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MEKONG RIVER COMMISSION
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Annual Report

Dai Fishery Monitoring in the Tonle Sap River, Cambodia in the Fishing Season 2020-2021

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Executive summary

Dai fishery, established around 144 years ago, is the only inland industrial fishery that exists in Cambodia today. It operates along the 35 km stretch of Tonle Sap River from Chrang Chomres of Phnom Penh to the border of Kandal and Kampong Chhnang provinces. Dai fishery targets returned-to-refuge migratory fishes from the Tonle Sap Lake and the floodplains surrounding the lake and the Tonle Sap River which usually takes place between late October and early March.

Inland Fisheries Research and Development Institute of the Fisheries Administration in close cooperation with MRC have been monitoring the fishery since 1995-1996. In monitoring this fishery, stratified sampling methods have been applied. The stratification is made on (1) administrative boundary between Kandal Province and Phnom Penh Capital in order to report catch and value in the two locations, (2) time – peak period and low period based upon lunar month – moon face and (3) size of *Dai* yield – high-yield Dai and the low-yield Dai.

In general, seasonal Dai catch was between 6,000 and 40,000 tons over the monitoring period since 1995-1996. The lowest seasonal catches took place in the fishing season of 1998-99 and 2003-04 during which drought also occurred. The seasonal catch in 2005-06 was unusually high, estimated around 28,000 tons 2011-12 fishing season was the highest of around 46,000 tons It took place especially in the time of high and prolonged flood in Cambodia and the region. For fishing season of 2013-14, the seasonal estimated catch was around 24, 254 tons. In seasonal catch 2020-2021 of *Dai* fishery estimated 8,512 tons declined 27% compared with 2019-2020 (11,167 tons). The biggest catch occurred in December 2020, which was estimated at 6,854 tons, the sale value estimated at *Dai* fisheries around 22,298,443 million Riels. The overall average weight price at the *Dai* fisheries seasonal 2020-2021 is around 2,735 Riel/kg. In the season Dai fisheries catch in 2020-21 shown *Paralaubuca barroni* and *Henicorhynchus cryptopogon* were the most abundant species in catch each comprised of 17% following *Henicorhynchus siamensis* 11%, *Botia lecontei* (9%), *Labiobarbus lineata (*9%), *Clupeichthys aesarnensis* (5%), *Labeo chrysophekadion, Acantopsis sp., Pangasius pleurotaenia* and *Labiobarbus siamensis* each species (3%) others (111species) comprised 20% in the total catch.

1. INTRODUCTION

1.1 Background

The Dai (Stationary bag net) has been operating along the 35 km stretch of Tonle Sap River from Chrang Chomres of Phnom Penh to the border of Kandal and Kampong Chhnang provinces over 100 years (Figure 1: map showing Dai location). The gear targets the with-flow migrants from the Tonle Sap Lake to the Mekong main channel from October to March each year. Production of the Dai contributes about 10 percent of the annual inland capture fisheries in the country. There are about 120 to 130 fish species identified every fishing season, the biomass predominated by small cyprinids belonging to *Cirrhinus* spp., *Paralaubuca barroni, Osteochilus hasselti, Labiobarbus* spp. and *Botia* spp. This fishery has been considered as a large-scale fishery in the country (Cambodian fisheries law, 1996), and recognized as an accurate indicator of the national inland fisheries and could be a good indicator of the whole Mekong fisheries and its ecological health.

The Inland Fisheries Research and Development Institute (IFReDI), with financial supports from Fisheries Administration (FiA) and the Environmental Management Division (ED) of the Mekong River Commission (MRC) through the National Mekong River Commission (CNMC) has carried out the catch monitoring of this fishing activity since 1994. In the fishing season 2020-21, a total number of 61 unit of Dais are active in the river, of which 40 units (row 7-15; row 11') are in Kandal province and the remaining 21 units (row 2-6) are in Phnom Penh capital.

The trends of catch obtaining from this activity provides a means to evaluate the performance of fisheries management efforts as well as the effect of basin development activities and climate change on fisheries resources in Cambodia and beyond.

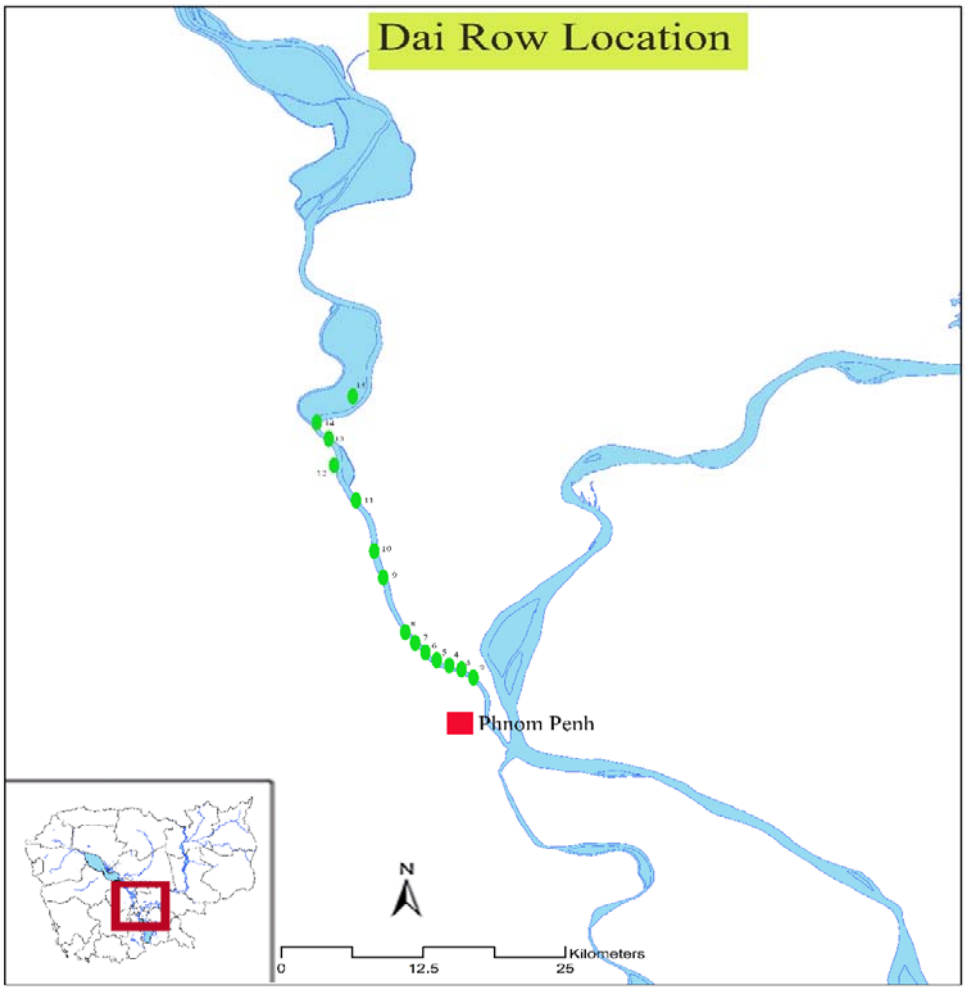

Figure 1: Map of Dai fishery along Tonle Sap River, and location of the 11 raw of Dais

1.2 The purpose of the study

1.2.1 Overall objective

The overall objective of this activity is to provide scientific information on the most important fishery indicator for policy makers and scientific use. Dai fishery monitoring contributes to the understanding on and interpretation of the status and trends of capture fisheries in the Lower Mekong Basin.

1.2.2 Specific objectives

Specific objectives are as follows:

- To assess annual fish production and value of the *Dai* Fishery fishing on Tonle Sap River in Kandal Province and Phnom Penh Capital, Cambodia;
- To determine and describe trends in key fishery indicators: resource abundance, biomass biodiversity, length frequencies and fish prices at landing sites.
- To update the *Dai* fishery database for the scientific use.

2. ENVIRONMENTTAL CONDITIONS

Dai targets longitudinal migrating species, known as *whitefish*, a majority of them is small Cyprinid. The productivity of these small cyprinid or mud carps are closely linked to 3 key Mekong hydrological parameters, flood timing, flood level and flood duration.

The Mekong flood in 2020 started at Sep, the flood level increased steadily, reaching over 7 meters at Prek Kdam hydrological station at October. The Mekong and Tonle Sap hydrological condition in 2020 created a favorable condition for fish to nurse feed and grow, especially for *whitefish* that contributes more than 70% percent in Cambodian annual inland capture fisheries.

3. METHODS

3.1 Fishing operations

Three types of *Dai* varying according to mesh size and shape are used by Dai operators during the course of the fishing season according to the prevailing hydrological conditions and the mean size of migrating fish. These *Dais* include:

- Dai Chhieu (big mesh-size) is used between October to November during high water velocity to target medium and large size fish species;
- Dai Nheuk (small mesh-size) is used between December and February while lower velocity is in the river to target smaller species including *Henichoryncus* spp. (trey riel); *Paralaubuca* spp. (trey slak russy) and *Labiobarbus* spp. (trey khnang veng); and
- The Yor (smaller mesh-size) is used between January and March when the flow is weak to target small species, such as *Henichoryncus* spp. (trey riel); *Paralaubuca* spp. (trey slak russy) and *Botia* spp. (trey khanh chruk).

3.2 Methodology

Dai fishery is a complex and dynamic fishing activity, challenging the accuracy of the catch estimation. The methodology for *Dai* fishery monitoring was evolved gradually toward a sophisticated method. The methodology was standardized in 2001 by Ngor and van Zalinge (2001), and that standardized method has been employed strictly in the following *Dai* monitoring activities.

3.2.1 Sample collection

Biological data and fish prices at landings were recorded by 9 field data collectors of whom four work regularly (16 days both in the low and peak period of the *Dai* Fishery) for a period of 6 months and five others who are additionally recruited to assist to collect data for a period of 7 days in the peak catch of the fishery through the fishing season.

- In the low catch period:

  Normally, a *Dai* unit soaks every 1 to 3 hours, catching 3-10 kg. Because the catch was relatively small, the total fish catch was sampled for species composition.

- In the high catch period:

In the high catch period, the *Dai* soaked every 15 to 45 minutes, catching from 200 to 1,400 kg of small-sized fish. An approximately10 kg sub-samples was taken from each haul, to measure total length, weigh by species, the biological and prices per kg of first sale were recorded in field datasheets.

- For catch estimation, stratified sampling method is applied. The stratification is made according to the peak and low period (often strongly correlated with moon face), provincial boundary between Phnom Penh and Kandal province, and *Dai* yield (high yielding and low yielding *Dai*).

3.2.2 Data analysis

All collected data will be computerized using MS ACCESS and analyzed in MS Excel Spreadsheet.

4. RESULTS

4.1. Number of Dais licensed

As total, 35 units of Dais were licensed for operating along Tonle Sap River in Kandal province and Phnom Penh capital in the 2020-2021, fishing season. Compared to the number of Row in year 2019-2020 was 43 units. The Row 8G, 11B, and 11C were removed in Kandal province. The Row 2 and Row 5 and Row3D were removed in Phnom (Figure 1 and **Error! Reference source not found.**).

Table 1: Official number, locations and change of Dais in the fishing season 2020-2021

Province	Row No.	Relative Transversal Positions of *Dai* Unit in Tonle Sap river									Total No. of *Dai* Unit
Kandal province	Row 15		A	B	C	D	E				5
	Row 14		A	B	C						3
	Row 13		A	B	C						3
	Row 12		A	B	C	D	E	F	G		7
	Row 11'			B'	C'						2
	Row 11		A	B	C						1
	Row 9				C						1
	Row 8						E	F	G	H	3
Sub-total	**8 rows**										**25**
Phnom Penh capital	Row 6				C	D	E				3
	Row 5			B	C						0
	Row 4		A	B	C	D					4
	Row 3		A	B	C	D					3
	Row 2				C	D					0
Sub-total	**5 rows**										**10**
Grand-total	**16 rows**										**35**

Note: Red highlight indicates Row Dai removal

4.2 Active Fishing Days

In the fishing season 2020-2021, the Dai fishery activity started in November 2020. The observed peak period occurred in December 2020.

Thirty-five units of Dai were observed to be fully active in November 2020, December 2020 and January 2021. All Dai units were actively of only around 7 days. It is noted that active fishing days especially in the peak periods is an important raising factor which influence the catch and value landing estimate for the fishery.

4.3 Soak Hours

- In the low catch period:

Normally, a *Dai* unit soaks every 1 to 3 hours, catching 3-10 kg, because the catch was relatively small, the total fish catch was sampled for species composition.

- In the high catch period:

In the high catch period, the *Dai* soaked every 15 to 45 minutes, catching from 200 to 1,400 kg of small-sized fish. An approximately 10 kg sub-samples was taken from each haul, to measure total length, weigh by species, the biological and prices per kg of first sale were recorded in field datasheets.

- For catch estimation, stratified sampling method is applied. The stratification is made according to the peak and low period (often strongly correlated with moon face), provincial boundary between Phnom Penh and Kandal province, and Dai yield (high yielding and low yielding Dai).

4.4. Top ten species in the catch composition

The catch composition shown that *Paralaubuca barroni* and *Henicorhynchus cryptopogon* were the most abundant species in catch each species comprised of 17% following by *Henicorhynchus siamensis* 11%, *Botia lecontei* (9%), *Labiobarbus lineata (*9%), *Clupeichthys aesarnensis* (5%), *Labeo chrysophekadion, Acantopsis sp., Pangasius pleurotaenia* and *Labiobarbus siamensis* each species (3%) other species (111 species) comprised of 20% in the total catch of Dai fishery in 2020-2021(Figure 1and Appendix 1).

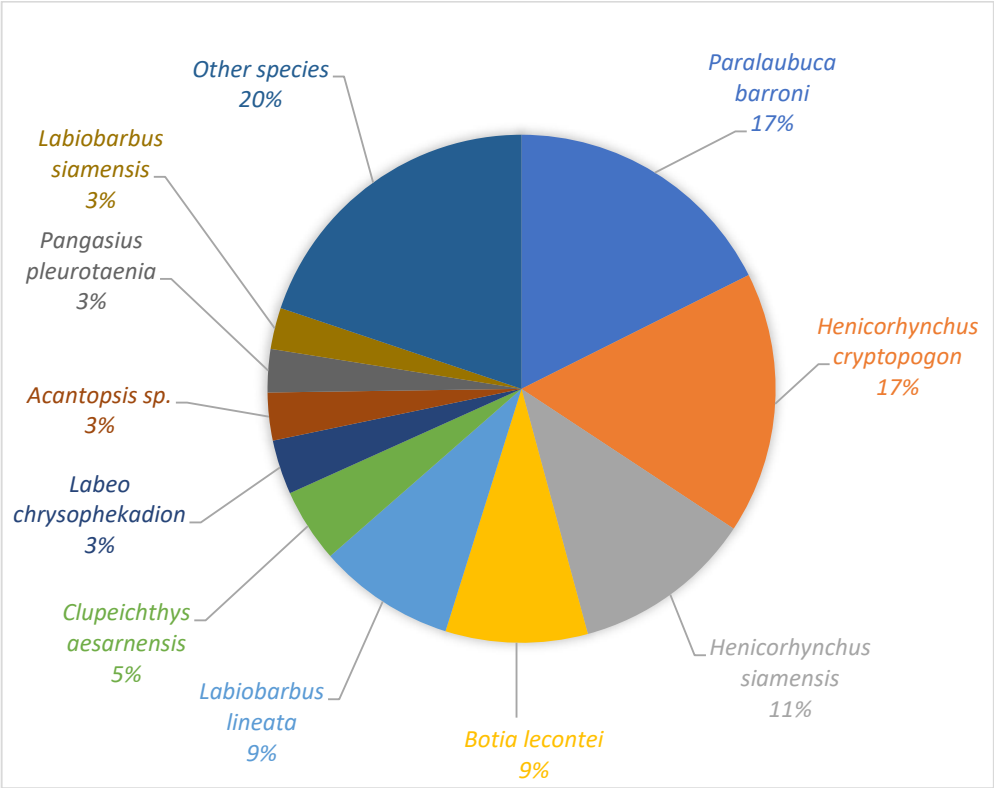

Figure 2. Top ten species in terms of biomass in 2020-2021

4.5. Total monthly landed weight and value estimate

Seasonal catch of *Dai* fishery estimated for the fishing season of 2020-2021 was 8,152 tons, it declined 27% compared with 2019 (11,167 tons) the biggest catch occurred in December, which estimated at 6,854 tons, it is making up around 78% of the total catch. The monthly catch and value estimated for the fishing season 2020-2021 is 22,298,443 million Riels given in figure 2.

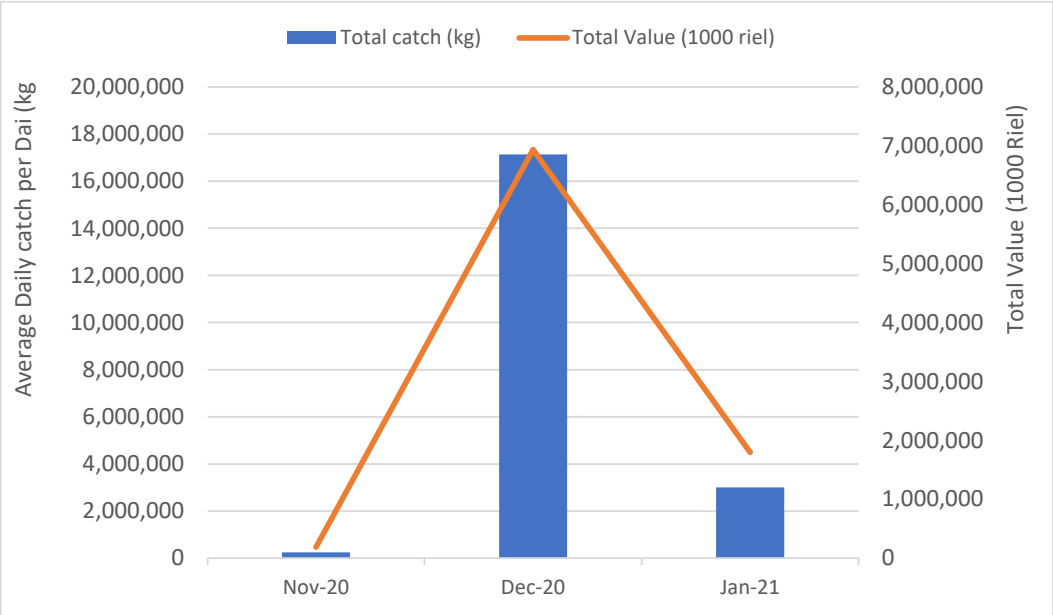

Figure 3. Monthly catch (tons) and the value (thousand Riel) of Dai of Year 2020-2021

4.6. Total landed weight estimate and trend versus water level

Catch from the fishery known to have been closely correlated with maximum annual water levels at Kampong Loung station, Tonle Sap River. The relationship between seasonal catch and maximum flood levels (Figure 3).

From the graph, on average, seasonal Dai catch was between 6,000 and 40,000 tons over the monitoring period since 1995 to 2021.

The lowest seasonal catches took place in the fishing season of 2003-2004 was about 6,000 tons which drought was occurred. The seasonal catch in 2005-06 was unusually high, estimated at around 28,000 tons. The reason driving this high catch is still not explained. The graph also shows that catch for 2011-12 fishing season was the highest on record of around 46,000 tons. It took place especially in the time of high and prolonged flood in Cambodia and the region. For this fishing season of 2020-2021, the seasonal estimated catch was around of 8,152 tons. The maximal flooding level over the Tonle Sap River was 8.86m in 2020-2021 was higher than 2019-2020 (8.68 m).

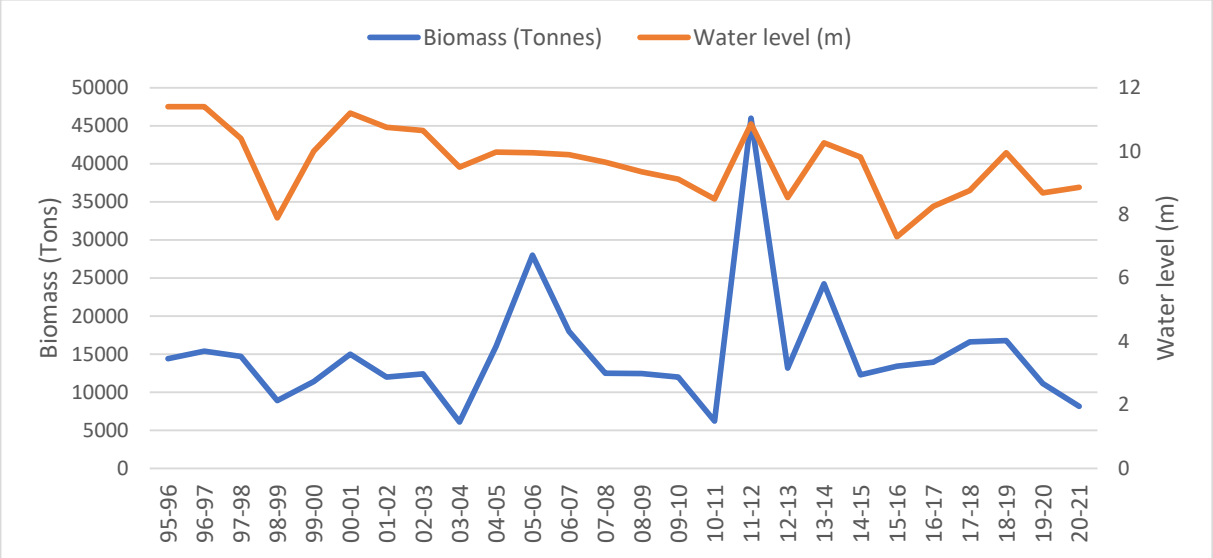

Figure 4. Seasonal catch of Dai fishery at Kampong Loung, Tonle Sap River, 1995-2096-2020-2021

5. DISCUSSIONS AND CONCLUSIONS

Dai fishery targets returned-to-refuge migratory fishes from the Tonle Sap Lake and the floodplains surrounding the lake and the Tonle Sap River which usually takes place between late October and early March. In season 2020 *Dai* catch was estimated around 8,512 tons, the sale value estimated 22,298,443 million Riel in fishing season 2020-2021.

Seasonal Dai fisheries catch 2020-2021 there were 121 fish species. The catch composition is dominated by small mud carps. For this fishing season small mud carps that *Paralaubuca barroni* and *Henicorhynchus cryptopogon* were the most abundant species in catch each comprised of 17% following *Henicorhynchus siamensis* 11%, *Botia lecontei* (9%), *Labiobarbus lineata (*9%), *Clupeichthys aesarnensis* (5%), *Labeo chrysophekadion, Acantopsis sp., Pangasius pleurotaenia* and *Labiobarbus siamensis* each species (3%) other species (111 species) comprised 20% in the total catch.

In contrast, the catch trend of small cyprinids such *Paralaubuca barroni* (R-strategist) was increased in 2018-2019. This could be an indication of depleting fish population, where the production of large and medium size fish species is declining, and replaced by small fish population.

6. RECOMMENDATIONS

To improve the Dai fishery monitoring, to improve the estimate of Dai fishery yield as well as to make use of the results of the monitoring, the following recommendations are made as follows:

- Since the Dai fishery monitoring contributes significantly to the understanding on and interpretation of the status and trend in basin-wide inland capture fisheries, the monitoring should be continued.
- Apart from the Dai fishery, many other types of fishing gears also operate along the Tonle Sap River to harvest fishes migrating out of floodplains and the Tonle Sap Lake. The yield

of Dai fishery therefore also depends upon the fishing effort of other fishing gear in the Tonle Sap River. Gill net is observed to be the most popular gear being practiced in the area. Thousand sets of gill net are believed to be in operation at the same time in the Tonle Sap River as the Dai fishery does. Catches harvested by gill net fishers, which could otherwise have been harvested by Dai, have been ignored in Dai fishery estimate. Therefore, in order to understand the overall fisheries, yield of the returned-to-refuge migratory fishes from the Tonle Sap Lake and its floodplains, the survey of gill net operating along the Tonle Sap River during Dai fishing season is of critically important.

- Species list in the current Dai fishery monitoring database need to be updated
- There has been change in staff member in the Dai fishery team. Therefore, capacity building (with support from Environmental Management Division (ED) should be provided to new field data collectors and data recorders (data entry, cleaning as well analyses).
- Since Dai fishery data is the only long-term fishery monitoring in this region, with assistance from ED, a Dai fishery paper should be prepared for a publication in a scientific/international journal for wider audience in scientific communities.

7. REFERENCES

Ngor, P. and N. van Zalinge. 2001. *Dai* (Bagnet) fishery: 1994/95-2000/01: catch assessment methodology and results. Project for Management of the Freshwater Capture Fisheries of Cambodia. Mekong River Commission/DoF/DANIDA. pp. 47.

APPENDICES

Appendix 1: Catch (kg) and landing value (thousand riel) estimated for the Dai fishing season 2020

Species name	**Total Catch (Kg)**	**Total Value(1000riel)**
Acantopsis sp.	247,461.56	566,675
Albulichthys albuloides	13,994.52	35,317
Amblyrhynchichthys truncatus	88,595.86	253,183
Anabas testudineus	851.66	1,933
Arius maculatus	0.83	1
Bagrichthys macracanthus	7,968.15	19,045
Barbichthys nitidus	5,216.68	11,561
Barbonymus altus	2,712.01	8,317
Barbonymus gonionotus	380.32	2,583
Barbonymus schwanenfeldii	595.28	1,472
Belodontichthys truncatus	11,537.54	99,383
Boesemania microlepis	20,519.62	95,187
Botia helodes	156,622.08	398,240
Botia lecontei	736,904.53	1,526,093
Botia modesta	184,012.27	547,416
Carinotetraodon lorteti	3,423.19	7,961
Catlocarpio siamensis	12.63	15
Channa lucius	13.85	97
Channa micropeltes	347.26	8,948
Channa striata	680.99	2,792
Chanos chanos	7.81	23
Chitala ornata	3,646.76	24,780
Cirrhinus jullieni	2,170.35	5,146
Cirrhinus microlepis	24,764.12	68,430
Clarias batrachus	8.99	18
Clarias gariepinus	5.78	29
Clarias nieuhofi	5.25	8
Clupeichthys aesarnensis	382,460.80	964,033
Clupisoma sinensis	310.39	938
Coilia lindmani	6,894.33	19,439
Cosmochilus harmandi	41,273.01	106,020
Cyclocheilichthys armatus	1,075.87	2,567
Cyclocheilichthys enoplos	113,677.25	354,350
Cyclocheilichthys furcatus	394.56	1,474
Cynoglossus feldmanni	63,422.03	407,056
Datnioides quadrifasciatus	2.25	3
Doryichthys boaja	95.08	238
Epalzeorhynchos frenatum	1,211.82	3,650
Epalzeorhynchos munense	100.85	250
Esomus longimana	232.11	500

Gerres filamentosus	19.71	296
Glossogobius aureus	4,054.04	10,533
Gyrinocheilus aymonieri	77,078.52	202,190
Hampala dispar	797.40	1,691
Helicophagus waandersii	469.42	961
Hemibagrus wyckii	113.52	450
Hemisilurus mekongensis	634.69	2,001
Henicorhynchus cryptopogon	1,359,081.75	3,870,883
Henicorhynchus lobatus	3,251.65	6,627
Henicorhynchus siamensis	938,922.80	2,567,932
Heterobagrus bocourti	58.12	177
Hyporhamphus limbatus	4,862.05	11,685
Hypsibarbus malcolmi	9,565.60	102,425
Hypsibarbus vernayi	850.08	14,609
Hypsibarbus wetmorei	2,190.81	6,976
Kryptopterus cryptopterus	453.29	1,165
Kryptopterus micronema	40,103.69	198,793
Kryptopterus schilbeides	2,540.68	6,554
Labeo chrysophekadion	283,049.21	809,286
Labiobarbus lineata	711,629.30	1,811,377
Labiobarbus siamensis	214,767.02	607,622
Lates calcarifer	30,441.97	91,312
Leptobarbus hoevenii	4,511.05	12,962
Lobocheilos davisi	21,210.19	55,965
Luciosoma bleekeri	4,561.82	9,251
Lycothrissa crocodilus	14.83	30
Macrochirichthys macrochirus	854.64	1,715
Macrognathus siamensis	114.24	271
Mastacembelus armatus	1,310.11	4,097
Mastacembelus erythrotaenia	33.01	503
Mystacoleucus marginatus	877.51	1,655
Mystus albolineatus	5,110.97	10,163
Mystus atrifasciatus	4,242.03	9,453
Mystus nemurus	49,646.36	152,951
Mystus singaringan	3,922.69	10,569
Notopterus notopterus	169.91	332
Oreochromis mossambicus	950.68	3,329
Osphronemus exodon	1,035.93	2,073
Osteochilus lini	4,461.65	11,345
Osteochilus melanopleura	5,130.27	15,411
Osteochilus schlegeli	29,483.13	94,004
Oxyeleotris marmorata	301.83	758
Pangasianodon gigas	16.01	24
Pangasianodon hypophthalmus	7,442.79	56,895

Pangasius bocourti	720.34	9,152
Pangasius conchophilus	40,498.59	160,023
Pangasius krempfi	129.03	239
Pangasius larnaudii	32,469.24	313,083
Pangasius pleurotaenia	223,809.58	624,242
Pangasius sanitwongsei	592.31	7,239
Parachela siamensis	10,197.62	26,881
Paralaubuca barroni	1,435,296.37	3,475,533
Parambassis apogonoides	395.99	959
Parambassis ranga	825.49	2,006
Parambassis wolffii	56,554.51	145,549
Plotosus canius	3,643.68	10,232
Polynemus borneensis	1,233.70	3,108
Polynemus dubius	615.22	1,881
Polynemus multifilis	3,075.80	9,983
Pristolepis fasciata	1,660.66	4,350
Probarbus jullieni	123.04	561
Probarbus labeamajor	6.78	10
Pseudomystus siamensis	42.24	119
Puntioplites bulu	714.50	1,612
Puntioplites proctozysron	181,767.31	667,004
Puntius brevis	8,329.09	22,807
Puntius orphoides	400.24	659
Raiamas guttatus	372.16	1,068
Rasbora borapetensis	2,192.95	6,753
Rasbora pauciperforata	584.71	1,717
Rasbora tornieri	22,339.40	56,396
Setipinna melanochir	2,808.14	6,847
Synaptura marginata	872.22	4,632
Tenualosa thibaudeaui	584.77	2,523
Thryssocypris tonlesapensis	87.81	168
Thynnichthys thynnoides	119,419.88	298,544
Toxotes chatareus	6,714.01	17,465
Trichogaster pectoralis	5.34	5
Trichogaster trichopterus	2.01	4
Wallago attu	2,686.02	8,964
Xenentodon cancila	36,299.46	81,655
Grand Total	**8,152,017.43**	**22,298,443**