Supplementary Materials for

Larval dispersal modeling reveals low connectivity among national marine protected areas in the Yellow and East China Seas

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Table S1. Source of biological parameters for study species

Scientific name	PLD （days）	Depth （m）	Spawning window	Source
Nemipterus virgatus	75	25	Apr-May	https://www.fishbase.se/summary/Nemipterus-virgatus.html
Sepiella maindroni	45	10	Apr-May	WU C, DONG Z, CHI C, et al. (2010) [1]
Epinephelus bruneus	45	20	May-Jun	WANG B, SUN P, ZHANG Z, et al. (2006) [2]
Larimichthys crocea	33	15	Apr-May	ZHUANG P. (2006) [3]
Argyrosomus argentatus	33	50	Jun-Aug	https://www.fishbase.de/Summary/SpeciesSummary.php?ID=434&AT=%26%2330333%3B%26%2322993%3B%26%2340060%3B
Argyrosomus japonicus	33	100	Jan-Mar	WANG B, ZHANG X, QU X, et al. (2002) [4]
Evynnis cardinalis	30	45	Nov-Jan	CAI Y, CHEN Z, XU Z, et al. (2017) [5]
Apostichopus japonicus	20	10	May-Jun	https://www.reeflex.net/tiere/6815_Apostichopus_japonicus.htm
Scomberomorus niphonius	19	20	May-Jun	Tang Q. (2012) [6]
Portunus Trituberculatus	17	20	Apr-Jun	CHUL O. (2011) [7]
Epinephelus akaara	15	25	Apr-Jun	M UKAWA. (1966) [8]
Anguilla japonica	10	3	Nov-Dec	ZOU Y. (2002) [9]
Penaeus japonicus	10	20	Dec-Mar	CAI X. (1981) [10]
Acropora solitaryensis	7	5	Apr-May	ZHANG Y, HUANG H, HAUNG J, et al. (2013) [11]

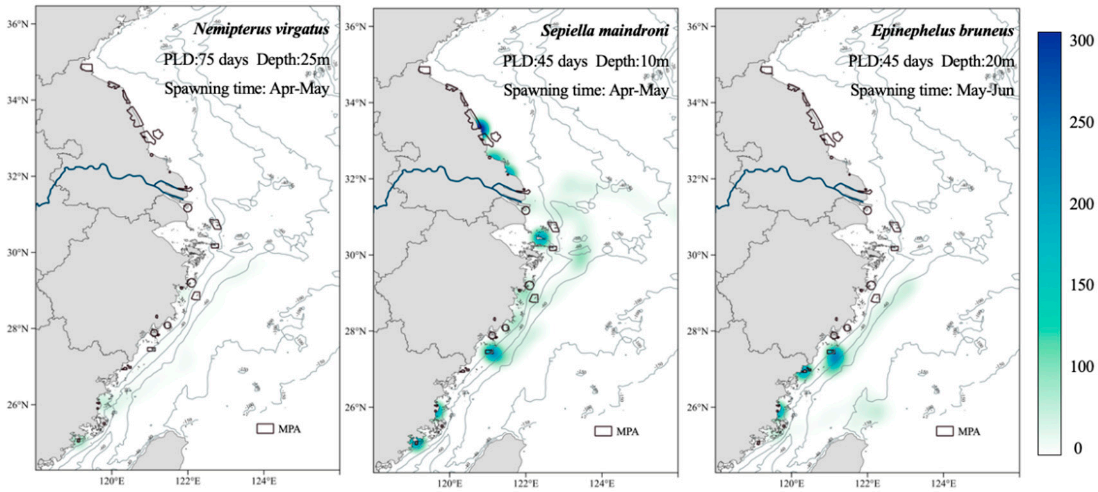

Figure S1. Potential larval export of species with PLD⩾45: *Nemipterus virgatus, Sepiella maindroni, Epinephelus bruneus*

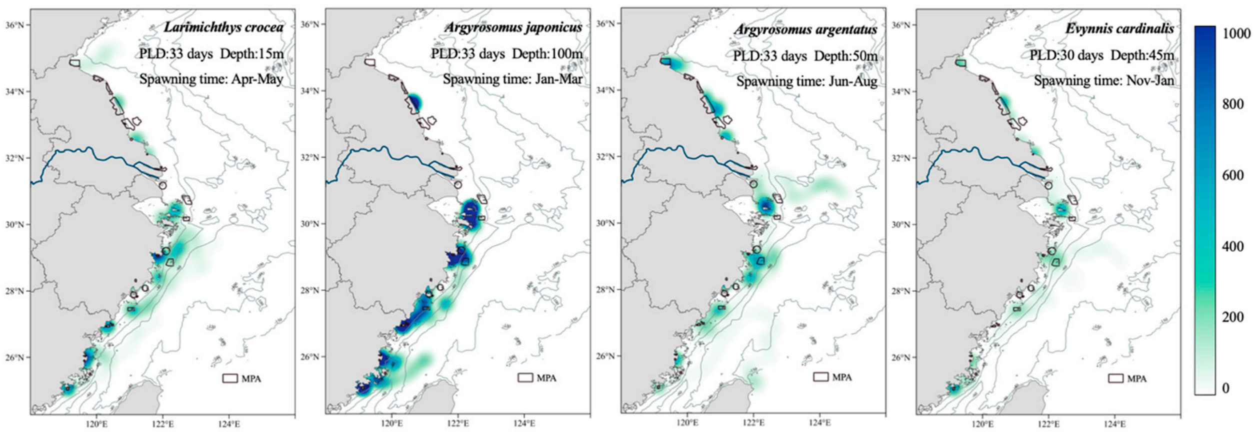

Figure S2. Potential larval export of species with PLD (30~44): *Larimichthys crocea, Argyrosomus argentatus, Argyrosomus japonicus, Evynnis cardinalis*

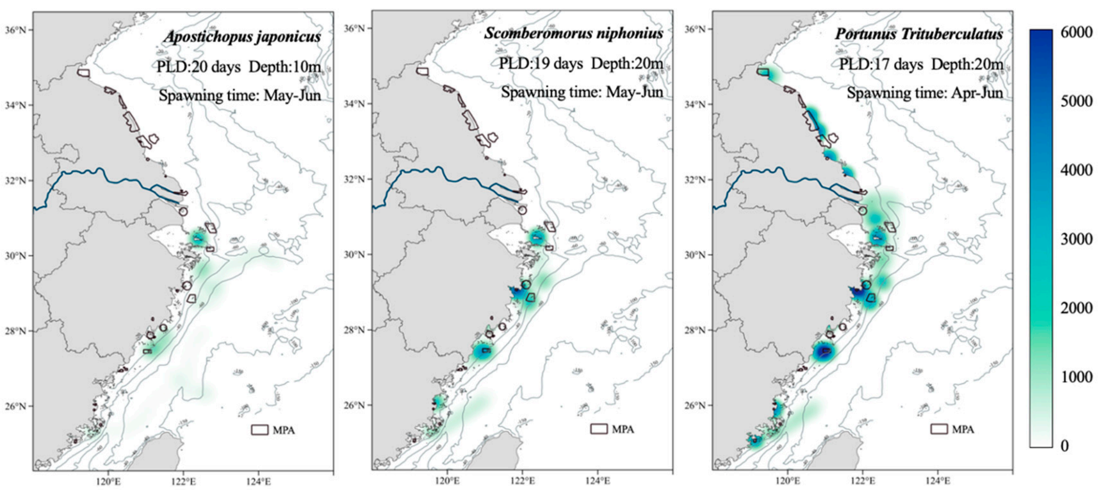

Figure S3. Potential larval export of species with PLD (16~29): *Apostichopus japonicus, Scomberomorus niphonius, Portunus Trituberculatus*

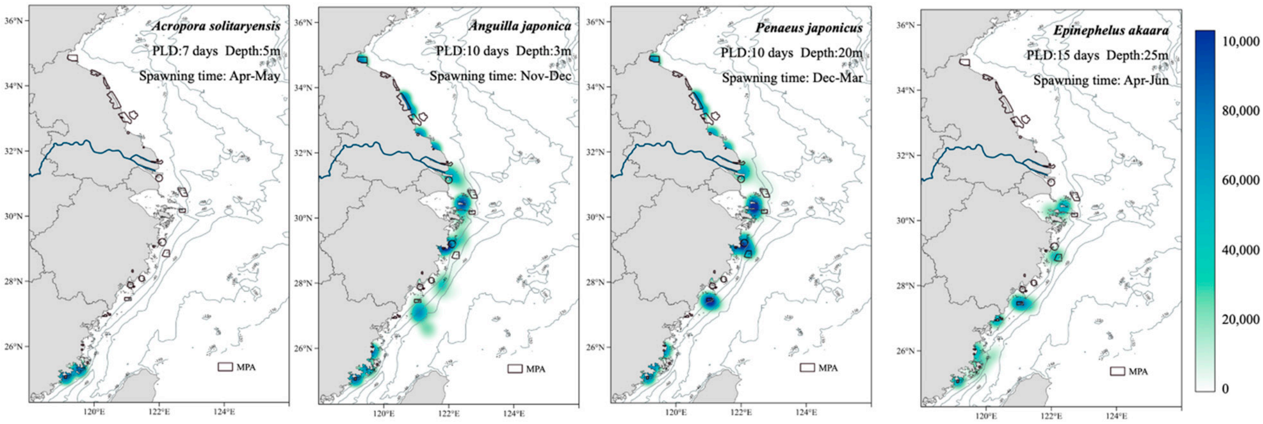

Figure S4. Potential larval export of species with short PLD (⩽15): *Epinephelus akaara, Anguilla japonica, Penaeus japonicus, Acropora solitaryensis*

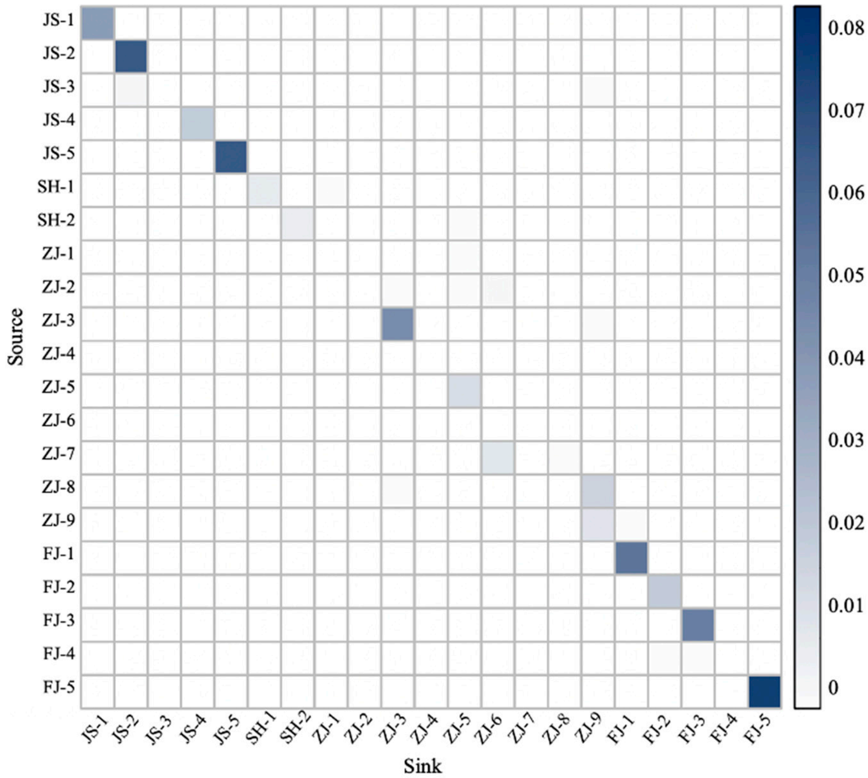

Figure S5. Self-recruitment fraction and subsidy recruitment fraction of MPAs

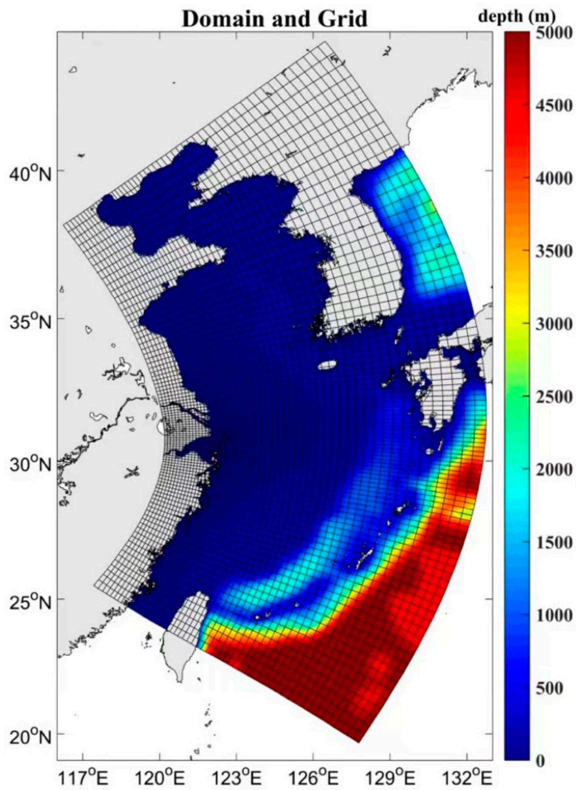

Figure S6. The computational grid of the ROMS model and the domain of configuration area.

Particle stability analysis for recent eight years

The reason for selecting the year 2016 because the particle dispersal dynamics in 2016 basically was an average field while there can be differences from year to year.

We have verified the rationality of selecting the year 2016 through simple model test when we built the model in 2019. We did Lagrangian particle tracking with altimeter-derived geostrophic velocities using 4th order Runge-Kutta method with Dormand-Prince pairs. We selected Shengsi SMPA (ZJ-1) as the release point and July 1st as the release start time. The particles floated for seven days. The simulation was conducted based on eight years of surface geostrophic satellite data from 2014 to 2018(https://data.marine.copernicus.eu/products?option=com_csw&task=results). In order to see the particle stability of each year, we divided every three years into a group and mapped the positions of three points from different groups at the same time to a plane. Then we calculated the area of the circumcircle of the triangle formed by them, so as to see the degree of dispersion of the three points.

The results (the figure below) showed that the particle dispersion of all the other groups showed relatively stable except for the group 2014-2016. The reason why the three particles from 2014-2016 were really discrete could be attributed to the strong El Niño which caused dramatic changes in the global climate. Besides, the group 2015-2017 was more stable than the group 2016-2018. Since the model was built in 2019, the data of 2016 was relatively new at the time. Based on the above results, we considered that the particle dispersal was more stable in 2016 during 2014-2018.

In conducting this study, we updated the particle stability test by 2021. The particles from group 2017-2019 and the group 2018-2020 were the most stable while the particles from group 2019-2021 were more discrete than group 2015-2017. Compared with the group 2014-2016 and 2016-2018, the circumcircle areas of other groups were relatively close. The results indicated that besides the year 2016, the particle dispersal dynamics of the years after 2018 could also be considered average fields in recent eight years.

Of course, the selection still has some limitations. First, we admit that the model test was simple, considering only one release point and short floating time. The results could only show the changes in the coastal current near the release point and the preliminary judgment on the particle stability of different years. Second, several researches and our study simulated for one year [12,13] while some new studies have begun to explore long-term simulations and predict impacts of future climate change on MPA connectivity[14-16]. There could be heterogeneous connectivity patterns during the spawning events at inter-annual scales[15]. Climate change can lead to reduced pelagic larval duration and larvae survival rate, affecting population connectivity and the optimal location of MPAs[16]. If larval dispersal simulation can be carried out in coastal China for years, these studies will provide more reliable references for Marine protection in China to cope with future climate change.

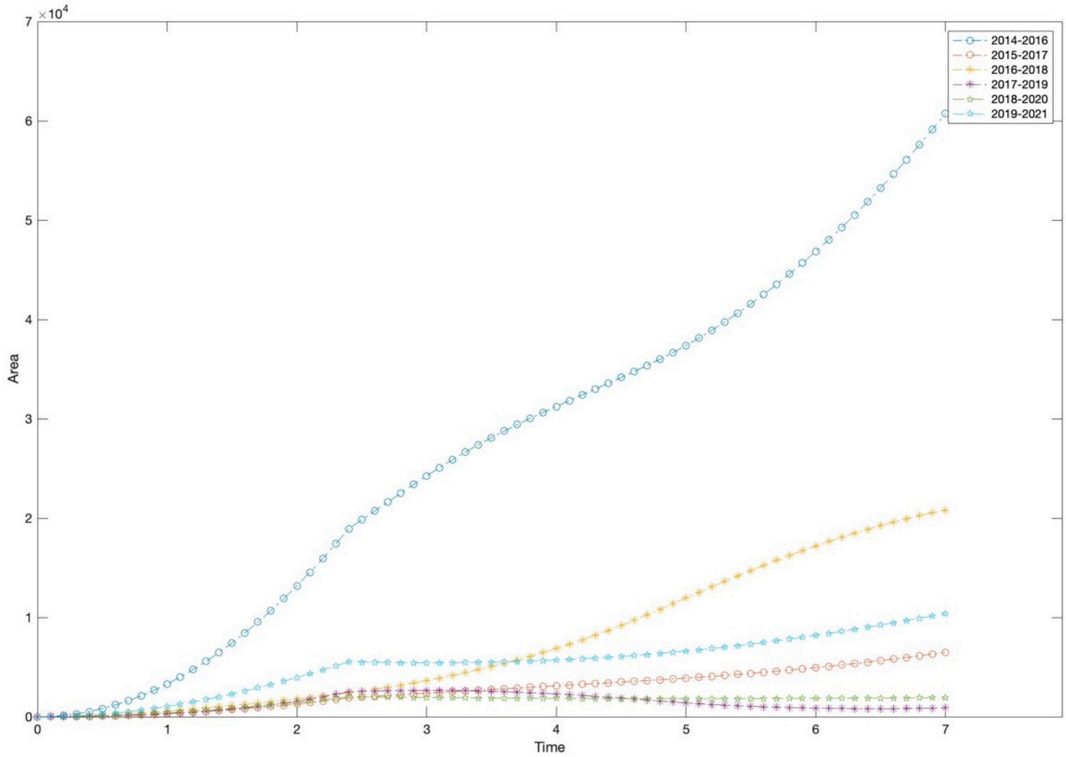

Figure S7. The circumcircle areas of the triangles formed by particles for recent eight years (2014-2021)

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