
Standing crop and fish species association in Cambodian floodplains

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ABSTRACT

Cambodia has a diverse range of aquatic habitat ranging from small lakes, dikes, swamps, marshes, grasslands, flooded forests, shrub-land, rice fields, streams, rivers, ponds and canals. Some of these habitats are flooded on a seasonal basis, but to differing degrees. Habitats that are subject to seasonal flooding in Northeast Cambodia, close to the border with the Lao PDR, are important fish habitats and where many 'white' (migratory) fish species spawn. Young fish resulting from spawning activities in these areas contribute greatly to floodplain fish production further downstream. Larvae and fry of at least 130 species of fish drift from upper Cambodia down the Mekong to floodplains, where they feed and grow. These migratory species (white fish) and the floodplain-resident 'black' fish species are generally associated with different kinds of habitat, although some species from both general categories occur in all types of habitats.

Standing crop varies between habitats, depending on their quality, the extent and duration of inundation, and the species present. Several studies on standing crop in representative habitats in Cambodia have attempted to quantify these differences between habitat type. For example, the standing crop from an area of flooded forest near the Tonle Sap Lake was found to be around 95 kg/ha. The standing crop of fish and other aquatic animal from rice fields was found to be approximately 90 kg/ha and the standing crop of fish and other aquatic animal from grasslands, swamps and deep pool/small lake habitats were estimated at about 113 kg/ha, 84 kg/ha and 2,525 kg/ha respectively. The data from deep pools and small lakes included fish and other aquatic animal from a larger surrounding area. In general, species diversity was found to be higher in habitats that were more diverse. The data and information obtained during this study, carried out from March to June 2004, may be of use for estimating standing crop, and its monetary value, from the Tonle Sap system, but data were gathered over a limited time period. The data and information obtained may also be useful for management planning regarding both habitat type and species.

KEYWORDS: Fish, Standing Crop, OAAs, Grassland, Marsh, Deep Pools, Small Lakes, Tonle Sap Floodplain, Cambodia

INTRODUCTION

Studies on the functioning of river-floodplain systems (ecosystem services) that address issues concerning the maintenance of naturally productive habitats have received attention (Bayley, in press). In addition, other types of habitat should also be maintained for the conservation of species diversity. Information on fish standing crops and overall production from different floodplain habitats may be useful in forming the basis of a management tool, and may ultimately help to protect both habitats and species (Bayley, in press). According to a land-use study conducted by the Mekong Secretariat Project CMB/92/005 of UNDP/LUMO/FAO in 1992, the habitat types found in Cambodian Mekong floodplains can be categorised as permanent water (rivers, lakes, ponds, etc), flooded forests, flooded secondary forests, flooded grasslands, receding and floating rice fields, seasonally flooded crop fields and swamps or marshes.

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This study of standing crop by habitat in flooded forest areas of Battambang, Pursat and Prey Veng Provinces was carried out during the period from March to June 2004. The study focussed on two types of flooded forest area. Firstly, those areas where the forest was intact and in good condition, and secondly, those areas where the forest had been cleared.

Studies on fish standing crop from other types of aquatic habitat such as marshes, swamps, rice fields, flooded grass land, small lakes, and flooded shrub-land, where different fish species may be resident, have never been carried out so far. Standing crops for fish and other aquatic animal from these other habitats may very well be different from the flooded forest habitats. Therefore, this study was required to fill in the data gaps on various types of aquatic habitat to provides an estimation of the standing crop of fish and OAAs found in marshes, swamps, flooded grassland, and in deep pools/small lakes in Kampong Chhnang Province. Kampong Chhang Province is located within the floodplain area of the Tonle Sap Lake where various aquatic species are found.

OBJECTIVES

The study was aimed at achieving the following objectives:

- To identify aquatic fauna and estimate their standing crop in marshes, swamps, flooded grassland, and deep pools/small lakes in a target area of Kampong Chhnang Province over a period from March to June 2004.
- To determine aquatic species composition, species occurrence and their association with different types of habitat over a period from March to June 2004.

METHODS

The area of marshes/swamps, flooded grassland, deep pools/small lakes in the Kampong Chhnang Province floodplain were selected using a map from the Ministry of Public Works (Figure 1). In total, 46 sites were sampled during the study. These included 13 flooded grassland sites, 20 flooded marshland sites, and 13 sites where deep pools or small lakes were located. At the flooded grassland sites, nets or bamboo fences were used to capture all fishes and OAAs using the knowledge and experience of local fishers. All aquatic fauna in the selected area was caught as far as was possible. Each area was measured in square meters (m^2) and later converted to hectares. Standing crop (kg/ha) was calculated using the following formula; [Standing crop = total catch in kg/area (ha)]. Fish species were identified using the guidebook *Fishes of the Cambodian Mekong* (Rainboth, 1996) and other reliable sources of literature. Fish or other aquatic species from each habitat type was recorded.



Figure 1. Study Sites in Kampong Chhnang Province, Tonle Sap floodplain, Cambodia

RESULTS

Occurrence of fish species and OAAs

At least 63 species of fish were encountered together with other aquatic animals such as crabs, clams, snakes, shellfish and shrimps. These were found in flooded grasslands, marshes and deep pool/small lake habitats. Abundance of aquatic fauna varied between each habitat type (Annex 1).

Most of the animals found in grassland, marsh and deep pool/small lake habitats are fish. OAAs represent only a small percentage of the total weight of all animals captured (Table 1). Most of the fish caught fall into the broad category of 'white' fish, and represent about 46 per cent to 74 per cent of the total catch (Table 2). Some estuarine fish were also found in the catch. Estuarine fish species formed approximately ten per cent of the total catch in grassland and marsh habitats, but

only about two per cent of the total catch from deep pools/small lakes (Table 2). At least 50 per cent of the total catch of fish from deep pools/small lakes can be described as ‘black’ fish species. (Table 2). Carnivorous fish species represent about half of the total catch in all habitats investigated, and most of the remaining species are either omnivorous or herbivorous (Table 3). OAAs, whose mode of nutrition is not known, only represent a small percentage of the total catch. Herbivorous fish species represent about 20 per cent of the total catch in grassland habitats, but less in marsh and pools habitats (Table 3). Omnivorous fish species make up about 20 to 35 per cent of total catch in all habitats investigated (Table 3).

Table 1. *Standing crop percentages of fish and OAAs (kg/ha)*

	Kg/ha			Per cent		
	Grassland	Marsh	Pool	Grassland	Marsh	Pool
Fish	106.6	75.5	2,458.7	94.9%	89.7%	97.6%
OAA	2.3	2.4	28.0	2.0%	2.9%	1.1%
Other*	3.4	6.2	32.3	3.0%	7.4%	1.3%
Total	112.3	84.1	2,519.0	100.0%	100.0%	100.0%

* ‘Other’ refers to small fish species and OAAs that could not be identified.

These species amounted to about ten aquatic animals in total.

Table 2. *Categories of fish species and OAAs*

	Kg/ha			Per cent		
	Grassland	Marsh	Pool	Grassland	Marsh	Pool
Black	12.7	14.0	1,259.7	11.3%	16.6%	50.0%
White	83.5	53.7	1,158.7	74.3%	63.9%	46.0%
Estuarine	10.5	7.8	40.3	9.3%	9.2%	1.6%
Mixed	3.4	6.2	32.3	3.0%	7.4%	1.3%
OAA	2.3	2.4	28.0	2.0%	2.9%	1.1%
Total	112.3	84.1	2,519.0	100.0%	100.0%	100.0%

Table 3. *Fish species classified by dietary category.*

Diet	Kg/ha			Per cent		
	Grassland	Marsh	Pool	Grassland	Marsh	Pool
Carnivorous	55.8	45.6	1,486.4	50.8%	55.9%	59.7%
Herbivorous	20.9	11.3	137.4	19.0%	13.8%	5.5%
Omnivorous	29.8	18.6	834.9	27.1%	22.8%	33.5%
Mixed species	3.4	6.2	32.3	3.1%	7.6%	1.3%
Total	110.0	81.6	2,491.0	100.0%	100.0%	100.0%

Important species in the total catch from grassland habitats

Fifty-three fish species were found in grassland habitats during the sampling period in the floodplain of the Tonle Sap Lake. The ten most common species appearing in total catch are shown in Figure 2. These ten species represented 67 per cent of the total catch, and the remaining 43 species contributed to 33 per cent of the total catch (Figure 2).

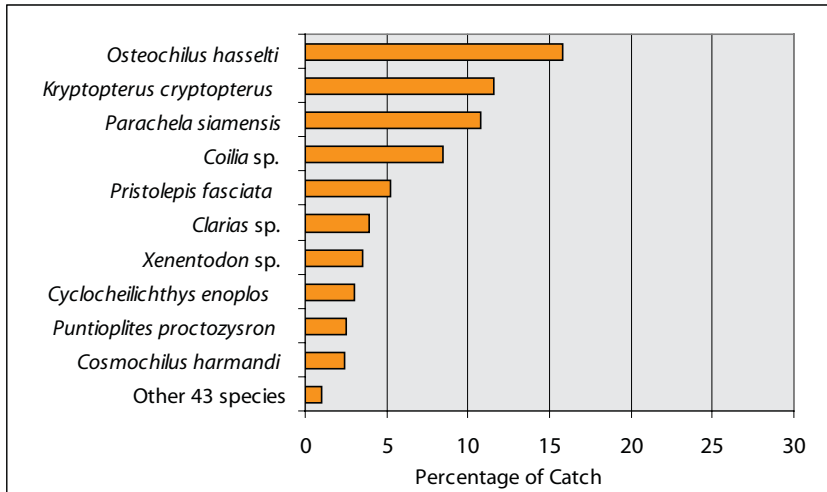


Figure 2. The percentage of fish-catch by species in flooded grassland habitat

Important species in the total catch from flooded marshland habitats

Fifty fish species were found in marshland habitats during the sampling period in the floodplain of the Tonle Sap Lake. The ten most common species appearing in total catch are shown in Figure 3. These ten species represented 62 per cent of the total catch, and the remaining 44 species contributed to 38 per cent of the total catch (Figure 3).

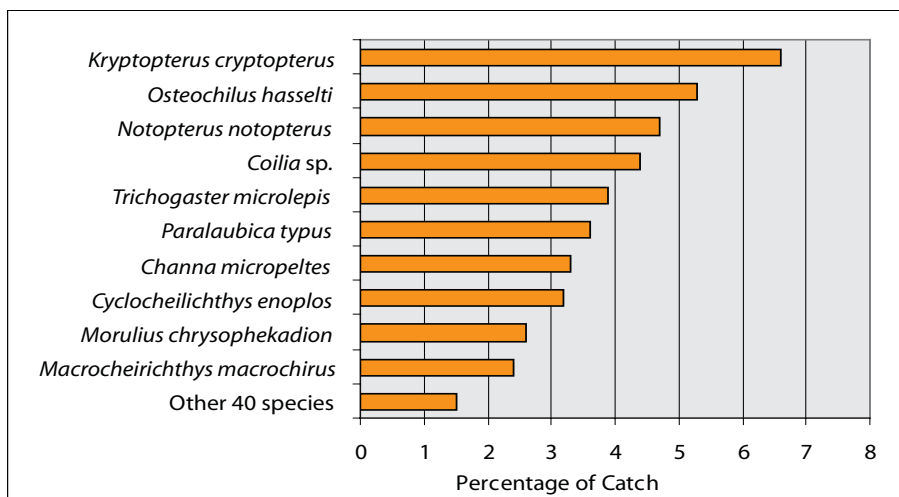


Figure 3. The percentage of fish-catch by species in marshland habitats

Important species in the total catch from deep pools and small lake habitats

Fifty-seven fish species were found in deep pool/small lake habitats during the sampling period in the floodplain of the Tonle Sap Lake. The ten most common species appearing in total catch are shown in Figure 4. These ten species represent 74 per cent of the total catch, and the remaining 47 species contributed to 36 per cent of the total catch (Figure 4).

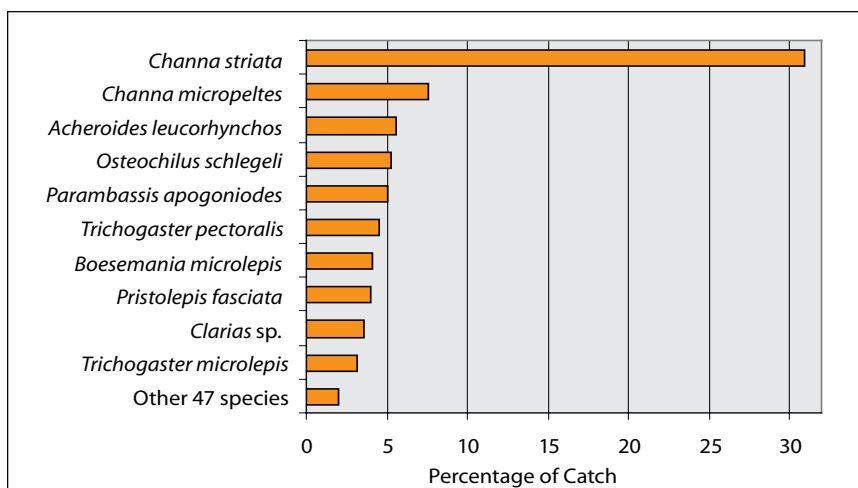


Figure 4. The percentage of fish-catch by species in deep pools/small lake habitats

In total 64 species, including OAAs, were recorded in the three different types of fish habitat. Most of them were found in all habitat types. However, 16 species were only found in either one or two of the habitat types under investigation (Table 4).

Table 4. The occurrence of fish species in grassland, marsh and deep pool/small lake habitat types

No	Scientific names	Khmer names	Grassland	Marshland	Small lake
1	<i>Achiroides leucorhynchos</i>	trey andat chhke	√	√	-
2	<i>Amblyrhynchichthys truncatus</i>	Kam But Chramos	√	√	-
3	<i>Mystus nemurus</i>	trey Chhlang	-	√	-
4	<i>Setipinna melanochir</i>	trey chhmar	√	√	-
5	<i>Pangasius pleurotaenia</i>	trey chhwiet	√	√	-
6	<i>Oxyeleotris mamorata</i>	trey damrey	√	-	√
7	<i>Barbonymus altus</i>	trey kahe kra horm	-	√	-
8	<i>Kryptopterus kryptopterus</i>	trey kamphliev khlanh	√	√	-
9	<i>Channa lucius</i>	trey kanh chorn chey	-	-	√
10	<i>Hampala dispar</i>	trey khman	-	√	√
11	<i>Anabas testudineus</i>	trey kranh	-	-	√
12	<i>Ompok bimaculatus</i>	trey kromom	-	√	√
13	<i>Glossogobius aureus</i>	trey khsan	√	√	-
14	<i>Pangasius sp.</i>	trey pra	√	√	-
15	<i>Boesemania microlepis</i>	trey prama	√	√	-
16	<i>Acantopsis sp.</i>	trey rushek	√	√	-

Notes: sign '√' = presence of the species in the habitat type and sign '-' = the absence of the fish species in the habitat type.

General abundance of fish species in grassland, marsh and deep pool/small lake habitats

Fourteen fish species, amongst a total 64 recorded, were found in all three types of habitat studied. These species are of importance in the diet of people living in the Mekong region. They are commercially important, and some are exported to neighboring countries.

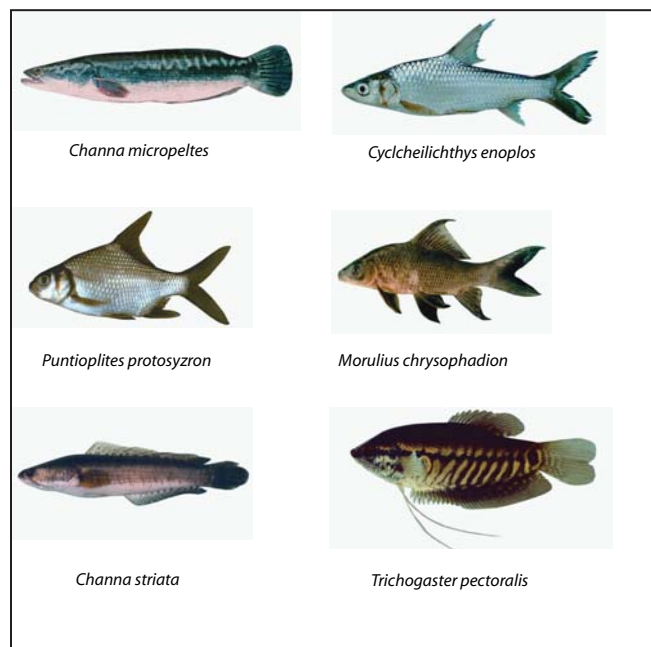
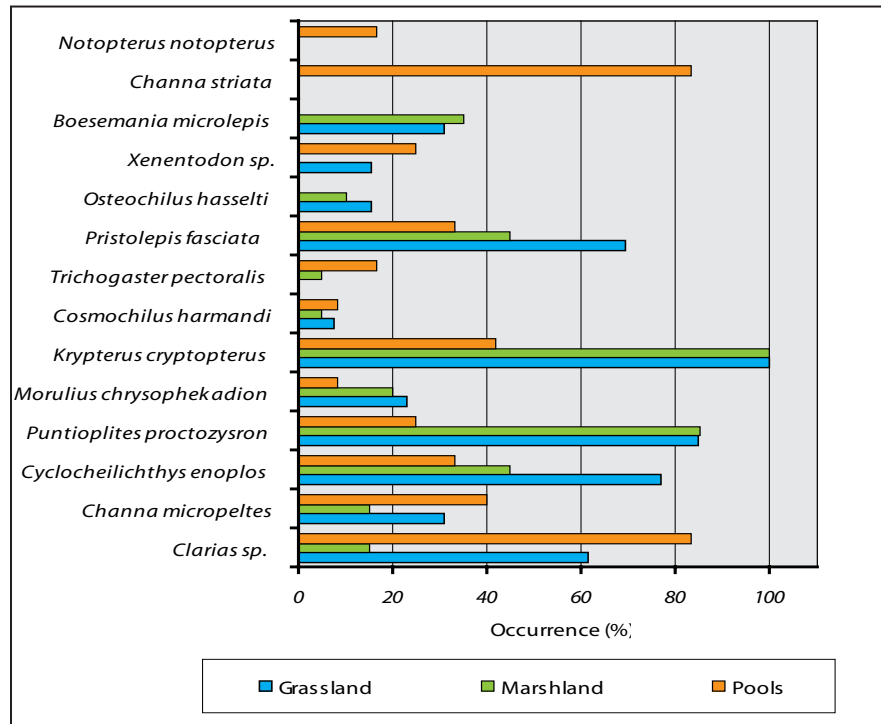


Figure 5. Some of the most abundant species found in grassland, marsh and deep pool/small lake habitats

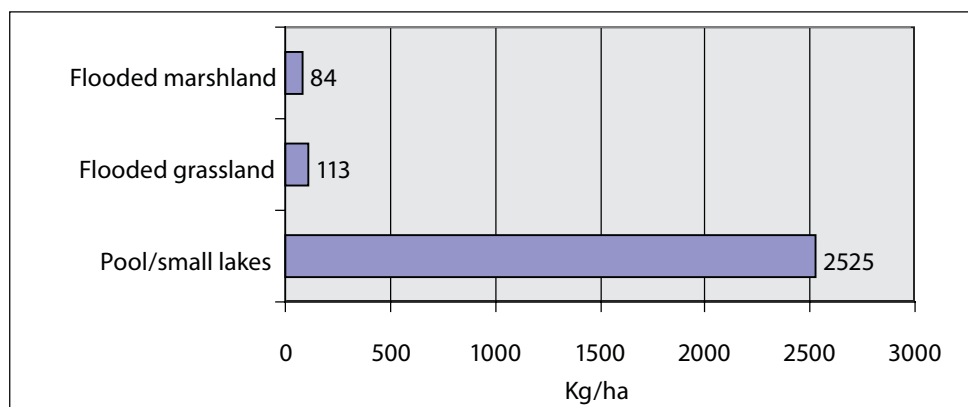


Figure 6. Standing crop of fish and other aquatic animal (kg/ha) in different types of habitat

Standing crop

Standing crop and OAAs were found to be 113 kg/ha in grassland habitats, 84 kg/ha in marshlands and 2,525 kg/ha in deep pool/small lake habitats. The standing crop in grasslands and marshland habitats were recorded in a defined area over one specific time period. The catch from pools/small lakes was also recorded over a specific time period. Sampling during other times of the year may have produced different results. The standing crop of fish and OAAs in deep pools and small lakes was gathered from surrounding areas when floodplain waters were receding late in the year from December to April.

DISCUSSION

Fish and other aquatic animal recorded during this study were found to be similar to the species encountered in the Dai and middle-scale fisheries operating in the Mekong and elsewhere in Cambodia as reported by Diep *et al.*, 1998. Diep *et al.* (1998) reported on 75 species and, or, genera occurring in the other fisheries mentioned above. However, the total number of species recorded during this investigation is comparatively small compared to the total number fish species known to exist in the Tonle Sap floodplain; estimated at around 300. A recent report on the Dai fisheries indicated that there were about 150 species caught in the Tonle Sap River (Pengbun, pers.comm., 2005). The report concluded that species diversity in the Tonle Sap River was less than that in the flooded forest areas around the Tonle Sap Lake. For example, 83 species were encountered in Battambang Province and 179 species and 171 species were recorded from two different fishing lots in Prey Veng Province (Troeng *et al.*, 2003). However, species diversity in the Tonle Sap River was considered to be higher than that found in rice-fields (35 species reported) on the Tonle Sap floodplain. Correct identification of fish species, or species groups, together with a comparatively short study period may mean that complete species inventories were not recorded in these rice-field habitats. During the time that this study was carried out (March to June 2004) it is highly likely that many 'white' fish species would have returned to the Mekong mainstream. In addition, fish species

inventories may be difficult to obtain because standing water bodies are dominated by 'black' fish species during this period.

The standing crop of fish and OAAs in the flooded grassland habitat was recorded at around 113 kg/ha and was higher than the standing crop from the flooded forest habitats found to be at around 95 kg/ha. The flooded forest area in Battambang Province where part of this study was carried out is reported to be in good condition (Troeng *et al.*, 2003). By comparison, it is similar to conditions found in some floodplain areas of Bangladesh (Eric Baran 2005 after Hoggarth and Halls 1997). The report of Eric Baran *et al.* (2000) on fish and other aquatic animal production in the Tonle Sap Lake floodplains from 1994 to 1997 was higher than the 95kg/ha in this study. Lieng *et al.* (2001) reported that the average standing crops of fish and other aquatic animal in the floodplain fisheries around the Tonle Sap Lake from 1995 to 1999 ranged between about 130 to 190kg/ha.

The standing crop estimates of fish and other aquatic animal from two fishing lots in Prey Veng Province were found to be 55 kg/ha and 92 kg/ha respectively as reported by Troeng *et al.*, (2003). Troeng *et al.* (2003) found that the standing crop in flooded marshlands at 84kg/ha was lower than that for flooded grasslands. Troeng *et al.* (2003) reported that the standing crop in deep pools or small lakes was high at around 2,525 kg/ha. However, it should be mentioned that this standing crop estimate was based on data from surrounding areas close to the Tonle Sap Lake and included OAAs also.

CONCLUSIONS

At least 64 fish species were encountered in flooded grassland, marshland and deep pool or small lake habitats in the Tonle Sap Floodplain during the months of March to June in 2004. It is important to notice that the standing crop is very high in deep pools or small lakes. The fish species diversity is also comparatively high in these habitat types. During the period from March to June, fish populations in deep pools and small lakes are dominated by 'black' fish species. These species were also commonly found in flooded rice fields and flooded grassland habitats. Many fish species associated with these kinds of habitat contribute significantly to food security for rural fishers, farmers and their families. Some of the most important species in this category are: *Achiroides leucorhynchus*, *Amblyrhynchichthys trunctaus*, *Mystus nemurus*, *Setipinna melanochir*, *Pangasius pleurotaenia*, *Oxyeleotris mamorata*, *Barbonymus altus*, *Kryptopterus kryptopterus*, *Channa lucius*, *Hampala dispar*, *Anabas testudineus*, *Ompok bimaculatus*, *Pangasius sp.*, and *Boesemania microlepis*. Not all species are common.

In order to maintain fish bio-diversity and food security for the rural people in Cambodia, management should focus on protection of critical habitats and the most important fish species identified in this study.

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No.	Species	Black/ White	Diet	Fish OAA	Khmer	Grassland	Marsh	Pool
1	<i>Acantopsis spp.</i>	White	Carnivorous	Fish	trey reus chek	0.47		
2	<i>Achiroides leucorhynchus</i>	White	Carnivorous	Fish	trey andat chhke			133.79
3	<i>Amblyrhynchichthys truncates</i>	White	Herbivorous	Fish	trey kambut chramoh	0.51		
4	<i>Anabas testudineus</i>	Black	Carnivorous	Fish	trey kranh	1.13	0.63	36.52
5	<i>Barbodes gonionotus</i>	White	Omnivorous	Fish	trey chhpin		0.04	0.04
6	<i>Barbonymus altus</i>	White	Omnivorous	Fish	trey kahe	0.94		
7	<i>Belodontichthys dinema</i>	White	Carnivorous	Fish	trey khlang hai	1.80	1.11	3.89
8	<i>Boesemania microlepis</i>	White	Carnivorous	Fish	trey prama			97.24
9	<i>Botia spp.</i>	White	Carnivorous	Fish	trey kanh chrouk	1.56	1.39	1.39
10	<i>Channa lucius</i>	Black	Carnivorous	Fish	trey kanh chorn chey	0.55	0.72	0.91
11	<i>Channa micropeltes</i>	Black	Carnivorous	Fish	trey chhdoar/diep	0.60	3.26	182.20
12	<i>Channa striata</i>	Black	Carnivorous	Fish	trey ras/phtuok	1.34	0.68	737.00
13	<i>Cirrhinus microlepis</i>	White	Omnivorous	Fish	trey kralang	1.45	0.77	19.78
14	<i>Clarias sp.</i>	Black	Carnivorous	Fish	trey andeng	3.59	2.21	86.50
15	<i>Clupeoides borneensis</i>	White	Carnivorous	Fish	trey bandoul ampov	1.02	0.35	0.35
16	<i>Coilia macrognathos</i>	Estuarine	Carnivorous	Fish	trey chunluon moan	7.80	4.36	4.36
17	<i>Cosmochilus harmandi</i>	White	Omnivorous	Fish	trey kampoulbai	2.21	2.01	10.40
18	Crab	OAA	Omnivorous	OAA	kdam			0.13
19	<i>Cyclocheilichthys enoplus</i>	White	Omnivorous	Fish	trey chhkok	2.77	3.23	28.40
20	<i>Cyclocheilichthys repasson</i>	White	Omnivorous	Fish	trey sawkar kdam	1.61	0.93	69.80
21	<i>Glossogobius aureus</i>	Estuarine	Carnivorous	Fish	trey khsan	0.63	1.95	1.95
22	<i>Hampala dispar</i>	White	Carnivorous	Fish	trey khman	1.17	0.55	27.96
23	<i>Henicorhynchus siamensis</i>	White	Herbivorous	Fish	trey riel	1.45	0.77	19.78
24	<i>Indostomus/Doryichthys/Hippichthys</i>	Estuarine	Carnivorous	Fish	trey chai krapoeu	1.46	0.13	16.91
25	<i>Kryptopterus apogon</i>	White	Carnivorous	Fish	trey kes	1.37	1.44	1.44
26	<i>Kryptopterus cryptopterus</i>	White	Carnivorous	Fish	trey kampliev	10.63	6.62	6.62
27	<i>Labeo chrysophekadion</i>	White	Herbivorous	Fish	trey kaek	1.73	2.55	9.42
28	<i>Labiobarbus lineatus</i>	White	Omnivorous	Fish	trey khnang veng	1.69	1.54	11.16

No.	Species	Black/ White	Diet	Fish OAA	Khmer	Grassland	Marsh	Pool
29	<i>Macrochirichthys macrochirus</i>	White	Carnivorous	Fish	trey dangkhteng	2.00	2.40	2.40
30	<i>Macrogathus taeniagaster</i>	White	Carnivorous	Fish	trey khchoeung	1.37	1.44	1.44
31	<i>Macrogathus siamensis</i>	White	Carnivorous	Fish	trey chhlonh	1.05	0.64	36.16
32	<i>Macrogathus spp.</i>	White	Carnivorous	Fish	trey khchoeung	0.72	1.90	38.85
33	Clam A	OAA	Herbivorous	OAA	leas	0.08		9.32
34	Clam B	OAA	Herbivorous	OAA	khchao	0.65	2.16	2.16
35	<i>Monopterus albus</i>	Black	Carnivorous	Fish	trey antong	0.41		
36	<i>Monotretus sp.</i>	Estuarine	Omnivorous	Fish	trey kampot		0.19	20.30
37	<i>Mystus nemurus</i>	White	Carnivorous	Fish	trey chhlang		0.78	0.78
38	<i>Mystus sp.</i>	White	Carnivorous	Fish	trey kanh chos	1.98	0.92	32.58
39	<i>Notopterus notopterus</i>	White	Carnivorous	Fish	trey slat	2.14	4.67	23.97
40	<i>Osteochilus hasselti</i>	White	Herbivorous	Fish	trey kros	14.49	5.26	58.77
41	<i>Osteochilus melanopleurus</i>	White	Herbivorous	Fish	trey krum	1.01	1.51	12.46
42	<i>Oxyeleotris marmorata</i>	White	Carnivorous	Fish	trey damrey	0.48		
43	<i>Pangasius pleurotaenia</i>	White	Omnivorous	Fish	trey chhwiet	0.83	0.30	0.30
44	<i>Pangasius sp.</i>	White	Carnivorous	Fish	trey pra		0.22	0.22
45	<i>Parachela siamensis</i>	White	Carnivorous	Fish	trey chanteas phluk	9.92		
46	<i>Paralabuca typus</i>	White	Carnivorous	Fish	trey sloeuk russey	1.52	3.61	34.95
47	<i>Parambassis wolffi</i>	White	Carnivorous	Fish	trey kantrang preng	0.38	0.77	33.72
48	<i>Pseudambassis notatus</i>	White	Carnivorous	Fish	trey kanh chanh chras			119.63
49	<i>Polynemus multifilis</i>	Estuarine	Carnivorous	Fish	trey kampream	0.45	1.13	1.13
50	<i>Poropuntius deauratus</i>	White	Omnivorous	Fish	trey loloksor			127.00
51	<i>Pristolepis fasciata</i>	White	Omnivorous	Fish	trey kantrawb	4.77	1.01	95.60
52	<i>Puntioptiles falcifer</i>	White	Omnivorous	Fish	trey chrakeng	2.30	1.07	58.67
53	<i>Rasbora spp.</i>	Black	Omnivorous	Fish	trey changwa	1.44		
54	<i>Setipinna melanochir</i>	Estuarine	Carnivorous	Fish	trey chhmar	0.13		
55	<i>Small freshwater shrimp</i>	OAA	Omnivorous	OAA	kampoeuh			16.07

No.	Species	Black/ White	Diet	Fish OAA	Khmer	Grassland	Marsh	Pool
56	Snake	OAA	Carnivorous	OAA	puoh chhoeu	1.54	0.28	0.28
57	<i>Thynnichthys thynnoides</i>	White	Herbivorous	Fish	trey linh	1.71	0.94	0.94
58	<i>Toxotes microlepis</i>	White	Carnivorous	Fish	trey kancheaksla	1.11	0.36	0.36
59	<i>Trichogaster microlepis</i>	Black	Carnivorous	Fish	trey kampheanh	1.61	3.87	77.08
60	<i>Trichogaster pectoralis</i>	Black	Omnivorous	Fish	trey kanthor	2.00	1.47	108.07
61	<i>Trichopsis pumila</i>	Black	Carnivorous	Fish	trey kreoum tunsay		1.13	31.40
62	<i>Xenentodon cancila</i>	White	Carnivorous	Fish	trey phtong	3.25	2.40	2.40
63	Other*	Mixed	Mixed	Mixed	Mixed	3.40	6.18	32.34

