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REVIEW OF INLAND FISHERIES IN NETHERLANDS NEW GUINEA

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I. INTRODUCTION

A. GENERAL

As in many other countries, the government of Netherlands New Guinea has undertaken the comprehensive task of promoting and developing the territorial fisheries in co-operation with the Food and Agricultural Organization of the United Nations and the South Pacific Commission. So far as the Inland Fisheries Section is concerned, this task comprises in the main the operation of fisheries in open waters (lakes, swamps, rivers) and pisciculture in ponds and other suitable inland waters.

The fundamental problems in this field were:

a) knowledge of the indigenous fish varieties that may have economic value;

b) knowledge of the fish stocks;

c) research into the ecological conditions in which the fish stocks occur.

B. INDIGENOUS FISH VARIETIES

The first-mentioned problem - fish varieties - has been the subject of intensive studies of BLEEKER, DE BEAUFORT, MAX WEBER, MUNRO, BOESEMAN, and others. Their researches revealed that among the locally found ATHERINIDAE, MUGILIDAE, LUTJANIDAE, APOGONIDAE, ARRIDAE, GOBIIDAE, ELECTRIDAE, PLEURONECTOIDES, and ELASMOBRANCHIDAE, there were few varieties of actual economic value. Only MUGILIDAE, which species was not being fished for with the primitive equipment used, and LUTJANIDAE, could be regarded as species of possible economic significance. Catches of LUTJANUS JOHNII on Lake Sentani alone total $6\frac{1}{2}$ metric tons annually. Improved fishing methods may raise this production to 12 metric tons. To this end a barricade raised across the Jafuri river, the outlet of Lake Sentani, was changed into an arrow-shaped barricade pointing upstream and with a detachable part to facilitate the recruitment of young fish swimming up the river from the sea.

The determination of the size of fish stocks in the other open inland waters is still being carried out. This work is making progress notwithstanding the often extremely difficult local conditions. There are indications, however, that in southern New Guinea improved fishing methods, preservation, and better means of transportation will result in a considerable expansion of swamp and river fisheries and a sharp rise in production of almost intact inland fish stocks.

Especially in the periodically expanding swamps in the MAPPI area, which are fed by large rivers and in the Kokoda have an open connection with the Banda Sea, which abounds in fish, there are large stocks of species of marine immigrants. PLECTOGNATIS LEICHARDTII and other typical fresh water fish complete the stocks.

Here is still a large scope for the promotion of fishing techniques, among which the barricade method, whereby locally found materials are used, will figure largely.

The third fundamental research, viz. that into the ecological conditions, has given rise to the view that it might be possible to introduce exotic fish varieties with a higher production, to fill ecological niches. This was also considered urgent in view of the shortage of protein and the consequent deficiencies that are felt especially in the Central Highlands.

C. EXOTIC FISH VARIETIES

Following this research, it was realized that it would be necessary and desirable to introduce fish varieties that did not previously occur in the waters studied; fish varieties, which had yielded valuable results in other parts of the world or which had been valuable in a certain area, but are no longer found there.

Moving fish varieties to such an area is generally known as transplantation. This method is drawing much attention, notably in connection with the improvement of the protein diet of the indigenous population, and has yielded satisfactory results also in Netherlands New Guinea.

It is obvious that particularly those species have been introduced which the summary data from the ecological research work of i.a. BOTKE, REESKAMP and DE VRIES, as well as experience in other tropical regions have proved to yield the most promising results.

To this end particularly, herbivores (TRICHOGASTER PECTORALIS, HELOSTOMA TEMMINCKII, OSPHRONEMUS GOURAMY) and omnivorous microphagous species (CYPRINUS var. and TILAPIA MOSSAMBICA) were transplanted in Netherlands New Guinea.

These varieties were bred in central breeding ponds to study a number of biological properties in the new environment, and to acquaint fishery trainees and laymen with breeding and cultivation methods. In this manner the distribution of the fish varieties throughout the territory can be kept under control.

II. SHORT HISTORY OF PREVIOUS INTRODUCTIONS

A. CONTROLLED INTRODUCTIONS

As early as 1938, TRICHOGASTER PECTORALIS, HELOSTOMA TEMMINCKII and the POENTEN variety of CYPRIMUS CARPIO were planted in Lake Ajamaroe to supply the requirements of a military post in that area. The two first-mentioned species are still found there as a result of a highly successful acclimatization. "Sepat" and "tambakan" at Ajamaroe are the species on which further transplantation in Netherlands New Guinea is based. The POENTEN carp has disappeared from the lake, possible causes for its disappearance being:

a) the strongly oligotrophic nature of the lake water (visibility to a depth of over 35 ft; bottom vegetation to 13 ft; poor buffering, apparent from widely varying pH's: 6.4 - 7.8). Algae do not occur or only sporadically;

b) the apparent overfishing of the lake (few fully developed specimens of different species; large-scale fishing, also making use of fish poison);

c) fishing by the Japanese in the period from 1942/45.

For exactly the same reason POENTEN carp was planted in Lake Paniai near Enarotali (Wissel Lake region in the Central Highlands) in 1942, in which connection Mr. SCHUSTER of the then Netherlands Indies Fisheries Service rendered assistance. The species has also disappeared from this lake. A most likely cause may be the very cold water, which at the surface has a temperature of 62°F. The frequently occurring thermic stratification of open waters in the Central Highlands may very well be present also in the Wissel Lakes. However, this has not yet been proven for want of the necessary equipment. The survival of a single specimen in the adjoining swamps without reproduction of the species was observed in November, 1961, when a specimen of this fish species was caught there. The possibilities of stocking European carp varieties (e.g. the scale carp) are being investigated.

B. UNCONTROLLED INTRODUCTIONS

Uncontrolled introductions of OPHIOCEPHALUS STRIATUS and CLARIAS BATRACHIUS took place in January, 1950, when the officer in charge of Sorong-Remoe prison introduced the species from Watampone (Celebes). Being cultivated in a pond, a number of specimens escaped during a flood. The Warsamson river area soon appeared to be infested by the aggressive Ophiocephalus. In 1961 the species appeared to have penetrated as far as north-west of Ajamaroe. The breeding biological circumstance that this species protects its nest, prevents its extermination. Production of the Ophiocephalus infested areas has dropped to such an extent as has caused the species to be found only at the mouths of the rivers where it predominates.

This is a striking example of the tragic consequence of transplantation of a fish species, which would have been rejected by any insider in this difficult matter.

We are therefore somewhat reluctant to transplant, for example, trout varieties to the Central Highlands, to which incomplete observations could easily lead. Typical trout waters (trout feeder streams and trout streams) are plenty; poor fish stocks or even a complete absence of stocks press for stocking; fish serving as food for other species sometimes are present and if not, may be made available by planting them. The property of living in pairs and at times solitarily, as well as the gluttony of this predacious fish, and in particular the possibility of introducing the NEPALESE DESMIDEATING OREINUS MOLEWORTHII, tipped the balance against trout.

III. STAFF AND INSTITUTIONS

A. INLAND FISHERIES SECTION

In September, 1958, the Inland Fisheries Section was established as a branch of the Division of Agriculture and Stock of the Department of Economic Affairs. The first Fisheries Officer was Mr. G.A. REESKAMP, who was succeeded in November, 1959 by Mr. J. DE VRIES.

The section has its headquarters at Sentani, near the lake of this name. The staff of the section in 1961 was made up of 2 European officers (J. DE VRIES, head of the section; and J. GEISSLER, Inland Fishery Officer) and a number of indigenous assistants, including 4 inland fishery assistants; 5 fishery trainees; 1 nursery assistant; and a number of locally engaged workers.

The inland fishery assistants are trained at the Central Inland Fisheries Station at Jabaso on Lake Sentani; upon completion of the course they are posted throughout the Territory. As long as their number is small, it is their duty principally to promote pisciculture, while they are in charge of regional fish breeding stations, which are the centres of regional distribution of fry for the fish ponds of the local population. Particularly in the beginning a regular control of the newly built ponds in the regions under their supervision is of utmost importance. Minor faults in the construction of demonstration ponds will avenge themselves later in that they will be difficult to manage.

B. CENTRAL INLAND FISHERIES STATION - JABASO

The breeding ponds of the Central Inland Fisheries Station are favourably situated at a short distance from Sentani airport, from which at least five major lines operate services. This will facilitate transportation of fry by air throughout the territory.

With a view to improving fish varieties wherever possible the following varieties are being bred:

CYPRINUS CARPIO - Cantonese var.

" " - Japanese gold carp; originally with black and red spots, due to insufficient trueness, to be selected each time;

CYPRINUS CARPIO - European variety, in different sub-varieties.

Other species bred are: HELOSTOMA TEMMINCKII: OSPHRONEMUS GOURAMY: TILAPIA MOSSAMBICA: and GAMBUSIA AFFINIS.

TRICHOGASTER PECTORALIS is supplied from Lake Sentani, where this species appears to have acclimatized very well.

The ponds, which are still expanding, at the end of 1961 covered the following area:

1 carp breeding pond	-	½ are*
4 carp segregation ponds	-	2 ares
5 carp fry feeding ponds	-	5 ares
5 carp stock ponds	-	10 ares
1 fermenting-pond	-	18 ares
2 Tilapia ponds, Djaeni-Hofstede type	-	6 ares
6 Anabantidae ponds	-	18 ares
		59½ ares

In 1962 the following ponds will be added:

2 carp feeding ponds	-	48 ares
2 Puntius ponds	-	24 ares
2 selection ponds	-	48 ares
		120 ares

(* 1 are = 119.6 sq. yds.)

A station for cold water fish (CYPRINUS, TINCA, OREINUS) will be established in the Baliem Valley at an altitude of 4,600 ft.

Production of the various species was as follows:

PRODUCTION AT JABASO FISHERIES STATION

	1959	1960	1961
CYPRINUS CARPIO (all vars.)	983	4.570	5.050
TILAPIA MOSSAMBICA	2.000 3.000	25.000	48.000
OSPHRONEMUS GOURAMY	10	150	1.060
HELOSTOMA TEMMINCKII	77	224	383
GAMBUSIA AFFINIS	some 1.000s	many	1.000s

Numbers of fish distributed and planted:

	1958	1959	1960	1961
CYPRINUS CARPIO (Canton var.)	515	70	825	2.783
CYPRINUS CARPIO (Japanese var.)	-	-	133	1.473
TILAPIA MOSSAMBICA	2.876	5.000	3.850	4.735
OSPHRONEMUS GOURAMY	-	-	25	627
GAMBUSIA AFFINIS	753	2.500	3.000	3.500

The Agricultural Department is aiming at 5.000 ponds of about 2 ares each throughout the Territory by the end of 1965. The Jabaso Central Inland Fisheries Station together with some of the regional stations will be able to supply the demand for fry.

IV. TRANSPLANTATION IN CHRONOLOGICAL ORDER OF INTRODUCTION

TRICHOGASTER PECTORALIS (REGAN).

Introduced at Ajamaroe from Amboina in 1938, at the same time as HELOSTOMA TEMMINCKII, CYPRINUS CARPIO (extinct since 1942), and OSPHRONEMUS GOURAMY (failed?).

Still a satisfactory species, but small. Fully developed 18 centimetres long (Lake Sentani 23 cm.). Apparently filling an ecological niche and derives its value from its being caught in greater than normal quantities. Was transplanted to Lake Sentani in 1951, to be planted at Joka (east side of the lake). In 1962 the species is found to abound at Dojo-Sosiri (west side of the lake). Scarce population in the eastern part of the lake attributable to presence there of predacious marine immigrants (LUTJANUS JOHNII, APOGON spec. and others).

In 1961 a production of 9 tons was achieved at Sosiri. Better fishing methods could easily raise the catch to three times the present volume. Fish trap trials proved to yield greater catches: 40 kilos of adult fish per trap per night.

Despite the inconstant climate, which can hardly be regarded as monsoonal, the species finds excellent protection for its floating foam nest against rainfall in the vast sago swamps and in the northern part of the lake.

In May, 1960, 23 specimens were planted in the Maro river swamps north of Merauke. The results are not yet known. Lake Sentani is a lake of a eutrophic type. Its water is an opaque green, caused by Aerogenes algae and Diatoms (Synedra, Navicula, etc.).

In addition, there are vast fields of Najas, Hydrilla, Potamogeton, and Myriophyllium. The detritus- and plankton-eating TRICHOGASTER has, therefore, plenty of food at its disposal.

Fishing is carried out by means of spears and casting nets. The species is too fast for the typical method of hand-catching by women in fish "gardens", which are periodically fenced in; this method is still practised. The indigenous fishermen have a saying that:

"Ikan sepat terlalu tjepat" - which means: The sepat fish is too fast.

Preservation by means of salt is applied, but only on a limited scale.

HELOSTOMA TEMMINCKII

Like TRICHOGASTER, introduced from Amboina in 1938. For experiments 69 specimens were planted in ponds at Jabaso on July 11, 1959. In 1961 this number had increased to 224. The species is used to check the growth of algae in breeding ponds, i.a. where OSPHR. GOURAMY is bred. The occasion for planting the species has not been discovered.

The fish is high in demand for consumption among the indigenous station hands.

OSPHRONEMUS GOURAMY

Was imported from Manila on March 15, 1958. First spawning took place on August 11, 1960; 6 ♀♀ and 4 ♂♂ = 10 specimens were involved. The first distribution took place on December 5, 1960. Distributions totalled:

1960 - 20

1961 - 564, including 360 in Lake Sentani and 12 destined for Lae, Territory of Papua and New Guinea.

Spawning takes place in 4 separate ponds and continues regularly throughout the year, with intervals of 4-5 weeks. Arenga palm fibre is distributed for nest building, which takes place in a corner under a supply pipe, in an artificial nest of furcated bamboo poles. The place of the nest depends on the height of the water in the ponds, which is kept at a constant level. The phenomenon of the placing of floating material under the nest when the waterlevel rises could not, therefore, be observed.

At the age of $3\frac{1}{2}$ years the fishes have attained the following lengths:

♂ - 54 centimetres

♀ - 47 centimetres

On November 12, 1961, 360 specimens were released in Lake Sentani in 13 ft. deep water with much floating and submerged vegetation. It was the intention to stock the lake with a big herbivorous species as a counterpart of LUTJANUS JOHNII, another big species. SEPAT SIAM being a great success, it is expected that OSPHRONEMUS GOURAMY will also offer good prospects. As a labyrinth fish, SEPAT is little affected by the periodically occurring mortality among fish populations. The cause of this mortality is the sharply increased B.O.D.* of the water when the

* Biochemical oxygen demand

rains set in. The submerged vegetation is killed by obstructed assimilation due to the raised lake water level.

CYPRINUS CARPIO

Cantonese variety

As a flat-bellied carp for warm waters (77°F.up) the Cantonese variety was imported from Manila on December 23, 1958. The fish is brass in colour, and dark grey along the back. Has two pairs of prominent whisker-like barbels. Very prolific at temperatures from 82 to 90°. In the Jabaso ponds the species reaches sexual maturity at the age of 7-8 months. Genetic factors are very steady. Accelerated or retarded growth in different generations does not occur. The species is a fervent bottom feeder.

The Cantonese carp is used for stocking ponds and natural waters. Its size varies widely in waters with a different production of natural food. In the Jabaso ponds, with their highly oligotrophic water, 17 centimetres was the maximum length observed. When it was observed that the species in Lake Sentani, where specimens were kept in fish boxes, attained a length of 32 centimetres and a weight of 1,500 grammes, it was decided to plant large breeding surpluses in the lake, which appeared to be an ideal carp water with its dense bottom vegetation in shallow places and an abundance of food in the form of DIPTERA larvae.

Specimens of 42 cm. long and over 3 kilos in weight are now, indeed, being caught.

Since June 24, 1961, hundreds of surplus fry has been regularly planted in the lake.

At present, the fish is expanding beyond the centre of the lake.

Japanese Gold Carp

A torpedo-shaped oriental carp variety, mainly orange gold in colour. However, the colour is by no means genetically fixed, and a range of shades varying from dark grey to almost white occurs in the fry. The shape seems to be true.

Optimum spawning temperatures are lower than those for the Cantonese carp, namely around 77°F. The species is at present used for stocking the ponds in the Central Highlands, where it yields excellent results.

In the lowlands, in water with a temperature verying from 82 to 90°, the fish will within a year attain a length of 35 cm. and a weight of 1,500 grammes. Growth is, of course, slower in the highlands, but the fish will eventaully grow bigger in size.

European Carp

Like the Japanese Carp, this species was introduced from the Netherlands on December 6, 1959. The shipment consisted of 50 specimens of widely varying subvarieties.

Cultivation at Jabaso at water temperatures of 82-90° revealed the

fastest growth in the scale carp. Two female specimens of this variety have now attained a length of 65 and 72 cm. However, at the prevailing water temperatures both the female and the male specimens proved infertile.

The maximum spawning temperature indicated in literature is 77°F.(HORA). Efforts will be made to move the fishes to a highland station, which is bound to present difficulties, having regard to their extraordinary size. It is the intention to anaesthetize the fishes and to transport them by air in a low metabolic condition (artificial hibernation).

TILAPIA MOSSAMBICA

Was imported from Manila on October 3, 1957 for cultivation at the Wefersdorp agricultural experiment station. On October 20, no less than 200 fry appeared to be present, and on November 4, 1957 the first specimens were distributed. The species has since been distributed throughout the territory.

TILAPIA is of much value to start an indigenous inland fish-culture. In addition, the fish has been used to stock large areas of open system waters.

At Jabaso, TILAPIA is hatched according to the Jaëni-Hofstede system in separate age groups. This greatly facilitates the packing of large quantities. Rearing is carried out in accordance with the mono-sex system, raising male and female specimens separately. This method is encouraged among the indigenous population. When using a magnifier, accuracy in determining the sex may be raised to 98 per cent.

V. TRANSPORTATION OF FRY

A major difficulty with the transportation of fry has turned out to be packing material that can meet reasonable requirements. Bamboo tubes were used, but proved unsuitable in view of the lack of useful space as against their weight (important in connection with the high air freight). Leakage of the material could not be tolerated either. Eventually two systems have been selected:

1. Transportation in plastic bags (30 x 50 cm. and 0.3 millimetre thickness of foil), to which a bubble of technical oxygen is added. In the lowlands the fish will stay alive for 36 hours, in the highlands for 48 hours.

2. Transportation in cans with pressure lid (size: 45 x 45 cm., 30 cm. in height). No oxygen is added.

The first-mentioned system is used to transport fish to waters near the terminal airstrip. The water in the plastic containers cannot be renewed.

The second system is used for transport by carriers or first by air and thereafter by carrier. The water can be regularly renewed during transport.