REPORT FOR THE NIES/WORLDFISH CENTER PROJECT
"SCENARIO-BASED ASSESSMENT OF THE POTENTIAL EFFECTS
OF ALTERNATIVE DAM CONSTRUCTION SCHEMES
ON FRESHWATER FISH DIVERSITY
IN THE LOWER MEKONG BASIN".

ESTIMATION OF ANNUAL YIELD OF FISH BY GUILD IN THE LOWER MEKONG BASIN

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This consultation is a contribution to an assessment of the impacts of basin development on fish production in the Lower Mekong Basin (LMB).

Fish of different species respond to development activities, in particular hydropower development, in different ways depending upon their migratory behaviour and their ability to adapt to and tolerate new environmental conditions. Halls & Kshatriya (2010) grouped the species of the LMB into 9 groups or "guilds" according to these characteristics.

In order to better assess the impact of hydropower development on fish production in each country and along main Mekong tributaries, it is necessary to assess i) how migratory a given species is (longitudinal/lateral migrations; scale of migration, resilience to environmental change), i.e. what guild it belongs; ii) what contribution this species makes to fish catches basinwide.

The present study builds the MRC AMCF catch monitoring survey undertaken between November 2003 and December 2004 – the 12 month period corresponding to maximum spatial and temporal coverage of the survey following the methodology reported by Halls & Kshatriya (2009).

This study deepens the work initiated by Halls & Kshatriya (2009) by adjustments aimed at better reflecting the proportion of *black fish* in the catch. This proportion is likely to have been underestimated by Halls & Kshatriya because of the predominance of mainstream habitat sampled by the AMCF survey which is typically not inhabited by blackfish species.

For the purposes of the assessment, the contribution made by each guild to the baseline total yield of each country is estimated. Whilst some ad hoc surveys have been undertaken in specific locations in the LMB to provide areal estimates of yield sometimes for specific habitat types, fisheries and seasons (e.g. Hortle et al (2008); Hortle & Suntornratana (2008); Sjorslev (2001); Coates (2000), no attempts have been made to conduct a nationwide CAS in the LMB.

In the absence of such a CAS, estimates of yield from the fish consumption survey described by Hortle (2007) were used as the baseline for the assessment (Table 1), assuming that the proportion of cultured fish consumed (approx. 10%) equals the proportion of the wild fishery used for animal feed or wasted.

Table 1 Estimates of yield of inland fish and OAA in the LMB (tonnes/year). Source: Hortle (2007)

	Cambodia	Lao PDR	Thailand	Vietnam	Total
Inland Fish	481,537	167,922	720,501	692,118	**2,062,077**
OAA	105,467	40,581	190,984	160, 705	**497,737**
Total	**587,004**	**208,503**	**911,485**	**852,823**	**2,559,815**

These consumption-based estimates contain no information about the respective yields by species and therefore by guild. Instead, the contribution made by each species to total consumption-based yield estimates of each country was estimated from the AMCF catch monitoring survey undertaken between December 2003 and November 2004 – the 12 month period corresponding to maximum spatial and temporal coverage of the survey. This survey monitored the landings of fishers at 44 villages in the LMB mainly exploiting main channel, riverine and canal habitat but also lakes, reservoirs and floodplains to a lesser extent. Most observations corresponded to the village locations along the main channel of the Mekong (Figure 1). It is assumed that all guilds except Guild 6 (Blackfish) inhabit the main channel or riverine habitat at some period of the year. Therefore some indication of the relative contribution of species to the total catch in each country (except blackfish) can be estimated from the reported landings by species from the main channel and other riverine habitat. The contribution of blackfish to total yield can be estimated as the product of their mean areal yield and the total habitat area of blackfish.

Table 2 summarises the catch estimates by guild from riverine habitat. Averaged across fishing locations, blackfish species comprised less than 3 % of the reported landings from river habitat. The median blackfish proportion estimate for this habitat was less than 1 %.

Figure 1 Locations of the AMCF catch monitoring sites. Source: Halls & Kshatriya (2009).

Table 2 Estimates of catch by guild from riverine habitat. Data source: AMCF catch monitoring programme (01 Dec

(a) Cambodia

		Village name									
Guild	Catch weight (g)	Banfang	Baren	Day Lo	Kang Memai	Kbal Chroy	Koh Khne	Ou Run	Peam chumnik	Pram	Pres E
?	102147	15619	0	3340	36416	0	3570	1156	0	42047	
1	366426	53733	0	22310	135447	0	16198	1950	629	136159	1(
2	8063514	273969	372954	1556482	1046271	78955	410544	827875	28193	3468271	4(
3	45025549	139212	2572625	150214	801394	836292	288073	887712	2166336	37183692	9(
4	14834747	209843	4258765	278780	717982	189626	677863	451229	132912	7917748	34
5	33084626	181035	7228505	712916	639545	1594717	898129	961415	401259	20467104	13(
6	850395	48310	12658	67259	21179	595	139730	217359	3864	169416	4(
7	302902	10738	58948	8865	19878	92290	18050	21165	2092	70875	
8	80314	0	60	0	8415	100	3778	300	608	67053	
9	92274	335	9032	110	0	0	0	650	0	82147	
10	2989	500	15	190	140	0	1920	0	224	0	
	101955488	933294	14513561	2800466	3426666	2792575	2457855	3370810	2736118	69604513	68(
	Blackfish %	5%	0%	2%	1%	0%	6%	6%	0%	0%	

(b) Lao PDR

		Village name					
Guild	Catch weight (g)	Ban Done	Ban Mouang Sum	Ban Nam Ngieb	Ban Pha O	Ban Thamuang	Ban Xinh Xay
?	10400	140	1140	7460	1260		400
1	33956	2250	6655	15766	5155	660	3470
2	4943664	1780725	1277587	75598	257454	308500	1243800
3	9054123	7431230	571017	86955	271801	169690	523430
4	1741436	931052	422960	132074	103680	33010	118660
5	8340586	5555640	1177156	353959	306826	143415	803590
6	147925	1920		108955	1680	1060	34310
7	134810	39070	5900	46080	36000		7760
8	22440		17080	3840	20		1500
9	2400		1500	900			
10	2565	700		615	1250		
All	**24286380**	15742727	3480995	832202	985126	656335	2736920
	Blackfish %	0%	0%	13%	0%	0%	1%

(c) Thailand

Guild	Catch weight (g)	Ban Nam Kum	Huasai	Nalair	Nongbeung	Pa-sak	Phaphang	Pi man thay	Song-khon
?	2060	1960	100	0	0	0	0	0	0
1	9115	300	4600	0	0	0	20	4195	0
2	1052992	275105	295131	76900	0	168800	2955	20451	213650
3	876131	117155	44640	156700	2300	84400	7225	47611	416100
4	551599	327523	38114	0	3645	36100	4865	35952	105400
5	1279574	335210	188192	169900	6710	170100	20605	35757	353100
6	41904	1420	7354	0	1220	0	70	30840	1000
7	41	0	0	0	0	0	0	41	0
8	5682	4190	1342	0	0	0	0	150	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
Total	**3777194**	1062863	579473	403500	13875	459400	35740	174997	1089250
	Blackfish %	0%	1%	0%	9%	0%			

(d) Vietnam

Guild	Catch weight (g)	39/9A Tran Phu	An Binh A	Dai Thon	Khom Dinh	Khu 9	Kim Son	Phu Duc	Phu T
?	970745	0	649292	382	8023	1044	0	303382	
1	1500	0	0	0	1470	0	30	0	
2	28066968	855750	2737616	131871	470943	631874	718023	18119925	
3	103039057	27920	33636803	1340	74232	150966	96679	66458137	
4	76014157	2370	30094323	4297	9479	15149	3643	43487090	
5	331738017	96330	40563719	61601	407539	857753	323217	281570646	
6	63465260	500	3440650	23433	12401	0	7317	59720714	
7	18918990	652750	5782155	23189	259877	7035206	258186	548903	
8	29787	0	12651	4435	7908	0	634	0	
9	4084543	849920	432928	296287	217308	156068	196485	0	
10	3325508	300	136190	57667	300513	37007	28850	1212636	1
Total	**566189270**	**2485840**	**117486327**	**604502**	**1769692**	**8885068**	**1633064**	**471421433**	**3**
	Blackfish %	0%	3%	4%	1%	0%	0%	13%	

The yield of each guild was expressed as a proportion of the total yield summed across guilds and villages (excluding the yield of blackfish). Each guild proportion was then adjusted to account for the estimated proportion of blackfish yield in each country (Table 3) as follows: $Guild\ proportion \times (1 - blackfish\ proportion)$.

Table 3 Estimated yield proportion by guild for the LMB.

Blackfish Proportion	**0.29**	**0.27**	**0.43**	**0.12**
Guild	**Cambodia**	**Lao PDR**	**Thailand**	**Vietnam**
1	0.003	0.001	0.001	0.000
2	0.056	0.149	0.159	0.044
3	0.314	0.273	0.132	0.160
4	0.103	0.052	0.083	0.118
5	0.231	0.251	0.193	0.514
6	0.289	0.268	0.430	0.122
7	0.002	0.004	0.000	0.029
8	0.001	0.001	0.001	0.000
9	0.001	0.000	0.000	0.006
10	0.000	0.000	0.000	0.005
Total	1	1	1	1

The blackfish proportion of the yield of each country was estimated as the product of the estimate of total area of each blackfish habitat type, the mean areal yield for the habitat (all species) and the estimated mean proportion of the yield of blackfish reported in the literature (Table 4), expressed as a proportion of the total consumption-based yield estimate for each country given in Table 1. Blackfish were assumed to inhabit (i) (seasonally) river-inundated wetlands (floodplains, swamps, flooded forests etc) [Flood zone], (ii) rain-fed and irrigated ricefields [rainfed zone] and (iii) reservoirs and large waterbodies outside the flood zone. Estimates of each habitat area were taken from Hortle & Penroong (2009).

Flood zone and rainfed zone

The distribution of areal yield estimates from the literature was positively skewed. The median areal yield estimate (all fish species) was approximately 100 kg ha^{-1} $year^{-1}$ and 50 kg ha^{-1} $year^{-1}$ for the flood zone and rainfed zones, respectively (Table 5). Yield estimates for rain-fed ricefields were more variable (CoV = 81 %) than those for the floodzone (CoV = 65 %) probably reflecting a wider range of eco-hydrological conditions in this habitat category (see below). Bambardeniya and Amerasinghe (2004) describe five different categories of ricefields based upon water regime, drainage, temperature, soil type and topography.

Table 4 Estimation of the blackfish yield proportion by country from estimates of habitat area, areal yield and b habitat type. *and large waterbodies outside floodzone.

(a) **Area estimates (km^2)**					
		Cambodia	**Lao**	**Thailand**	**Vietn**
Flood Zone		28262	4617	7795	
Rainfed Zone		17605	8962	93119	
Reservoirs*		853	2143	3521	
Total		**46720**	**15722**	**104435**	

(b) Area yield estimates (tonnes y^{-1})

	kg/ha/year	**Cambodia**	**Lao**	**Thailand**	**Vietn**
Flood Zone	100	282620	46170	77950	
Rainfed Zone	50	88025	44810	465595	
Reservoirs*	200	17060	42860	70420	
Total		**387705**	**133840**	**613965**	

(c) Blackfish Yield Estimates (tonnes y^{-1})

	Blackfish yield proportion	**Cambodia**	**Lao**	**Thailand**	**Vietn**
Flood Zone	0.3	84786	13851	23385	
Rainfed Zone	0.6	52815	26886	279357	
Reservoirs*	0.1	1706	4286	7042	
Total	**Total**	**139307**	**45023**	**309784**	
Consumption-based estimates of total yield (t/y)		**481537**	**167922**	**720501**	**6**
Blackfish yield proportion (all habitats)		**0.29**	**0.27**	**0.43**	

Table 5 Estimates of areal yield and blackfish yield proportion from ricefields and floodplains. Table excludes d that is reported to underestimate yields by exclusion of artisanal catches, and Lim et al (2005) due to artificial natu & Penroong 2009).

						Wildfish			Proportion of yield			
Country	Location	Habitats	Flooded, Irrigated or Rainfed?	AEZ	Stocked?	Yield all (kg/ha/year)	Yield fish (kg/ha/year)	Mid-range fish yield (kg/ha/year)	Fish	OAA	Blackfish	Black (kg/h
Cambodia	Battambang	Ricefields, single crop	Rain-fed (& flooded?)		N	119	92	92	0.77	0.23	0.93	
Cambodia	Svay Rieng (L)	Ricefields, single crop	Rain-fed	Low	Y	40	30	30	0.75	0.25		
Cambodia	Takeo (U)	Ricefields, single crop	Rain-fed	Dry	Y	5	3	3	0.54	0.46		
Cambodia		Ricefields	?		?		25 - 61	43				
Cambodia	Svay Rieng, Theap District	Ricefields, single crop	Rain-fed		?	100	82	82	0.82	0.18		
Cambodia							51	51				
Lao PDR	3 provinces in southern Laos	Ricefields, single crop	Rain-fed and irrigated		Y		60	60				
Thailand	Khu Khat	Ricefields, single crop	Rain-fed		N		25 - 125	75				
Thailand	Koh Wang District, NE Thailand	Ricefields, single crop	Rain-fed		Y		33	33				
Thailand	Koh Wang District, NE Thailand	Ricefields, single crop	Rain-fed		Y		209	209				
Thailand	NE Thailand	Ricefields, single crop	?		?		25	25				
Thailand	Yasothon (L)	Ricefields, single crop	Rain-fed	Low	Y	26	22	22	0.84			
Thailand	Sisaket (U)	Ricefields, single crop	Rain-fed	Dry	Y	65	55	55	0.84			
Vietnam	Hanoi (L)	Ricefields	Irrigated	Dry	Y	52	44	44	0.84			
Vietnam	Phu Xuyen (U)	Ricefields	Irrigated	Low	Y	151	127	127	0.84			
Cambodia	Tonle Sap	Floodplain, ricefield and perm. w/bs	Flooded	Low	N	243 - 532	310	310	0.8			
Cambodia	Tonle Sap	Entire floodplain	Flooded	Low	N		230	230				
Cambodia	Tonle Sap	Entire floodplain (1995-99)	Flooded	Low	N		139 - 190	164.5				
Cambodia	Kratie	Rice fields in floodplain system	Flooded	Low	N						0.15	
Thailand	Songkhram	River-floodplain system	Flooded, irrigated & ra	Low	N		79	79	0.63		0.37	
Thailand	Nongbeung	River-floodplain system	Flooded	Low	N						0.43	
Thailand	Nakornphanom	River-floodplain system	Flooded	Low	N						0.23	
Vietnam	An Giang	Mainly floodplain canals and rivers	Flooded	Low	N						0.16	
Vietnam	Mekong Delta	Floodplain ricefields	Flooded	Low	?	42 - 63	25	30	0.47	0.53		
Vietnam	Mekong Delta	Floodplain ricefields	Flooded	Low	?	119	106	106	0.89	0.11		
Africa	Various	Floodplain-river systems	Flooded				47	47				
Asia	Various	Floodplain-river systems	Flooded				90	90				
Bangladesh	Pabna (NW)	Floodplains	Flooded	Low	N		104 - 130	117				
Bangladesh	Tangail	Floodplains & Perm. w/bs	Flooded	Low	N		165	165				
Bangladesh	Tangail	Floodplains	Flooded	Low	N		83					
Bangladesh	Various	Floodplains & beels	Flooded	Low	N			107				
Asia		Ricefields	?		?		1.5 - 84	43				
Malaysia		Ricefields, double crop	Irrigated		?		68 - 140	104				
Malaysia		Ricefields	?		?		up to 150					
						Aithmetic mean (rainfed)		63	0.78	0.28	0.93	
						Arithmetic mean (flooded)		123	0.70	0.32	0.27	
						Median (rainfed)		51	0.83	0.24	0.93	
						Median (flooded)		106	0.72	0.32	0.23	

The mean blackfish yield proportion from floodplains across the entire LMB is estimated to be approximately 30 % (Table 4). This is consistent with the opinions of 13 fisheries scientists from Lao PDR, Cambodia and international organisations operating in the LMB (see Barlow et al 2008).

Few studies have reported the relative contribution of different species to fish yields from rainfed or rainfed irrigated ricefields. Bambardeniya and Amerasinghe (2004) cite studies reporting the presence of up to 40 species of fish in ricefields in Sri Lanka and Malaysia. Nguyen Khoa et al (2005) recorded 124 species of fish in rainfed irrigated ricefield landscapes in southern Lao PDR. Only eight of the 21 most frequently reported species were blackfish. Hortle et al (2008) estimated that blackfish accounted for 93 % of rainfed ricefield yields in Battambong. The same authors cite estimates of blackfish yield proportions from other studies in the range of 80 % to 95 % but mainly from ricefields and their trap ponds.

The blackfish proportion of the yield from rain-fed ricefields is also expected to vary according to eco-hydrological conditions particularly the depth and duration of flooding and availability of dry season refuges (e.g. trap ponds, reservoirs, rivers). A greater proportion of blackfish would be expected in shallow ricefields with rapidly fluctuating water levels and with limited (access to) the river system of other dry season refuge habitat. Irrigated ricefields, on the other hand, are likely to have a higher diversity of fish species with greater contributions to yield from *greyfish* and *whitefish* because of more abundant and diverse dry season habitat and potentially greater connectivity to the river system provided by river and irrigation channels. Therefore, the inclusion of catches from nearby rivers, streams and permanent waterbodies forming the irrigated 'ricefield landscape' would be expected to lower estimates of the proportion of blackfish yield from ricefields alone.

Most rice-fields in the LMB that are classified as 'rain-fed' appear to be associated with irrigation schemes (see Figures 4 and 5 in Hortle and Penroong (2009)). Therefore perhaps a more balanced estimate of the blackfish yield proportion for the irrigated 'ricefield landscape' outside the floodzone might be in the region of 30 % to 90 %. For the purposes of this assessment we might therefore assume the mid-range value i.e. 60 %.

Reservoirs and large waterbodies outside the flood zone.
The mean areal yield estimate for reservoirs and large waterbodies outside the flood zone is estimated to be in the region of 200 kg ha^{-1} $year^{-1}$ after Hortle & Penroong (2009). Many reservoirs in the LMB are stocked with exotic species particularly carps and Nile tilapia forming almost the entire catch in some cases (Table 9, Hortle & Penroong 2009). Whilst blackfish inhabit reservoirs, their contribution to the overall yield appears low in most cases. Here, it is assumed that the blackfish yield proportion for these habitats is in the region of 10 % after Nakkaew et al (2002) who found that the indigenous blackfish yield proportion in Haui Luang reservoir, Udon Thani, Thailand was less than 10 %.

Total yield by guild estimates

The total yield by guild (Table 6) was estimated by combining the consumption-based yield estimates in Table 1 with the guild yield proportions in Table 3. The small differences (<0.1 %) in the total inland fish yield estimates for each country when compared to Table 1 reflect rounding errors.

It is estimated that blackfish (Guild 6) form almost 30 % of the total yield of the LMB, arising from the large area of the irrigated 'ricefield landscape' in Thailand. Generalist species (Guild 5) are also estimated to form approximately 30 % of the yield, whereas migratory whitefish (Guilds 2, 3 and 4) combine to form nearly 40 % of the total. The remaining proportion 2 % comprises mostly estuarine resident, and marine and catadromous species (Table 6).

Table 6 Estimated yield by guild for the LMB.

Guild	Cambodia	Lao PDR	Thailand	Vietnam	Total	% Total inland fish
1	1,230	172	991	2	2,395	0.1%
2	27,066	25,017	114,498	30,122	196,704	9.5%
3	151,135	45,818	95,267	110,585	402,805	19.5%
4	49,795	8,812	59,979	81,581	200,167	9.7%
5	111,054	42,207	139,136	356,032	648,428	31.5%
6	139,307	45,023	309,784	84,466	578,580	28.1%
7	1,017	682	0	20,304	22,003	1.1%
8	270	114	618	32	1,033	0.1%
9	310	12	0	4,384	4,706	0.2%
10	10	13	0	3,569	3,592	0.2%
Inland Fish	**481,194**	**167,869**	**720,273**	**691,076**	**2,060,412**	100.0%
OAA	105,467	40,581	190,984	160,705	497,737	
Total	**586,661**	**208,450**	**911,257**	**851,781**	**2,558,149**	

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ANNEX: SPECIES AND GUILDS

	Presence reported in:	
MC	Main Channel	AMCF (Survey data)
DP	Deep Pools	Halls et al (in press)
LARV	Larvae Surveys (MRC)	Various larvae papers in Tech Symposium Proceedings
FP	FloodPlains	AMCF (Survey data)
KF*	* Species landed in significant quantities below Khone Falls (Baran et al 2005)	
KF**	** Species landed in significant quantities in HSY channel and dry season migrations in Champassak (Soukhaseum et al 2006)	
Yunnan	Yunnan Province	From MFD
Impound	Impoundments	From MFD

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Cyprinidae	Aaptosyax grypus	20	1								2	Restricted to main channel, mig abundance after dam constructi
Siluridae	Acanthocobitis sp. cf. bilotorio	76	1									Not found in database
Cobitidae	Acanthopsis sp.1	169	1	1		1						Not found in MFD
Cobitidae	Acanthopsis sp.5	170	1								5	Not highly migratory
Cobitidae	Acanthopsoides delphax	171	1	1							5	Not highly migratory
Cyprinidae	Albulichthys albuloides	25	1		1				1		5	Displays lat and long migrations (MFD)
Cyprinidae	Amblyrhynchichthys truncatus	26	1	1	1	1				1	5	Seems to display only longitudir FOUND IN IMPOUNDMENTS
Anabantidae	Anabas testudineus	123							1	1	6	Morphological adaptations to lo
Anguillidae	Anguilla marmorata	2	1	1							9	Catadromous spp
Sciaenidae	Argyrosomus sp.	3027									10	Stated as Marine in AMCF spec
Ariidae	Arius maculatus	150	1	1		1					7	Coastal/estuarine species not fo Vietnam and Cambodia
Ariidae	Arius malacanthus	153									7	Found only in Vietnam delta
Sisoridae	Bagarius bagarius	91	1	1		1			1		5	Remains in main channel but no portracted spawning period;
Sisoridae	Bagarius suchus	174	1	1							2	Found only in mainstream and s longitudinal migrations.
Sisoridae	Bagarius yarrelli	90	1	1		1		1	1		5	Remains in main channel but no portracted spawning period; juv length are seen all the year
Bagriichthidae	Bagrichthys macracanthus	1329									7	Found only in Vietnam delta

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Bagriichthidae	Bagrichthys obscurus	82	1	1		1					5	Restricted to mainstream with li
Cyprinidae	Bangana behri	54	1	1		1		1			2	Riverine species preferring rock mainstream from Sambor and u may not reach sampling locatio may remain close to spawning l
Cyprinidae	Bangana sp.	168	1	1		1					2	Riverine species preferring rock mainstream from Sambor and u may not reach sampling locatio may remain close to spawning l
Cyprinidae	Barbichthys nitidus	55	1	1							4	Floodplain spawner and main cl
Cyprinidae	Barbonymus altus	40	1	1	1	1		1		1	5	Floodplain spawner. BUT FOUN IMPOUNDMENTS
Cyprinidae	Barbonymus gonionotus	39	1	1	1	1				1	5	Inhabits diverse habitats. Most is a “local migrant”
Cyprinidae	Barbonymus schwanenfeldii	38	1	1		1					5	Inhabits diverse habitats. Omni
Batrachoididae	Batrichthys grunniens	3028									7	Found only in Vietnam delta
Siluridae	Belodontichthys truncatus	92	1	1	1	1		1			5	Generalist largely restricted to m migrations
Osphronemidae	Betta smaragdina	999									6	Morphological adaptations to lo
Sciaenidae	Boesemania microlepis	121	1	1		1					5	Limited non-critical migrations i
Gobiidae	Boleophthalmus boddarti	1631									7	Found only in Vietnam delta
Cobitidae	Botia helodes	79	1	1	1	1					3	Sapwning migrations with larval
Cobitidae	Botia modesta	77	1	1	1	1		1			3	Strong upstream spawning migr larval stage.
Cobitidae	Botia sidthimunki	81	1								5	Little data and very rare
Cobitidae	Botia sp. cf. beauforti	78	1								2	Botia spp generally found in loti reported to be migratory or high
Cobitidae	Botia sp. cf. lecontei	80	1								2	Botia spp generally found in loti reported to be migratory or high
Soleidae	Brachirus harmandi	139	1	1	1	1					2	Found mainly in the mainstream may be incidental
Soleidae	Brachirus orientalis	140	1	1		1					7	Estuarine and main channel spe
Cyprinidae	Catlocarpio siamensis	52	1	1	1	1					4	Appears to spawn on floodplain migrations uncertain.
Channidae	Channa gachua	184							1	1	6	Morphological adaptations to lo
Pongasiidae	Channa grandinosa	130									6	Morphological adaptations to lo
Channidae	Channa lucius	185							1	1	6	Morphological adaptations to lo
Channidae	Channa marulioides	183									6	Morphological adaptations to lo

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Channidae	Channa melasoma	182									6	Morphological adaptations to lo
Channidae	Channa micropeltes	129								1	6	Morphological adaptations to lo
Channidae	Channa striata	128							1	1	6	Morphological adaptations to lo
Cyprinidae	Chela laubuca	12									7	Found only in Vietnam delta
Notopteridae	Chitala blanci	4	1	1		1					4	Migrates locally and moves into and flooded areas including inu Returns to the main river chann reecede.
Notopteridae	Chitala lopis	142	1	1	1	1					4	Very little information. Categori other notopterus spp.
Notopteridae	Chitala ornata	3	1	1	1	1				1	5	Migrates locally and moves into and flooded areas including inu Returns to the main river chann reecede. BUT FOUND IN IMPO
Cyprinidae	Cirrhinus cirrhosus	166	1	1							5	Appears to be a generalist
Cyprinidae	Cirrhinus jullieni	61	1	1		1					5	Due to taxonomic confusion, the information that pertains to this
Cyprinidae	Cirrhinus microlepis	59	1	1	1	1		1			3	Migratory pelagic spawner. Egg semi-buoyant and drift downstre flooded areas.
Cyprinidae	Cirrhinus molitorella	60	1	1				1	1		3	Upstream spawninging migratio stage
Cyprinidae	Cirrhinus prosemion	164	1	1							3	Synonym of Cirrhinus molitorell
Cyprinidae	Cirrhinus spilopleura	165	1	1		1					5	It spawns in floodplains and ma rivers during wet-season (Ref. 1 a pelagic spawner, which produ buoyant eggs (Ref. 1037982).
Clariidae	Clarias batrachus	116								1	6	Morphological adaptations to lo
Clariidae	Clarias cataractus	181									6	Morphological adaptations to lo
Clariidae	Clarias gariepinus	180								1	6	Morphological adaptations to lo
Clariidae	Clarias macrocephalus	158									6	Morphological adaptations to lo
Clupeidae	Clupeichthys aesarnensis	143	1	1		1				1	5	Found in diverse range of habit
Schilbeidae	Clupisoma sinensis	114	1	1					1		2	Found mainly in main channels Yunnan
Engraulidae	Coilia lindmani	1050									7	Found only in Vietnam delta
Engraulidae	Coilia macrognathos	1051									7	Found only in Vietnam delta
Characidae	Colossoma macropomum	1813									7	Found only in Vietnam delta
Clupeidae	Corica laciniata	1039									7	Found only in Vietnam delta
Cyprinidae	Cosmochilus harmandi	27	1	1	1	1	1	1			3	Seems to display only longitudi

Family	ScienceName	Code	MC	DP	LA RV	FP	KF *	KF **	Yu nn an	Im po un d	Gu ild	Reason
Cyprinidae	Crossocheilus atrilimes	72	1					1			4	Floodplain/forest spawner and r season
Cyprinidae	Ctenopharyngodon idella	1121								1	7	Found only in Vietnam delta
Cyprinidae	Cyclocheilichthys enoplos	29	1	1	1	1		1			3	Eggs and larvae are pelagic) ar spawning ground. Smaller indiv river-bank
Cyprinidae	Cyclocheilichthys furcatus	30	1	1		1					2	Found mainly in mainstream an significant longitudinal migration
Cyprinidae	Cyclocheilichthys repasson	31	1	1	1	1			1	1	5	Inhabits diverse habitats. Some
Cyprinidae	Cyclocheilichthys tapiensis	28	1	1		1					4	A white fish species (Ref. 10369 rivers during the dry season and floodplains to spawn in the rainy 12693).
Cynoglossidae	Cynoglossus microlepis	136	1	1	1	1					2	Found only in the mainstream b Floodplain catches may be incid
Cyprinidae	Cyprinus carpio	19	1	1	1	1				1	5	Generalist
Dasyatidae	Dasyatis laosensis	1	1	1							2	Found in mainstream and tributa below GFL
Datnioididae	Datnioides quadrifasciatus	1522									7	Found only in Vietnam delta
Datnioididae	Datnioides undecimradiatus	133	1	1							5	Found in mainstream and tributa below GFL
Cyprinidae	Discherodontus ashmeadi	32	1	1		1				1	5	Mainstream generalist with limit Found in localized populations a sporadically in the Middle Meko 27732); Recorded in the Xe Ban 26580).
Eleotridae	Eleotris fusca	1571									7	Found only in Vietnam delta
Polynemidae	Eleutheronema tetradactylum	1530									10	Stated as Marine in AMCF spec
Mugilidae	Ellochelon vaigiensis	187									10	Stated as Marine in AMCF spec
Cyprinidae	Esomus metallicus	14								1	7	Found only in Vietnam delta
Poeciliidae	Gambusia affinis	190								1	10	Stated as Marine in AMCF spec
Cyprinidae	Garra fasciacauda	73	1	1	1	1					2	Appears to be restricted to lotic
Gobiidae	Glossogobius aureus	1591									7	Found only in Vietnam delta
Gobiidae	Glossogobius giuris	132									7	Found only in Vietnam delta
Gobiidae	Glossogobius sparsipapillus	1594									7	Found only in Vietnam delta
Gobiidae	Gobiidae sp2.	3031									7	Found only in Vietnam delta
Gobiidae	Gobiidae sp3.	3032									7	Found only in Vietnam delta

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Gobiidae	Gobiopterus brachypterus	1604									7	Found only in Vietnam delta
Gyrinocheilidae	Gyrinocheilus pennocki	75	1	1	1	1	1	1			2	Appears to be restricted to lotic particularly tributaries
Cyprinidae	Hampala dispar	50	1	1		1				1	5	Inhabits diverse habitats. Some
Cyprinidae	Hampala macrolepidota	51	1	1	1	1			1	1	5	Generalist
Harpadontidae	Harpadon nehereus	1415									10	Stated as Marine in AMCF spec
Pangasiidae	Helicophagus waandersii	101	1	1	1	1		1			2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Ariidae	Hemiarius stormii	115	1	1		1					7	Sea catfish - not found above G
Bagridae	Hemibagrus filamentus	1330	1	1	1	1		1			4	Floodplain spawner and main ch
Bagridae	Hemibagrus spilopterus	84	1	1		1					4	Migrations between floodplain s main channel.
Bagridae	Hemibagrus wyckii	86	1	1		1					4	Migrations between spawning h channel.
Bagridae	Hemibagrus wyckioides	87	1	1		1		1	1	1	5	Migrations between spawning h channel. BUT FOUND IN IMPO
Siluridae	Hemisilurus mekongensis	93	1	1	1	1		1	1		5	Generalist largely restricted to n migrations
Cyprinidae	Henicorhynchus lobatus	62	1	1		1	1	1			3	Highly migratory. Main channel reports of spawning on floodpla Henichrynchus lobatus larvae m Henichrynchus spp.
Cyprinidae	Henicorhynchus siamensis	63	1	1	1	1		1			3	Highly migratory
Bagridae	Heterobagrus bocourti	89	1	1	1	1					5	Generalist
Cyprinidae	Hypophthalmichthys molitrix	167	1		1					1	5	Generalist that does well in imp
Cyprinidae	Hypophthalmichthys nobilis	138	1	1						1	5	Generalist that does well in imp
Hemiramphidae	Hyporhamphus limbatus	188									10	Stated as Marine in AMCF spec
Loricariidae	Hypostomus plecostomus	1387								1	7	Found only in Vietnam delta
Cyprinidae	Hypsibarbus lagleri	45	1	1		1					2	Appears restricted to main chan spawning migration behaviour

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Cyprinidae	Hypsibarbus malcolmi	44	1	1	1	1	1	1			2	Mainstream pelagic spawner nc Catches in floodplains may be i
Cyprinidae	Hypsibarbus vernayi	148	1	1							4	Found in mainstream and tributa migrations
Cyprinidae	Hypsibarbus wetmorei	149	1	1		1					2	Appears restricted to main char spawning migration behaviour
Unknown	Inmicus didactylus	3029									7	Found only in Vietnam delta
Siluridae	Kryptopterus bicirrhis	94	1	1	1			1			2	Found mainly in main channel u sometimes found hiding among stream bank.
Siluridae	Kryptopterus cryptopterus	95	1	1	1	1					5	Generalist largely restricted to n migrations
Siluridae	Kryptopterus micronema	1345	1	1							5	Appears to be a generalist. Fou and lakes as well as impoundm
Cyprinidae	Labeo chrysophekadion	58	1	1	1	1	1	1		1	5	Generalist. Extent of migrations
Cyprinidae	Labeo dyocheilus	57	1		1						5	Migratory with pelagic eggs and to be a generalist given that in p impoundments
Cyprinidae	Labeo rohita	56	1	1						1	5	Found in a variety of habitats ar floodplain but also found in deep RESERVOIRS
Cyprinidae	Labiobarbus lineata	162	1	1		1			1		5	It readily adapts to reservoirs
Cyprinidae	Labiobarbus siamensis	163	1	1	1	1					3	Migratory upstream spawner
Cyprinidae	Labiobarbus sp. cf. lineata	65	1	1		1					5	It readily adapts to reservoirs
Schilbeidae	Laides longibarbis	113	1	1	1	1					5	Generalist largely restricted to n migrations
Centropomidae	Lates calcarifer	154									10	Stated as Marine in AMCF spec
Leiognathidae	Leiognathus sp.	195									10	Stated as Marine in AMCF spec
Cyprinidae	Leptobarbus hoevenii	18	1	1							4	Appears to be somewhat migrat floodplain and found in deep po
Cyprinidae	Lobocheilos melanotaenia	64	1	1	1	1			1		4	Reported to migrate laterally to
Cyprinidae	Luciocyprinus striolatus	144	1						1		4	Migrates into small and medium May-June to spawn
Cyprinidae	Luciosoma bleekeri	17	1	1	1	1					3	Appears to be a mainstream spa downstream nursery locations
Engraulidae	Lycothrissa crocodilus	9	1	1		1					8	Could belong to Guild 2. Usuall water in the estuaries of large ri ascends into fresh water (Ref. 1 to inhabit deep pools in the mai least part of the year (Ref. 1037
Palaeomonidae	Macrobrachium sp.	192									9	Found only in Vietnam delta

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Cyprinidae	Macrochirichthys macrochirus	13	1	1		1			1		5	Mainstream generalist with limit
Mastacembelidae	Macrognathus circumcinctus	141	1	1							6	Recorded as blackfish in MFD
Mastacembelidae	Macrognathus siamensis	119	1	1	1	1					5	Reported to be non-migratory a found in main channel
Mastacembelidae	Mastacembelus armatus	118	1	1	1	1			1	1	5	Found in diverse range of habita perform only short local migratio
Megalopidae	Megalops cyprinoides	6	1								9	Catadromous - A marine and es often enters lowland rivers; It br
Cyprinidae	Mekongina erythrospila	74	1	1			1	1			2	Distribution appears restricted t
Siluridae	Micronema apogon	96	1	1	1	1					5	Generalist largely restricted to n migrations
Siluridae	Micronema bleekeri	97	1	1	1	1			1		5	Generalist largely restricted to n migrations
Siluridae	Micronema cheveyi	175	1	1	1	1			1		5	No evidence of significant migra mainstream and floodplain
Synbranchidae	Monopterus albus	120							1	1	6	Morphological adaptations to lo
Tetraodontidae	Monotrete barbatus	191	1		1	1				1	5	Found in diverse range of habita
Mugilidae	Mugil cephalus	186									10	Stated as Marine in AMCF spec
Muraenesocidae	Muraenesox cinereus	1028									10	Stated as Marine in AMCF spec
Cyprinidae	Mystacoleucus marginatus	33	1	1					1	1	5	Found in a diverse range of hab
Bagridae	Mystus gulio	1333									7	Found only in Vietnam delta
Bagridae	Mystus micracanthus	1334									7	Found only in Vietnam delta
Bagridae	Mystus mysticetus	173	1	1	1	1				1	5	Inhabits diverse habitats. No ev migrations
Bagridae	Mystus singaringan	88	1	1	1	1				1	5	Generalist
Cyprinidae	Neolissochilus blanci	145	1			1					1	Found in pools of clear forest st
Ariidae	Netuma thalassinus	151									10	Stated as Marine in AMCF spec
Notopteridae	Notopterus notopterus	5	1	1	1	1				1	5	Migrates locally and moves into and flooded areas including inu Returns to the main river chann reecede.BUT FOUND IN IMPOU
Siluridae	Ompok bimaculatus	98	1	1	1	1				1	5	Generalist
Siluridae	Ompok hypophthalmus	177	1	1	1	1						Not found in MFD
Cichlidae	Oreochromis niloticus	137								1	6	Morphological adaptations to lo
Osphronemidae	Osphronemus exodon	126								1	6	Morphological adaptations to lo

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Osphronemidae	Osphronemus goramy	127								1	6	Morphological adaptations to lo
Cyprinidae	Osteochilus hasseltii	66	1	1		1				1	5	Generalist
Cyprinidae	Osteochilus lini	67	1	1	1	1					4	Reported to migrate laterally to
Cyprinidae	Osteochilus melanopleura	68	1	1	1	1					5	Generalist
Cyprinidae	Osteochilus microcephalus	70	1	1	1	1					5	Generalist
Cyprinidae	Osteochilus schlegeli	69	1	1		1					4	A white fish species (Ref. 10369 into flooded forests and grassla season, it returns to the rivers la numbers appearing from Decem (Ref. 12693).
Cyprinidae	Osteochilus waandersii	71	1	1	1	1					2	Appears to be restricted to lotic particularly highland streams
Ariidae	Osteogeneiosus militaris	152									7	Found only in Vietnam delta
Eleotridae	Oxyeleotris marmorata	131	1	1	1	1				1	5	Reported to be non-migratory a found in main channel
Eleotridae	Oxyeleotris siamensis	1574									7	Found only in Vietnam delta
Pangasiidae	Pangasianodon gigas	109	1								2	Highly migratory, only found in r Mainstream spawner
Pangasiidae	Pangasianodon hypophthalmus	104	1	1	1	1					2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius bocourti	103	1	1	1	1	1	1			2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius conchophilus	102	1	1	1	1	1	1			2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius krempfi	105	1	1			1	1			2	catadromous
Pangasiidae	Pangasius kunyit	108	1	1	1	1			1		2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.

Family	ScienceName	Code	MC	DP	LA RV	FP	KF *	KF **	Yu nn an	Im po un d	Gu ild	Reason
Pangasiidae	Pangasius larnaudii	107	1	1	1	1	1	1			2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius macronema	110	1	1	1	1	1	1			2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius micronemus	179	1	1		1			1		2	Only seems to display longitudir
Pangasiidae	Pangasius pangasius	159	1	1		1		1			2	Appears to be a main channel r longitudinal migrations. Floodpl incidental or in TS. Synonym of
Pangasiidae	Pangasius pleurotaenia	111	1	1	1	1					2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius polyuranodon	106	1	1	1	1	1				2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius siamensis	112	1	1	1	1					2	Appears to be a main channel r longitudinal migrations. Floodpl incidental.
Pangasiidae	Pangasius spp.	161									2	Found only in Vietnam delta
Cyprinidae	Paralaubuca typus	11	1	1	1	1		1			3	Strongly migratory in mainstrea floodplains during the flood; Spa of the flood season both in the r floodplain habitats. May belong
Chandidae	Parambassis siamensis	135	1	1	1	1				1	5	Found in diverse range of habita
Chandidae	Parambassis wolffii	189	1	1	1	1					5	Found in diverse range of habita
Gobiidae	Parapocryptes serperaster	1633									7	Found only in Vietnam delta
Gobiidae	Periophthalmodon schlosseri	1635									7	Found only in Vietnam delta
Ophichthidae	Pisodonophis boro	1034									10	Stated as Marine in AMCF spec
Platycephalidae	Platycephalus indicus	1489									10	Stated as Marine in AMCF spec
Platycephalidae	Platycephalus sp.	3037									10	Stated as Marine in AMCF spec
Plotosidae	Plotosus canius	157	1	1		1					7	Could belong to Guild 2. Usuall water in the estuaries of large ri
Poeciliidae	Poecilia reticulata	1463								1	6	Morphological adaptations to lo
Polynemidae	Polynemus longipectoralis	156	1	1		1					7	Could belong to Guild 2. Usuall water in the estuaries of large ri
?	Poropuntius deauratus	43	1			1						Not in MFD
Nandidae	Pristolepis fasciata	122	1	1	1	1				1	5	Inhabits diverse habitats. No ev migrations

Family	ScienceName	Code	MC	DP	LA RV	FP	KF *	KF **	Yu nn an	Im po un d	Gu ild	Reason
Cyprinidae	Probarbus jullieni	23	1	1	1	1	1	1			2	Appears to be a mainstream or (lithophil/psammophil). Juvenile margins. Migratory over large d Reported landings in FP habitat
Cyprinidae	Probarbus labeamajor	24	1	1				1			2	Found only in mainstream and t
Gobiidae	Pseudapocryptes elongatus	1641									7	Found only in Vietnam delta
Gobiidae	Pseudapocryptes lanceolantus	3026									10	Stated as Marine in AMCF spec
Gobiidae	Pseudogobiopsis lanceolatus	3033									7	Found only in Vietnam delta
Bagridae	Pseudomystus siamensis	83	1	1	1	1					5	No significant longitudinal migra
Cyprinidae	Puntioplites bulu	36	1								2	Found mainly in mainstream
Cyprinidae	Puntioplites falcifer	35	1	1		1					4	Spawns on floodplains and in m found in deep pools in dry seas
Cyprinidae	Puntioplites proctozysron	34	1	1	1	1			1		3	It is a riverine species, which se standing water. A pelagic spaw buoyant or semi-buoyant eggs; floodplains and mainstreams of
Cyprinidae	Puntioplites waandersi	37	1						1		2	Found mainly in mainstream do
Cyprinidae	Puntius brevis	1178	1		1						5	Generalist found in a variety of
Cyprinidae	Puntius orphoides	42	1	1		1				1	5	Spawns on floodplains but retur tributary BUT FOUND IN IMPO
Cyprinidae	Puntius rhombeus	41	1	1		1					1	Appears to be restricted to sma
Cyprinidae	Raiamas guttatus	10	1	1		1			1		1	Found in rapidly flowing rivers a water
Cyprinidae	Rasbora borapetensis	15								1	7	Found only in Vietnam delta
Cyprinidae	Rasbora trilineata	16	1			1				1	5	Non-migratory generalist
Synodontidae	Saurida sp.	1788									7	Found only in Vietnam delta
Cyprinidae	Scaphognathops bandanensis	48	1	1		1		1			4	Spawns on floodplains but retur tributary
Cyprinidae	Scaphognathops stejnegeri	49	1	1		1		1			4	Spawns on floodplains but retur tributary
Scatophagidae	Scatophagus argus	155									10	Stated as Marine in AMCF spec
Osteoglossidae	Scleropages formosus	147									6	Morphological adaptations to lo
Scombridae	Scomberomorus sp.	1778									10	Stated as Marine in AMCF spec

Family	ScienceName	Code	MC	DP	LARV	FP	KF*	KF**	Yunnan	Impound	Guild	Reason
Carangidae	Selaroides leptolepis	1509									10	Stated as Marine in AMCF spec
Gobiidae	Taenioides anguillaris	1646									7	Found only in Vietnam delta
Gobiidae	Taenioides cirratus	1647									7	Found only in Vietnam delta
Gobiidae	Taenioides gracilis	1648									7	Found only in Vietnam delta
Clupeidae	Tenualosa thibaudeaui	7	1	1	1	1					8	Appears to be a mainstream sp downstream nursery locations
Clupeidae	Tenualosa toli	8	1	1							8	Anadromous
Tetraodontidae	Tetraodon biocellatus	1696									7	Found only in Vietnam delta
Cyprinidae	Thynnichthys thynnoides	53	1	1	1	1					4	Appears to spawn on floodplain migrations uncertain.
Cyprinidae	Tor laterivittatus	146	1			1			1		1	Large adults are found in deep most frequently found in shallow substrate
Cyprinidae	Tor sinensis	22	1			1			1		1	Occurs in pools and runs over g clear rivers in forest areas (Ref.
Cyprinidae	Tor tambroides	21	1						1		1	Found in lotic upstream habitats
Toxotidae	Toxotes chatareus	134									7	Found only in Vietnam delta
Toxotidae	Toxotes microlepis	193	1	1		1					5	Main channel (fringe) species.
Carangidae	Trachurus sp.	1772									10	Stated as Marine in AMCF spec
Osphronemidae	Trichogaster pectoralis	124								1	6	Morphological adaptations to lo
Osphronemidae	Trichogaster trichopterus	125							1	1	6	Morphological adaptations to lo
Gobiidae	Trypauchen vagina	1651									7	Found only in Vietnam delta
Siluridae	Wallago attu	99	1	1	1	1			1	1	5	Generalist
Siluridae	Wallago leerii	100	1	1							4	Spawns on floodplains and und migrations
Belonidae	Xenentodon cancila	117	1	1	1	1				1	5	Inhabits diverse habitats. No ev migrations