

## FISHERIES IN YONKI RESERVOIR, PAPUA NEW GUINEA

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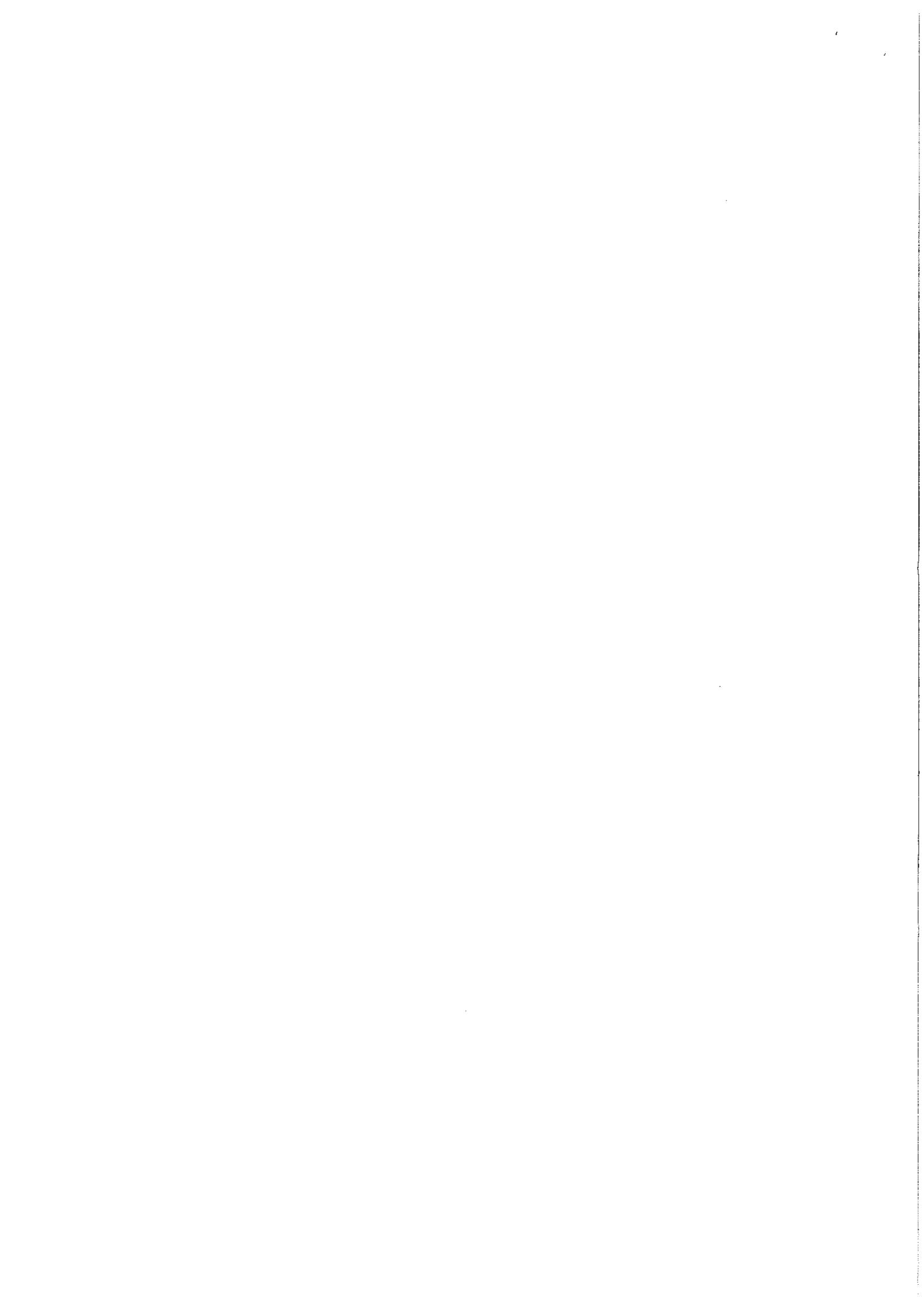
### ABSTRACT

A year after Yonki Reservoir (Eastern Highlands Province, Papua New Guinea) had been completed, a survey was conducted among people found fishing at the shore. Rod and line was used in 99% of the reported fishing trips. On an average 0.42 kg of fish was caught per person per trip. The average catch per hookhour was 0.033 kg of the past fishing trips, and 0.021 kg of the on-going fishing trips. The first half of the year during which interviews were conducted the catch was composed only of *Cyprinus carpio* and *Oreochromis mossambicus*. In mid-1992 *Tilapia rendalli* appeared in the catch, and six months later this species was responsible for 48% of the weight of the daily catch. The total catch from the reservoir for the year 1992 was estimated at 40.2 tons.

### INTRODUCTION

There is an abundance of creeks and small rivers in the Central Highlands region of Papua New Guinea but the area is poor in stagnant waters such as lakes, swamps or reservoirs. The fishing taking place in running waters is predominantly conducted by men. Handline, set line and funnel traps are the most commonly used fishing methods. Nearly all the catch is consumed at home and contributes on average 1.8 kg of fish per resident per year to the diet of people living in the high altitude villages with access to creeks and rivers (Heijden, 2002). Other natural sources of animal protein are equally scarce in most parts of the area. In most of the surveyed villages a big part of the catch is composed of the indigenous eel species *Anguilla marmorata* and *A. bicolor*. Several exotic fish species have been introduced in the New Guinea Highlands in the 1950s and 1960s for fish farming purposes and to enhance the catch from natural waters. Common carp *Cyprinus*

*carpio* has been the most successful exotic species at the higher altitudes and is now commonly found in rivers and creeks that are not fast flowing (Heijden, 2002). Rainbow trout *Oncorhynchus mykiss* was brought in from Australia and has established in waters at altitudes higher than 1800 meters above sea level (Povlsen 1991). Between 1991 and 1997 new fish species were introduced in the Sepik-Ramu catchment area to boost fish stocks at altitudes lower than those preferred by the trout. Before these recently introduced fish species became part of the fish stock Mys & van Zwieten (1990) and (Heijden, 2002) conducted baseline surveys of the fishery situation in the Sepik-Ramu region. Their reports include catch rates from various types of water bodies. This article reports the results of a survey conducted among fishers at Yonki Reservoir, the biggest high altitude water body in the Sepik-Ramu catchment area, one year after its creation.

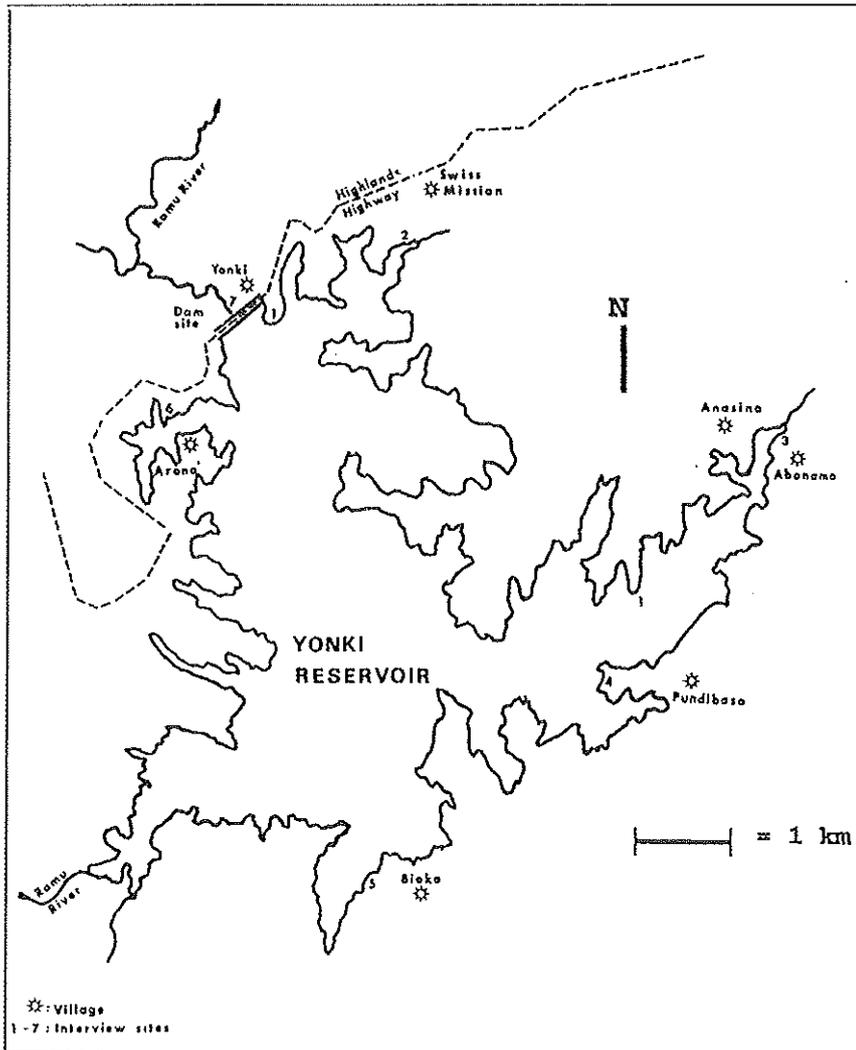


*Fisheries in Yonki Reservoir*

**The study area**

The dam that blocks the Ramu River near Yonki Township (Eastern Highlands Province) was completed at the beginning of 1991. Full Supply Level of the reservoir was reached for the first time in November 1991. The reservoir is situated 1260 meters above sea level at 146 00'E and 06 16'S. It

covers an area of 2200 hectares and has a depth of 60 metres at the deepest spot. The shoreline is very dendritic and has a length of 50 km (Figure 1.). Most rain in the area falls between December and May. According to the 1990 National Population Census 9179 people live in census units within 6 km from the reservoir.



**Figure 1. Sketch map of Yonki Reservoir.**

**METHODS**

In 1992, 201 structured interviews were held with people found fishing along the Yonki reservoir. The interviews were conducted in February, May, July, October and December. For each series 38 to 45 respondents were interviewed. A total of 196 persons were interviewed once and 5 persons were interviewed twice. The respondents interviewed were fishing at 6 sites along the reservoir and along the pool below the spillway (Figure 1). The respondents were divided in 4 categories according to their age and sex. Respondents older than 15 years are defined as men and women, the others as boys and girls. During the interview the respondents

were asked about their fishing frequency in the wet and dry season, the composition of their household and which of the household members used to fish at the Yonki Reservoir. Detailed information (type and numbers of gear used, estimated duration of the fishing trips, species composition of the catch, the sizes of the fish caught, how the catch was used) was collected about the fishing trip that was on-going at the time of the interview (= "unfinished fishing trip"). The same details were asked for 1 to 3 most recent previous fishing trips of the respondent to the reservoir (= "completed trips"). Details about a total of 189 unfinished trips and 361 completed fishing trips were thus collected (Table 1).

**Table 1. The number of respondents interviewed, the percentage who had fished before the Yonki Reservoir was created, and the number of unfinished and completed fishing trips reported about.**

	Feb	May	Jul	Oct	Dec	Total	%	Fished before(%)
Men	32	24	28	21	24	129	64.0	63.1
Women	3	6	6	10	5	30	14.9	21.4
Boys	4	7	4	8	14	37	18.4	52.9
Girls	0	1	0	2	2	5	2.5	20.0
Total	39	38	38	41	45	201	100	
Number of unfinished trips	39	28	38	38	45	188		
Number of Completed trips	82	62	73	76	68	361		
Trips with raft/canoe		9	4	9		22		

For the identification of the fish coloured pictures of the species commonly found at higher altitudes of the Sepik-Ramu catchment area were shown to the respondents. Of each species 4 or 5 different sizes ranging from very small to large specimens of that particular species were shown. Respondents indicated the size of the fish caught by comparison with the sizes of the fish on the pictures. The weight of fish with a size as shown on the pictures

was estimated with length-weight equations which were derived from the numerous measurements and weightings of fish done by the project in the past.

A respondent who stated to have fished "the whole day", was assumed to have fished for 9 hours, and 4.5 hours if he stated to have fished only "a half day". Fishing effort was expressed in persondays and hookhours. A personday is the effort of one person during one completed trip, without taking the

duration of the trip or number of gears into account. A hookhour is defined as an hour of fishing with one hook. Multiplying the duration of the trip (in hours) with the number of hooks used results in the fishing effort expressed in hookhours.

The fishing frequency for the season was estimated from the dates the most recent fishing trips took place and from the fishing frequency as stated by the respondent. When the stated fishing frequency differed from the frequency with which the most recent fishing trips took place the average of these two was considered to be the most reliable estimate of the actual fishing frequency. For computation of the average yearly fishing frequency a rainy season lasting six months and a dry season of the same duration was assumed.

On three different occasions all men, women, boys and girls found fishing at the shore or from a canoe or raft, and all rafts and canoes found lying on the shore were counted. The total annual yield ( $Y_{ann}$ ) of each category of respondents was estimated by multiplying the average number ( $N$ ) of men, women, boys and girls seen fishing during these counts with the average yield/fishing day ( $Y_{day}$ ) of that category:

$$Y_{ann} = N * Y_{day} * 365$$

The total annual yield of the reservoir was estimated by adding the total annual yield of men, women, boys and girls.

## RESULTS

### Fishing Frequency

Twenty respondents reported to fish only for the first, second or third time in the reservoir during the time of the interview. The average annual fishing frequency of the other 176 respondents was 124.4 times/year

(Standard Deviation =  $SD = 75.7$ ). Of the male respondents 61% stated that they used to fish in creeks and rivers before the reservoir had been created. Only 21% of the female respondents stated to have fished before Yonki Reservoir existed (Table 1).

### Fishing Methods

In 99.0% of the fishing trips a bamboo rod of 2 to 4 m length with a nylon line and one baited hook was used. A small piece of styrofoam or reed served as floater to detect a fish that had taken the bait. Most of the respondents used factory-made hooks, but some had made the hooks themselves from a piece of metal wire. On an average a completed fishing trip lasted 5.9 hours, and 2.65 hooks were used. Bow and arrow, a fine-meshed handnet and bare hands had each been used during 2 of the reported fishing trips.

In 22 reported trips (3.8% of total number of completed trips) a canoe or bamboo raft had been used to reach the spot where fishing took place.

### Yield per trip and per hookhour

The average yield/person/completed trip from the shore was 0.42 kg (Figure 2, Table 3), and the average number of fish in the catch was 8 (Figure 3). The average yield/hookhour was 21 g ( $SD = 41.6$ ,  $N = 160$ ) for the unfinished and 46 g ( $SD = 88.1$ ,  $N = 291$ ) for the completed fishing trips from the shore. Of the completed trips from the shore 25% had a zero result. The 22 fishing trips with raft or canoe resulted on an average in larger catches than were realised from the shore. The respondents expressed the size of the catch in terms of "a bucket full", or "a 10 kg rice bag half full", and using rough estimates of the weight of such quantities it was estimated that these trips resulted in an average yield of 2 kg/person/trip and in 104 g/hookhour.

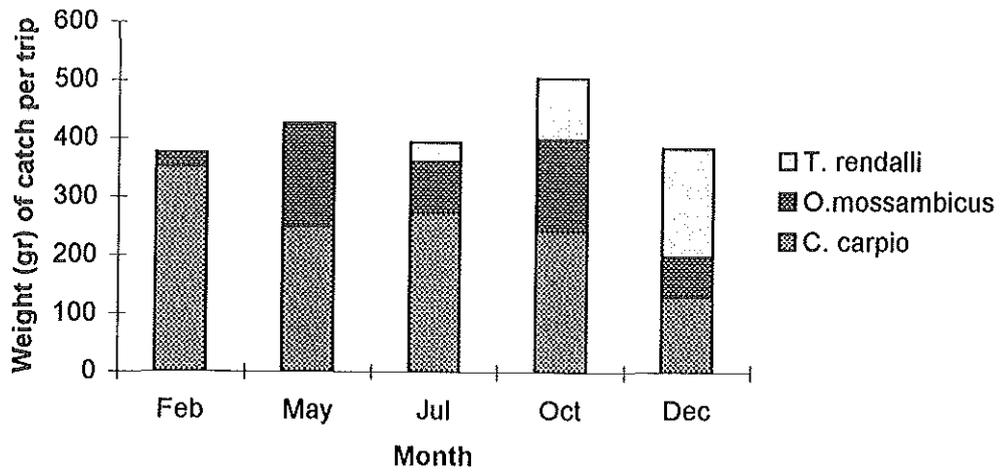


Figure 2. Weight (g) and composition of the catch of rod and line fishers at the shore of Yonki Reservoir.

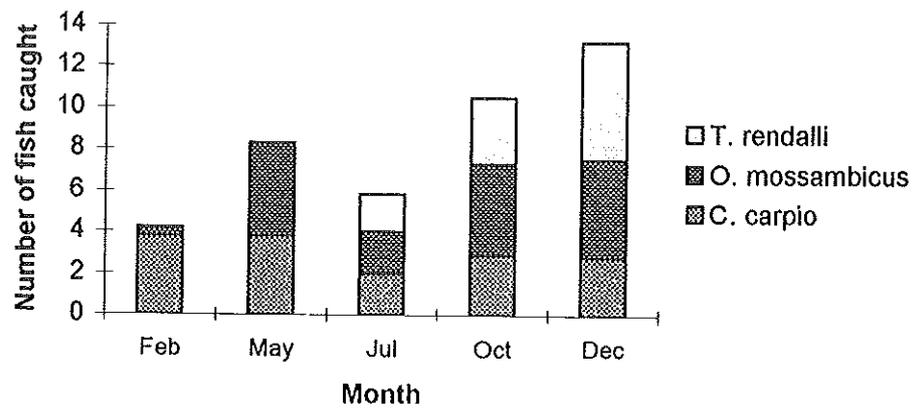


Figure 3. Average number of fish per trip of rod and line fishers at the shore of Yonki Reservoir.

Fisheries in Yonki Reservoir

**Table 2. Composition of the fishing population, average annual fishing frequency, and the average yield per person per completed trip.**

	Men	Women	Boys	Girls	All respondents
Composition of fishing population (%)	45.6	20.3	23.0	11.1	
Average yearly fishing frequency	123.2	129.7	112.5	88.6	124.4
Yield/person/completed trip (kg)*	0.64	0.48	0.40	0.10	0.42

\* Yield computed from trips from the shore, with a raft or canoe including other fishing methods than rod and line.

**Table 3. The number of unfinished and completed fishing trips with rod and line, the effort in persondays and hookhours, the total yield and the average yield per unit effort (kg) for each series of interviews.**

	Feb	May	July	Oct	Dec	Total
Unfinished trips*	39	28	39	38	45	189
Hookhours	69.5	204.75	233.5	356.5	460.25	1324.5
Total yield	2.76	4.62	3.78	8.32	8.46	27.94
Yield/hookhour	0.040	0.023	0.016	0.023	0.018	0.021
Completed trips*	82	62	73	76	68	361
Total yield	6.74	28.50	28.72	45.59	26.88	136.43
Hookhours	274.5	571	1126.5	1044	1108	4124
Yield/hookhour	0.025	0.050	0.025	0.044	0.024	0.033
Persondays:	82	67	73	86	70	378
Yield/person/trip*	0.38	0.43	0.39	0.53	0.38	0.424

\* Of the February interviews the number of hookhours and yield/hookhour could be estimated of only 13 unfinished and 19 completed trips. The 39 unfinished and 82 completed trips resulted respectively in 4.19 kg and 30.76 kg of fish.

### Catch composition

In the interviews in February and May only common carp *Cyprinus carpio* and Mozambique tilapia *Oreochromis mossambicus* were reported or observed

to be caught. In July the redbreasted tilapia *Tilapia rendalli* started to appear in the catch.

The average size of the fish that was reported to be caught during the completed trips with rod and line from

the shore decreased from 90 gr in February to 29 gr in December (Figures 2 & 3). Sixty % of the total number of fish reported to be caught belonged to the 2 smallest size classes as shown on the pictures. Fish placed in these size classes will be mostly tilapia below 30 gr and carp below 45 gr.

**Number of people fishing and total annual yield**

On an average 398 (SD = 304.3) persons were seen to fish in the reservoir during the days the fishing persons, canoes, and rafts were counted (Table 4). However, the total number of fishing people that were observed to fish during the third count was exceptionally high due to school holidays and favourable weather conditions for fishing. On all other days during the year when the reservoir was visited, far less people

were seen fishing. The average of the first 2 counts (224 persons) is therefore believed to be the best estimate of the average number of people that fished at the reservoir during a day. The total yield from the reservoir was estimated at 40.2 tons/year, which is equivalent to 109.6 kg/day.

**Use of the catch**

The catch of 88.0% of the reported and observed fishing trips was taken home and consumed by the respondent and his household. The catch of 9.6% of the reported trips was donated to other people from the respondent's village. The catch of 1.3% of the trips was sold, and the catch of 1.0% of the reported trips was taken home alive and stocked in backyard ponds.

**Table 4. The number of fishing persons and the number of fishing vessels counted during 3 different occasions in Yonki Reservoir.**

	May	October	December
Men	99	102	307
Women	39	61	139
Boys	22	56	193
Girls	7	31	93
Sex/age not sure	11	20	13
Total	178	270	745
Bamboo rafts	44	69	125
Canoes	26	21	38

**DISCUSSION**

Most respondents applied the same fishing method that was commonly used to fish in slow flowing parts of the Ramu River. Methods that would probably be more effective in stagnant waters such as gill nets, seine nets or fixed traps were not known by most people in the area. To allow the fish population time to build up the

agency that managed the fishery in the reservoir at the time the survey took place, discouraged the use of such more efficient gear. The number of people (especially women) taking up fishing, the high fishing frequency, and the growing number of boats and rafts show that the people living near the reservoir used the opportunities offered by the new water body. It should be noted that before the reservoir was established rafts

and canoes had never been seen or used in the Eastern Highlands region.

The fishery that took place in Yonki Reservoir during the survey was mainly a subsistence activity. All fish, including the ones weighing around 10 g, were taken home and eaten. The part of the catch that was sold was small but showed a slight increase during 1992.

The catch from Yonki Reservoir consists for 100% of exotic species. *C. carpio* and *O. mossambicus* were introduced in the New Guinea Highlands in the 1960's, and *T. rendalli* was introduced in the Upper Ramu region in the second half of 1991. At the end of 1992 this species contributed nearly 50% to the daily fish yield of Yonki Reservoir. Assuming a linear increase from 0% of the weight of the daily catch on July 1, 1992, to 50% on December 31 of the same year, the contribution of *T. rendalli* to the total weight of the catch from Yonki Reservoir in 1992 is estimated at 5 tons. This estimate is significantly lower than previously reported by Werry (1998) who mistakenly stated that *T. rendalli* contributed 4,000 tons to the fish harvest from Yonki Reservoir.

Several species from the Gobiidae family, *Anguilla bicolor* and *Anguilla marmorata* are reported to be present in streams draining in the Upper Ramu (Allen, 1991), but they were not present in the catches reported by the respondents. Compared with reservoirs in South-east Asia and elsewhere Yonki reservoir is very poor in fish species. This situation resembles the situation in numerous reservoirs in Sri Lanka where the same exotic fish species make up the major part of the catch (Fernando 1984).

Besides people and a small number of fish-eating birds no predators seemed to be present in Yonki reservoir. The low fishing pressure (10 to 18 hooks/km shore line during 6 hours/day) may not be enough to avoid stunting of fish in the future. Stunting was reported to have occurred despite the presence of rainbow trout *Oncorhynchus mykiss* in Kandep Lakes in Enga Province, Papua

New Guinea (Wright 1980). The catch of these lakes consisted predominantly of common carp with a forklength of 10 cm.

The high standard deviation of the yield/hookhour of the completed fishing trips from the shore is caused by the wide range in the results of the fishing trips. Without the highest value of 1019 g/hookhour (realised by one respondent who caught 3 big fish within an hour) the SD would be 67 g.

The average daily yield per person at Yonki Reservoir is higher than from high altitude rivers and streams in the Sepik-Ramu area. In these running waters, fishing with a hand line is the most popular method used and results in an average catch between 0.2 and 0.3 kg/person per trip (Heijden, 2002).

Average daily yield of men and women fishing at Yonki reservoir is somewhat lower as found for men and women fishing along Lake Iviva, a 1 km lake in the Papua New Guinea Highlands. Men and women fishing with hook and line at the shore of this lake caught on an average 0.88 and 1.03 kg/person/fishing trip (Heijden, 2002). The average catch/trip of people fishing along the shore of Yonki Reservoir is the same as for people fishing with rod and line along reservoirs in Zimbabwe (Chimbuya 1993). The average yield/hookhour from Yonki is lower than reported from Kandep Lakes, where the average catch was estimated at 72.2 gr/hookhour (Wright 1980). This difference may be caused by the different methods used to estimate the yield per unit effort, but Wright did not give any details of the method he used.

The fish yield from Yonki Reservoir (40.2 tons, or 18.2 kg/ha/year) is low compared with other reservoirs in Asia (De Silva 1988). The mean yield from Sri Lankan reservoirs is 100 kg/ha/year (Fernando 1984). The low yield of Yonki reservoir is a result of the low fishing pressure (small number and low efficiency of the most commonly used gear). Also the primary and secondary productivity of the aquatic

ecosystem in the new reservoir were most likely not yet well established when the survey took place and the fish stock had probably not yet reached its full size, balanced age and species composition.

In September 1995 a second survey was conducted along Yonki Reservoir (van Herwaarden, unpubl.). On an average 310 people were observed to fish along the reservoir, and 100 of them were interviewed. *C. carpio*, *O. mossambicus* and *T. rendalli* contributed 13.4%, 54.0% and 32.6% respectively to the weight of the catch. The average yield per trip and per hookhour for people fishing from the shore and from rafts is summarised in

Table 5. Comparing the results of the 1995 survey with the 1992 survey the yield/hookhour for the unfinished trips had increased with 6 g (29%). The yield per hookhour and per person of the completed trips taking place from the shore increased with 49% and 76% respectively. Van Herwaarden (unpubl.) thought that especially the adult respondents exaggerated the catches of the completed trips and considered the computed yield per unit effort of completed trips as unreliable. Based on measurement of the fish caught during the unfinished fishing trips he estimated that the annual catch from Yonki Reservoir was 60.8 tons, an increase of 50% over the estimated total catch of 1992.

Table 5. Yield per person and per hookhour (gr) of Yonki Reservoir fishers in 1995 (van Herwaarden, unpublished).

Sex/age Group	Unfinished trips		Completed trips	
	Yield/person per trip	Yield/hookhour	Yield/person per trip	Yield/hookhour
Men, shore	225	23	814	51
Boys, shore	351	33	483	46
Women, shore	173	31	861	98
Girls, shore	121	17	300	25
All, shore	223	27	745	58
Men, raft	1706	30	2142	40
Boys, raft	849	20	784	17

Without any data about the composition of the catch at other times of the year it is too early to conclude that the difference in catch composition between 1995 and 1992 (increasing share of Mozambique tilapia, decreasing share of carp and redbreasted tilapia) indicates a trend. Mozambique tilapia, the common carp and redbreasted tilapia are respectively predominantly planktivorous, bottom feeding (omnivorous) and herbivorous, and will not prey heavily on each other once they are beyond the egg and fry stages. They are known to co-exist for over 2 decades in some Sri Lankan reservoirs, often with either *O. mossambicus* or *T. rendalli* as

the most dominant species. Female *O. mossambicus* carry the eggs, larvae and early fry in their mouth and a better survival rate of the fry may account for the important contribution of this species to the catch in Sri Lankan reservoirs, and possibly for the growing share of this species in the Yonki Reservoir fish stock.

#### ACKNOWLEDGEMENTS

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