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Supplementary materials to

**Benthic habitat quality assessment in estuarine intertidal flats based on long-term data with focus on responses to eco-restoration activity**

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Table S1. List of macrobenthos species and grouping in the intertidal flats of Liaohe Estuary.

Scientific name	AMBI groups	Scientific name	AMBI groups
<b>Annelida</b>	-	-	-
<i>Glycera alba</i>	IV	<i>Glycinde gurjanovae</i>	II
<i>Aglaophamus sinensis</i>	II	<i>Goniada japonica</i>	II
<i>Diopatra chiliensis</i>	II	<i>Goniada maculata</i>	II
<i>Glycera capitata</i>	II	<i>Lumbrineris latreilli</i>	II
<i>Glycera tenuis</i>	II	<i>Lumbrineris cruzensis</i>	II
<i>Glycera chirori</i>	II	<i>Lumbrineris heteropoda</i>	II
<i>Glycera rouxii</i>	II	<i>Lumbrineris longifolia</i>	IV
<i>Glycera onomichiensis</i>	II	<i>Neanthes japonica</i>	III
<i>Nectoneanthes multignatha</i>	III	<i>Lumbrineridae</i> sp.	II
<i>Nectoneanthes oxypoda</i>	III	<i>Inermonephtys inermis</i>	II
<i>Nephtys oligobranchia</i>	II	<i>Nephtys ciliata</i>	II
<i>Nephtys californiensis</i>	II	<i>Hemipodus longipapillatus</i>	II
<i>Nephtys caeca</i>	II	<i>Glycera subaenea</i>	II
<i>Nereis grubei</i>	NA	<i>Euclymene annandalei</i>	I
<i>Perinereis aibuhitensis</i>	III	<i>Euclymene lombricoides</i>	I
<i>Glyceridae</i> sp.	II	<i>Eulalia viridis</i>	II
<i>Aricidea fragilis</i>	I	<i>Ophelina acuminata</i>	III
<i>Haploscoloplos elongatus</i>	III	<i>Paralacydonia paradoxa</i>	II
<i>Laonice cirrata</i>	II	<i>Paraprionospio pinnata</i>	IV
<i>Notomastus latericeus</i>	III	<i>Phyllodoce malmgreni</i>	II
<i>Phyllodoce papillosa</i>	II	<i>Poecilochaetus serpens</i>	I
<i>Phyllodoce chinensis</i>	II	<i>Praxillella praetermissa</i>	III
<i>Arandia intermedia</i>	I	<i>Phyllodocidae</i> sp.	II
<i>Heteromastus filiformis</i>	IV	<i>Pseudopolydora kemp</i>	III
<i>Nereiphylla castanea</i>	II	<i>Scolecopsis squamata</i>	III
<i>Sthenolepis japonica</i>	II	<i>Marphysa bellii</i>	II
<i>Terebellides stroemii</i>	II	<i>Notomastus latericeus</i>	III
<i>Chaetopterus variopedatus</i>	I	<i>Mediomastus</i> sp.	III
<b>Crustacea</b>	-	-	-
<i>Ampelisca cyclops</i>	I	<i>Austinogebia</i> sp.	I
<i>Byblis japonicus</i>	I	<i>Exopalaemon modestus</i>	I
<i>Leptochela gracilis</i>	III	<i>Gammaropsis nitida</i>	I
<i>Ogyrides orientalis</i>	I	<i>Harpiniopsis vadiculus</i>	I
<i>Crangon hakodatei</i>	I	<i>Nihonotrypaea harmandi</i>	III
<i>Penaeus orientalis</i>	II	<i>Neomysis awatschensis</i>	II
<i>Monoculodes koreanus</i>	I	<i>Phoxocephalus</i> sp.	I
<i>Acetes chinensis</i>	I	<i>Grandifoxus cuspis</i>	I
<i>Philyra pisum</i>	II	<i>Asthenognathus inaequipes</i>	II
<i>Portunus trituberculatus</i>	I	<i>Helice tientsinensis</i>	II
<i>Macrophthalmus dilatatus</i>	I	<i>Macrophthalmus japonicus</i>	I

Scientific name	AMBI groups	Scientific name	AMBI groups
<i>Scopimera globosa</i>	I	<i>Diogenes edwardsii</i>	II
<i>Tritodynamia horvathi</i>	II	<i>Orithya sinica</i>	NA
<i>Hemigrapsus sinensis</i>	II	<i>Cirolana japonensis</i>	II
<i>Cyathura peirates</i>	II	<i>Diastylis tricineta</i>	I
<i>Synidotea</i> sp.	NA	<i>Grandidierella japonica</i>	III
<b>Mollusca</b>	-	-	-
<i>Neptunea cumingii</i>	I	<i>Barnca davidi</i>	II
<i>Bullacta exarata</i>	I	<i>Lunatia gilva</i>	II
<i>Rapana venosa</i>	I	<i>Nassarius festivus</i>	II
<i>Neverita didyma</i>	I	<i>Nassarius variciferus</i>	II
<i>Assiminea lutea</i>	II	<i>Nassarius semiplicatus</i>	II
<i>Cyclina sinensis</i>	I	<i>Cerithium sinense</i>	II
<i>Meretrix meretrix</i>	I	<i>Musculista senhousia</i>	III
<i>Scapharca kagoshimensis</i>	IV	<i>Potamocorbula laevis</i>	V
<i>Mactra veneriformis</i>	I	<i>Mitrella bella</i>	I
<i>Moerella rutila</i>	I	<i>Terebra taylori</i>	I
<i>Umbonium thomasi</i>	II	<i>Solen strictus</i>	I
<b>Nemertea</b>	-	-	-
<i>Lineus</i> sp.	III	<i>Lineus fuscoviridis</i>	III
<b>Brachiopoda</b>	-	<b>Cnidaria</b>	
<i>Lingula anatina</i>	I	<i>Anthopleura xanthogrammica</i>	II
<b>Platyhelminthes</b>		<b>Chordata</b>	
<i>Discloplana gigas</i>	NA	<i>Gobiidae</i> sp.	NA

Note: EGI, sensitive species; EGII, indifferent species; EGIII, tolerant species; EGIV, second order opportunistic species; EGV, the first order opportunistic species, NA, No assigned.

Table S2. List of undefined macrobenthos species when the references about the sensitivity of that are not found.

Scientific name	Assigned AMBI groups
<i>Anthopleura xanthogrammica</i>	changed by <i>Anthopleura</i> sp. (II)
<i>Assiminea lutea</i>	changed by <i>Assiminea latericea</i> (II)
<i>Austinogebia</i> sp.	changed by <i>Austinogebia wuhsienweni</i> (I)
<i>Barnca davidi</i>	changed by <i>Barnea davidi</i> (I)
<i>Cerithium sinense</i>	changed by <i>Cerithium</i> sp. (II)
<i>Crangon hakodatei</i>	changed by <i>Crangon affinis</i> (I)
<i>Cyathura peirates</i>	changed by <i>Cyathura</i> sp. (III)
<i>Exopalaemon modestus</i>	changed by <i>Exopalaemon carinicauda</i> (I)
<i>Glyceridae</i> sp.	changed by GLYCERIDAE (II)
<i>Gobiidae</i> sp.	changed by GOLFINGIIDAE (I)
<i>Grandifoxus cuspis</i>	changed by <i>Grandifoxus grandis</i> (I)
<i>Llyella gigas</i>	no assigned
<i>Lumbrineridae</i> sp.	changed by <i>Lumbrinerides</i> sp. (II)
<i>Monoculodes koreanus</i>	changed by <i>Monoculodes</i> sp. (I)
<i>Neptunea cumingii</i>	changed by <i>Neptunea antiqua</i> (I)
<i>Nereis grubei</i>	changed by <i>Nereis</i> sp. (III)
<i>Orithya sinica</i>	no assigned
<i>Penaeus orientalis</i>	changed by <i>Penaeus indicus</i> (II)
<i>Phyllodocidae</i> sp.	changed by <i>Phyllodoce</i> sp. (II)
<i>Synidotea</i> sp.	no assigned
<i>Terebra taylori</i>	changed by <i>Terebra</i> sp. (II)

Table S3. Annual run off, sediment discharges and sediment concentration of Liaohe in Liujianfang hydrology station.

Year	Annual run off (hundred million m <sup>3</sup> )	Annual sediment discharges (Million tons)	Annual sediment concentration (kg/m <sup>3</sup> )
2013	57.2	427	0.747
2014	23.08	87.6	0.38
2015	9.16	15.7	0.172
2016	26.33	109	0.413
2017	15.93	85.7	0.538
2018	9.373	26.9	0.287
2019	31.08	179	0.576
2020	32.5	156	0.48

Table S4. One-way ANOVA results of M-AMBI and organic matter content for different sections in the intertidal flats of Liaohe Estuary from 2013 to 2020.

Sections	M-AMBI			Organic matter content	
	df	F	<i>P</i>	F	<i>P</i>
A	63	5.047	0.000	4.182	0.008
B	39	1.882	0.106	2.182	0.155
C	47	1.039	0.420	2.405	0.069
D	47	2.461	0.034	13.226	0.001
E	71	0.434	0.877	0.175	0.987
F	55	1.169	0.338	1.328	0.291
G	39	1.244	0.309	1.890	0.138

Table S5. One-way ANOVA results for organic matter content, median grain size, clay, sand, and silt sand of sediments in the intertidal flats of Liaohe Estuary from 2013 to 2020.

Sediment factors	df	F	<i>P</i>
Organic matter content	327	2.938	0.008
Median grain size	327	0.416	0.892
Sand	327	0.865	0.534
Silt sand	327	0.571	0.779
Clay	327	6.013	0.000

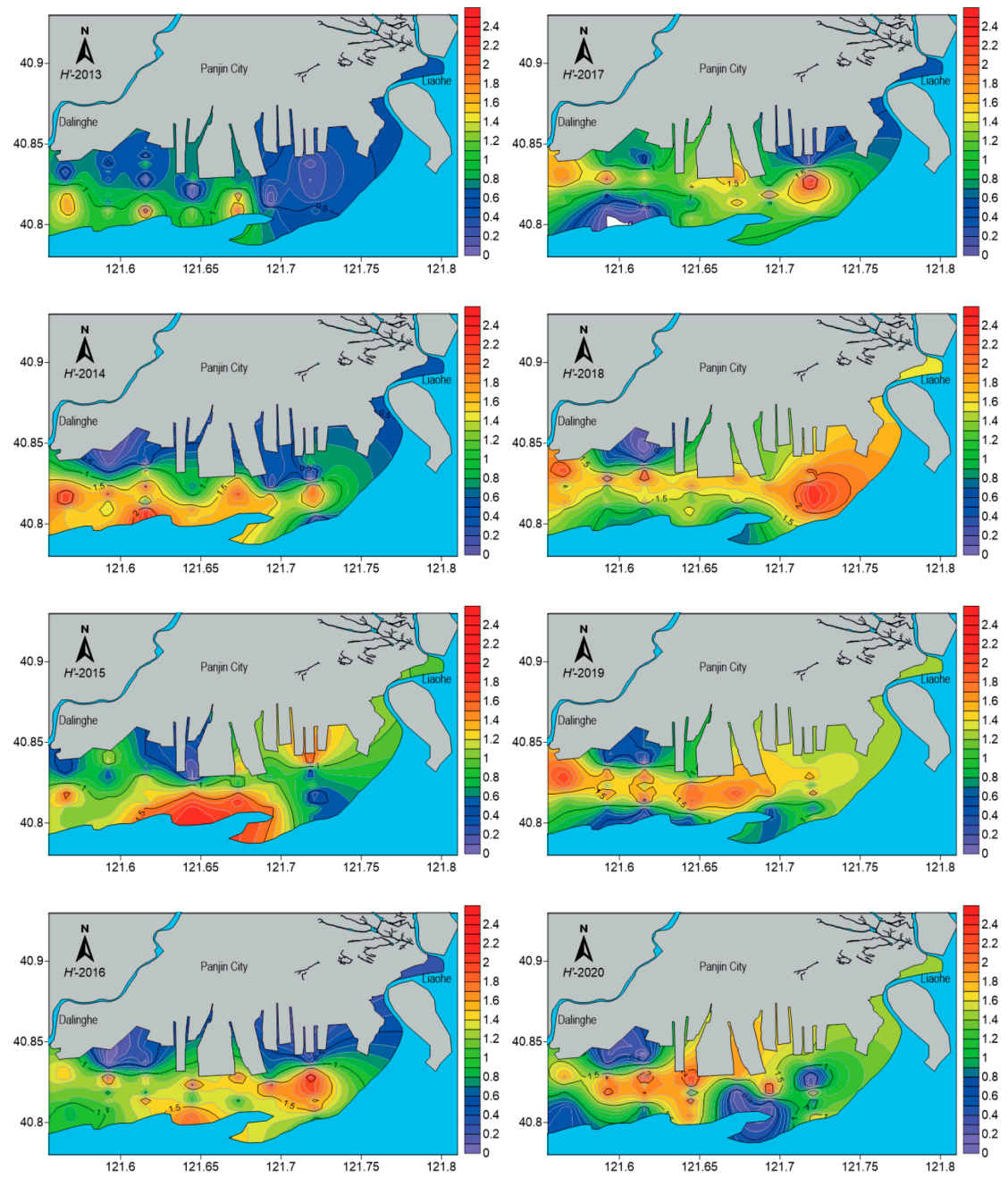


Figure S1 Spatial distribution maps of the  $H'$  values of the intertidal flats in Liaohu Estuary from 2013 to 2020

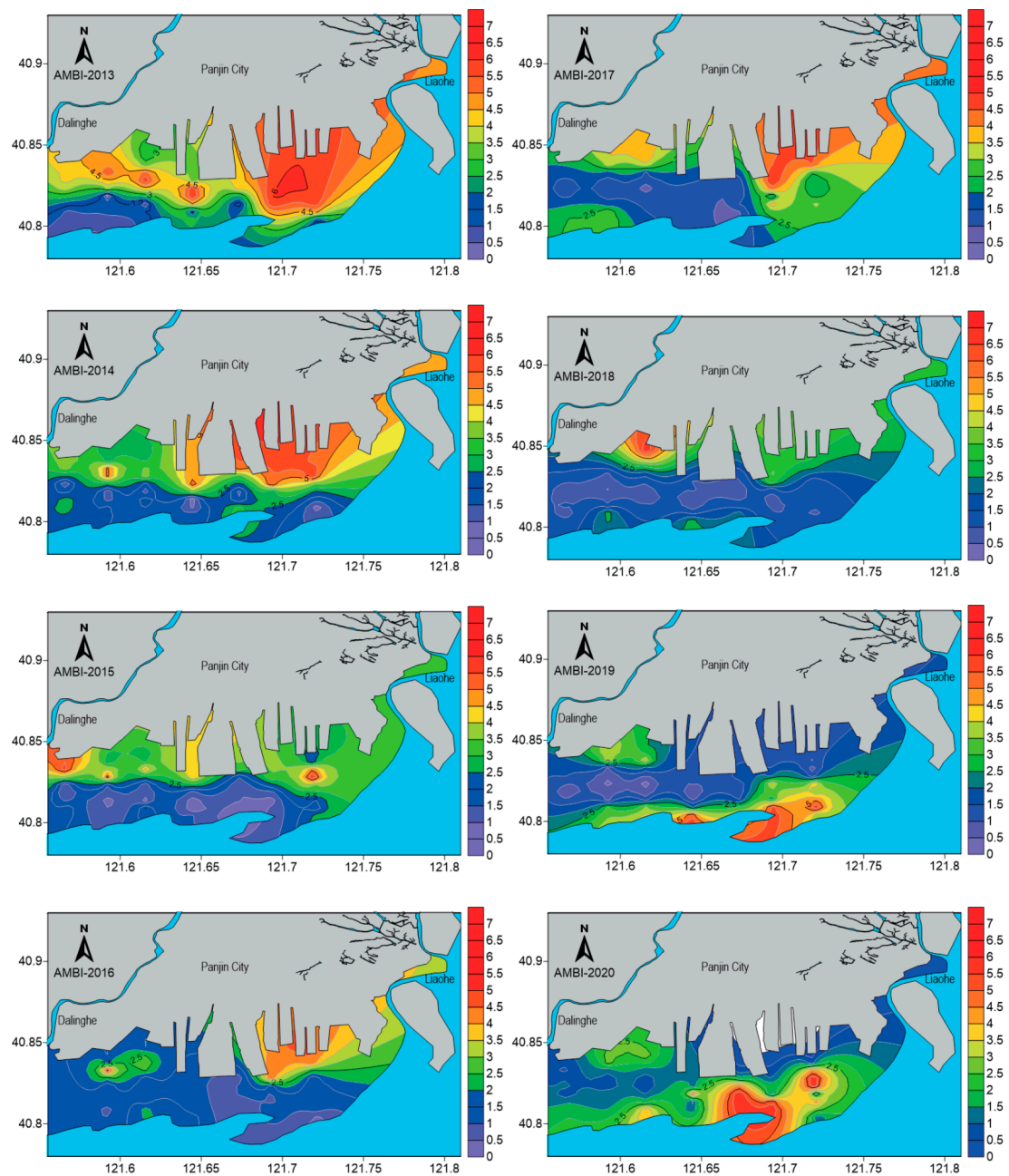


Figure S2 Spatial distribution maps of the AMBI values of the intertidal flats in Liaohu Estuary from 2013 to 2020



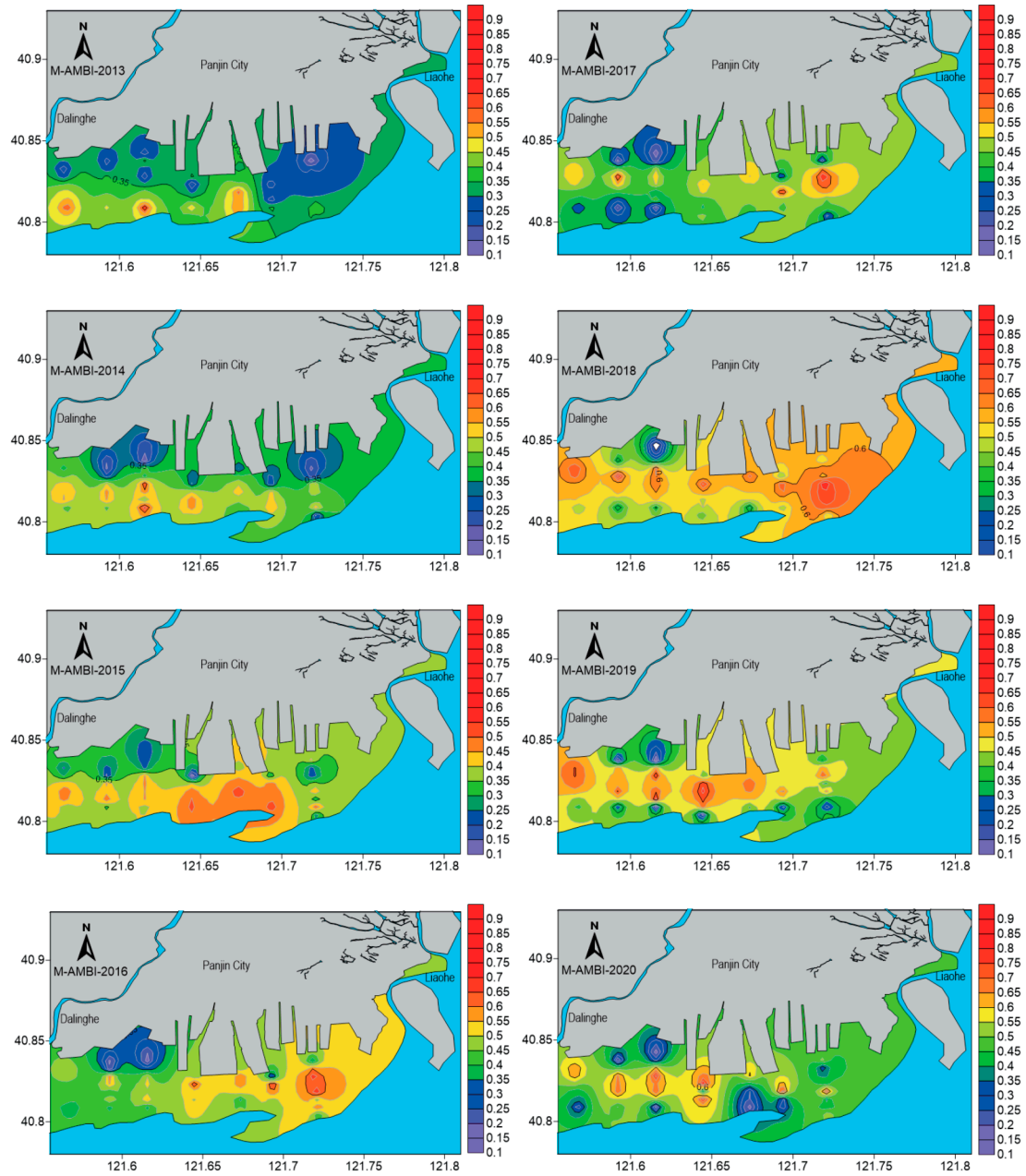


Figure S3. Spatial distribution maps of the M-AMBI values of the intertidal flats in Liaohé Estuary from 2013 to 2020