer. Under these trees, other smaller trees varying in height form a multiplayer structure.

c) Other observations

The helicopter reconnaissance survey resulted in clarification of the following points:-

i) There is no apparent difference in flora between the Tekai River Basin including the proposed sites and Taman Negara (National Park).

ii) Lowland dipterocarp forests can apparently be distinguished from hill dipterocarp forests. It was noted that the distribution boundary between these forest appears to be at 300 m above sea level.

iii) That part of the lowland dipterocarp forest within the flood area of the Tekai River shows a different appearance from the lowland forests on its hinterland. This is attributed to the repeated flooding and rising of the river and trees which will tolerate such conditions.

iv) Only one small patch of ground used for slash-and burn agriculture belonging to the Orang-Asli village was found around the proposed development sites. There were no other occurrences of land used for slash-and burn agriculture.

2.3.2 Animal Life

1) Present status

No scientific research has been made on animals living the Tekai River Basin up to the present. The animal survey was made with special reference to mammals, birds and fish.

(1) Survey method

a) Mammals

Direct observations were made for diurnal mammals, while nocturnal species were identified on the basis of their tracks and droppings. Commentaries of local assistants were also noted.

b) Birds

Observations were made inside forests or along roads and birds were identified by their appearance. Observations were also made from boats.

c) Fish

Fish were caught using casting nets, fishing rods and other equipment. Measurement of length was also made.

(2) Result of survey

a) Mammals

A total of 53 species are listed (Table 5), including 17 species identified from direct observation, one from droppings and tracks and 36 species recorded from discussions with local people. Most of the small mammals are nocturnal and field assistants are not reliable in their ability to identify species. Thus, an in-depth survey with sufficient field work would lead to the identification of more species of mammals and confirm whether rare species are actually present.

b) Birds

A total of 74 species were identified in this survey (Table 6). Birds in the Coraciiformes category (particularly kingfishers and hornbills) were confirmed in comparatively large numbers in the zone near the main rivers. Although the

majority of birds in the Tekai River basin inhabit the forests, several species tend to live only near water, including the following: Little Heron, Grey-headed Fish-eagle, Osprey, Silver-rumped Swift, Red-legged Crake, Pintail Snipe, Common Tern, White throated needle-tailed swift, Kingfisher, Stork-billed kingfisher, White-throated Kingfisher, Black-capped Kingfisher, Malay bee-eater, Swallow, Ryukyu shallow.

According to Wells (1971), 216 species have been recorded in the neighboring Taman Negara (National Park). Davison (1982), on the other hand, records 254 species. Since the forests along the Tekai River Basin are generally in a primitive state, the birds are considered similar to those recorded in the lowland areas of Taman Negara.

c) Fish

According to the survey collection and discussions with local residents, 55 species of fish were identified as existing in the Tekai River (Table 7). It was possible to collect only 22 species from 232 fish caught but carp and catfish were collected in large numbers. As shown in Table 8, Kerai (Kerai Kunyit and Kerai Jelawat) showed the largest concentrations of these fish (25% of all fish), followed by Sia (15.1%), Baung (10.8%), Jemerong (8.6%), and Lampan (10.8%). These species alone made up nearly 70% of all fish.

The length of fish collected are shown in Table 9 and indicate that Kerai, Baung, Kelah, Nuar and Jemerong had the largest mean values for length. In particular, one of the Kelah caught had a length of 51 cm, the longest noted. Fish with small mean valves for length were Sia, Terbui, Patung and Bagoh. Species with more than 10 samples available were selected and the distribution of their length shown in Fig. 17. Based on calculations of the standard deviations from Fig. 17 and Table 9, Kerai, Baung, and Kelah

showed substantial variation in length but for Sia, Jemerong and Kawan, the standard deviation was small.

(3) Animals protected by law

Of a total of 53 mammals and 74 bird species identified in this survey, there are 40 mammals and 63 bird species shown in the list which are protected under the Protection of Wild Life Act, 1972.

Under this Act, fauna are divided into two groups: totally protected animals and protected animals. Totally protected animals cannot be caught unless specifically approved by the minister. Protected animals can be caught if one has a license. The above act is a law to control the catching of animals and has no regulatory power over the development of land areas where animals are living or over destruction of animals by major projects such as the Tekai project.

(4) Animals ranked at "Near Extinction" by IUCN

The International Union for Conservation of Nature and Natural Resource: (IUCN), which was established in 1948 under the sponsorship of UNESCO, lists animals ranked as being "Near Extinction" in the Red Data Book (IUCN, 1975). Only one animal, the Red Dog which is in this category was identified for the Tekai River Basin but this is uncertain as it was listed as being seen by field assistants. As this tends to be very shy its identification can not be taken as definite.

2) Effects

Probable effects of dam construction on animals include noise from blasting, equipment operation and human activity during the construction period and destruction of forests in the filling area, filling of the lake changes in river flow rate, and changes in water quality after the completion of work. Of these impacts,

the most critical for animals are the destruction of forests and filling at the lake. In particular, the number of birds may suffer a decrease as they have to move from destroyed habitat. Birds have an established territory system and their living density is close to staturation, and thus, if they have more to other locations, overcrowding may occur and result in population decreases. It is well established that birds have altitude zones for breeding and feeding based on vegetation. So birds from the lowland river zones will be most seriously affected by the project.

The dam and the dam lake, when completed, will present a barrier to migrating fish such as Kelah, Sebarau and Jelawat and large land animals having a wide range of movement such as elephants and tigers.

Due consideration should also be paid to the indirect impact on aquatic animals resulting from the deterioration of water quality downstream caused by increased sediments or construction materials during construction and rotting trees in the reservoir.

2.4 Effects on Society and the Economy

2.4.1 The Community

1) Present status

A small group of Orang Asli of the Batak tribe engage in slash-and-burn agriculture and hunting and gathering in the region of the proposed reservoirs. As of 1978, its population around the Tekai River estimated at 61 in 10-12 families. The principal village along the Tekai River is found at Kg . BATANG, upstream of PASIR GAJAK adjacent to the lower reservoir on land which is an Orang Asli Reserve.

2.4.2 Public Health

1) Present status

At the proposed site and in the Tekai River Basin surrounding the site, there are several tropical diseases such as malaria, typhoid, tuberculosis, dengue fever, filariasis, schistosoniasis which could occur. Accurate studies on specific probabilities are not included in this report due to the absence of scientific surveys at the proposed site. However, detailed surveys have recently been completed in the Ulu Tembeling area by the Institute for Medical Research.

Factors leading to continued presence by such diseases are generally related not only to direct infection but also the existence of vectors carrying such diseases and suitable breeding habitats. In order, therefore, to control such infections, preventive measures will be vital, including proper steps and control methods to prevent human infections, breeding of intermediate hosts/vectors of such diseases and betterment of human living environments particularly for the concentration of population accompanying the construction of the proposed projects.

2) Predicted effects

Possible causes for occurrences or increases of diseases resulting from the implementation of this project will be the concentration of workers during the construction period, and environmental effects on changes in water quality and waterside plants which are associated with breeding habitats of vectors.

Malaria

Malaria is carried by Anopheles maculatus a particular a kind of mosquito. This mosquito thrives in moist soil of newly cleared areas. Since dam construction tends to create this kind of environment through log removal and large cleared areas with wet ground, adequate precautions will be necessary. Prevention of malaria incidences and medical treatment after infection can be adequately handled by the preventative measures such as anti-malarial pills and spraying of potential breeding areas by the Pahang State Anti-Malaria Program group.

Filariasis

Monkeys, cats, and rodents are intermediate hosts of semi-periodical Brugia malayi which causes filariasis in humans. This disease is transmitted by mosquitoes of the Mansonia group which tend to favor water plants such as waterhyacinth (Eichhornia Crossipes) and Water fern (Salvinia SPP.) as their habitats. Due to the fluctuation of the water levels and the increase in seasonal water plant growth, some increases in habitats for the Mansonia group are expected but this can only be confirmed after impounding the reservoirs.

Treatment measures are available for Brugia malayi infection in humans and public health surveys can be use to detect and treat infections so this disease is controlled.

Schistosomiasis

Malaysian type schistosomiasis has been found in Orang Asli residents elsewhere in the Upper Pahang region (Table 10). The intermediate host for this disease is a very small snail (Robertsella Kaporensis) which breeds in small streams on submerged tree roots. These snails have been found in the Sg. Tahan basin and some of the local Orang Asli have been detected as infected with schistosomiasis.

It is not known whether the intermediate host snail can survive under reservoir conditions but additional research on this could be completed before construction of the Tekai Projects.

As mentioned in the foregoing discussion, the incidence of malaria, filariasis, schistosomiasis, in local population could be affected by the Tekai Project. Hence, measures including adequate epidemiological surveys once construction starts will be necessiated.

2.4.3 Cultural Assets

1) Present status

In the region of the proposed development areas along the Tembeling River, several important archaeological sites have been discovered some of the more important sites and have been verified at, (from north to south) Kg. Bantal, Kg. Kuching Jeram Kawi, Kuala Nyong, Kg. Atok, Lubok Puai and Bukit Jong some of these famous remains have been the object of archaeological surveys since the early 1900's, and various artifacts such as neolithic stone implements, bronze jewellery and implements, iron implements, have been found and their ages and origins verified.

The Tembeling River Basin holds archaeological interest because it is thought to have been a migration and trade route from South-east Asia and China in ancient times. There is an general theory

of a southern land and sea trade route from the China to the Malay Peninsula running through Pattani in Thailand, Kota Baru in Malaysia, the Kelantan River Basin and the Tembeling River Basin. For example a bronze bell, assumed to have been made around BC 200, was found along the Tembeling River Basin. This and other artefacts thus indicate the existence of the southern trade route at least.

The Tekai River, on the other hand, has not been subject to a particular archaeological survey, and hence the question of whether remains of habitation or artefacts exist in the area has not been clarified. However, it is generally assumed that any sites would be limited to the lower part of the valley due to the access problems in the upper region of the Tekai basin.

2) Predicted effects

Effects of the development project on cultural assets may be divided into a positive effect of the discovery of any remains, and a negative effect of their possible destruction. Generally, artefacts have been discovered scattered around on the ground surface, and some others buried underground in river gravel deposits due to erosion of original sites.

Possible destruction of remains by the construction work would occur in cases where the work continues without knowing that remains exist, and cases where discoveries are made but not reported to the authority concerned. There may be additional cases where the discovery is made but excavation has to be limited due to time or finances for studies.

In order to avoid the destruction or damage to archaeological remains by the construction work, efforts should be made to conduct preliminary investigations, and to establish a system to take appropriate steps upon discovery even after the initiation of the construction work.

2.5 Effects on Industrial Activities

Forestry is the major industry of the Jerantut District and at the proposed construction site. Fishery and agriculture are carried out on a small scale along the Tembeling River Basin, mainly for local consumption. The effects on forestry activities is mentioned in Section 5.3.2 of the Main Report.

Some potential for tourism and recreation could be associated with the Tekai project as shown in Section 5.6. The economic benefits from power generation could be very important to the future development of the Jerantut area.

2.6 Conclusion

This report constitutes a preliminary forecast and consideration of the effect of the proposed construction plan on hydrologic conditions, biota, and social and economic conditions. However, data available on the environment is limited and the project, when executed, is expected to exert a wide influence on the environment. It is recommended, therefore, to carry out, with the utmost care, a detailed survey which will yield conclusive data on the state of the environment at the present time or prior to construction.

Table-1 Results of Water Quality Tests at Tekai River

Item \ Date of Test	July 28, 1981	September 1, 1981					September 22, 1981					October 14, 1981				
	No.2	No.1	No.2	No.3	No.4	No.5	No.1	No.2	No.3	No.4	No.5	No.1	No.2	No.3	No.4	No.5
Turbidity (APHA Formazin Units)	24	<5	5	5	5	5	2	4	5	1	2	74	114	33	26	24
pH Value	7.8	7.2	7.2	7.2	7.3	7.5	7.3	7.1	7.3	7.2	7.3	7.1	7.2	6.8	6.9	7.1
Total Suspended Solids	20	5	10	10	10	10	5	10	5	5	15	300	285	50	35	25
Chemical Oxygen Demand	7	35	15	<5	<5	10	8	6	8	6	4	50	30	15	40	35
Biochemical Oxygen Demand @ 20°C for 5 days	2	9	5	2	2	3	2	1	3	2	1	5	5	5	5	5
Nitrate Nitrogen as N	0.91	0.91	0.82	0.74	0.91	0.78	0.62	0.66	0.58	0.54	0.54	0.91	0.62	0.91	0.82	0.54
Ammoniacal Nitrogen as N	0.98	3.13	1.44	1.40	2.55	1.48	1.40	1.48	1.56	1.19	0.91	1.77	1.69	1.89	1.36	1.61
Hydrolysable Phosphate as PO_4	2.32	<0.01	<0.01	<0.01	0.04	<0.01	0.08	0.09	0.11	0.23	0.08	0.19	0.01	0.24	<0.01	0.32

Table-2 Water Quality in the Pahang River

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. S. Jurnch	22-VI	17:00	32.0	28.5	6.9	-	B	
2. S. Jelai	23-VI	12:00	31.0	28.0	6.8	-	B	
3. S. Pahang	25-VI	13:10	30.8	30.5	6.8	14	RB	
4. S. Pahang	25-VI	12:10	29.0	26.5	5.7	20	RB	
5. S. Tekan	25-VI	12:45	31.0	27.0	6.7	18	B	
6. S. Jengka	25-VI	14:00	34.0	29.0	6.6	50	B	
7. S. Jampol	23-VI	14:00	34.0	29.0	6.6	50	B	
8. S. Jampol	25-VI	12:30	29.0	27.0	6.6	19	YB	
9. S. Luit	25-VI	10:25	27.0	26.5	7.0	30	YB	
10. S. Lepar	23-VI	15:40	33.0	29.0	6.2	18	RB	
11. S. Lepar	23-VI	16:00	33.0	33.0	6.2	45	RB	
12. S. Tanglir	22-VI	10:25	27.2	23.0	6.9	-	YB	
13. S. Benus	25-VI	14:25	29.5	28.3	6.8	29	YB	
14. S. Benus	25-VI	14:10	30.0	28.0	6.8	14	YB	
15. S. Benus	25-VI	15:35	30.5	27.0	6.8	60<	T	Insects
16. S. Telemony	25-VI	15:00	32.5	27.0	6.6	25	Y	
17. S. Teris	25-VI	14:00	32.0	27.0	6.2	5	YB	
18. Tasek Bera	16-V	9:00	27.0	26.5	4.7	-	DB	
19. Tasek Bera	16-V	14:00	30.2	27.8	4.6	-	DB	
20. S. Gombak	22-VI	9:00	-	23.0	6.9	60<	T	Insects, Shrimp

(1) Name of River
(2) Date
(3) Time
(4) Atmosphic Temperature (°C)
(5) Water Temperature (°C)
(6) PH
(7) Depth (m)
(8) Colour of Water

(9) Insect, etc.

B : Brown
RB : Red Brown
YB : Yellow Brown
Y : Yellow
T : Transparency
DB : Dark Brown

(Source; Mizuno and Mori, University Report of Ohsaka Educational Univ.,1969)

Table-3 Major Tree Species Identified in Sample Plots in Upper Reservoir Area

	Botanical Name	Vernacular Name	Symbol	Timber	Storey Class
	Melastomataceae				
1	Memecylon spp.	nipis kulit	NK		
	Malvaceae				
2	Hibiscus floccosus	kangsar	KGS	LHW	M
	Bombacaceae				
3	Durio griffithii	durian tupai	DR	LHW	M
4	Durio lowianus	durian daun	DRD	LHW	E
	Sterculiaceae				
5	Scaphium spp.	kembang semangkok	KS	LHW	
	Linaceae				
6	Ixonanthes icosandra	pagar anak	PA		M
	Bursenaceae				
7	Bursenaceae spp.	kedondong	KD	LHW	M-E
	Meliaceae				
8	Lansium domesticum	langsat hutan	LNTH		
9	Sandoricum koetjape	sentul	ST	LHW	E
	Polygalaceae				
10	Xanthophyllum spp.	minyak berok	MB	LHW	
	Euphorbiaceae				
11	Baccaurea spp.	tampoi	TPI		
12	Elateriospermum tapos	perah	PH	MHW	M-E
	Celastraceae				
13	Kokoona spp.	mata ulat	MTUL	LHW	M-E
14	Lophopetalum spp.	perupok	PRK	LHW	M-E
	Sapindaceae				
15	Xerospermum spp.	rambutan pachat	RP	MHW	
	Anacardiaceae				
16	Bouea oppositifolia	kundang rumenia	KGR	MHW	M-U
	Sapotaceae				
17	Palaquium maingayi	nyatoh tembaga	NYTB	LHW	M
18	Sapotaceae spp.	nyatoh	NY	LHW	M-E
	Ebenaceae				
19	Diospyros spp.	kayu arang	KA	MHW-HHW	M

	Botanical Name	Vernacular Name	Symbol	Timber	Storey Class
	Styracaceae				
20	Styrax benzoin	kemenyan	KMN		M
	Oleaceae				
21	Ochanostachys amentacea	petaling	PTG	MHW	M
	Verbenaceae				
22	Vitex spp.	leban	LBN	HHW	
	Magnoliaceae				
23	Aromadendron elegans	chempaka hutan	CPH	LHW	M
	Annonaceae				
24	Annonaceae spp.	mempisang	MS		
	Myristicaseae				
25	Myristicaceae spp.	penarahan	PN	LHW	M
26	Myristica spp.	penarahan arang	PNAG		
	Lauraceae				
27	Lauraceae spp.	medang	MG	LHW	
	Rosaceae				
28	Parinari spp.	merbatu	MRU	MHW	
	Leguminosae				
29	Cynometra malaccensis	kekatong	KTG		M
30	Koompassia malaccensis	kempas	KPS	MHW	E
31	Pithecellobium splendens	kungkur	KGR	LHW	M
	Dilleniaceae				
32	Dillenia spp.	simpoh	SM	MHW	
33	Dillenia reticulata	simpoh gajah	SMGH	MHW	M
	Guttiferae				
34	Calophyllum spp.	bintangor	BN	LHW	
	Dipterocarpaceae				
35	Shorea balanocarpoides	damar katup	DAKP	LHW	M
36	Shorea leprosula	meranti tembaga	MTTB	LHW	E
37	Shorea macroptera	meranti melantai	MTML	LHW	E
38	Shorea parvifolia	meranti sarang punai	MTSP	LHW	E

	Botanical Name	Vernacular Name	Symbol	Timber	Storey Class
	Anisoptera laevis	mersawa durian	MADR		E
39	Dipterocarpus baudii	keruing bulu	KRBL	MHW	E
	Fagaceae				
40	Castanopsis spp.	berangan	BRG	LHW	
	Ulmaceae				
41	Gironniera spp.	hampas tebu	HT		
	Moraceae				
42	Antiaris toxicaria	ipoh	IP	LHW	E
43	Ficus spp.	ara	ARA		
	Myrtaceae				
44	Eugenia spp.	kelat	KT	MHW	
	Lecythidaceae				
45	Barringtonia spp.	putat	PUT	LHW	

Explanation for SPECIES LIST

Botanical name	Family name on top line and species or group name on following lines in Latin.
Vernacular name	Malaysian name applied most commonly as a standard.
Symbol	Symbols used refer to "Pocke Check List of Timber Trees" (Malayan Forest Records No.17) with some species only discretionally identified for convenience of field work.
Timber	Information is given as to whether the timber is a Heavy (HHW), Medium (MHW) or Light (LHW) Hardwood.
Storey Class	The trees are classified into emergent storey (E), main storey (M) or under storey (U) species.

Table-4 Sapling Numbers in Each Plot

Plot No.	Size of Saplings in height	
	Less than 0.5m	More than 0.5m
1	14,196 (56,784/ha)	6,052 (24,208/ha)
2	14,196 (94,640/ha)	1,101 (7,340/ha)

Table-5 Mammals of the Tekai Area

1	ORDER INSECTIVORA	
	1) Family Erinaceidae	
	(1) Echinosorex gymnurus (Moonrat)	3
	2) Family Tupaiidae	
	(2) Ptilocercus lowii (Pentail Treeshrew)	3
2	ORDER DERMOPTERA	
	3) Family Cynocephalidae	
	(3) Cynocephalus variegatus ((TP) Flying Lemur)	3
3	ORDER CHIROPTERA	
	4) Family Pteropidae	
	(4) Pteropus vampyrus ((P) Large Flying Fox)	1
	5) Family Rhinolophidae	
	(5) Rhinolophus trifoliatus (Trefoil Horseshoe Bat)	1
4	ORDER PRIMATES	
	6) Family Lorisidae	
	(6) Nycticebus coucang ((TP) Slow Loris)	3
	7) Family Cercopithecidae	
	(7) Presbytis cristata ((P) Silvered Leaf Monkey)	3
	(8) P. obscura ((P) Spectacled Leaf Monkey)	3
	(9) Macaca fascicularis ((P) Long-tailed Macaque)	1,3
	(10) M. nemestrina ((P) Pig-tailed Macaque)	1,3
	(11) M. speciosa (Stump-tailed Macaque)	3
	8) Family Pongidae	
	(12) Hylobates lar ((TP) White-handed Gibbon)	1,3
	(13) H. syndactylus ((TP) Siamang)	3

(TP) Totally Protected Animal in Malaysia

(P) Protected Animal in Malaysia

5 ORDER PHOLIDOTA

9) Family Manidae

(14) Manis javanica ((TP) Pangolin) 3

6 ORDER RODENTIA

10) Family Sciuridae

(15) Ratufa affinis (Cream-coloured Giant Squirrel) 1

(16) R. bicolor ((P) Black Giant Squirrel) 1

(17) Callosciurus prevostii ((P) Prevost's Squirrel) 3

(18) C. notatus (Plantain Squirrel) 1,3

(19) C. nigrovittatus (Black-banded Squirrel) 1,3

(20) Sundasciurul tenuis (Slender Squirrel) 3

(21) S. lowii (Low's Squirrel) 3

(22) Tamiops macclellandii (Himalayan Striped Squirrel) 3

11) Family Rhizomidae

(23) Rhizomys sumatrensis (Large Bamboo Rat) 3

12) Family Muridae

(24) Rattus tiomanicus (Malaysian Wood Rat) 1

13) Family Hystricidae

(25) Hystrix brachyura ((P) Common Porcupine) 3

(26) Atherurus macrourus ((P) Brush-tailed Porcupine) 3

7 ORDER CARNIVORA

14) Family Canidae

(27) Cuon alpinus ((TP) Red Dog) 3

15) Family Ursidae

(28) Helarctos malayanus ((P) Sun Bear) 3

16) Family Mustelidae

(29) Martes flavigula ((TP) Yellow-throated Marten) 3

(30) Musttla nudipes ((TP) Malay Weasel) 3

(31) Amblonyx cinerea ((P) Oriental Small-clawed Otter) 1,3

17) Family Viverridae

(32) Viverra tangalunga ((P) Malay Civet) 3

(33) Prionodon linsang ((TP) Banded Linsang) 3

(34) Paradoxurus hermaphroditus ((P) Common Palm Civet) 3

	(35) Paguma larvata ((P) Masked Palm Civet)	3
	(36) Arctitis binturung ((TP) Binturoung)	3
	(37) Arctogalidia trivirgata ((P) Small-toothed Palm Civert)	3
	18) Family Felidae	
	(38) Panthera tigris ((P) Tiger)	3
	(39) P. pardus ((P) Leopard)	3
	(40) Neofelis nebulosa ((TP) Clouded Leopard)	3
	(41) Felis benegalensis ((P) Leopard Cat)	3
	(42) F. marmorata ((TP) Marbled Cat)	2,3
	(43) F. planiceps (Flat-headed Cat)	3
8	ORDER PROBOSCIDEA	
	19) Family Elephantidae	
	(44) Elephas maximus ((P) Indian Elephant)	1,2,3
9	ORDER PERISSODACTYLA	
	20) Family Tapiridae	
	(45) Tapirus indicus ((TP) Malay Tapir)	3
	21) Family Rhinicerotidae	
	(46) Didermocerus sumatrensis ((TP) Sumatran Two-horned Rhinocers)	3
10	ORDER ARTIODACTYLA	
	22) Family Suidae	
	(47) Sus scrofa ((P) Wild Pig)	3
	23) Family Tragulidae	
	(48) Tragulus javanicus ((P) Lesser House Deer)	1,3
	(49) T. napu ((P) Large House Deer)	3
	24) Family Cervidae	
	(50) Muntiacus muntjak ((P) Barking Deer)	1,2,3
	(51) Cervus unicolor ((P) Sambar)	3
	25) Family Bovidae	
	(52) Bos gaurus ((P) Gaur)	3
	(53) Capricornis sumatraensis ((TP) Serow)	2,3

Ten order Twenty-five family Fifty-three species.

Note: 1 - authors

2 - members of the project

3 - labours of the project

Table-6 Birds of the Tekai Area

1 ORDER CICONIIFORMES

1) Family Ardeidae

(1) Butorides striatus ((TP) Little Heron)

2 ORDER FALCONIFORMES

2) Family Accipitridae

(2) Ichthyophaga ichthyaetus ((TP) Grey-headed Fish-eagle)

(3) Spilornis cheela (Crested Serpent Eagle)

(4) Pandion haliaetus ((TP) Osprey)

3) Family Falconidae

(5) Microhierax fringillarius (Black-thighed Falconet)

3 ORDER GRUIFORMES

4) Family Turnicidae

(6) Turnix suscutator (Barred Buttonquail)

5) Family Rallidae

(7) Rallina fasciata (Red-legged Crake)

4 ORDER CHARADRIIFORMES

6) Family Scolopacidae

(8) Gallinago stenura (Pintail Snipe)

7) Family Laridae

(9) Sternal hirundo ((TP) Common Tern)

5 ORDER COLUMBIFORMES

8) Family Columbidae

(10) Treron olax (little Green Pigeon)

6 ORDER PSITTACIFORMES

9) Family Psittacidae

(11) Psittinus cyanurus (Blue-rumped Parrot)

7 ORDER CUCULIFORMES

10) Family Cuculidae

(12) Rhinortha chlorophaea ((TP) Raffles' Malkoha)

(13) Rhamphococcyx curvirostris ((TP) Chestnut-breasted Malkoha)

(14) Centropus sinensis ((TP) Greater Coucal)

8 ORDER STRIGIFORMES

11) Family Strigidae

(15) Strix leptogrammica ((TP) Brown Wood Owl)

12) Family Tytonidae

(16) Phodilus badius ((TP) Bay Owl)

9 ORDER APODIFORMES

13) Family Apodidae

(17) Rhaphidura leucopygialis ((TP) Silver-rumped Swift)

14) Family Hemiprocnidae

(18) Hemiprocne comata ((TP) Whiskered Treeswift)

10 ORDER CORACIIFORMES

15) Family Alcedinidae

(19) Alcedo atthis ((TP) Kingfisher)

(20) Ceyx rufidorsum ((TP) Rufous-backed Kingfisher)

(21) Pelargopsis capensis ((TP) Stork-billed Kingfisher)

(22) Lacedo pulchella ((TP) Banded Kingfisher)

(23) Halcyon smyrnensis ((TP) White-throated Kingfisher)

(24) H. concreta ((TP) Rufous-collared Kingfisher)

(25) H. pileata ((TP) Black-capped Kingfisher)

16) Family Meropidae

(26) Merops viridis ((TP) Blue-throated Bee-eater)

(27) Nyctyornis amictus ((TP) Red-bearded Bee-eater)

17) Family Coraciidae

(28) Eurystomus orientalis ((TP) Dollarbird)

18) Family Bucerotidae

(29) Anorrhinus galeritus ((TP) Bushy-crested Hornbill)

(30) Aceros undulatus ((TP) Wreathed Hornbill)

(31) Anthracoceros malayanus ((TP) Black Hornbill)
(32) A. coronatus ((TP) Pied Hornbill)
(33) Buceros rhinoceros ((TP) Rhinoceros Hornbill)

11 ORDER PICIFORMES

19) Family Captonidae
(34) Calorhamphus fuliginosus ((TP) Brown Barbet)
20) Family Picidae
(35) Meiglyptes tukki ((TP) Buff-necked Woodpecker)

12 ORDER PASSERIFORMES

21) Family Eurylaimidae
(36) Cymbirhynchus macrorhynchos ((TP) Black-and-Red Broadbill)
22) Family Hirundinidae
(37) Hirundo rustica ((TP) Barn Swallow)
(38) H. tahitica ((TP) Pacific Swallow)
23) Family Campephagidae
(39) Coracina striata ((TP) Bar-bellied Cuckoo-shrike)
(40) Pericrocotus divaricatus ((TP) Ashy Minivet)
24) Family Dicruridae
(41) Dicrurus aeneus ((TP) Bronzed Drongo)
(42) D. remifer ((TP) Lesser Racket-tailed Drongo)
25) Family Oriolidae
(43) Irena puella ((TP) Asian Fairy-Bluebird)
26) Family Corvidae
(44) Corvus enca (Slender-billed Crow)
27) Family Timaliidae
(45) Trichastoma abbotti ((TP) Abbott's Babbler)
(46) Malacopteron magnum ((TP) Rufous-crowned Babbler)
(47) Stachyris maculata ((TP) Chestnut-rumped Babbler)
28) Family Aegithinidae
(48) Aegithina tiphia ((TP) Common Iora)
(49) Chloropsis cyanopogon ((TP) Lesser Green Leafbird)
(50) C. cochinchinensis ((TP) Blue-winged Leafbird)

29) Family Pycnonotidae

(51) Pycnonotus zeylanicus (Straw-headed Bulbul)

(52) P. brunneus ((TP) Red-eyed Bulbul)

(53) P. simplex ((TP) Cream-vented Bulbul)

(54) Criniger phaeocephalus ((TP) Yellow-bellied Bulbul)

30) Family Turdidae

(55) Erythacus cyane ((TP) Siberian Blue Robin)

(56) Copsychus saularis (Magpie Robin)

(57) C. malabaricus ((TP) White-rumped Shama)

31) Family Sylvidae

(58) Prinia rufescens ((TP) Rufescent Prinia)

(59) Orthotomus sutorius ((TP) Common Tailorbird)

(60) O. sericeus ((TP) Rufous-tailed Tailorbird)

(61) O. ruficeps ((TP) Ashy Tailorbird)

32) Family Muscicapidae

(62) Rhinomyias umbratilis ((TP) Grey-chested Flycatcher)

(63) Philentoma pyrhorpterum ((TP) Rufous-winged Flycatcher)

(64) Terpsiphone paradisi ((TP) Paradise Flycatcher)

33) Family Laniidae

(65) Lanius tigrinus ((TP) Tiger Shrike)

34) Family Sturnidae

(66) Gracula religiosa (Hill Myna)

35) Family Nectariniidae

(67) Hypogramma hypogrammicum ((TP) Purple-naped Sunbird)

(68) Nectarinia sperata ((TP) Purple-throated Sunbird)

(69) Arachnothera longirostra ((TP) Little Spiderhunter)

(70) A. robusta ((TP) Long-billed spiderhunter)

(71) A. chrysogenys ((TP) Yellow-eared Spiderhunter)

36) Family Dicaeidae

(72) Prionochilus percussus ((TP) Crimson-breasted Flowerpecker)

37) Family Ploceidae

(73) Passer montanus (Tree Sparrow)

38) Family Estrildidae

(74) Lonchura leucogastra ((TP) White-bellied Munia)

Table-7 Fishes of the Tekai River and its Branches
(Caught during Field Survey)

1. Bagoh (Puntius lateristriga)
2. Batu (Barbichthys laevis)
3. Baung
4. Belida (Notopterus sp.)
5. Bulu Ayam (Oxygaster sp.)
6. Buntal
7. Daun (Acrossocheilus deauratus)
8. Depu (Glyptothorax sp.)
9. Gerahak (Belodontichtys dinenema)
10. Hangus (Balantocheilus melanopterus)
11. Jemerong (Lobocheilus sp.)
12. Jenkua (Horulias chrysophekadion)
13. Kalui (Osphromenos sp.)
14. Kawan (Labiobarbus cuviers)
15. Kejau (Acrossocheilus sp.)
16. Kelah (Tor tambroites)
17. Keli (Clarias batrachus)
18. Kemperas (Cyclocheilichthys sp.)
19. Kenerak
20. Kepar (Pristolepsis fasciatus)
21. Jelawat (Leptobarbus hoeveni)
22. Kerai (Puntius spp.)
23. Lalang (Oxygaster anomalura)
24. Lais (Kryptopterus sp.)
25. Lali (Botia hymenophysa)
26. Lampam (Puntius schwanefeldi)
27. Lawang (Pangasius micronemus)
28. Nyua, Nyanuar
29. Pasir (Acanthopsis choirorhynchus)
30. Parang (Macrochirichthys macrochirus)
31. Patin (Pangasius ponderosus)
32. Patung (Pristolepis fasciata)
33. Pucok Pisang (Labiobarbus fasciato)

34. Riu (Lais hexanema)
35. Rong (Osteochilu vittatus)
36. Selimang Batang (Epalzeorrhynchus kallopterus)
37. Selimang Batu (Crossochilus oblongus)
38. Seluang (Rasbora elegans)
39. Sebarau (Hampala macrolepidota)
40. Sengaring (Labiobarbous tambra)
41. Sia (Hystacoleucus marginatus)
42. Sikang (Barilius guttatus)
43. Tapah (Wallago leeri)
44. Tapah Bemban (Ompok biniaculatus)
45. Tebal Sisek (Puntius binotatus)
46. Tengas (Acrosocheilus hasselti)
47. Tengku Lolah (Hystus wycky)
48. Tengalan (Pumtius bulu)
49. Terbui (Osteochilus hasselti)
50. Tilan (Mastocembelus sp.)
51. Toman (Ophiocephalus striatus)
52. Toman Ekor Kuang, Toman Jela (O. melonoptera)
53. Toman Tarong (O. micropeltes)

Table-8 Numbers and Relative Abundance of Fishes Collected - Field Survey, Sept/Oct. 1982

Species	No	Relative abundance (%)
Kerai K & J	58	25.0
Sia	35	15.1
Baung	25	10.8
Jemerong	20	8.6
Lampam	18	7.8
Kelah	13	5.6
Kenperas	11	4.7
Kawan	9	3.9
Terbui	8	3.4
Sengering	7	3.0
Sebarau	5	2.2
Nuar	4	1.7
Rong	4	1.7
Patung	4	1.7
Bulu Ayam	3	1.3
Bagoh	3	1.3
Kenerak	1	0.4
Sikan	1	0.4
Tilan	1	0.4
Lali	1	0.4
Buntal	1	0.4

Table-9 Measurements of Fishes

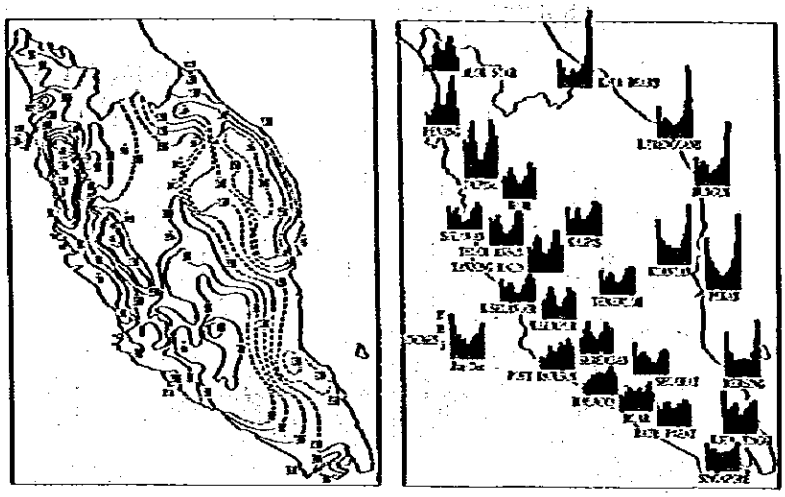
Species	Sample Size	Total Length (cm) Min.	Max.	Mean.	S.D.
Kerai K&J	58	13	46	23.8	7.5
Sia	35	7.5	15	11.9	2.1
Baung	25	12	45	23.1	8.0
Jemerong	20	15	27	21.3	2.7
Lampam	18	10.5	28	19.4	4.2
Kelah	13	21	51	31.8	9.3
Kenperas	11	10.5	25	16.9	4.9
Kawan	9	16	21	17.9	1.5
Terbui	8	9	13	11.4	1.7
Sengering	7	11	21	13.8	3.4
Sebarau	5	19	26	22.0	3.0
Nuar	4	24	28	26.0	1.4
Rong	4	16	24	18.9	3.2
Patung	4	7.5	10	8.8	1.2
Bulu Ayam	3	-	-	16.5	0
Bagoh	3	9.2	12	10.5	1.2
Kenerak	1	-	-	46	-
Sikan	1	-	-	18	-
Tilan	1	-	-	26	-
Lali	1	-	-	18	-
Buntal	1	-	-	7	-

Table-10 Infection Rates for Schistosomiasis

Percentage affected by schistosomiasis	Sample	Scientific Name
1 1%	Snails	Robertisiella Kaporensis
2 20%	Jungle rats	Rattus Muelleri
3 1.5%	Human population of local Orang Asli group	

Source: Results of data collected by Institue of Medical Research at Kg Kuala Koyan River Jelai

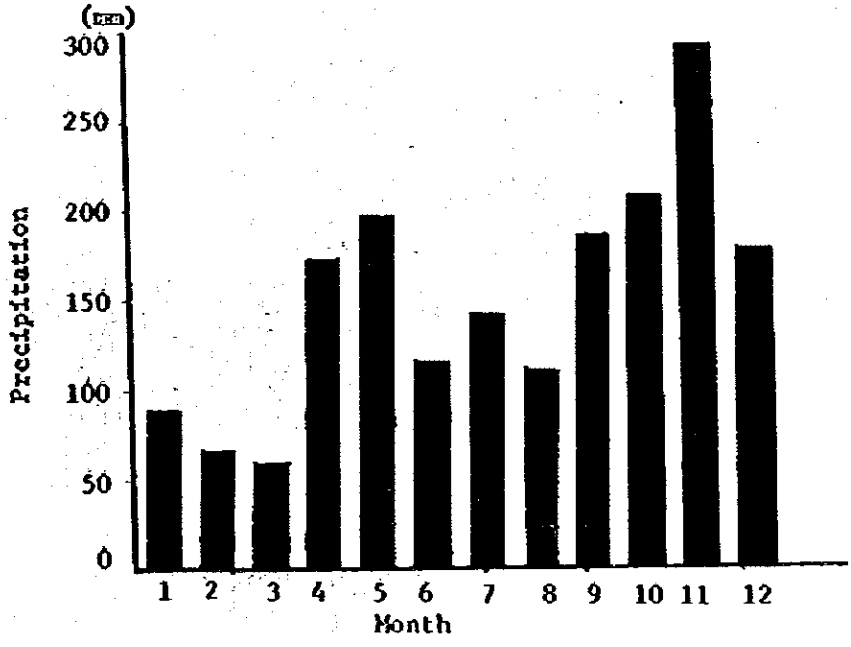
Fig. 1 Annual Rainfall in West Malaysia



(Source; Wyatt-Smith,Malay Forest Rec.23,1963)

Fig. 2 Annual Rainfall in Kuala Tahan

(Average 1973 - 1981)



(Source; NEB)

Fig. 3 Location of Water Test Sampling in 1981

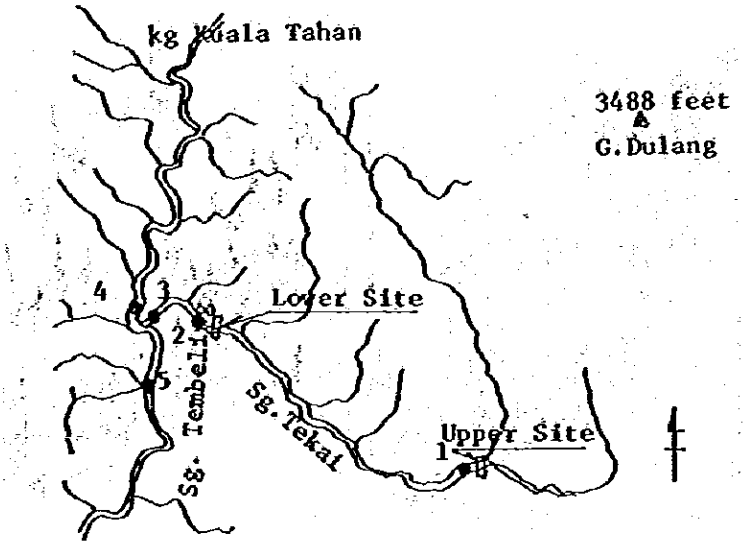
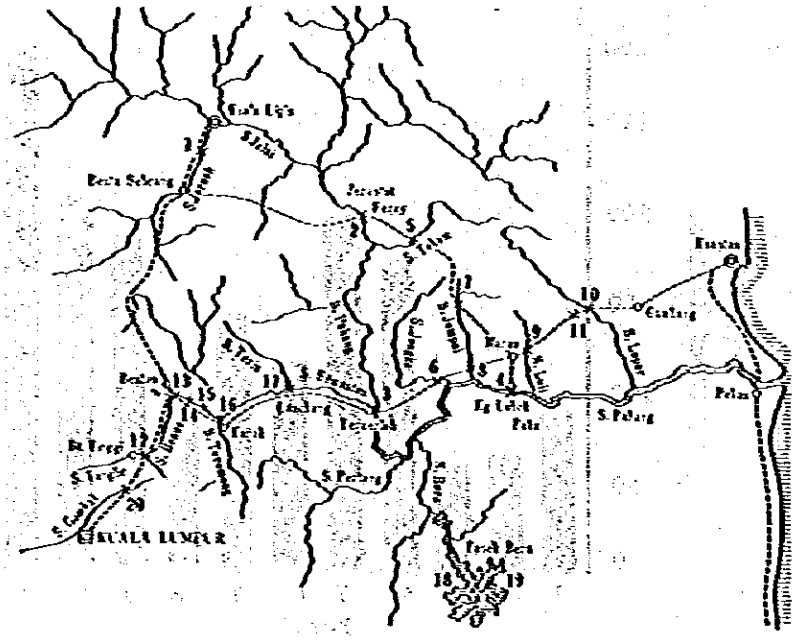


Fig. 4 Location of Water Quality Sampling in Pahang



(Source; Hizuno and Mori, University Report of Ohsaka Educational Univ., 1969)

Fig. 5 Location of Plot-1. and Plot 2.

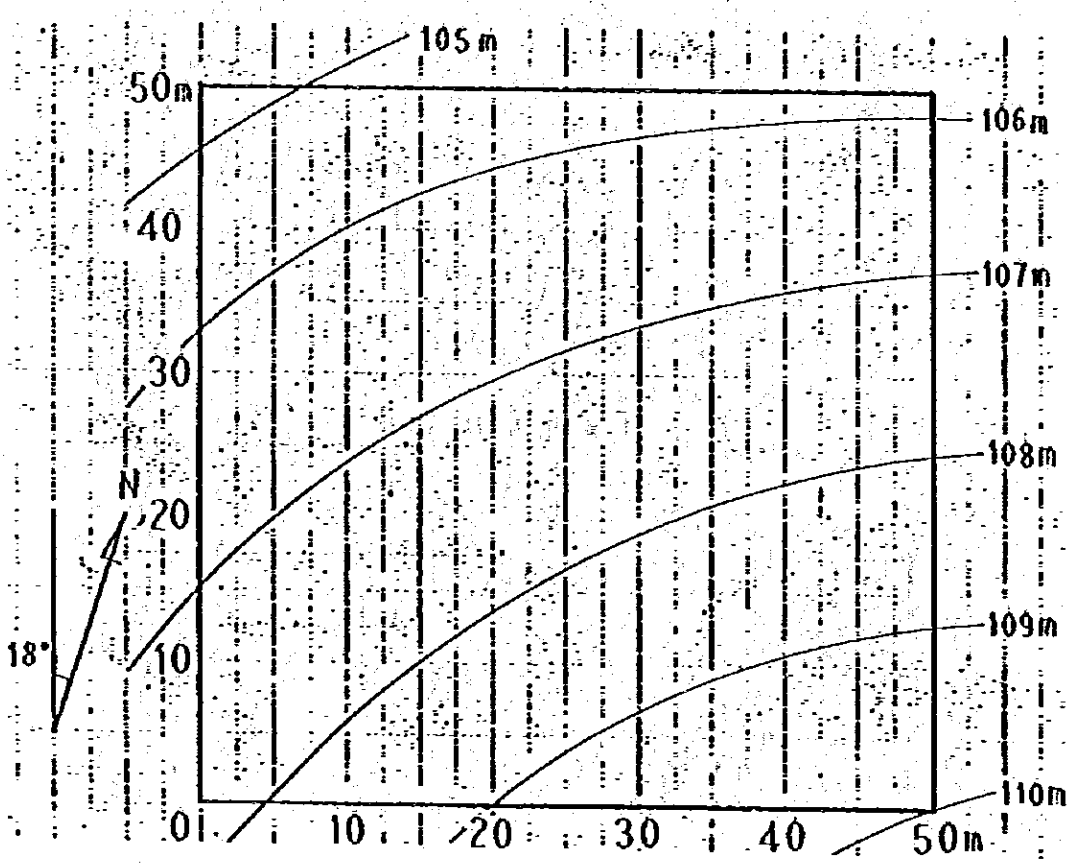


Fig. 6 Topographic map of Plot-1.

(Located approximately 1 km upstream (left bank) of the upper damsite)

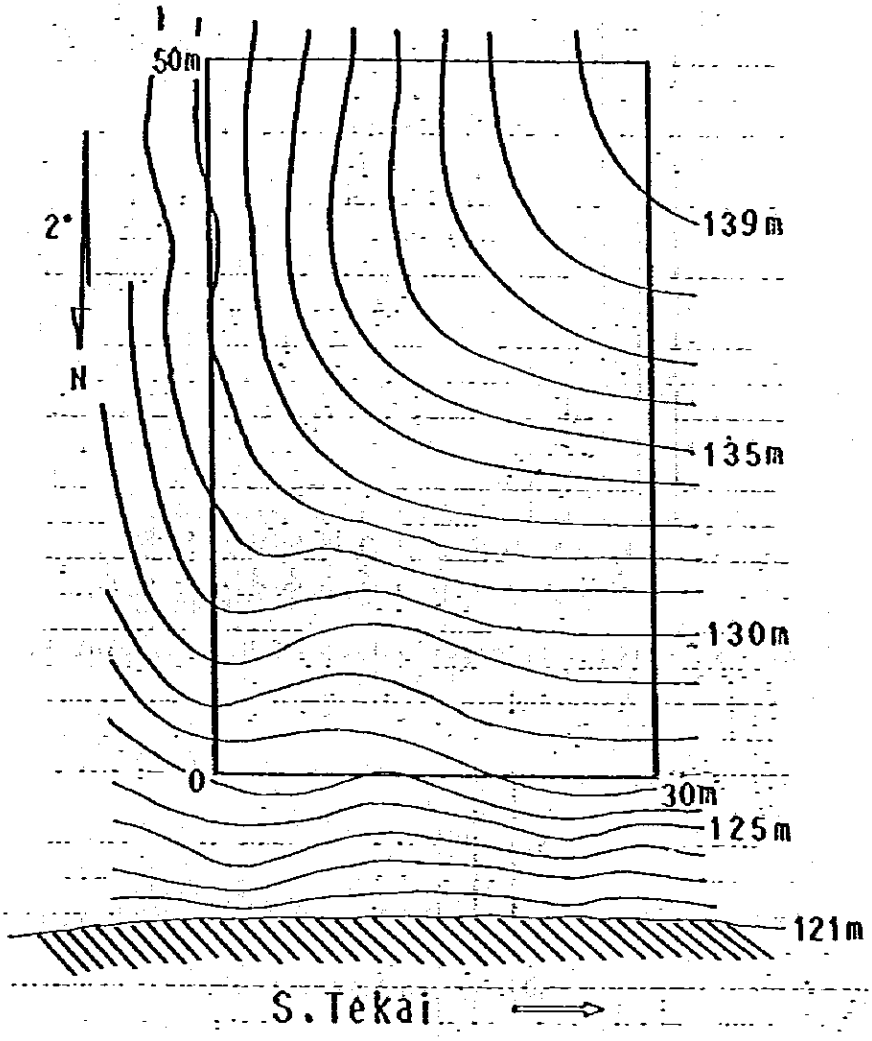


Fig. 7 Topographic map of Plot-2.

(Located approximately 20 km upstream (left bank) of the upper damsite)

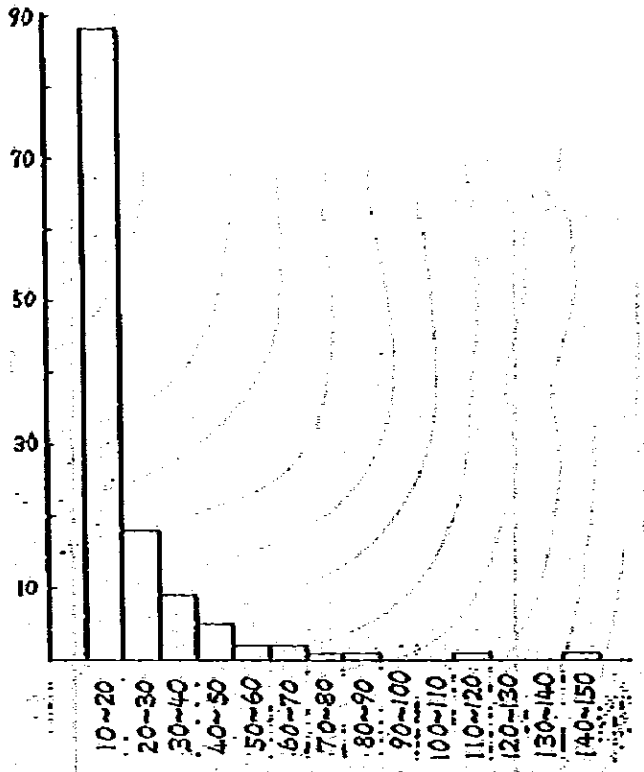


Fig. 8 Frequency distribution of D.B.H., Plot-1.

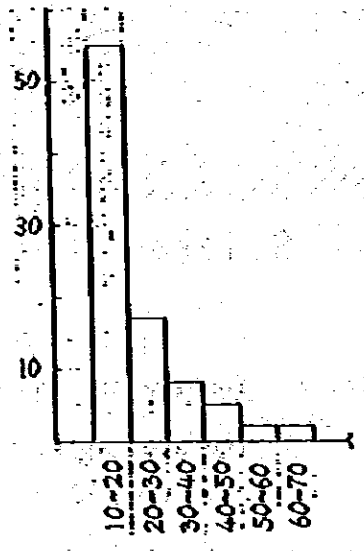


Fig. 9 Frequency distribution of D.B.H., Plot-2.

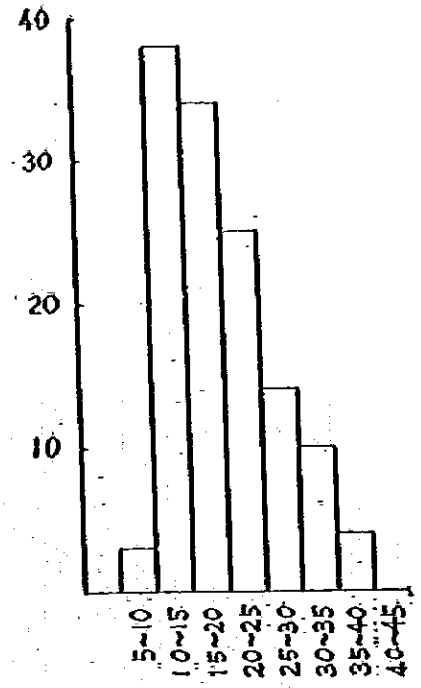


Fig. 10 Frequency distribution of height. Plot-1.

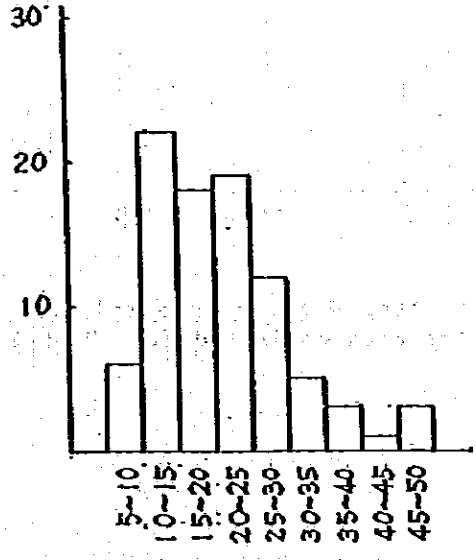


Fig. 11 Frequency distribution of height. Plot-2.

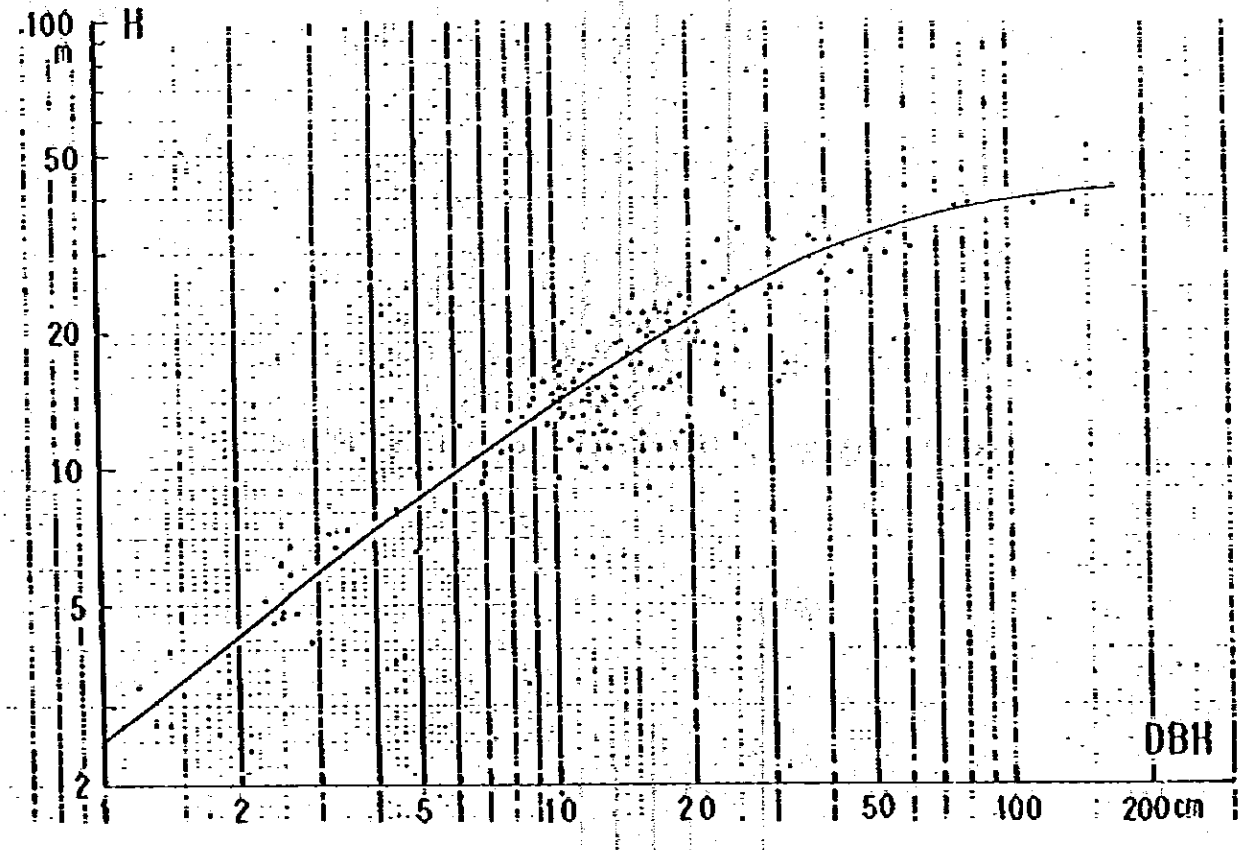


Fig. 12 Scatter diagram on a relation between D.B.H. and H. on the data collected from Plot-1.

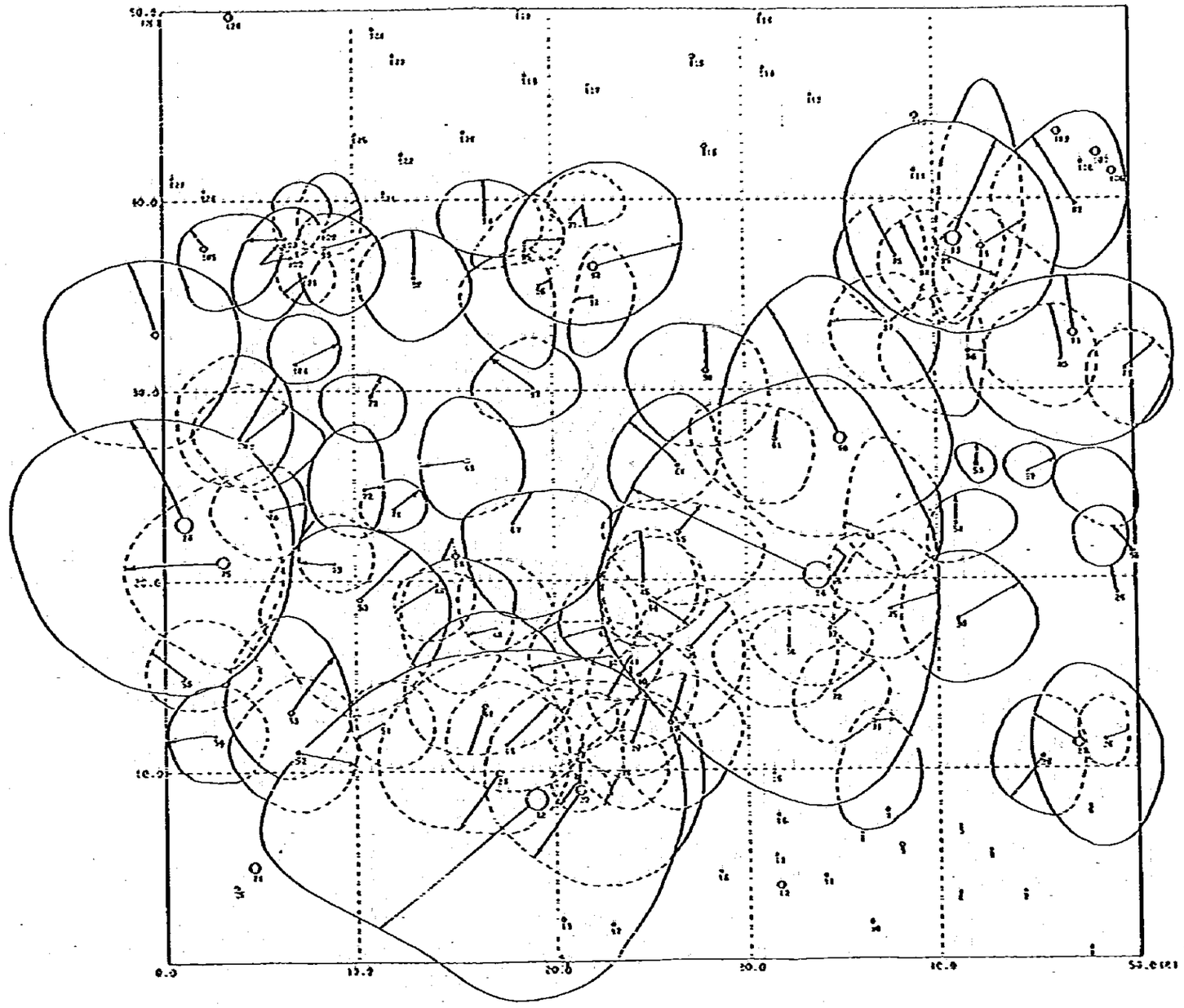


Fig. 13 Crown projection map of Plot-1

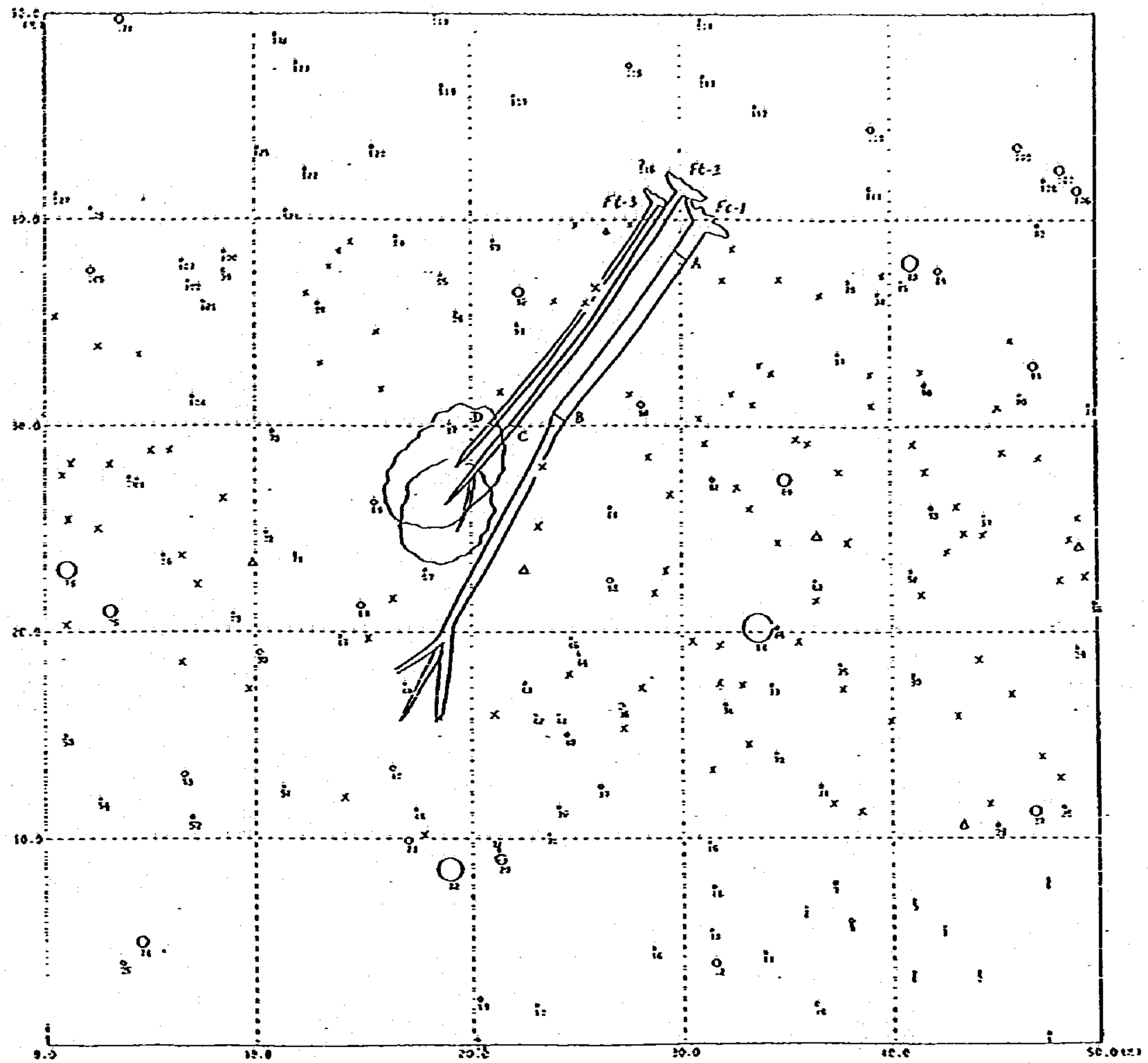


Fig. 14 Position of sound, dead and fallen trees in Plot-1

o : sound trees more than 10 cm in diameter.
x : sound trees more than 5 and less than 10 cm except the first and last lines.
Δ : standing dead trees.

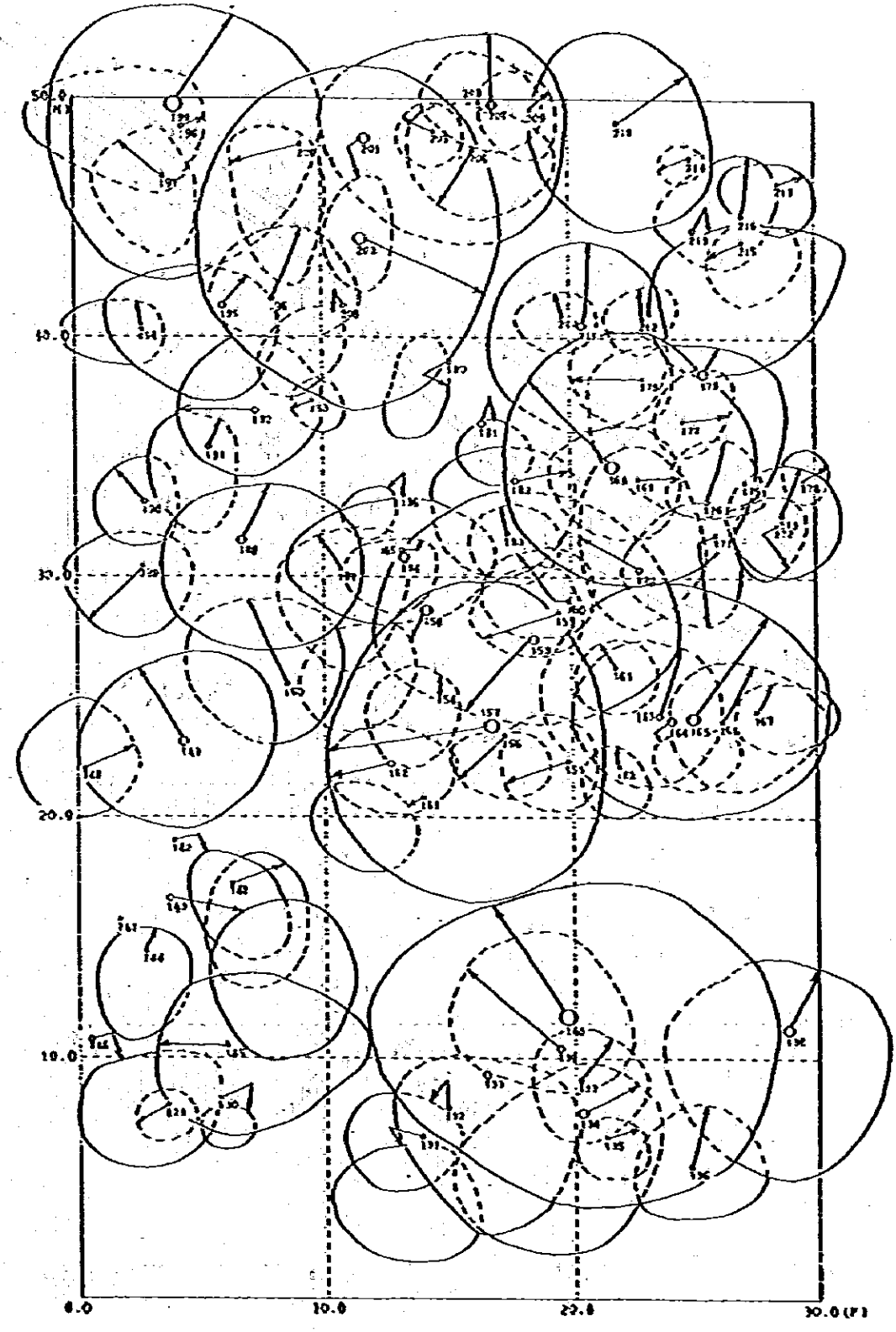


Fig. 15 Crown Projection map of Plot-2.

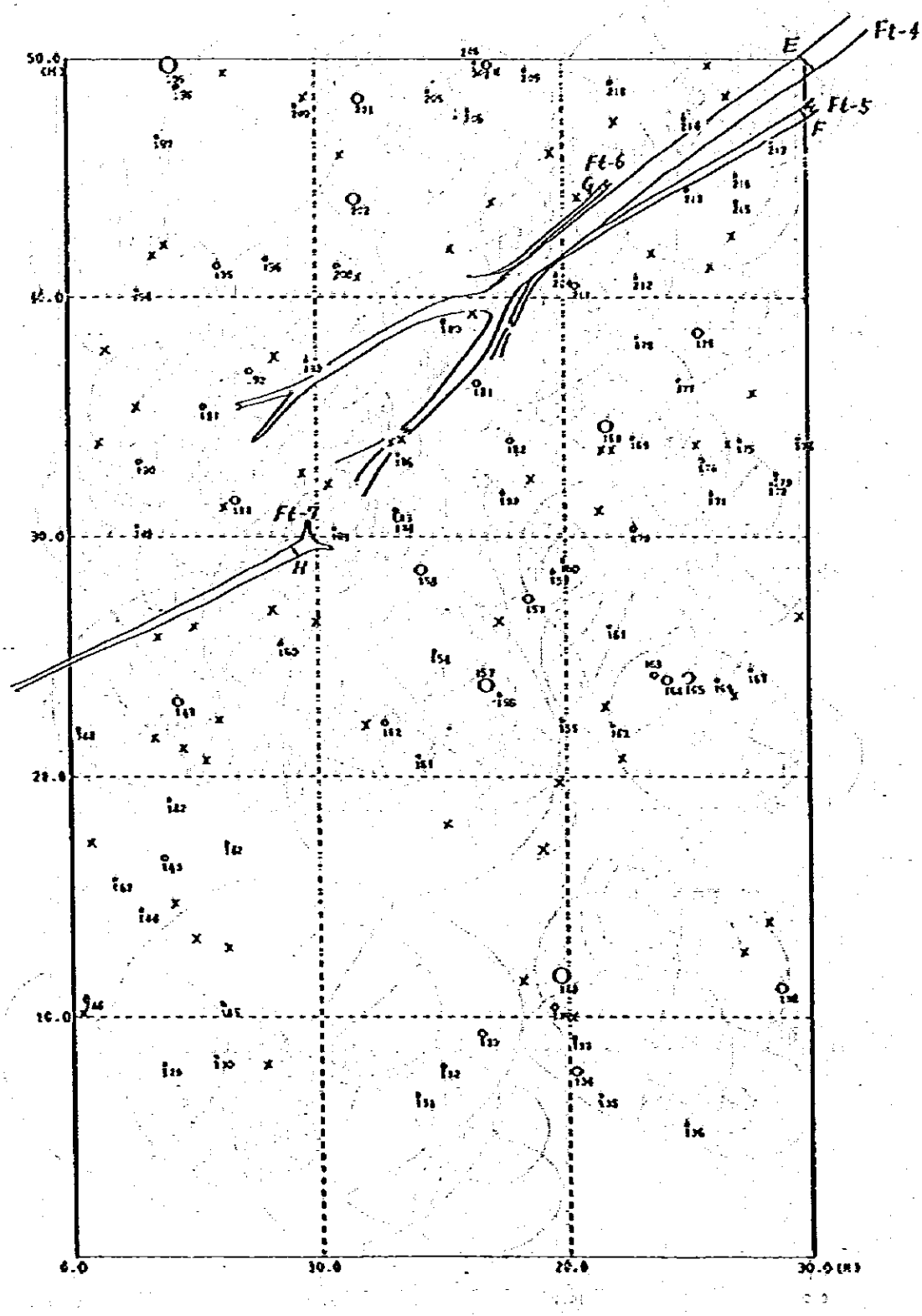


Fig. 16 Position of sound, dead and fallen trees in Plot-2

o : sound trees more than 10 cm in diameter.
× : sound trees more than 5 and less than 10 cm.
Δ : standing dead trees.

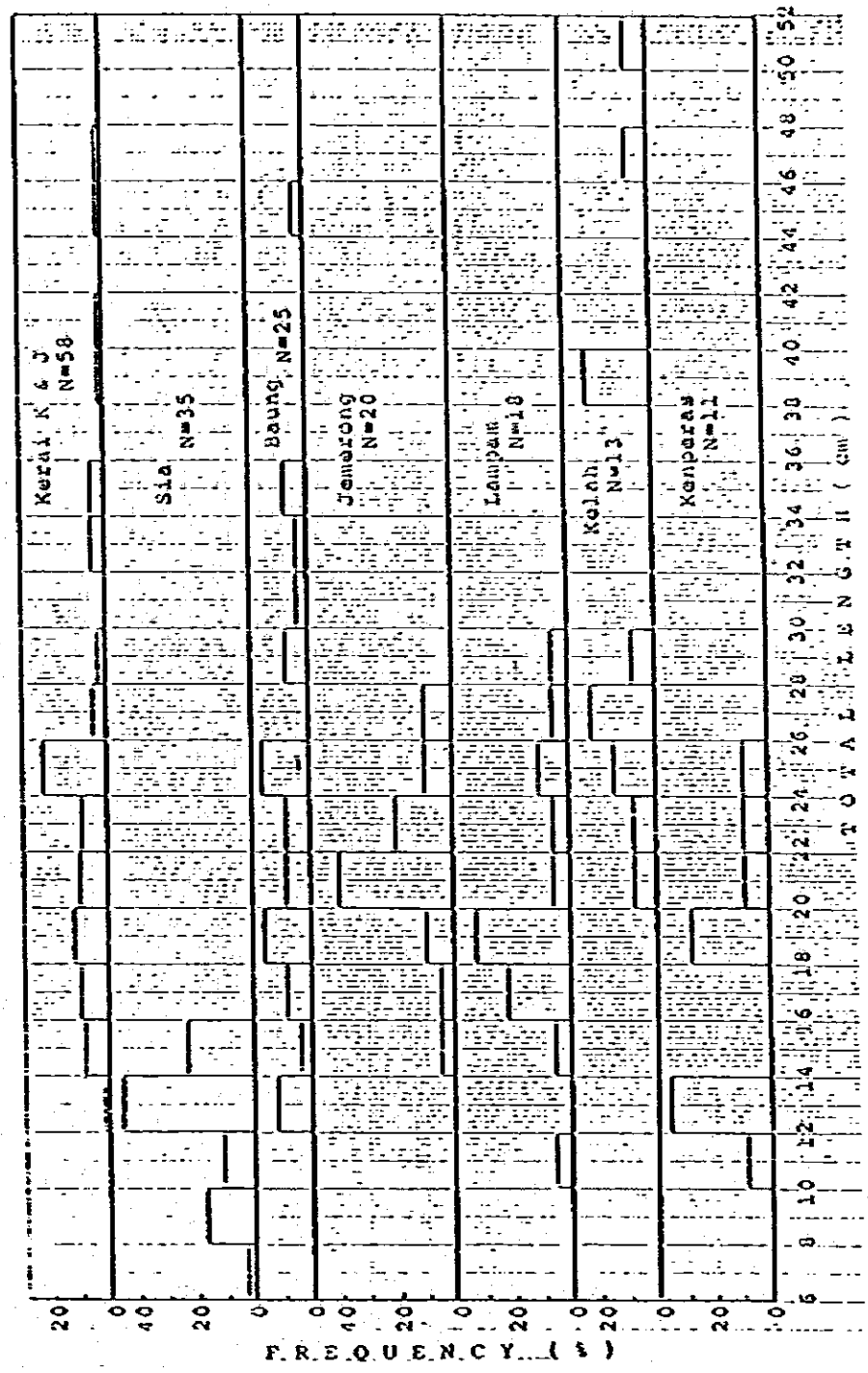


Fig. 17 Frequency distribution of total length for dominant species

Appendix 3

Scope of for the Feasibility Study of Hydro-Electric Development Project, Pahang, Malaysia

3.1 Introduction

In response to a request of the Government of Malaysia, the Government of Japan has decided to offer technical assistance in accordance with laws and regulations in force in Japan for undertaking of a Feasibility Study on the TEKAI Hydro-Electric Project, and the Japan International Cooperation Agency (hereinafter referred to as JICA), the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, will carry out the study in close cooperation with the Government of Malaysia and the executing agency, the National Electricity Board (hereinafter referred to as NEB).

3.2 Objective of the Study

The objective of the study will be i) to carry out a feasibility study, including detailed site investigations for the development of the TEKAI Hydro-Electric Project; ii) to undertake site investigations and office studies for the development of the TEKAI Project in order to determine the ultimate development taking into consideration other pertinent factors; and iii) to present the findings of the feasibility study for a final report which should be in sufficient detail for the Malaysian Government.

3.3 Scope of the Study

The feasibility study of the TEKAI Hydro-Electric Project will be carried out within a period of about two (2) years and eight months in the following three (3) stages:

i) Preliminary Investigation Stage
ii) Detailed Field Investigation Stage
iii) Feasibility Design Stage

The detailed scope of works at the respective stages are itemized as follows:

3.3.1 Preliminary Investigation Stage

(1) Field Investigations into Social and Economic Background

a. Electric power
Investigations and data collection concerning the existing power facilities, load forecast, power source development program and financial and economic conditions.

b. Sociological and environmental factors
Investigations and data collection concerning sociological and environmental assessment.

c. Flood control
Investigation and data collection concerning river improvement program, potentials of damage by flood and erosion control.

d. Water utilisation
Investigations and data collection concerning irrigation, industrial water utilisation, water supply, sewerage and drainage, navigation, fishery, etc.

e. Diversion and Pumped Storage Schemes
Diversion and Pumped Storage Schemes will be studied by utilising the maps which will be supplied by the Malaysian Government.

(2) Comparative Layout Studies

Comparative study of the previous plans and alternative plans of the Project based upon the existing topographic maps of 1:63,360.

(3) Site Reconnaissance

a. Site reconnaissance on the project site including alternative sites.

b. Ground surface surveys on topography and geology of dam sites, power station sites, switch-yard and quarry sites.

c. Surveys on transportation program

d. Siting of hydrological observation stations
Siting of rainfall gauging stations, water stage gauging stations and discharge observation stations.

(4) Preliminary Field Investigation Works

a. Topographic survey
Topographic surveys on the proposed sites for main structures including alternative sites and reservoir area.

b. Field geological investigation
Preliminary field geological investigations necessary for comparative study of the alternative sites.
Seismic prospecting, drilling works and permeability tests.

c. Installation guidance of hydrological observation stations
Installation guidance of observation instruments and establishment of a system for continuous observations.

(5) Selection of the Optimum Site

a. Selection of the sites
Preliminary layout studies of several alternative sites will be made. Then, construction costs of respective sites will

be estimated based on the preliminary layout design, and costs and benefits will be obtained. The optimum site of Upper TEKAI as well as Lower TEKAI will be selected from the alternative sites from the technical and economic viewpoints.

b. Preparation of detailed field investigations program
The program of the detailed field investigation works on the selected site will be prepared. The detailed field investigation works will include topographic survey, seismic prospecting, drilling works and field/laboratory tests.

3.3.2 Detailed Field Investigation Stage

(1) Topographic Survey

Ground survey on the proposed sites of dam, spillway, waterway, power station, tailrace, switchyard and quarry, including the installation of survey posts and bench marks.

(2) Seismic Prospecting

Seismic prospecting on the proposed sites of dam, spillway, headrace, power station and quarry sites.

(3) Drilling Works

Drilling works and permeability tests on the optimum site of Upper TEKAI and Lower TEKAI, which will be selected on 3.1. (5), of dam, spillway, headrace, power station, tunnel and quarry.

(4) Trench Excavation

Geological investigations by trench excavation and collection of soil test materials on the proposed sites of dam, spillway and quarry.

(5) Test Pitting

Collection of investigation materials by test pitting on the proposed sites of concrete aggregates quarry and river-bed materials.

(6) Discharge Observations

Guidance of actual measurement of discharge, bed loads and suspended loads at the installed discharge observation stations.

(7) Field/Laboratory Tests

Mechanical tests of fill materials, soil tests, concrete aggregate tests, bed-rock mechanical tests and water quality tests.

3.3.3 Feasibility Design Stage

Using the results of the studies carried out at the Detailed Field Investigation stage, the following design will be carried out by JICA.

(1) Project Output Studies

The optimum installed and firm capacities and energy availability of the Project will be developed, taking into account of multi-purpose aspects including land development scheme upstream of the reservoir. The timing, staging and phasing of the development of the Project will be ascertained by incorporation into the national grid system of the National Electricity Board.

(2) Investigation of Non-Power Benefits and Environmental Consequences

The investigations will include irrigation in the Project area, flood control, navigation, fishery, evaluation of impacts on regional economy, soil erosion, river water quality and biological

consideration.

(3) Feasibility Design

The design work will include civil works and structural analyses, steel structures and electro-mechanical equipment and temporary construction facilities. The line route, adopted kV and approximate cost estimates of the associated transmission lines, whose routes will be determined by incorporation into the national grid system of the National Electricity Board, will be studied on the existing maps on the scale of 1/63,360.

(4) Detailed cost estimates

The cost estimates of the Project will be broken down into local currency costs and foreign currency costs. The schedule of yearly disbursements will be carried out.

(5) Construction Schedule for Implementation of the Project

The construction schedule for implementation of the Project will be prepared by time-oriented bar chart.

(6) Economic Analyses of the Project

Separate economic analyses will be carried out for power generation only and also for power generation together with multi-purpose aspects. The economic analyses will include computation of Project costs and Operation, Management costs, examination and economic analyses of alternative power sources, Project assessment from the viewpoint of national economy, cost-benefit analyses and calculation of economic rate of return and sensitivity analyses.

(7) Financial Analyses of the Project

The financial analyses will include determination of financial

Project costs, preparation of cash flow, evaluation of specific revenue per kWh of energy sales and calculation of financial internal rate of return.

3.4 Reports

The following reports and plans will be prepared in English and submitted to the Malaysian Government within the time periods indicated below:

(1) Inception Report

The Inception Report (30 copies) within one (1) month of the starting date.

(2) Monthly Progress Report

Monthly Progress Report (12 copies) covering the field and office studies of the Feasibility Study.

(3) Interim Report

The Interim Report (30 copies) summarising the studies done at the stage of Preliminary Investigation, especially concerning the proposal of a selected site for the Project, within four and a half (4.5) months after the completion of the Preliminary Investigation.

(4) Draft Final Report

The Draft Final Report (30 copies) within five and a half (5.5) months of completion of the Detailed Field Investigation. This Report shall summarise all works performed, the findings and recommendations and shall provide maps, plans and diagrams of the proposed Project.

(5) Final Report

The Final Report (50 copies) within one (1) month after receiving comments on the Draft Final Report from the Malaysian Government and JICA.

3.5 Contributions of Both Malaysian and Japanese Sides

3.5.1 Division of Technical Undertakings in Carrying out the Study

The division of technical undertakings by Japan and Malaysia of TEKAI Hydro-Electric Feasibility Study is as per Appendix-B.

3.5.2 Contribution of the Government of Malaysia

(1) To provide the study team with available data, information and materials necessary for the study and such survey connected with it.

(2) To arrange/coordinate meetings with authorities/agencies concerned.

(3) To obtain official permission for the members of the study team to enter into, stay and work in, and depart from Malaysia.

(4) To exempt from taxes and duties normally accorded under the provisions of General Circular No. 1 of 1979 for equipment, materials and personal effects brought into Malaysia by the study team for the purpose of the study.

(5) To obtain customs clearance, hardling and storage at the port/airport and inland transportation (to and from the Project site) and custody of equipment, machines, instruments, tools and other articles to be brought into Malaysia and then brought back to Japan

by the study team.

(6) To assign counterpart personnel to the study team during the study period.

(7) To obtain necessary permission for the team to use radiophone and to undertake geological and topographic investigations (including the use of explosives in carrying out the study) subject to approval from the authorities concerned.

(8) To make arrangement to obtain permission for the team for entry into the Project area and private-owned land for purpose of the study.

(9) To undertake additional hydrological observations, if necessary.

(10) To provide the following facilities/services:

(a) first aid services

(b) office accomodation in Kuala Lumpur with adequate floor space

(c) necessary lodging/camping accomodation with lighting and raw water supply at the Project site with a floor space of about 40 m^2.

(d) temporary warehouse with a floor space of about 20 m^2 at the Project site

(e) transportation facilities in the Project area comprising 2 units of 4-wheel drive jeep (with drivers and fuel) a motor boat and rafts for river crossing.

(f) construction of access tracks for execution of field investi-

gation works, geological investigation and drilling works as well as of all associated reconnaissance on the Project site.

3.5.3 Contribution of JICA

(1) To despatch the Japanese Study Team to conduct the study.

(2) To provide for the duration of the study the necessary equipment as specified in Appendix-B for the efficient conduct of the study.

(3) To transfer the knowledge and technology to Malaysian counterparts during the period of the study.

Appendix-B Division of Undertakings by JICA and the Government of Malaysia for TEKAI Hydro-Electric Feasibility Study

Working Item	Contribution by JICA	Contribution by the Government of Malaysia
1. Site reconnaissance	1. Site reconnaissance	1. Provision of counterpart engineers and labourers for guidance, learning of paths, and transport facilities.
2. Topographic survey		
2.1. Aerial survey and mapping	1. Programming 2. Preparation of specifications 3. Survey of control points 4. Decision of control points 5. Supervision of aerographic survey 6. Despatch of surveyors 7. Hire of surveying instruments 8. Aerial triangulation 9. To bear the cost of (a) aero-photographing (b) aerographic mapping	1. Aerial photographing by Survey Department of the Malaysian Government 2. Provision of assistants and labourers for aerographic survey. 3. Provision of existing aerophoto films on the scale of 1:25,000. 4. Provision of existing maps on the scales of 1:63,360 and 1:25,000 for the whole Tekai and Tembeling catchment area.
2.2. Ground survey	1. Programming 2. Determination of locations 3. Preparation of specifications 4. Carrying-out of ground survey including (a) despatch of surveyors (b) hire of surveying instruments 5. Production of survey maps	1. Provision of 2 assistants and labourers for ground survey. 2. Provision and ascertaining of height at the bench mark available in the nearest terminal to the site.

Working Item	Contribution by JICA	Contribution by the Government of Malaysia
3. Geological investigation		
3.1. Drilling works and permeability tests	1. Selection of drilling locations 2. Preparation of specifications 3. Despatch of supervisors for drilling works and permeability tests 4. Necessary topographic survey 5. Geological assessment of boring cores 6. Contracting with local Contractor(s) for drilling works, penetration tests and permeability tests 7. Carrying-out of drilling works and all associated tests by contracting with local Contractor(s)	NIL
3.2. Seismic prospecting	1. Programming 2. Identification of locations and area 3. Hire of equipment 4. Supervision of seismic prospecting 5. Despatch of an expert in seismic prospecting 6. Necessary topographic survey 7. Recording of results 8. Analyses of data	1. Provision of labourers for seismic prospecting 2. Provision of explosives for seismic prospecting 3. Provision of technical assistants for seismic prospecting, and guards of powder magazine 4. Provision of powder magazine.

Working Item	Contribution by JICA	Contribution by the Government of Malaysia
3.3. Trench and pit excavations	1. Programming 2. Determination of location 3. Preparation of specifications 4. Supervision of trench and pit excavations 5. Geological assessment of results of trench and pit excavations	1. Carrying-out of trench and pit excavations
3.4. Field/laboratory tests	1. Programming 2. Identification of locations for sampling 3. Preparation of specifications 4. Despatch of an expert 5. Hire of testing device 6. Carrying-out of tests 7. Analyses of data	1. Provision of labourers for sampling and local transport of sampled materials
3.5. Preparation of geological maps	1. Field reconnaissance 2. Geological assessment based on results of field geological explorations 3. Preparation of geological maps	NIL

Working Item	Contribution by JICA	Contribution by the Government of Malaysia
4. Hydrological investigation	1. Hire of measuring instruments 2. Planning of hydrological measurements 3. Analyses of data	1. Installation of measuring instruments, if necessary 2. Observation and recording, if necessary 3. Provision of labourers for sediment sampling
5. Studies on floods, land use, environment, etc.	1. Field investigations 2. Analyses and studies	1. Provision of the existing available data associated
6. Office studies	1. Analyses 2. Designs 3. Reports	1. Provision of the existing available data on past earthquake records in Malaysia
7. Load demand and transmission studies	1. Review and analysis of previous studies	1. Provision of previous studies on potential load demand and transmission requirement.

Appendix 4

List of Project Staff

List of Staff (Japanese)

Takahira, Keiichi	Team Leader
Sugimoto, Takuji	Deputy Team Leader (Chief Geologist)
Ogano, Shiro	Geologist
Okajima, Shinichi	Geologist
Kubota, Minoru	Chief Civil Engineer
Okano, Yoshihiro	Civil Engineer
Hirata, Kenshi	ditto
Ohtagaki, Tatsunori	ditto
Hamada, Takayoshi	ditto
Sugawara, Tsuneaki	Hydrorologist
Kameyama, Tsutomu	ditto
Yoshida, Yoshio	ditto
Ohto, Hiroshi	Electrical Engineer
Hirano, Tsutomu	ditto
Yagi, Kaoru	ditto
Inoue, Yutaka	Economist
Suzuki, Toshio	Agriculture Economist
Kashio, Masakazu	Ecologist (Plants)
Kaneko, Yoshio	Ecologist (Animal)
Wada, Katsumi	Surveyer
Takahashi, Hironasa	ditto
Iimuro, Teruo	ditto
Yamaji, Kazuhiro	ditto
Nakamoto, Takashi	ditto
Takahashi, Tsutomu	ditto
Nakayama, Mikio	ditto
Hayasaki, Hidemi	ditto
Horaguchi, Katsumi	Surveyer (Airial Photographing)
Ohnuma, Katsuro	Surveyer (Supervisor)
Tennyo, Hiroshi	ditto

Home (In Japan) Work Members

Miyata, Miyuki	Civil Engineer
Sano, Takeo	ditto
Kanokogi, Tadao	ditto
Ohuchida, Toshiyuki	Economist

List of Staff (Malaysian)

Mr. Martin Dorai	-	Drainage and Irrigation Department, Kuala Lumpur.
Mr. Ho Yueh Chuen	-	Environment Section, Ministry of Science, Technology and Environment, Kuala Lumpur.
Mr. Salehan bin Lamin	-	Fisheries Department, Kuala Lumpur.
Mr. Wan Abu Baker	-	State Economic Planning Unit, Pahang.
Mr. Ab. Rashid Mat Amin	-	Forestry Department, Pahang.
Mr. Lung Heng Toh	-	Drainage and Irrigation Department, Pahang.
Mr. Pong Thin Yiew	-	National Electricity Board, Kuala Lumpur.
Mr. Th'ng Yong Huat	-	- ditto -
Mr. Ridza Abdoh	-	Implementation Coordination Unit, Prime Minister's Department, Kuala Lumpur.
Mr. K. Kananatu	-	Economic Planning Unit, Prime Minister's Department, Kuala Lumpur.
Mr. Kamarulzaman bin Abdul Ghani	-	- ditto -