

Supplementary material

The Interannual Variations of Summer Ichthyoplankton in the Pearl River Estuary as a Response to Climate Change

Shuofu Li ¹, Jianguo He ^{1,2}, Zhigang Lai ^{1,2,3,*}

¹ School of Marine Sciences, Sun Yat-sen University, Guangzhou 510275, China

² Southern Marine Science and Engineering Guangdong Laboratory, Zhuhai 519080, China

³ Key Laboratory of Marine Resources and Coastal Engineering in Guangdong Province, Guangzhou 510240, China

* Correspondence: lsshjg@mail.sysu.edu.cn (J.H.); laizhg@mail.sysu.edu.cn (Z.L.)

Table S1a. Fish larvae composition and guilds. Dominant species are labeled “***”, and common species are labeled “**”. The species with an abundance lower than 0.01% of the total catch are ignored.

Family	Taxon	Category	IRI	Proportion
Engraulidae	<i>Coilia mystus</i> **	Brackish	20.13	3.66%
Gobiidae	<i>Unknown species</i> **	Brackish	68.73	2.47%
Mugilidae	<i>Liza</i> sp.	Brackish	1.48	0.25%
Mugilidae	<i>Liza carinata</i>	Brackish	0.06	0.03%
Gobiidae	<i>Taenioides anguillaris</i>	Brackish	0.02	0.02%
Clupeidae	<i>Sardinella</i> sp.***	Neritic	2761.05	67.30%
Ambassidae	<i>Ambassis gymnocephalus</i> ***	Neritic	301.71	9.15%
Engraulidae	<i>Stolephorus commersonii</i> **	Neritic	90.59	3.75%
Blenniidae	<i>Omobranchus elegans</i> **	Neritic	50.53	2.06%
Engraulidae	<i>Stolephorus</i> sp.**	Neritic	31.06	1.97%
Engraulidae	<i>Stolephorus chinensis</i> **	Neritic	18.29	1.43%
Engraulidae	<i>Thryssa mystax</i>	Neritic	2.93	0.67%
Hemiramphidae	<i>Hyporhamphus intermedius</i>	Neritic	3.25	0.55%
Ambassidae	<i>Ambassis</i> sp.	Neritic	2.45	0.51%
Hemiramphidae	<i>Hemiramphus</i> sp.	Neritic	2.53	0.49%
Sciaenidae	<i>Unknown species</i>	Neritic	1.94	0.33%
Engraulidae	<i>Thrissa</i> sp.	Neritic	0.11	0.14%
Callionymidae	<i>Unknown species</i>	Neritic	0.27	0.12%
Blenniidae	<i>Unknown species</i>	Neritic	0.37	0.11%
Sillaginidae	<i>Sillago japonica</i>	Neritic	0.15	0.08%
Engraulidae	<i>Stolephorus chinensis</i>	Neritic	0.02	0.07%
Theraponidae	<i>Unknown species</i>	Neritic	0.07	0.04%
Theraponidae	<i>Therapon oxyrhynchus</i>	Neritic	0.03	0.03%
Atherinidae	<i>Atherina bleekeri</i>	Neritic	0.09	0.03%
Gerreidae	<i>Unknown species</i>	Neritic	0.04	0.03%
Sciaenidae	<i>Pennahia argentata</i>	Neritic	0.03	0.03%
Sciaenidae	<i>Collichthys lucidus</i>	Neritic	0.01	0.02%
Synodontinae	<i>Harpodon nehereus</i>	Neritic	0.01	0.01%
Engraulidae	<i>Thrissa dussumieri</i>	Neritic	0.01	0.01%
Sparidae	<i>Rhabdosargus sarba</i>	Coastal	4.77	1.45%
Sparidae	<i>Unknown species</i> **	Coastal	23.89	1.42%
Apogonidae	<i>Unknown species</i>	Coastal	1.02	0.46%
Clupeidae	<i>Konosirus punctatus</i>	Coastal	0.34	0.31%
Carangidae	<i>Unknown species</i>	Coastal	0.21	0.14%
Sillaginidae	<i>Sillago sihama</i>	Coastal	0.56	0.12%
Cynoglossidae	<i>Unknown species</i>	Coastal	0.32	0.11%
Gerreidae	<i>Gerres oyena</i>	Coastal	0.08	0.07%
Tetraodontidae	<i>Lagocephalus laevigatus</i>	Coastal	0.02	0.04%
Pristigasteridae	<i>Ilisha elongata</i>	Coastal	0.01	0.04%
Sillaginidae	<i>Unknown species</i>	Coastal	0.06	0.04%
Scatophagidae	<i>Nemipterus</i> sp.	Coastal	0.02	0.03%
Carangidae	<i>Caranx sexfasciatus</i>	Coastal	0.01	0.02%

Mullidae	<i>Upeneus bensasi</i>	Coastal	0.01	0.02%
Belonidae	<i>Hemiramphus sajori</i>	Coastal	0.01	0.01%
Sparidae	<i>Acanthopagrus latus</i>	Coastal	0.00	0.01%
Synodontidae	<i>Saurida sp.</i>	Coastal	0.01	0.01%
Synodontidae	<i>Saurida undosquamis</i>	Coastal	0.00	0.01%
Ophichthyidae	<i>Unknown species</i>	Coastal	0.00	0.01%
Cyprinidae	<i>Unknown species</i>	Freshwater	0.96	0.20%

Table S1b. Fish egg composition and guilds. Dominant species are labeled “***”, and common species are labeled “**”. The species with an abundance lower than 0.01% of the total catch are ignored.

Family	Taxon	Category	IRI	Proportion
Mugilidae	<i>Liza</i> sp.**	Brackish	97.28	9.30%
Mugilidae	<i>Unknown species</i>	Brackish	0.95	0.18%
Mugilidae	<i>Liza carinata</i>	Brackish	0.03	0.03%
Mugilidae	<i>Osteomugil ophuyseni</i>	Brackish	0.01	0.02%
Anguillidae	<i>Anguilla japonica</i>	Brackish	0.01	0.01%
Engraulidae	<i>Coilia mystus</i>	Brackish	0.01	0.01%
Ambassidae	<i>Ambassis gymnocephalus</i> ***	Neritic	161.73	16.81%
Engraulidae	<i>Stolephorus</i> sp.***	Neritic	321.92	13.50%
Engraulidae	<i>Stolephorus commersonii</i> ***	Neritic	164.78	10.36%
Engraulidae	<i>Stolephorus chinensis</i> **	Neritic	93.74	8.62%
Engraulidae	<i>Unknown species</i> **	Neritic	20.86	7.12%
Engraulidae	<i>Thrissa</i> sp.**	Neritic	42.57	2.75%
Clupeidae	<i>Sardinella</i> sp.**	Neritic	21.16	2.41%
Sciaenidae	<i>Unknown species</i> **	Neritic	10.95	1.74%
Theraponidae	<i>Unknown species</i>	Neritic	0.79	0.95%
Engraulidae	<i>Thryssa mystax</i>	Neritic	2.43	0.73%
Sciaenidae	<i>Johnius grypotus</i>	Neritic	0.48	0.29%
Sciaenidae	<i>Collichthys lucidus</i>	Neritic	0.01	0.02%
Ambassidae	<i>Unknown species</i>	Neritic	0.01	0.02%
Hemiramphidae	<i>Hyporhamphus intermedius</i>	Neritic	0.01	0.01%
Pleuronectidae	<i>Unknown species</i>	Neritic	0.00	0.01%
Carangidae	<i>Unknown species</i> **	Coastal	48.93	6.15%
Cynoglossidae	<i>Unknown species</i> ***	Coastal	102.29	5.43%
Sparidae	<i>Unknown species</i> **	Coastal	69.19	4.86%
Sillaginidae	<i>Sillago japonica</i>	Coastal	6.16	2.45%
Sillaginidae	<i>Unknown species</i> **	Coastal	24.61	2.18%
Cynoglossidae	<i>Unknown species</i>	Coastal	0.81	0.32%
Synodontidae	<i>Saurida undosquamis</i>	Coastal	0.58	0.23%
Lutjanidae	<i>Unknown species</i>	Coastal	0.05	0.11%
Mullidae	<i>Unknown species</i>	Coastal	0.07	0.08%
Mullidae	<i>Upeneus</i> sp.	Coastal	0.07	0.06%
Ophichthyidae	<i>Unknown species</i>	Coastal	0.05	0.06%
Sillaginidae	<i>Sillago sihama</i>	Coastal	0.22	0.26%
Trichiuridae	<i>Trichiurus haumela</i>	Coastal	0.02	0.04%
Scorpaenidae	<i>Unknown species</i>	Coastal	0.04	0.03%
Synodontidae	<i>Trachiocephalus myops</i>	Coastal	0.01	0.01%
Leiognathidae	<i>Unknown species</i>	Coastal	3.42	0.91%
Champsodontidae	<i>Unknown species</i>	Coastal	0.01	0.01%
Clupeidae	<i>Unknown species</i>	Coastal	0.00	0.01%
Serranidae	<i>Unknown species</i>	Coastal	0.00	0.01%
-	<i>Unknown species</i> **	-	16.79	1.91%

Table S2. Correlations among the environmental factors and monthly ONI (** means p<0.01, * means p<0.05). Only the correlation coefficients greater than 0.5 are in Bold for the environmental factors.

	ONI	River runoff	Chl-a	DO	NO ₃	PO ₄	pH	Salinity	Temperature
ONI	1								
River runoff	0.19**	1							
Chl-a	0.01	0.12	1						
DO	-0.02	-0.38**	0.35**	1					
NO ₃	0.09	0.74**	0.17*	-0.21**	1				
PO ₄	-0.05	0.38**	-0.36**	-0.52**	0.50**	1			
pH	-0.07	-0.14*	0.34**	0.25**	-0.26**	-0.43**	1		
Salinity	-0.12	-0.82**	-0.25**	0.26**	-0.94**	-0.47**	0.16*	1	
Temperature	0.09	0.69**	0.26**	-0.40**	0.64**	0.37**	-0.05	-0.74**	1

Table S3. Oceanic Niño Index (ONI), the box area with black dash lines indicates the period with a shift in climate state

Time	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	0.9	0.6	0.4	0	-0.3	-0.2	0.1	0.2	0.3	0.3	0.4	0.4
2004	0.4	0.3	0.2	0.2	0.2	0.3	0.5	0.6	0.7	0.7	0.7	0.7
2005	0.6	0.6	0.4	0.4	0.3	0.1	-0.1	-0.1	-0.1	-0.3	-0.6	-0.8
2006	-0.8	-0.7	-0.5	-0.3	0	0	0.1	0.3	0.5	0.7	0.9	0.9
2007	0.7	0.3	0	-0.2	-0.3	-0.4	-0.5	-0.8	-1.1	-1.4	-1.5	-1.6
2008	-1.6	-1.4	-1.2	-0.9	-0.8	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.8	-0.7	-0.5	-0.2	0.1	0.4	0.5	0.5	0.7	1	1.3	1.6
2010	1.5	1.3	0.9	0.4	-0.1	-0.6	-1	-1.4	-1.6	-1.7	-1.7	-1.6
2011	-1.4	-1.1	-0.8	-0.6	-0.5	-0.4	-0.5	-0.7	-0.9	-1.1	-1.1	-1
2012	-0.8	-0.6	-0.5	-0.4	-0.2	0.1	0.3	0.3	0.3	0.2	0	-0.2
2013	-0.4	-0.3	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.4	-0.2	0.1	0.3	0.2	0.1	0	0.2	0.4	0.6	0.7
2015	0.6	0.6	0.6	0.8	1	1.2	1.5	1.8	2.1	2.4	2.5	2.6
2016	2.5	2.2	1.7	1	0.5	0	-0.3	-0.6	-0.7	-0.7	-0.7	-0.6
2017	-0.3	-0.1	0.1	0.3	0.4	0.4	0.2	-0.1	-0.4	-0.7	-0.9	-1
2018	-0.9	-0.8	-0.6	-0.4	-0.1	0.1	0.1	0.2	0.4	0.7	0.9	0.8

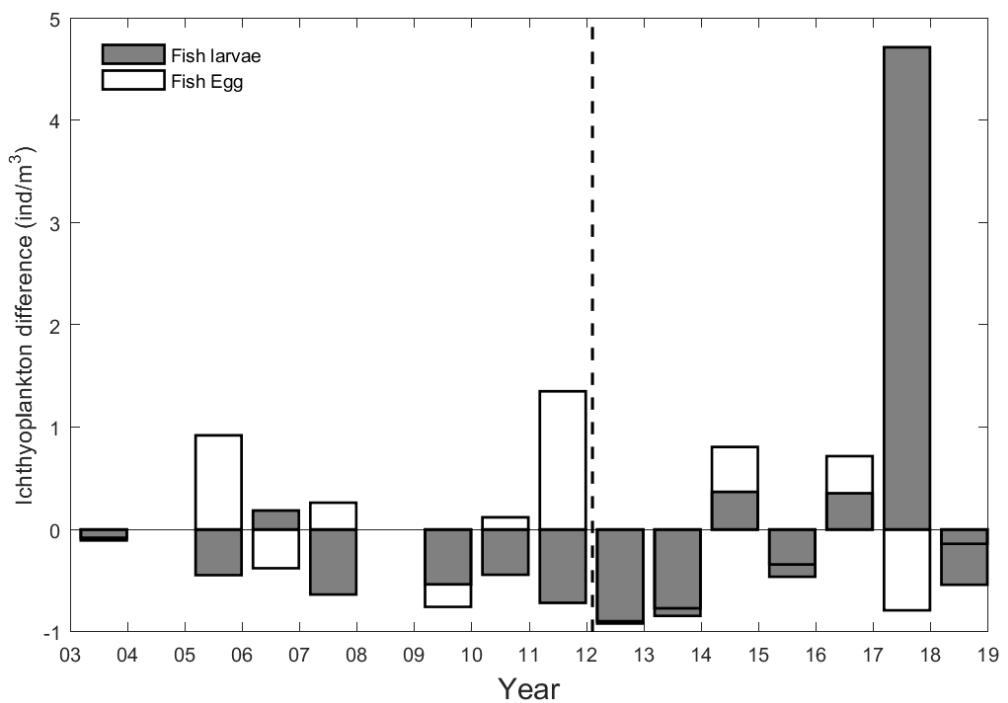


Figure S1. Abundance anomalies for the fish larvae and eggs

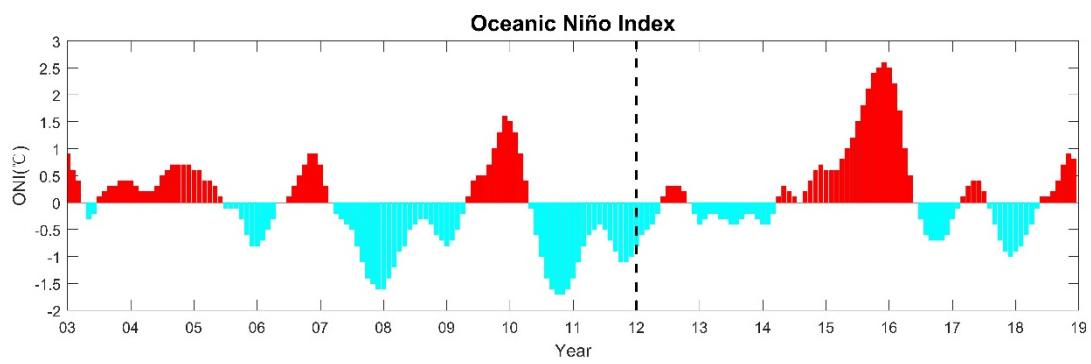


Figure S2. Monthly Ocean Niño index from 2003-2018. The dashed line is the same as in Figure 3 to indicate the long-term abundance variations for the fish larvae and eggs.

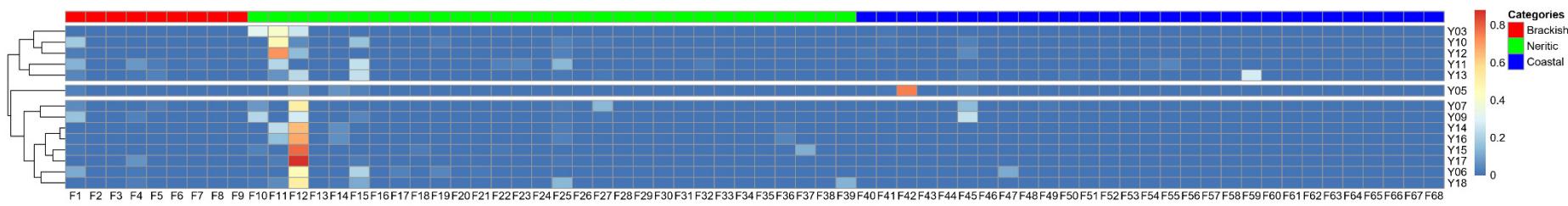


Figure S3. Dendrogram from the two-way cluster analysis using the 14-year data from the Bray-Curtis similarity matrix of taxa proportion (F1: Gobiidae sp., F2: Anguillidae sp., F3: *Coilia* sp., F4: *Coilia ectenes* Jordan et Seale, F5: *Liza* sp., F6: Mullidae sp., F7: Taenioididae sp., F8: *Liza carinata carinata*, F9: Tetraodontidae sp., F10: *Stolephorus* sp., F11: *Ambassis gymnocephalus* Lacepede, F12: *Sardinella* sp., F13: Engraulidae sp., F14: *Stolephorus chinensis*, F15: *Stolephorus commersonii*, F16: *Thrissa kammalensis*, F17: *Thrissa* sp., F18: Blenniidae sp., F19: Sciaenidae sp., F20: *Thrissa dussumieri*, F21: *Sardinella nymphaea*, F22: Carangidae sp., F23: *Sillago japonica* Temminck et Schlegel, F24: Theraponidae sp., F25: *Omobranchus elegans*, F26: Callionymidae sp., F27: Hemiramphus sp., F28: *Argyrosomus argentatus*, F29: *Harpodon nehereus*, F30: *Collichthys lucidus*, F31: *Syngnathus acus* Linnaeus, F32: *Therapon oxyrhynchus* Temminck et Schlegel, F33: *Allanetta bleekeri*, F34: *Johnius grypotus*, F35: *Scatophagus argus*, F36: *Thrissa mystax*, F37: *Ambassis*, F38: Gerreidae sp., F39: *Hyporhamphus intermedius*, F40: *Sillago sihama*, F41: Cynoglossidae sp., F42: *Rhabdosargus sarba*, F43: Scorpaenidae sp., F44: Sillaginidae sp., F45: Sparidae sp., F46: *Upeneus* sp., F47: Apogonidae sp., F48: Leiognathidae sp., F49: *Nemipterus* sp., F50: *Caranx sexfasciatus*, F51: *Saurida* sp., F52: Platyccephalidae sp., F53: *Saurida tumbil*, F54: *Acanthocepola*, F55: *Gerres oyena*, F56: *Acanthocepola*, F57: *Psettina* sp., F58: *Decapterus macrosoma* Bleeker, F59: *Konosirus punctatus* Temminck et Schlegel, F60: Ophichthyidae sp., F61: *Ilisha elongate*, F62: *Trichiurus haumela*, F63: *Lobotes surinamensis*, F64: *Saurida undosquamis*, F65: *Sparus latus*, F66: Labridae sp., F67: Sphyraenidae sp., F68: *Tylosurus melanotus*)