

Article

# Copper in Commercial Marine Fish: From Biomonitoring to the ESG (Environment, Social, and Governance) Method

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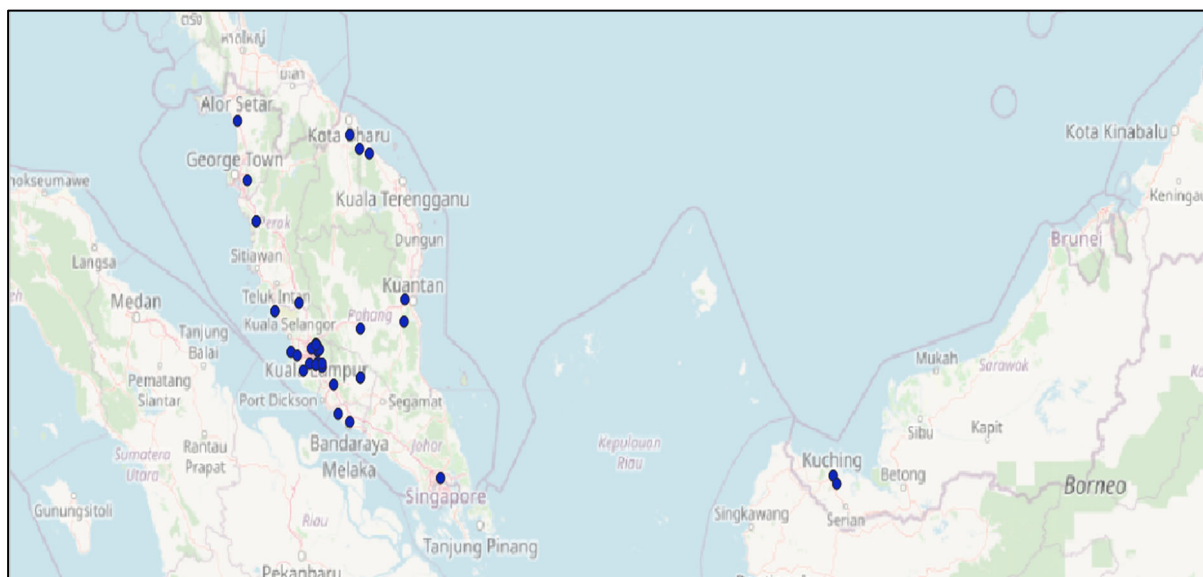


Figure S1: The purchase sites for 40 species of fish, some sites were not shown due to similar purchase location and distance settings. The sites were plotted via QGIS software.

Table S1: Purchased commercial fish from different purchase sites and dates.

Site	Common name	Scientific name	Purchase date	Purchase site	GPS of purchase site
1	Butterfish (Daun baru)	<i>Drepana punctata</i>	25 April 2023	Pasar Malam Sri Serdang, Selangor	3°01.336', 101°70.115'
2	Yellowstripe scad (ikan selar kuning)	<i>Selaroides leptolepis</i>	1 May 2023	Segi Fresh, Batu Caves	3°24.990', 101°66.273'
3	Gold-spotted sweetlips (Ikan kaci)	<i>Plectorhinchus flavomaculatus</i>	25 April 2023	Pasar Besar, Kuantan	2°81.431', 102°41.265'
4	Rainbow runner (Ikan pisang-pisang)	<i>Elagatis bipinnulata</i>	28 April 2023	Lotus Hypermarket Bahau, Negeri Sembilan	2°81.431', 102°41.265'
5	Silver White Croaker (Ikan Gelama)	<i>Pemahia argentata</i>	1 May 2023	Chow Kit Road Market, KL	3°16.506', 101°69.589'
6	Threadfin sea catfish (Ikan Duri Jahan)	<i>Arius arius</i>	1 May 2023	Chow Kit Road Market, KL	3°16.506', 101°69.589'
7	Bigeye scad (Ikan Lolong Mata Besar)	<i>Selar crumenophthalmus</i>	3 May 2023	Pasar Jabi, Besut, Terengganu	5°67.652', 102°56.542'
8	Starry triggerfish (Ikan jebong)	<i>Abalistes stellaris</i>	26 April 2023	ZEMART, Seremban, Negeri sembilan	2°72.616', 101°96.263'
9	Grouper (Ikan kerapu balong)	<i>Epinephelus tauvina</i>	3 May 023	Pasar Kok Lanis, Ketereh, Kelantan	5°91.709', 102°24.104'
10	Fourfinger threadfin (Senangin)	<i>Eleutheronema tetradactylum</i>	25 April 2023	Pasar Awam Sungai Besar, Selangor	3°66.414', 100°98.473'
11	Barred Javelin (Ikan gerut)	<i>Pomadasys kakaan</i>	28 April 2023	Unknown	
12	Hound Needlefish (Ikan banang)	<i>Tylosurus crocodilus</i>	26 April 2023	GIANT hypermarket, Batu Caves, Selangor	3°23.488', 101°69.162'
13	Fringescale Sardinella (Ikan Tamban Sisek)	<i>Sardinella fimbriata</i>	2 May 2023	Pasar Borong Seri Kembangan, Selangor	2°98.477', 101°66.762'
14	Indian mackerel (kembong)	<i>Rastrelliger kanagurta</i>	27 April 2023	Kedai Runcit Tanah Puteh, Pekan, Pahang	3°53.417', 103°15.428'
15	Longtail tuna (ikan tongkol hitam)	<i>Thunnus tonggol</i>	25 April 2023	Pasar Tani Slim River, Perak	3°76.479', 101°38.128'
16	Eastern Little Tuna (Ikan tongkol putih / Aya kurik)	<i>Euthynnus affinis</i>	29 April 2023	Hassan Mart, Bandar Sungai Buaya, Rawang, Selangor	3°14.257', 101°25.351'
17	Black pomfret (bawal hitam)	<i>Parastromateus niger</i>	27 April 2023	AEON Supermarket Shah Alam, Selangor	2°99.086', 101°57.226'
18	Blackfin scad (pelata)	<i>Alepes melanoptera</i>	28 April 2023	Pasar Borong Batu Berendam, Melaka	2°25.449', 102°23.697'
19	Oxeeye Scad (Lolong Kuning)	<i>Selar boops</i>	29 April 2023	Kedai Runcit Arridzky Enterprise, Selangor	2°95.461', 101°77.636'
20	Obtuse barracuda (ikan kacang-kacang)	<i>Sphyræna obtusata</i>	28 April 2023	Pasar Borong Selayang, Selangor	3°23.611', 101°66.655'
21	Climbing perch (ikan puyu)	<i>Anabas testudineus</i>	5 May 2023	Pasar Borong Seri Kembangan, Selangor	2°98.477', 101°66.762'
22	Hardtail scad (ikan cincaru)	<i>Megalaspis cordyla</i>	25 April 2023	S'mart Pandan Jaya Selangor	3°10.087', 101°35.886'
23	Sulphur Goatfish (Ikan Biji Nangka)	<i>Upeneus sulphureus</i>	30 April 2023	Unknown	
24	Indo-pacific mackerel (ikan pelaling)	<i>Rastrelliger brancysoma</i>	18 April 2023	Kedai runcit rezeki mulia, Kajang	2°99.921', 101°76.921'



25	Largehead hairtail (Ikan Timah/ Selayur)	<i>Trichiurus lepturus</i>	25 April 2023	BS Freshmart frozen Temerloh, Pahang	3°44.515', 102°42.171'
26	Streaked spinefoot (Ikan dengkis)	<i>Siganus javus</i>	31 March 2023	Pasar Borong Pandan, Johor Bharu, Johor	1°52.604', 103°76.163'
27	Yellowtail scad (ikan selar)	<i>Atule mate</i>	29 April 2023	Pasar Keramat, Kuala Lumpur	3°17.132', 101°73.508'
28	Barramundi (Ikan siakap)	<i>Lates calcarifer</i>	1 May 2023	Hero Market, Damansara Damai, Selangor	3°19.178', 101°59.072'
29	Fivelined threadfin bream (Kerisi jalur lima)	<i>Nemipterus tambuloides</i>	26 April 2023	Nirwana Maju Sdn Bhd, Kuala Berang, Terengganu	2°35.369', 102°03.889'
30	Indo Pacific King Mackerel (Dengkih)	<i>Scomberomorus guttatus</i>	27 April 2023	Pasar Matang, Perak	4°81.432', 100°67.386'
31	Narrow-barred Spanish Mackerel (Ikan Tenggiri)	<i>Scomberomorus commerson</i>	27 April 2023	Pasar Matang, Perak	4°81.432', 100°67.386'
32	Longfin Trevally (Ikan Cermin)	<i>Carangoides armatus</i>	28 April 2023	TMG Mart Kuantan, Pahang	3°82.412', 103°15.944'
33	Chevron/Military barracuda	<i>Sphyaera putnamae</i>	21 April 2023	Econsave Baling, Kedah	5°65.650', 100°87.019'
34	White Sardine (ikan sardin putih)	<i>Escualosa thoracata</i>	28 April 2023	Pasar Awam Taman Kenari, Kedah	5°58.041', 100°28.312'
35	Indian threadfin (Kurau)	<i>Leptomelanosoma indicum</i>	28 April 2023	Pasar Awam Telok Panglima Garang, Selangor	2°90.330', 100°85.930'
36	Doublespotted queenfish (Ikan talang)	<i>Scomberoides lysan</i>	27 April 2023	Pasar Besar Alor Setar, Kedah	6°10.358', 99°74.079'
37	Toli Shad (terubuk)	<i>Tenualosa toli</i>	27 April 2023	Kampung Boyan Kuching, Sarawak	1°56.144', 110°35.026'
38	Diamond trevally ( Rambai Ebek)	<i>Alectis indicus</i>	25 April 2023	Market Bandar Riyal, Samarahan, Sarawak	1°45.551', 110°40.863'
39	Shortfin scad (Ikan selayang)	<i>Decapterus macrosoma</i>	26 April 2023	Pasaraya Shakri Padang Luas Jerneh	5°74.024', 102°40.577'
40	Bluespot mullet (Belanak/ Kedera Tanda Biru)	<i>Valamugil seheli</i>	27 April 2023	Pasar Awam Sungai Besar, Selangor	3°66.414', 99°76.782'

Table S2: Description of the purchased commercial fish, biometric features, water content and conversion factors of dorsal parts of the fish samples.

Niche Habitat	Scientific name	N	Range of weight (g)	Range of length (cm)	Water content (%)	Conversion factor
Family Ariidae						
Amphidromous	<i>Arius arius</i>	3	20-40	24.5-28.9	91.34	0.087
Family Anabantidae						
Demersal Potamodromous	<i>Anabas testudineus</i>	3	7.25-26.66	15.7-17.2	71.38	0.286
Family Balastidae						
Amphidromous	<i>Abalistes stellaris</i>	3	18-25	31.0-34.0	80.00	0.200
Family Belanidae						
Reef-associated, Oceanodromous	<i>Tylosurus crocodilus</i>	3	3-5	48.3-55.9	78.80	0.212
Family Carangidae						
Reef-associated	<i>Alectis indicus</i>	3	15.4-19.9	16.0-19.0	30.61	0.694
Pelagic neritic, tropical	<i>Alepes melanoptera</i>	3	30-43	19.0-20.0	83.05	0.169
Reef associated	<i>Atule mate</i>	3	10-13	-	82.21	0.178
Reef-associated	<i>Carangoides armatus</i>	3	12-20	18.3-20.2	81.41	0.186
Reef associated	<i>Decapterus macrosoma</i>	5	10.0-11.0	19.8-22.5	73.80	0.262
Reef associated	<i>Elagatis bipinnulata</i>	3	8-12	29.0-33.3	75.62	0.244
Reef associated	<i>Megalaspis cordyla</i>	3	-	-	80.00	0.200
reef-associated; amphidromous	<i>Parastrumateus niger</i>	3	17-26	19.0-28.5	77.47	0.225
Reef associated	<i>Scomberoides lysan</i>	3	-	-	80.00	0.200
Reef associated	<i>Selar boops</i>	3	10-20	20.0-25.0	89.90	0.101
Reef-associated	<i>Selar crumenophthalmus</i>	3	18-23	27.6-30.5	77.64	0.224
Reef associated	<i>Selaroides leptolepis</i>	3	6-9	14.7-16.4	80.02	0.200
Family Dorosomatidae						
Pelagic-neritic, Amphidromous	<i>Escualosa thoracata</i>	3	12-32	-	80.00	0.200
Pelagic-neritic, anadromous	<i>Tenualosa toli</i>	3	24-42	30.0-32.7	80.00	0.200
Pelagic- Neritic	<i>Sardinella fimbriata</i>	3	3.8-4.3	20.0-21.0	56.19	0.438
Family Drepaneidae						
Reef associated	<i>Drepana punctata</i>	3	30-60	17.0-18.8	91.89	0.081
Family Epinephelidae						
Oceanodromous	<i>Epinephelus tauvina</i>	3	9-22	16.5-18.5	81.30	0.187
Family Haemulidae						
reef-associated	<i>Plectorhinchus flavomaculatus</i>	3	17-25	21.0-26.0	81.56	0.184
Reef-associated	<i>Pomadasys kakaan</i>	3	18-27	29.3-32.2	78.39	0.216
Family Latidae						



Catadromous	<i>Lates calcarifer</i>	2	9-12	28.0-31.0	77.91	0.221
Family Mugillidae						
Catadromous, Reef-associated	<i>Valumugil seheli</i>	3	3-4	16.5-16.8	80.00	0.200
Family Mullidae						
Demersal, Oceanodromous	<i>Upeneus sulphureus</i>	3	-	-	91.89	0.081
Family Nemipteridae						
Demersal	<i>Nemipterus tumbuloides</i>	2	10-20	23.0-26.0	83.59	0.164
Family Polynemidae						
Pelagic-neritic	<i>Eleutheronema tetradactylum</i>	3	10-12	24.1-25.3	71.25	0.287
Demersal, amphidromous	<i>Leptomelanosoma indicum</i>	3	10-23	29.4-34.2	79.82	0.202
Family Sciaemidae						
Benthopelagic, Oceanodromous	<i>Pennahia argentata</i>	3	8-14	17.5-18.4	83.30	0.167
Family Scombridae						
Pelagic neritic, Oceanodromous	<i>Euthynnus affinis</i>	3	245-315	46.9-48.2	91.89	0.081
Pelagic-Neritic, Oceanodromous	<i>Rastrelliger brancysoma</i>	3	7-10	16.0-17.0	74.74	0.253
Pelagic neritic, Oceanodromous	<i>Rastrelliger kanagurta</i>	3	8-11	23.0-23.6	76.60	0.234
Pelagic-neritic, Oceanodromous	<i>Scomberomorus commerson</i>	3	11.3-11.7	37.4-40.5	66.13	0.339
Pelagic-neritic, oceanodromous	<i>Scomberomorus guttatus</i>	3	10.8-19.4	37.4-40.5	78.13	0.219
Pelagic neritic, Oceanodromous	<i>Thunnus tonggol</i>	3	50	26.9-29.0	80.00	0.200
Family Siganidae						
Reef associated, Oceanodromous	<i>Siganus javus</i>	2	9-12	22.0-23.8	50.88	0.491
Family Sphraemidae						
Reef associated	<i>Sphyaena obtusata</i>	3	72-102	51.0-56.0	90.57	0.094
Reef-associated	<i>Sphyaera putnamae</i>	3	46-61	41.0-43.0	80.17	0.198
Family Trichiuridae						
Benthopelagic, amphidromous	<i>Trichiurus lepturus</i>	3	23-69	80.0-93.0	76.85	0.232

Table S3: Values of estimated daily intake (EDI) (mg/kg bw), target hazard quotient (THQ), and estimated weekly intake (EWI; mg/kg bw) to the provisional tolerable weekly intake (PTWI; mg/kg bw) of Cu in fish (n=40) from the present study.

No.	Species	Mean weight (g)	Length (cm)	Location	WC	CF	DW	WW	EDI	High EDI	THQ	High THQ	EWI	High EWI	PTWI%	High PTWI %
1	<i>Drepana punctata</i>	267	18.1	Pasar Malam Sri Serdang, Selangor	91.8	0.08	4.01	0.33	0.53	1.06	0.013	0.027	3.72	7.44	0.086	0.171
2	<i>Selaroides leptolepis</i>	430	15.5	Segi Fresh, Batu Caves	80.0	0.20	3.93	0.79	1.27	2.53	0.032	0.063	8.87	17.7	0.011	0.022
3	<i>Plectorhinchus flavomaculatus</i>	213	23.8	Pasar Besar, Kuantan	81.6	0.18	1.93	0.36	0.57	1.15	0.014	0.029	4.01	8.02	0.002	0.004
4	<i>Elagatis bipinnulata</i>	418	31.0	Lotus Hypermarket Bahau, Negeri Sembilan	75.6	0.24	2.11	0.51	0.83	1.66	0.054	0.108	5.81	11.6	0.002	0.005
5	<i>Pennahia argentata</i>	53.3	17.9	Chow Kit Road Market, KL	83.3	0.17	2.34	0.39	0.63	1.26	0.016	0.032	4.41	8.82	0.000	0.001
6	<i>Arius arius</i>	152	26.5	Chow Kit Road Market, KL	91.3	0.09	0.72	0.06	0.10	0.20	0.003	0.005	0.70	1.41	0.004	0.008
7	<i>Selar crumenophthalmus</i>	167.33	29.3	Pasar Jabi, Besut, Terengganu	77.6	0.22	3.46	0.77	1.25	2.50	0.031	0.062	8.73	17.5	0.007	0.013
8	<i>Abalistes stellaris</i>	625	32.7	ZEMART, Seremban, Negeri sembilan	80.0	0.20	82.3	16.5	26.6	53.1	0.664	1.327	186	372	0.008	0.016
9	<i>Epinephelus tauvina</i>	156	17.5	Pasar Kok Lanas, Ketereh, Kelantan	81.3	0.19	5.42	1.01	1.63	3.27	0.041	0.082	11.44	22.9	0.002	0.003
10	<i>Eleutheronema tetradactylum</i>	140	24.6	Pasar Awam Sungai Besar, Selangor	71.3	0.29	2.68	0.77	1.24	2.49	0.031	0.062	8.70	17.4	0.003	0.005
11	<i>Pomadasys kakaan</i>	305	30.4		78.4	0.22	3.45	0.75	1.20	2.40	0.030	0.060	8.42	16.8	0.004	0.008
12	<i>Tylosurus crocodilus</i>	155	51.1	GIANT hypermarket, Batu Caves, Selangor	78.8	0.21	79.9	16.9	27.3	54.6	0.683	1.365	191	382	0.005	0.011
13	<i>Sardinella fimbriata</i>	103	20.6	Pasar Borong Seri Kembangan, Selangor	56.2	0.44	7.91	3.46	5.59	11.2	0.140	0.279	39.1	78.2	0.029	0.057
14	<i>Rastrelliger kanagurta</i>	139	23.3	Kedai Runcit Tanah Puteh, Pekan, Pahang	76.6	0.23	8.89	2.08	3.36	6.71	0.084	0.168	23.4	46.9	0.002	0.003
15	<i>Thunnus tonggol</i>	295	27.8	Pasar Tani Slim River, Perak	80.0	0.20	5.41	1.08	1.75	3.49	0.044	0.087	12.2	24.4	0.001	0.002
16	<i>Euthynnus affinis</i>	1502	47.5	Hassan Mart, Bandar Sungai Buaya, Rawang, Selangor	91.0	0.09	3.70	0.33	0.54	1.07	0.013	0.027	3.76	7.52	0.005	0.011



17	<i>Parastromateus niger</i>	538	28.5	AEON Supermarket Shah Alam, Selangor	77.5	0.23	1.35	0.30	0.49	0.98	0.012	0.024	3.43	6.86	0.001	0.002
18	<i>Alepes melanoptera</i>	110	19.5	Pasar Borong Batu Berendam,	83.1	0.17	2.44	0.41	0.67	1.33	0.017	0.033	4.66	9.32	0.021	0.043
19	<i>Selar boops</i>	160	22.3	Kedai Runcit Arridzky Enterprise, Selangor	89.9	0.10	4.51	0.46	0.73	0.98	0.012	0.024	3.43	6.86	0.002	0.003
20	<i>Sphyaena obtusata</i>	625	52.5	Pasar Borong Selayang, Selangor	90.6	0.09	2.55	0.24	0.39	1.33	0.017	0.033	4.66	9.32	0.002	0.004
21	<i>Anabas testudineus</i>	86.3	16.7	Pasar Borong Seri Kembangan, Selangor	71.4	0.29	4.35	1.24	2.01	1.47	0.018	0.037	5.14	10.3	0.002	0.004
22	<i>Megalaspis cordyla</i>			S' mart Pandan Jaya Selangor	80.0	0.20	4.75	0.95	1.53	0.77	0.010	0.019	2.71	5.41	0.004	0.008
23	<i>Upeneus sulphureus</i>				91.9	0.08	1.39	0.11	0.18	0.36	0.005	0.009	1.27	2.55	0.012	0.023
24	<i>Rastrelliger brancysoma</i>	150	16.7		74.7	0.25	8.88	2.24	3.62	7.24	0.090	0.181	25.3	50.7	0.011	0.022
25	<i>Trichiurus lepturus</i>	596	90.3	BS Freshmart frozen Temerloh, Pahang	76.8	0.23	7.70	1.78	2.87	5.74	0.072	0.144	20.1	40.2	0.018	0.036
26	<i>Siganus javus</i>	151	22.9	Pasar Borong Pandan, Johor Bharu, Johor	50.9	0.49	6.74	3.31	5.34	10.7	0.133	0.267	37.4	74.7	0.006	0.012
27	<i>Atule mate</i>	151	22.7	Pasar Keramat, Kuala Lumpur	82.2	0.18	4.56	0.81	1.31	2.61	0.033	0.065	9.15	18.3	0.011	0.021
28	<i>Lates calcarifer</i>	330	29.5	Hero Market, Damansara Damai, Selangor	77.9	0.22	0.78	0.17	0.28	0.55	0.007	0.014	1.94	3.88	0.030	0.060
29	<i>Nemipterus tumbuloides</i>	185	24.5	Nirwana Maju Sdn Bhd, Kuala Berang, Terengganu	83.6	0.16	25.1	4.12	6.65	13.3	0.166	0.332	46.5	93.0	0.002	0.003
30	<i>Scomberomorus guttatus</i>	350	38.6	Pasar Matang , Perak .	78.1	0.22	26.3	5.76	9.29	18.6	0.232	0.465	65.0	130	0.004	0.008
31	<i>Scomberomorus commerson</i>	350	38.0	Matang, Perak	66.1	0.34	5.96	2.02	3.26	6.51	0.081	0.163	22.8	45.6	0.004	0.008
32	<i>Carangoides armatus</i>	123	19.4	TMG Mart Kuantan, Pahang	81.4	0.19	6.87	1.28	2.06	4.12	0.052	0.103	14.4	28.8	0.017	0.034
33	<i>Sphyaera putnamae</i>	351	43.0	Econsave Baling, Kedah	80.2	0.20	2.55	0.51	0.82	1.63	0.020	0.041	5.71	11.4	0.003	0.005
34	<i>Escualosa thoracata</i>			Pasar Awam Taman Kenari, Kedah	80.0	0.20	27.4	5.48	8.84	17.7	0.221	0.442	61.9	124	0.002	0.004
35	<i>Leptomelanosoma indicum</i>	284	31.9	Pasar Awam Telok Panglima Garang, Selangor	79.8	0.20	5.22	1.05	1.70	3.40	0.042	0.085	11.9	23.8	0.002	0.005





36	<i>Scomberoides lysan</i>			Pasar Besar Alor Setar, Kedah	80.0	0.20	5.92	1.18	1.91	3.82	0.048	0.095	13.4	26.7	0.006	0.011
37	<i>Tenuaulosa toli</i>	277	31.4	Kampung Boyan Kuching, Sarawak	80.0	0.20	2.22	0.44	0.72	1.43	0.018	0.036	5.01	10.0	0.009	0.019
38	<i>Alectis indicus</i>	10.6	17.5	Market Bandar Riyal, Samarahan, Sarawak	80.0	0.20	10.8	2.16	3.48	6.97	0.087	0.174	24.4	48.8	0.088	0.176
39	<i>Decapterus macrosoma</i>	104	20.6	Pasaraya Shakri Padang Luas Jerneh	73.8	0.26	5.85	1.53	2.47	4.94	0.062	0.124	17.3	34.6	0.001	0.001
40	<i>Valumugil seheli</i>	46.7	16.7	Pasar Awam Sungai Besar, Selangor	80.0	0.20	16.2	3.25	5.24	10.5	0.131	0.262	367	73.3	0.017	0.034

Note: DW= dry weight basis; WW= wet weight basis; WC= water content in %; CF= conversion factor; High= two times consumption of the normal consumption rate.

Table S4: Values of estimated daily intake (EDI) (mg/kg bw), target hazard quotient (THQ), and estimated weekly intake (EWI; mg/kg bw) to the provisional tolerable weekly intake (PTWI; mg/kg bw) of Cu in fish (N= 99), based on Cu cited data in the literature.

No.	Species	DW	WW	EDI	High EDI	THQ	High THQ	EWI	High EWI	PTWI%	High PTWI %	References
1	<i>Alectis indicus</i>	3.33	0.70	1.13	2.26	0.028	0.056	7.90	15.8	0.004	0.007	Yap & Mutairi [29]
2	<i>Anabas testudineus</i>	2.27	0.65	1.05	0.77	0.010	0.019	2.71	5.41	0.001	0.002	Sarker et al. [48]
3	<i>Atule mate</i>	5.00	1.53	2.47	4.94	0.062	0.123	17.3	34.6	0.008	0.016	Ong et al. [46]
		5.17	0.92	1.48	2.97	0.037	0.074	10.4	20.8	0.005	0.010	Wan Azmi et al. [58]
		7.83	1.80	2.9	5.81	0.073	0.145	20.3	40.7	0.009	0.019	Yap & Mutairi [29]
4	<i>Decapterus macrosoma</i>	3.48	0.70	1.13	2.26	0.028	0.056	7.90	15.8	0.004	0.007	Agusa et al [55]
		6.11	1.22	1.97	3.94	0.049	0.098	13.8	27.6	0.006	0.013	Khalaf et al [20]
		42.8	11.2	18.1	36.1	0.452	0.903	126	253	0.058	0.117	Ong et al. [46]
		3.36	0.88	1.42	2.84	0.035	0.071	9.94	19.9	0.005	0.009	Wan Azmi et al [58]
		7.12	1.42	2.29	4.58	0.057	0.115	16.0	32.1	0.007	0.015	Yap & Mutairi [29]
5	<i>Eleutheronema tetradactylum</i>	4.70	1.35	2.18	4.35	0.054	0.109	15.2	30.5	0.007	0.014	Deshpande et al [41]
6	<i>Epinephelus tauvina</i>	1.34	0.25	0.40	0.81	0.010	0.020	2.82	5.65	0.001	0.003	Ahmad & Al-Ghais [40]
		1.02	0.19	0.31	0.61	0.008	0.015	2.15	4.29	0.001	0.002	Ahmad & Al-Ghais [40]
7	<i>Euthynnus affinis</i>	7.89	0.71	1.15	2.29	0.029	0.057	8.02	16.0	0.004	0.007	Salam et al. [47]
8	<i>Lates calcarifer</i>	1.09	0.22	0.35	0.71	0.009	0.018	2.48	4.97	0.001	0.002	Agusa et al [55]
		0.82	0.16	0.26	0.52	0.006	0.013	1.81	3.61	0.001	0.002	Agusa et al [55]
		1.21	0.27	0.43	0.86	0.011	0.022	3.02	6.03	0.001	0.003	Agusa et al [55]
		1.40	0.31	0.50	1.00	0.012	0.025	3.49	6.98	0.002	0.003	Krishnamurthi & Nair [45]
		12.22	2.70	4.35	8.71	0.109	0.218	30.5	60.9	0.014	0.028	Kamaruzzaman et al. [60]
9	<i>Megalaspis cordyla</i>	2.21	0.51	0.82	3.06	0.038	0.077	10.7	21.5	0.005	0.010	Agusa et al [55]
		2.53	0.58	0.94	5.05	0.063	0.126	17.7	35.3	0.008	0.016	Agusa et al [55]
		2.48	0.57	0.92	3.32	0.042	0.083	11.6	23.3	0.005	0.011	Agusa et al [55]
		2.67	0.61	0.98	1.65	0.021	0.041	5.76	11.5	0.003	0.005	Agusa et al [55]
		2.96	0.68	1.10	1.87	0.023	0.047	6.55	13.1	0.003	0.006	Agusa et al [55]
		4.06	0.93	1.50	1.84	0.023	0.046	6.44	12.9	0.003	0.006	Agusa et al [55]

		3.57	0.82	1.32	1.97	0.025	0.049	6.89	13.8	0.003	0.006	Agusa et al [55]
		2.81	0.65	1.05	2.19	0.027	0.055	7.68	15.4	0.004	0.007	Agusa et al [55]
		4.39	1.01	1.63	3.00	0.038	0.075	10.5	21.0	0.005	0.010	Agusa et al [55]
		3.60	0.83	1.34	2.65	0.033	0.066	9.26	18.5	0.004	0.009	Agusa et al [55]
		1.51	0.35	0.56	5.19	0.065	0.130	18.2	36.4	0.008	0.017	Fathi et al+[51]
		3.10	0.71	1.15	19.1	0.238	0.477	66.7	133	0.031	0.061	Kamaruzzaman et al. [60]
		1.43	0.33	0.53	1.03	0.013	0.026	3.61	7.23	0.002	0.003	Nair et al [23]
		7.80	1.56	2.52	2.29	0.029	0.057	8.02	16.0	0.004	0.007	Nurmadia et al [76]
		1.40	0.32	0.52	2.48	0.031	0.062	8.69	17.4	0.004	0.008	Praveena & Lin [89]
		3.36	0.77	1.24	2.10	0.026	0.052	7.34	14.7	0.003	0.007	Salam et al. [47]
		25.7	5.91	9.53	3.26	0.041	0.081	11.4	22.8	0.005	0.011	Salam et al. [47]
		8.05	1.61	2.60	2.68	0.033	0.067	9.37	18.7	0.004	0.009	Wan Azmi et al [58]
		4.47	1.03	1.66	2.10	0.026	0.052	7.34	14.7	0.003	0.007	Yap & Mutairi [29]
10	<i>Parastromateus niger</i>	0.13	0.03	0.05	0.10	0.001	0.002	0.34	0.68	0.000	0.000	Tabezar et al. [49]
11	<i>Pennahia argentata</i>	0.10	0.02	0.03	0.05	0.001	0.001	0.18	0.36	0.000	0.000	Takarina et al [30]
		0.05	0.01	0.01	0.03	0.000	0.001	0.10	0.20	0.000	0.000	Takarina et al [30]
12	<i>Rastrelliger brancysoma</i>	1.80	0.45	0.73	1.47	0.018	0.037	5.13	10.3	0.002	0.005	Agusa et al [55]
13	<i>Rastrelliger kanagurta</i>	1.94	0.50	0.81	1.61	0.02	0.04	5.65	11.3	0.003	0.005	Agusa et al [55]
		1.09	0.28	0.45	0.90	0.011	0.023	3.16	6.32	0.001	0.003	Agusa et al [55]
		2.69	0.70	1.13	2.26	0.028	0.056	7.90	15.8	0.004	0.007	Agusa et al [55]
		1.64	0.43	0.69	1.39	0.017	0.035	4.85	9.71	0.002	0.004	Agusa et al [55]
		5.56	1.30	2.1	4.19	0.052	0.105	14.7	29.4	0.007	0.014	Arulkumar et al. [84]
		12.8	3.30	5.32	10.7	0.133	0.266	37.3	74.5	0.017	0.034	Irwindi and Farida [57]
		2.00	0.52	0.84	1.68	0.021	0.042	5.87	11.7	0.003	0.005	Kamaruzzaman et al [60]
		9.17	2.38	3.84	7.68	0.096	0.192	26.9	53.7	0.012	0.025	Mziray and Kimirei [39]
		2.10	0.55	0.89	1.77	0.022	0.044	6.21	12.4	0.003	0.006	Nair et al [23]
		3.80	0.89	1.44	2.87	0.036	0.072	10.1	20.1	0.005	0.009	Nurnadia et al [76]
		2.15	0.56	0.90	1.81	0.023	0.045	6.32	12.7	0.003	0.006	Praveena and Lin [89]
		2.75	0.72	1.16	2.32	0.029	0.058	8.13	16.3	0.004	0.007	Rejomon et al [75]
		4.15	0.97	1.56	3.13	0.039	0.078	10.9	21.9	0.005	0.010	Wan Azmi et al [58]

		5.56	1.45	2.34	4.68	0.058	0.117	16.4	32.7	0.008	0.015	Yap & Mutairi [29]
		2.23	0.58	0.94	1.87	0.023	0.047	6.55	13.1	0.003	0.006	Yap & Mutairi [29]
		4.10	0.96	1.55	3.10	0.039	0.077	10.8	21.7	0.005	0.010	Yap & Mutairi [29]
14	<i>Sardinella fimbriata</i>	7.33	3.21	5.18	10.4	0.129	0.259	36.2	72.5	0.017	0.033	Praveena and Lin [89]
15	<i>Scomberoides lysan</i>	1.37	0.27	0.44	0.88	0.011	0.022	3.09	6.19	0.001	0.003	Agusa et al [55]
16	<i>Scomberomorus commerson</i>	1.33	0.31	0.50	1.00	0.013	0.025	3.50	7.00	0.002	0.003	Agusa et al [55]
		5.52	1.27	2.05	4.10	0.051	0.102	14.3	28.7	0.007	0.013	Ahmed et al [26]
		1.09	0.37	0.60	1.19	0.015	0.030	4.18	8.35	0.002	0.004	Gu et al. [43]
		12.6	2.90	4.68	9.35	0.117	0.234	32.7	65.5	0.015	0.030	Irwandi & Farida [57]
		0.89	0.30	0.48	0.97	0.012	0.024	3.39	6.77	0.002	0.003	Wan Azmi et al [58]
		1.86	0.43	0.69	1.39	0.017	0.035	4.85	9.71	0.002	0.004	Yap & Mutairi [29]
17	<i>Selar crumenophthalmus</i>	2.94	0.66	1.06	2.12	0.027	0.053	7.42	14.4	0.003	0.007	Agusa et al [55]
		2.16	0.48	0.78	1.56	0.019	0.039	5.45	10.9	0.003	0.005	Agusa et al [55]
		2.23	0.50	0.80	1.61	0.020	0.040	5.63	11.3	0.003	0.005	Agusa et al [55]
		2.06	0.46	0.74	1.49	0.019	0.037	5.20	10.4	0.002	0.005	Agusa et al [55]
		1.91	0.43	0.69	1.38	0.017	0.034	4.82	9.64	0.002	0.004	Agusa et al [55]
		2.46	0.55	0.89	1.77	0.022	0.044	6.21	12.4	0.003	0.006	Agusa et al [55]
18	<i>Selaroides leptolepis</i>	2.10	0.50	0.81	1.61	0.020	0.040	5.65	11.3	0.003	0.005	Kamaruzzaman et al. [60]
		7.05	1.41	2.27	4.55	0.057	0.114	15.9	31.8	0.007	0.015	Nurnadia et al [76]
		2.46	0.59	0.95	1.90	0.024	0.048	6.66	13.3	0.003	0.006	Praveena and Lin [89]
		2.50	0.50	0.81	1.61	0.020	0.040	5.65	11.3	0.003	0.005	Wan Azmi et al [58]
		3.71	0.89	1.44	2.87	0.036	0.072	10.1	20.1	0.005	0.009	Yap & Mutairi [29]
19	<i>Sphyraena obtusata</i>	12.98	1.22	1.97	3.10	0.039	0.077	10.8	21.7	0.005	0.010	Agusa et al [55]
		13.62	1.28	2.06	4.13	0.052	0.103	14.5	28.9	0.007	0.013	Agusa et al [55]
		10.21	0.96	1.55	1.47	0.018	0.037	5.14	10.3	0.002	0.005	Jaziri et al. [44]
20	<i>Tenualosa toli</i>	2.71	0.54	0.87	1.75	0.022	0.044	6.12	12.2	0.003	0.006	Yap & Mutairi [29]
21	<i>Thunnus tonggol</i>	9.30	1.86	3.00	6.00	0.075	0.150	21.0	42.0	0.010	0.019	Kamaruzzaman et al [60]
22	<i>Trichiurus lepturus</i>	9.00	1.98	3.19	6.39	0.080	0.160	22.4	44.7	0.010	0.021	Anandkumar et al. [81]
		2.49	0.62	1.00	2.00	0.025	0.050	7.00	14.0	0.003	0.006	Rahman et al. [36]
		2.11	0.46	0.74	1.48	0.019	0.037	5.19	10.4	0.002	0.005	Velusamy et al. [27]

		2.99	0.66	1.06	2.13	0.027	0.053	7.45	14.9	0.003	0.007	Yap & Mutairi [29]
23	<i>Tylosurus crocodilus</i>	0.52	0.11	0.18	0.35	0.004	0.009	1.24	2.48	0.001	0.001	Ebrahim et al [42]
24	<i>Valumugil seheli</i>	1.09	0.22	0.35	0.70	0.009	0.018	2.46	4.92	0.001	0.002	Agusa et al [55]
		1.24	0.25	0.40	0.80	0.010	0.020	2.80	5.60	0.001	0.003	Agusa et al [55]
		1.36	0.27	0.44	0.88	0.011	0.022	3.07	6.14	0.001	0.003	Agusa et al [55]
		1.09	0.22	0.35	0.70	0.009	0.018	2.46	4.92	0.001	0.002	Agusa et al [55]
		1.88	0.38	0.61	1.21	0.015	0.030	4.25	8.49	0.002	0.004	Agusa et al [55]
		1.68	0.34	0.54	1.08	0.014	0.027	3.79	7.59	0.002	0.003	Agusa et al [55]
		2.03	0.41	0.65	1.31	0.016	0.033	4.58	9.17	0.002	0.004	Agusa et al [55]
		1.14	0.23	0.37	0.74	0.009	0.018	2.57	5.15	0.001	0.002	Agusa et al [55]
		1.44	0.29	0.46	0.93	0.012	0.023	3.25	6.5	0.001	0.003	Agusa et al [55]
		1.48	0.30	0.48	0.95	0.012	0.024	3.34	6.68	0.002	0.003	Agusa et al [55]
		1.15	0.23	0.37	0.74	0.009	0.019	2.60	5.19	0.001	0.002	Agusa et al [55]
		2.90	0.58	0.94	1.87	0.023	0.047	6.55	13.1	0.003	0.006	Krishnamurti & Nair [45]

Note: DW= dry weight basis; WW= wet weight basis; High= two times consumption of the normal consumption rate.

Table S5: Values of high estimated daily intake (EDI) (mg/kg bw), high target hazard quotient (THQ), and high estimated weekly intake (EWI) (mg/kg bw) to provisional tolerable weekly intake (PTWI) and high PTWI of Cu in selected fish species from the present study.

Species		High EDI	High THQ	High EWI	PTWI%	High PTWI %
<i>Drepana punctata</i>	Muscle	1.050	0.026	7.348	0.00169	0.00339
	Skin	1.186	0.030	8.301	0.00191	0.00383
<i>Elagatis bipinnulata</i>	Muscle	1.659	0.041	11.616	0.00268	0.00535
	Skin	2.116	0.053	14.809	0.00341	0.00682
<i>Selar crumenophthalmus</i>	Muscle	2.495	0.062	17.468	0.00402	0.00805
	Skin	8.604	0.215	60.228	0.01388	0.02775
<i>Eleutheronema tetradactylum</i>	Muscle	2.485	0.062	17.398	0.00401	0.00802
	Skin	1.233	0.031	8.634	0.00199	0.00398
<i>Pomadasys kakaan</i>	Muscle	2.405	0.060	16.833	0.00388	0.00776
	Skin	3.192	0.080	22.346	0.00515	0.01030
<i>Megalaspis cordyla</i>	Muscle	3.065	0.077	21.452	0.00494	0.00989
	Skin	5.045	0.126	35.316	0.00814	0.01627
<i>Trichiurus lepturus</i>	Muscle	5.750	0.144	40.252	0.00927	0.01855
	Skin	5.691	0.142	39.834	0.00918	0.01836
<i>Siganus javus</i>	Muscle	10.680	0.267	74.762	0.01723	0.03445
	Skin	8.874	0.222	62.117	0.01431	0.02863
<i>Lates calcarifer</i>	Muscle	0.556	0.014	3.890	0.00090	0.00179
	Skin	3.511	0.088	24.577	0.00566	0.01133
<i>Leptomelanosoma indicum</i>	Muscle	3.399	0.085	23.791	0.00548	0.01096
	Skin	2.643	0.066	18.504	0.00426	0.00853
<i>Scomberoides lysan</i>	Muscle	3.819	0.095	26.735	0.00616	0.01232
	Skin	4.052	0.101	28.361	0.00653	0.01307
<i>Tenualosa toli</i>	Muscle	1.432	0.036	10.026	0.00231	0.00462
	Skin	1.748	0.044	12.239	0.00282	0.00564

Note: \*Highlighted value indicates species with High THQ >1; High= two times consumption of the normal consumption rate.