FLOODPLAIN FISHERIES IN THE SOUTHERN PROVINCES OF VIETNAM

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ABSTRACT

A floodplain fisheries survey was conducted out at two sites (Binh Long and Phu Thanh) in the Mekong Delta of southern Vietnam during the monsoon of 1992. The study found a minimum yield of 80 kg/ha/year at Binh Long and a minimum yield of 42 kg/ha/year at Phu Thanh, with an average of 61 kg/ha/year. At Binh Long more than 50% of the catch belonged to the genus Cyprinidae including *Cirrhinus jullieni* (Sauvage 1878), *Puntioplites proctozysron* (Bleeker 1865) and *Paralaubuca spp*. At Phu Thanh crabs (*Somaniathelphusa sinensis*) and the *snakehead (Ophiocephalus striatus*, Bloch 1792), dominated the catch. The low yield estimated for the Phu Thanh site may be the result of low water pH, as this floodplain is located on moderate to severe acid sulphate soils which were disturbed following the modification of the hydrological regime during the last decade.

KEYWORDS: Floodplain fisheries, Vietnam, Mekong Delta, Catch and Effort, Species composition, Acid Sulphate Soils

INTRODUCTION

The Mekong Delta is a major source of fish in Vietnam. Approximately 44% of the total annual production of aquatic products of Vietnam is caught or cultured in the Delta. In 1990 the total production of the Mekong Delta estimated as 438,000 t. Marine capture fisheries and brackish water aquaculture accounted for 245,000 t of this production. The remaining 190,000 t was produced by inland fisheries and fresh water aquaculture (Nedeco, 1992).

The flow of the major rivers of the Delta, the Mekong and the Bassac River is closely related to the rainfall in the Lower Mekong Basin. Some 80-90% of this rainfall occurs during Southwest monsoon period between May and October, increasing discharge rates to 40,000 m^3/s at the Cambodian border. This increased discharge rate causes flooding in 30 to 40% of the Vietnamese area of the Delta. The inundation level of the flood depends on the drainage capacity of the area, but in general three zones are differentiated (Figure 1): a deep-water zone (1.5-3.0 m), a semi-deep water zone (0.6-1.5 m), and shallow water zone (<0.6 m) (Nedeco, 1992). In the Mekong Delta about 1.2 million ha of floodplain would require full flood protection for improved land use (Nedeco, 1993). Floodplains provide important spawning and feeding grounds for a large number of fresh water fishes (Welcomme, 1979, Payne, 1986, de Graaf *et al.,* 1999). Furthermore, research in Bangladesh has indicated that fishing during the monsoon is an important economic activity for people living adjacent to the floodplains (Payne, 1997, de Graaf *et al.,* 1994). Within the last decade the riverine fisheries production in Bangladesh declined with 44% from 207 000 t. in 1983 to 124 000 t in 1991. Between 1970 and 1990 about 2.1 million ha of floodplain were removed from riverine fisheries production due to the construction of embankments (Siddiqui 1990) and this is believed to be one of the causes of the reported decline.

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The potential negative impacts of flood control schemes were recognised during the formulation of the Mekong Delta Master Plan (Nedeco, 1992). Quantification of this impact made difficult by the poverty of information on the floodplain fisheries of the Mekong. The Mekong Committee (1976) estimated the standing stock of the rivers and floodplains in the Mekong Delta to be 70-200 kg ha^{-1}, providing an annual yield up to 10 000 t $year^{-1}$. However, during the same period, the Vietnamese Directorate of Fisheries statistics reported annual inland catches in the order of 60,000-75,000 t (Mekong Committee, 1976). The discrepancies between the two estimates prompted this study that the standing stock estimates should be considered as actual catch estimates, with a subjective average of 135 kg/ha/year. This paper presents the results of a floodplain fisheries survey carried out during the monsoon season of 1992 for the Mekong Delta Master Plan Study. Its major aim was the quantification of floodplain fisheries in the Mekong Delta of Vietnam.

MATERIALS AND METHODS

The study area

For the study two sites were randomly selected in the deepwater zone of the Delta (Figure 1);
Site 1; Phu Thanh was located in the Plain of Reeds and has a flooded area of 92 ha.
Site 2; Binh Long was located in the Long Xuyen Quadrangle and has a flooded area of 109 ha.

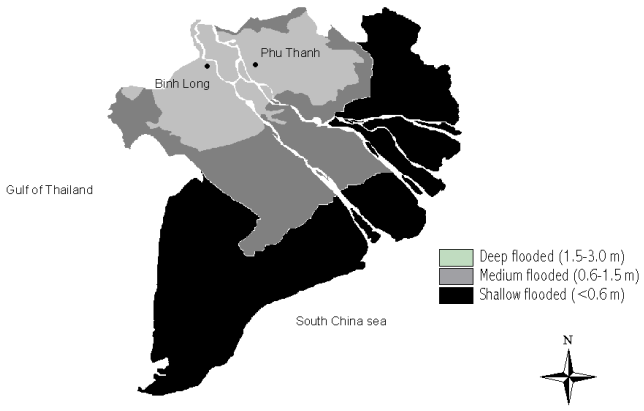

Figure 1: Extend of flooding in the Mekong Delta of Southern Vietnam and the location of the two studied floodplains.

METHODOLOGY

Preliminary investigation indicated that fisheries in the floodplains of the Mekong Delta of Vietnam is mainly carried out during the high flood and draw-down period In contrary to other floodplain systems almost no fishing is carried out during the dry

season as the number of residual pools is limited. Therefore the study was conducted only between September and November 1992 and comprised of standard catch assessment survey. A census of all gears operating at each site was undertaken twice weekly. Total catch by species were recorded for all operating fyke nets, gill nets cast nets, purse seines and Hook and lines while the total catch of traps were recorded from a subsample. Total daily catches by gear type were estimated from their average catch rates and the average number of gears recorded daily. The following formula was used:

$$Y_d = \sum_g \overline{CPUE}_g . \overline{f}_g$$

Where:

Y_d = total daily catch
$CPUE_g$ = daily mean catch per unit of effort
f_g = mean effort (gears.day^{-1}).

The daily Catch Per Unit of Area (CPUA) is the total daily catch divided by the sampled floodplain area.

Statistical analysis of data

Preliminary analysis of the data indicated a positive skewness and non-normal distribution patterns, especially in the effort data where a large number of "zero fishing days" were recorded. A Logarithmic-transformation of data could not be applied as the distribution seemed to approach a "delta-distribution"; a log-normal distribution with a spike at zero (Pennington, 1983, 1986). In general in such cases the data are divided into zero and non-zero units, followed by transformation of the non-zero values to natural logarithms. The Pennington estimator is then used to estimate more precise their mean and variance, if it is found that the transformed non-zero data are approximated by a log-normal distribution (Pennington, 1983, 1996). However the latter was not always the case in all data sets and therefore in the final analysis and comparison the arithmetic means and medians were calculated from the original data and differences were tested with the "non-parametric Mann-Whitney test for equality of the median (Sokal and Rohlf, 1981) The daily sum of the Catch per Unit of Area was Normal distributed for both sites and differences for the mean were tested wit a t-test (Sokal and Rohlf, 1981).

RESULTS

Traps and Fyke nets are the most frequently used gears at both floodplains. The most productive gear is however the Seine net followed by the Fyke net (Table 1).

With a total daily Catch Per Unit of Area of 1.31 ± 0.18 kg/ha/day at Binh Long produces almost twice as much as Phu Thanh (*P< 0.005*), with a daily CPUA of 0.68 ± 0.04 kg/ha/day and the average Catch per Unit of Area for the individual gears at the two sites is presented in Table 2.

The higher fishing effort of Gill and Fyke nets and the higher CPUE of the Gill nets at the Binh Long floodplain mainly causes this difference.

Depending on the intensity of the annual flooding, the fishing season last 60-90 days, which results in an annual yield ranging between 42 and 119 kg/ha/year for the deeper floodplains of Southern Vietnam (Table 3).

Table 1: Estimated Fishing Effort (no gears/ha/day±sem), Catch Per Unit of Effort (kg/ha/day±sem) for the different gears at the Binh Long and Phu Thanh floodplain (Different superscript letters indicate significant difference for the median (Mann-Whitney-test, *P<0.05*))

Geartype	Fishing effort (gears/ha/day)						Catch per Unit of Effort (kg/gear/day)					
	Binh long			Phu Than			Binh Long			Phu Thanh		
	Mean ± sem	Median	n	Mean ± sem	Media n	n	Mean ± sem	Median	n	mean +sem	Median	n
Cast net	0.0014±0.0009	0.000[a]	16	0.0014±0.0008	0.000[a]	16	6.0000±2.0000	6.000[a]	3	2.9330±0.5667	3.500[a]	2
Gill net	0.0580±0.1160	0.048[a]	16	0.0113±0.0039	0.009[b]	16	4.9400±0.6100	4.400[a]	86	1.9330± 0.8030	1.200[b]	19
Fyke net	0.0930±0.0032	0.092[a]	16	0.0625±0.0009	0.062[b]	16	8.8700±1.4300	8.825[a]	128	7.5360±0.5840	7.315[a]	108
Seine	0.0007±0.0007	0.000[a]	16	0.0070±0.0016	0.009[b]	16	20		1	9.6400±1.1190	10.100	13
Hook & Line	0.0248± 0.0063	0.016[a]	16	0.044 ±0.0050	0.037[b]	16	2.6390±0.4701	2.435[a]	38	1.8313± 0.1566	1.840[a]	79
Traps	1.4850± 0.2670	1.467[a]	16	0.9920±0.0580	1.028[a]	16	0.0492±0.0088	0.040[a]	21	0.0550±0.0043	0.055[a]	17
Baskets	0.0095± 0.0036	0.000	16	Na	Na		5.2900±1.7500	3.000	14	Na	Na	Na

Table 2: Estimated average daily Catch Per Unit of Area for the different gears at the Binh Long and Phu Thanh floodplain (Different superscript letters indicate significant difference of the median (Mann-Whitney-test, *P < 0.05*)).

Geartype	Binh Long			Phu Thanh		
	CPUA (kg/ha/day ± sem)	Median	n	CPUA (kg/ha/day ± sem)	Median	N
Cast net	0.009 ± 0.006	0.000[a]	16	0.004 ± 0.002	0.000[a]	16
Gill net	0.284 ± 0.060	0.237[a]	16	0.019 ± 0.008	0.006[b]	16
Fyke net	0.825 ± 0.138	0.720[a]	16	0.474 ± 0.040	0.453[a]	16
Seine	0.010 ± 0.014	0.000[a]	16	0.060 ± 0.0132	0.073[b]	16
Hook & Line	0.052 ± 0.011	0.050[a]	16	0.082 ± 0.012	0.071[a]	16
Traps	0.078 ± 0.019	0.057[a]	16	0.053 ± 0.005	0.052[a]	16
Baskets	0.057± 0.030	0.000	16	Na	Na	Na

Table 3: Estimated annual fish yield per hectare of floodplain, based upon a 60 or 90 fishing day season for Binh Long, Phu Thanh and both floodplains combined.

Para meter	Binh Long	Phu Tanh	Combined
Daily CPUA (kg/ha/day)	1,3	0,7	1,0
Annual Yield in kg per ha for 60 days fishing	80	42	61
Annual Yield in kg per ha for 90 days fishing	119	63	91

Species composition

The species composition of the combined samples indicated that at Binh Long more than 50% of the catch comprised the genus Cyprinidae including *Cirrhinus jullieni* (Sauvage 1878), *Puntioplites proctozysron* (Bleeker 1865) and *Paralaubuca spp*. However at Phu Thanh more than 50% of the total catch comprised of crabs (*Somaniathelphusa sinensis*) and the Snakehead (*Ophiocephalus striatus*, Bloch 1792) (Table 4).

Table 4: Species composition (% of total catch) estimated Binh Long and Phu Thanh floodplain Sept-Nov 1992.

Species name	Binh Long (% of total catch)	Phu Thanh (% of total catch)
Cirrhinus Jullieni (Sauvage 1878)	36,4%	9,3%
Puntioplites proctozysron (Bleeker 1865)	8,1%	0,3%
Paralaubuca spp	7,9%	2,2%
Somaniathelphusa sinensis	7,5%	44,8%
Puntius Leiacanthus (Bleeker 1860)	5,9%	0,0%
Pristolepus fasiatus (Bleeker 1860)	5,9%	0,8%
Puntius goniotus (Bleeker 1850)	5,5%	1,6%
Anabas Testudineus (Bloch 1792)	5,0%	1,2%
Ophiocephalus striatus (Bloch 1793)	4,7%	11,8%
Macrobrachium equidens	3,6%	8,3%
Botia spp	1,6%	1,9%
Rasbora spp	1,4%	6,8%
Kryptopterus spp	1,3%	1,2%
Chanda Wolfii	1,1%	0,3%
Hyperchamphus uniofasiatus	0,7%	1,5%
Others	3,3%	7,8%

DISCUSSION AND CONCLUSIONS

Catch, effort and yield

Average floodplain production has been estimated to be 40-60 kg/ha/year (Welcomme 1979; 1985). However, this estimate is based upon production estimates from lightly exploited floodplain-river systems. Bayley (1988) estimated maximum potential yields more highly exploited tropical floodplains at 110-160 kg/ha/year. In Bangladesh yields of 50-300 kg/ha/year have been estimated, the highest yields were corresponding to permanent waterbodies in the floodplains and the lowest yield were found at floodplains fished for 4 month a year (de Graaf *et al*, 1994, de Graaf, 2000). Differences in Fishing effort explained most of the variation in the annual yields of the different habitats (de Graaf *et al*., 2001).

The present study estimated the yield to be at best 80 kg/ha/year at Binh Long and 42 kg/ha/year at Phu Thanh, with an average of 61 kg/ha/year. Based upon a fishing season of 90 days, yield estimates are 119 kg/ha/year and 63 kg/ha/year for Binh Long and Phu Thanh respectively. Present yields are low compared to the Mekong Committee estimates of 135 kg/ha/year (Mekong Committee,1976). However, this yield was considered by the authors as a "subjective mean", and no data on fishing effort were provided.

The present study further indicate that if prawns (*Macrobrachium* spp.) and crabs (*Somaniathelphusa sinensis*) are not considered (Table 4), the annual yield decreases with 11% to 71 kg/ha/year at Binh Long and with 53% to 20 kg/ha/year at Phu Thanh.

The difference between the annual yield of the two sites, Binh long and Phu Thanh, can be explained by a significant higher CPUE for Gillnets and a significant higher Fishing effort for both Gill nets and Fyke nets at Binh Long.

Species composition

Floodplain fish are often categorised in two groups on the basis of their behaviour (Sao-Leang & Dom Saveun, 1955). "White fish" migrate to the main river channel in the late dry season in order to avoid the severe conditions on the floodplain. At the beginning of the monsoon with the rising of the water level, they either spawn upstream in the main channel *(Cirrhinus jullieni, Cirrhinus microlepus, Pangasius micronemus*, etc.) or spawn in the floodplain (*Mystus wyckii*, *Puntius altus*, etc). After spawning in the main channel, the eggs and larvae drift passively downstream towards the inundated floodplains (de Graaf *et al.,* 1999). The main species of "white fish" comprise of Cyprinidae and Schilbeidae. "Black fish" have a broad environmental tolerance and can sustain the harsh conditions of the floodplains during the dry season. They are mainly omnivorous/carnivorous bottom dwellers and have a wide variation in spawning behaviour (de Graaf *et al*., 1994). "Black fish" include members of the Clariidae, Siluridea and Ophiocephalidea.

On the basis of this classification high percentage of "white fish" are caught at Binh Long and a high percentage of "black fish" are caught at Phu Thanh (Table 5).

Table 5: Composition of the fish catches (crabs and prawns excluded) at Binh Long and Phu Thanh according to the classification of Sao-Leang and Dom Saveun (1955)

Classification	Binh Long (% of total fish catch)	Phu Thanh (% of total fish catch)
White fish	83%	52%
Black fish	13%	32%
Un known	4%	17%

Differences in yield and species composition between the two sites may be due large differences in environmental conditions, the acidity of the water. Acidic black waters are amongst the least productive tropical waters (Petrere 1989) and “black fish” belonging to genus Ophiocephalidea are the major species in the acid waters around the U Minh forest in the Mekong Delta (Chinh, unpublished data). Both characteristics; a relative low yield and a high percentage of “black fish” are observed at Phu Thanh. In the Mekong Delta around 1.3 million hectares lies on a of moderate to severe acid sulphate soil bed (van Mensvoort *et al*., 1993). During the last decades, large areas of these acid sulphate soils were disturbed and brought to the surface, leaching of sulphuric acid and a reduced pH of the surface waters is a problem (van Mensvoort, 1996, Nedeco, 1993). The floodplain of Phu Thanh is located on moderate to severe acid sulphate soils while the floodplain of Binh Long is located on neutral soils (van Mensvoort *et al*, 1993). Under normal hydrological conditions floodwater quickly dilutes the sulphuric acid thereby having little effect on pH of the floodplain water. However in the late 80’s and beginning of the 90’s the hydrological regime in the Dong Thap province and the Plain of Reeds, where Phu Thanh is located was changed. Large canals with embankments, connecting the Mekong river with the Vam Co river from West to East were constructed (van Mensvoort, pers comm.). The embankments modify the hydrological regime, delay flooding and could have worsened the environmental conditions around Phu Thanh. The reduced yields and species composition at Phu Thanh could be the result of this phenomena. Therefore future developments in the acid sulphate soils in the Mekong Delta should be carefully planned and take fisheries aspects into consideration.

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