Projecting changes in the distribution and maximum catch potential of warm water fishes under climate change scenarios in the Yellow Sea

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Abstract

Aim: Ocean warming has been observed in a number of marine ecosystems and is believed to influence marine species in many ways, such as through changes in distribution range and abundance. In this study, we investigated the potential impacts of climate change on the distribution and maximum catch potential of 34 warm water fishes from 2000 to 2060.

Location: Yellow Sea, China.

Methods: We used a dynamic bioclimate envelope model under the RCP2.6 and RCP8.5 scenarios with Earth system models, including GFDL, IPSL, MPI and their ensemble average, to predict current species distributions and their relative abundance and project future species distributions and maximum catch potential (MCP). Results are subsequently summarized by indices such as latitudinal centroid (LC) and mean temperature of relative abundance (MTRA).

Results: Our results showed that the 34 warm water fish species in the Yellow Sea will likely shift to lower latitude regions under future climate change scenarios. In particular, the average LC in the Earth system models of GFDL, IPSL and MPI from 1970 to 2060 is projected to shift at rate of $-2.96 \pm 1.29$ (SE) and $-3.20 \pm 1.94$ (SE) km per decade under the RCP2.6 and RCP8.5 scenarios, respectively. In addition, the corresponding maximum catch potential is decreased under the above climate change scenarios. The projected changes in the distribution may have major ecological and socio-economic importance as well as implications for invasive species management, marine ranching construction and shifts in fishing grounds.

Main conclusions: The projected distribution of 34 warm water fish species in the Yellow Sea shifted to lower latitudes from 2000 to 2060 following both RCP scenarios and Earth system models. This result is contrary to the projections of previous studies suggesting that fish species can shift to higher latitudes or deeper waters under increased temperature scenarios. This difference might be due to the...
1 | INTRODUCTION

The Intergovernmental Panel on Climate Change Fifth Assessment Report states that climate change is altering the marine environment and ecosystem at an unprecedented rate compared with the recent past (Church et al., 2013; Poloczanska, Hoegh-Guldberg, Cheung, Portner, & Burrows, 2014; Pörtner et al., 2014). Changes in the marine environment, such as physical (e.g., ocean current patterns, temperature) and chemical (e.g., oxygen content, acidity; Doney et al., 2012), have led to perturbation of the biotic compartments of marine ecosystems such as changes in physiology (Dulvy et al., 2008; Pauly & Cheung, 2018), phenology (Edwards & Richardson, 2004), community size structure (Baudron, Needle, Rijnsdorp, & Tara Marshall, 2014; Calbet et al., 2014; Lefort et al., 2014; Suikkanen et al., 2013; Woodworth-Jefcoats, Polovina, Dunne, & Blanchard, 2013), spatial distribution and abundance (Cheung, Reygondeau, & Frölicher, 2016; Cheung, Watson, & Pauly, 2013; Golden et al., 2016; Perry, Low, Ellis, & Reynolds, 2005; Stock et al., 2017).

Fewer studies have been conducted to investigate the impacts of climate change on the distribution and maximum catch potential at a regional scale. The Yellow Sea (China) is a highly dynamic, diverse and productive region; according to published literature, the FAO, FishBase and historical investigations from 1950 to 2011 (Liu & Ning, 2011), a total of 113 families and 321 species have been recorded in the Yellow Sea. Among them, 139 are warm temperate species, 107 are warm water species, 70 are cold temperate species and only 5 are cold-water species (Liu & Ning, 2011).

Since the 1950s, fishery resources in the Yellow Sea have changed in terms of both species composition and biomass (Li, Zhao, Liu, Zhang, & Hou, 2018). For example, the main fish species in the 1950s-1960s were demersal species with high economic value, such as Pseudosciaena polyactis, Trichiurus haumela and Cynoglossus semilaevis (Dai, Zhu, & Chen, 2018). Clupea pallasi, Scomberomorus niphonius and Scomber japonicus became the dominant species in the 1970s-1980s (Xu et al., 2003). Lophius litulon with low economic value and Liparis tanakae with no economic value gradually became the dominant species by the end of the 1990s (Zhang & Tang, 2004).

This study explores the projected changes in distribution and maximum catch potential under climate change scenarios from 2000 to 2060, namely low (RCP (representative concentration pathway) 2.6) and high (RCP 8.5) greenhouse gas emission scenarios from three different Earth system models (ESMs), the GFDL-ESM2G (developed by the Geophysical Fluid Dynamic Laboratory of the US National Oceanic and Atmospheric Administration, GFDL), IPSL-CM5A-MR (developed by the Institute Pierre Simon Laplace, IPSL) and MPI-ESM-MR (developed by the Max Planck Institute, MPI).

The changes in distribution and maximum catch potential will exacerbate existing fisheries challenges for the sustainable governance of common pool resources. This paper should provide results that contribute to the assessment of the impacts on marine ecosystems (such as local extinction and invasion) and fisheries (such as maximum catch potential) in the Yellow Sea, thereby promoting invasive species management, marine ranching construction and fishing ground conservation.

2 | MATERIALS AND METHODS

2.1 | Materials

The median preferred temperatures of the 34 studied species range from 16°C to 28°C (Figure 1). Species including Sphyraena lewini, Chelidonichthys kumu and Scomber australasicus were classified as extensive temperature distribution species, and mainly live in the East China Sea and only appear in the south-central Yellow Sea in warm months. Species such as Sphyra zygaena and Mugil cephalus are widely distributed in the tropical and temperate areas of the world’s three oceans. In addition, species such as Dasyatis akajei and Konusirus punctatus travel to the Yellow Sea only in summer and autumn with warm currents. Generally, the median preferred temperature of the species varied widely and in a positive quadratic function relationship with the range of the preferred temperature (calculated from the difference between the 5% and 95% percentiles of the cumulative predicted relative abundance of each species across the temperature range; Figure 1: p-value = .0023, R² = .1448). This suggests that warm water species tend to have a narrow range of preferred temperatures and are much sensitive to temperature changes.

2.2 | Model description

The model approach involves two stages: (a) predicting current species distributions and their relative abundance and (b) modelling
future species distributions and maximum catch potential (MCP) following three ESMs projections for two RCPs.

### 2.2.1 Predicting current species distributions

The current distributions and relative abundance of each warm water species in recent decades were developed by the Sea Around Us Project (see www.seaaroundus.org) using the algorithm proposed by Close et al. (2006). This algorithm estimates the current distributions and relative abundance of a species on a 30’ latitude × 30’ longitude grid based on input parameters such as the species’ northern and southern latitudinal range limits; maximum and minimum depth limits; an index of association to major habitat types including seamounts, estuaries, inshore, offshore, continental shelves, continental slopes and abyss; and known occurrence boundaries (Cheung, Dunne, Sarmiento, & Pauly, 2011; Cheung, Jones, et al., 2016; Cheung, Lam, & Pauly, 2008). The parameter values of each species were obtained from FishBase (www.fishbase.org), SeaLifeBase (www.sealifebase.org) and the Oceanic Biogeographic Information System (http://iobis.org). We then applied this model to predict the current distributions and relative abundances (normalized across a 30’ latitude × 30’ longitude grid) of the 34 species of warm water species in the Yellow Sea.

### 2.2.2 Modelling future species distributions and maximum catch potential (MCP)

The DBEM is used to simulate changes in the distribution, abundance and catches of the 34 warm water fishes under various climate change pathways, including the GFDL, IPSL and MPI ESMs for both RCP 2.6 and RCP 8.5. The structure, parameter settings and assumptions of the DBEM are described in Cheung et al. (2008, 2011) and Cheung, Jones, et al. (2016).

The performance of these ESMs, which are selected from the Coupled Model Intercomparison Project Phase 5 (e.g. CMIP5) database that the species distribution and abundance model (Cheung, Reygondeau, et al., 2016) requires, has been extensively examined and tested (Kwiatkowski et al., 2017; Laufkötter et al., 2015). The parameter values of seawater temperature (surface and bottom), oxygen concentration (surface and bottom), hydrogen ion concentration (surface and bottom), net primary production (depth integrated), salinity (surface and bottom), sea ice extent and surface advection can be obtained from the above ESMs, which can be used for DBEM to predict species distributions and maximum catch potential. All model data were regrided onto a 30’ latitude × 30’ longitude grid using bilinear interpolation.

### 2.3 Analysis methods

Using the projected changes in species distributions and abundance, we calculated the rate of the shift in distribution, measured by the latitudinal and longitudinal movement of the centroid of the species distribution within the Yellow Sea. For each species, the latitudinal centroid (LC) was calculated as follows:

\[
LC = \frac{\sum_{i=1}^{n} L_i \cdot \text{Abd}_i}{\sum_{i=1}^{n} \text{Abd}_i}
\]

where \(L_i\) and \(\text{Abd}_i\) are the latitudinal coordinates and the species’ relative abundance at the centre of cell \(i\), respectively. Relative abundance is weighted by the area of sea in each 30’ latitude × 30’ longitude grid. \(n\) is the total number of cells within the study region.

The difference between latitudinal centroids in projected and reference years (DC) is then calculated in kilometres (km) by:

\[
DC = (LC_{y1} - LC_{y2}) \cdot \frac{\pi}{180} \cdot 6,378.2
\]

### FIGURE 1

Inferred temperature preference profiles of the studied fish species: (a) with the median (black circles) and the lines delineating the 5 and 95 percentiles of the cumulative predicted relative abundance of each species across a range of sea surface temperature; (b) with the 5 and 95 percentiles range of preferred temperature plotted against the median preferred temperature. A quadratic curve was fitted to the data points.
where $y_1$ and $y_2$ are the projected and reference years, respectively. The invariant constant, 6,378.2, is the orbital radius of the equatorial plane (kilometres). We then calculated the rate of range shift from the slope of changes in DC from 1970 to 2060, standardized across species.

We examined shifts in species assemblages by calculating the mean temperature of relative abundance (MTRA), a metric that is similar in concept to the mean temperature of catch (Cheung, Watson, et al., 2013). The MTRA was computed from the average inferred temperature preference as documented in Cheung, Watson, et al. (2013) and Cheung, Sarmiento, et al. (2013) weighted by their predicted relative abundance, that is

$$\text{MTRA}_{i, \text{yr}} = \frac{\sum_{i=1}^{n} T_i \cdot \Abd_{i, \text{yr}}}{\sum_{i=1}^{n} \Abd_{i, \text{yr}}}$$

where $T_i$ is the median temperature preference of species $i$, and $n$ is the total number of species.

3 | RESULTS

3.1 | Current species distributions

The distribution (expressed by Spp. richness) of the 34 species calculated using the above methods is shown in Figure 2. Most of the 34 studied species are predicted to occur in the sea south of $35^\circ$ latitude (Figure 2). The Figure 2 shows that the lower the latitude, the greater the Spp. richness. In particular, the Spp. richness in the sea south of $35^\circ$ latitude is much higher than 12 species, even up to 27–30 species. Meanwhile, the Spp. richness in the vast majority of the northern sea area of $36^\circ$ latitude is just no more than nine species.

3.2 | Projected future species distributions

The latitudinal centroids of the studied species were projected to shift southward with increasing atmospheric CO$_2$ concentration in the future. Under the RCP2.6 scenario, SST is projected to increase by an average rate of 0.094, 0.159 and 0.106°C per decade in the Earth system models GFDL, IPSL and MPI, respectively, from 1970 to 2060 (Figure 3). Meanwhile, under the RCP8.5 scenario, SST is projected to increase by an average rate of 0.194, 0.297 and 0.197°C per decade in the Earth system models GFDL, IPSL and MPI, respectively (Figure 3). In comparison, under the RCP 2.6 and 8.5 scenarios, the ensemble average SST in the Earth System Models of GFDL, IPSL and MPI is projected to increase by 0.120 and 0.229°C per decade, respectively, during the same period (Figure 3). Meanwhile, the temperature increase rate of the coastal and northern areas of the Yellow Sea is much more dramatic than that of the central cold water area (Figures 9 and 10). As a result, the latitudinal centroids of the 34 warm water fish species were projected to shift anti-poleward at an average rate of $10.33 \pm 5.54$ (Standard Error, SE), $1.88 \pm 3.35$ and $4.04 \pm 3.27$ km per decade with forcing from the Earth system models GFDL, IPSL and MPI, respectively, under the RCP2.6 scenario, from 1970 to 2060 (Figure 4). Meanwhile, under the RCP8.5 scenarios, the corresponding latitudinal centroids were projected to shift at an average rate of $−37.30 \pm 14.14$ (SE), $−1.94 \pm 3.56$ (SE) and $−13.46 \pm 12.72$ (SE) km per decade (Figure 4). In comparison, under the RCP 2.6 and RCP 8.5 scenarios, the average latitudinal centroids in the Earth system models GFDL, IPSL and MPI are projected to shift at a rate of $−2.96 \pm 1.29$ (SE) and $−3.20 \pm 1.94$ (SE) km per decade, respectively, during the same period (Figure 4). Though the ensemble average rate of range shift under the RCP 2.6 scenario is lower than the rate projected under RCP 8.5 ($p < .001$ ANCOVA), the overall trend that the projected latitudinal centroids shift to lower latitudes is identical.

The equatorward distribution shifts may result in changes in species assemblages in the Yellow Sea (Figures 5 and 6). Generally, the local invasion rates in the southern region are predicted to be higher than those in the northern region due to the anti-poleward distribution shifts under the RCP2.6 and RCP8.5 scenarios of GFDL, IPSL and MPI. Meanwhile, the local extinction rate trends are the opposite the local invasion rates. In particular, the local extinction rates in the northern region are predicted to be higher than the southern local extinction rates under the RCP2.6 and RCP8.5 scenarios of GFDL, IPSL and MPI.

Changes in the mean temperature of relative abundance (MTRA), which is calculated from the projected changes in relative abundance of the 34 warm water fish species, show that the MTRA will decrease with the increased greenhouse gas emissions from 1970 to 2060 under the RCP2.6 and RCP8.5 scenarios of GFDL, IPSL and MPI (Figure 7). The relative abundance in the southern Yellow Sea region is much higher than that in the
northern region under the RCP2.6 and RCP8.5 scenarios of GFDL, IPSL and MPI and their ensemble average (Figure 8). The changes in the MTRA under the RCP2.6 scenarios of GFDL, IPSL, MPI and their ensemble average from 1970 to 2060 are −0.072, 0.013, −0.053 and −0.037°C per decade, respectively. Meanwhile, the corresponding changes in MTRA under the RCP8.5 scenarios during the same period are −0.039, 0.082, −0.020 and 0.008°C per decade, respectively.

4 | DISCUSSION

In the present study, we project the changes in distribution and maximum catch potential under RCP2.6 and RCP8.5 scenarios with three Earth system models (GFDL, IPSL and MPI) and their ensemble average from 2000 to 2060 using DBEM. Our results suggest that the projected latitude centroids of the 34 warm water fish species studied would in average shift southward with increasing atmospheric CO₂ concentrations. Our findings are contrary to previous studies that suggest that fish species can shift to higher latitudes or deeper waters under increased temperature scenarios, which may provide important management implications for invasive species management, marine ranching construction and fishing ground conservation.

The SST has been increasing significantly since the 1970s and is projected to increase in the future (Figure 3) as a result of the East Asian Monsoon, the Western Pacific Subtropical Anticyclone and anthropogenic emissions of greenhouse gases (Zhang, Weng, & Cheng, 2001). Generally, most fish species will shift to the polar regions or the deep sea in the North Sea (Dulvy et al., 2008; Perry et al., 2005), the northeast U.S. continental shelf (Nye et al., 2009), the Bering Sea (Mueter & Litzow, 2008) or the northeast Pacific shelf (Cheung, Brodeur, Okey, & Pauly, 2015). For example, 2/3 of fish species in the North Sea, such as Gadus morhua, Lophius budegassa and Lumpenus lamprotaeformis, have moved to higher latitudes or deeper sea regions with increasing SSTs during the past 25 years (Hiddink & Ter Hofstede, 2008; Perry et al., 2005). However, this paper shows that the 34 studied warm water fish species may shift to lower latitude regions, rather than the higher latitude regions noted above. This shift might be due to several factors, such as the specific geographical location, the Yellow Sea Cold Water Mass and fishing capacity.

The Yellow Sea is a semi-enclosed shelf sea situated between China and the Korean Peninsula. The seabed topography is relatively
flat, and most of the sea area is less than 100-m deep. The principal currents in the Yellow Sea include the Yellow Sea Coastal Current and the Yellow Sea Warm Current, which are strong in winter and weak in summer (Liu & Ning, 2011). Especially in summer, seawater stratification takes place due to the particular geographical environment in the central deep-water area of the Yellow Sea. The stratification forms the Yellow Sea Cold Water Mass, which provides good conditions for the survival and development of many fish species (Compilers of the “The Marine Fishery Environment of China,” 1991). The Yellow Sea is frequently influenced by the fluctuations of

**FIGURE 4** Predicted latitudinal centroids of the 34 warm water fish species from 1970 to 2060 under the RCP2.6 and RCP8.5 scenarios that were driven by outputs from Earth System Models (a) GFDL, (b) IPSL, (c) MPI and (d) ensemble of projections driven by the three Earth System Models. The thick black line represents median; the box represents 25 and 75 percentiles, while the solid line represents upper and lower limits. Positive values represent poleward range shifts.

**FIGURE 5** Predicted changes in species assemblages in each 30’ × 30’ grid by 2060 relative to that in 1970 represented by the rate of species invasion under the RCP2.6 and RCP8.5 scenarios. The results are ensemble outputs driven by the three Earth System Models including GFDL, IPSL and MPI.
the Yellow Sea Coastal Current, the Yellow Sea Warm Current and the Yellow Sea Cold Water Mass.

The northern Yellow Sea region is an important reproductive, hatching, baiting and growing area for many seasonal migratory fish species in the Yellow Sea, such as *Konosirus punctatus*, *Mugil cephalus*, *Auxis rochei* and *Sardinella zunasi*. The seasonal change in water temperature in the northern Yellow Sea (over 20°C) is much greater than that in the southern central Warm Water Mass region, so the seasonal variation in fish species biomass is obvious. The seasonal variation in biomass has decreased and even disappeared as the increasing SST exceeds the temperature survival range for fish species (Sherman, 1990; Tang, 1993).

Though the long-term mean temperature of the Yellow Sea Cold Water Mass from 1976 to 2006 showed a warming trend, the variation and the historical temperatures are still smaller than the surrounding sea area (Jiang, Bao, Wu, & Xu, 2007; Li, Yu, Si, & Wei, 2017; Yu, Yu, Diao, & Si, 2012). As shown in Figures 9 and 10, the temperature increase rate in the coastal and northern Yellow Sea area is much more dramatic than that in the central cold water area, and the fish species disappear or are forced to shift to a relatively low-temperature area, namely the central cold water area, which is located in the low-latitude southern area. As a result, the local extinction rate in the coastal and northern Yellow Sea area is projected to be higher than the extinction rate in the central cold water area (Figure 6), especially under the RCP2.6 and RCP8.5 scenarios of GFDL. Meanwhile, the increasing temperature is also projected to lead to higher local invasion in the southern central cold water area than in the coastal and northern Yellow Sea area, particularly under...
the RCP8.5 scenarios of the GFDL, IPSL, and MPI and their ensemble average outputs (Figure 5). Then, the relative abundance in the southern central cold water area is projected to be much higher than that in the coastal and northern Yellow Sea area under the RCP2.6 and RCP8.5 scenarios of GFDL, IPSL and MPI and their ensemble average (Figure 8). Similarly, the predicted species richness of the 34 warm water fish species in the southern central cold water area is predicted to be much higher than that in the coastal and northern Yellow Sea area under the RCP2.6 and RCP8.5 scenarios of GFDL, IPSL and MPI and their ensemble average (Figure 8).
Yellow Sea area under the RCP2.6 and RCP8.5 scenarios of GFDL, IPSL and MPI and their ensemble average because of the asynchronous fluctuation of the SST (Figure 11). It should be noted that Figure 2 and Figure 11 (MEAN RCP8.5) look the same; the reason is that the actual values are different in the same 30’ latitude × 30’ longitude grid (e.g., the value in the cell of latitude 121.25 and longitude 40.75 in Figure 2 and Figure 11 (MEAN RCP8.5) is 5 and 6, respectively), but the values are in the same range (e.g., 3–6).
Even though the DBEM did not account for the effects of historical fishing, it is more as an additional factor that may further affect the pattern of changes in distribution shift and abundance change. In the models used in this paper, including GFDL, IPSL and MPI, the fish population structure is shaped to some extent for the different fish species, especially for the species with more vulnerable life histories (Cheung, Watson, Morato, Pitcher, & Pauly, 2007). The maximum sustainable yield for the Yellow Sea is 1,030 thousand tons, and the corresponding optimal fishing capacity is 764 thousand kW. The total power of the fishing vessels in the Yellow Sea in the 1960s was 97 thousand kW, only 12.7% of the optimal fishing capacity. However, it had been increased to approximately 3,000 thousand kW by 1999, 3.94 times the optimal fishing capacity and 31 times the historical fishing capacity in the 1960s. Over the past 40 years, the catch per unit of power for fishing vessels has declined significantly. It was 4.5 t/kW in the 1960s, decreased to 2.2 t/kW in the 1970s and has been stable at the low level of 1.0-1.3 t/kW since the 1980s. Meanwhile, landings have increased dramatically, from 600 thousand tons in the 1980s to 3,000 thousand tons currently. The capture production has critically exceeded the sustainable yield, and fishery resources have declined severely, especially in the northern Yellow Sea region (Su & Tang, 2002; CCICED, 2011).

As mentioned above, the species’ distributions are modelled by using numerical descriptors of species relationships with environmental variables to predict distributions from occurrence databases. Environmental envelopes were calculated by associating occurrence data with current environmental variables to find the absolute and “preferred” preference ranges (Jones, Dye, Pinnegar, Warren, & Cheung, 2012; Kaschner, Tittensor, Ready, Gerrodette, & Worm, 2011). Predicted current distributions/habitat suitability was generated multiplicatively from a suite of “environmental envelopes” over each cell in a study area. The resulting cell values lie between 0 and 1 and represent the relative suitability of that cell for the specified species (Cheung, Watson, et al., 2013). The predicted current distributions for marine fishes were available through FishBase (www.fishbase.org). Hence, the other factors that not constrained in the model may affect the model’s capability for a solid projection (e.g., adaptation; interspecific interactions; changes in other trophic levels). In other words, there are various types of uncertainties for each modelling step (Cheung, Jones, et al., 2016).

Though the projected distribution and abundance using a DBEM under the RCP2.6 and RCP8.5 scenarios with GFDL, IPSL and MPI are not examined using surveyed or observed data and have considerable uncertainties, including (a) structural (model) uncertainty, (b) initialization and internal variability uncertainty, (c) parametric uncertainty and (d) scenario uncertainty, the general trends revealed from the analysis should be robust (Cheung et al., 2015; Cheung, Jones, et al., 2016; Frölicher, Rodgers, Stock, & Cheung, 2016; Payne et al., 2015; Pitcher, Ainsworth, Lozano, Lung, & Skaret, 2005). Generally, the projected oceanographic data, such as sea surface temperature (SST), global thermocline oxygen and regional surface pH, are assessed on a century-global scale, and the finer scale coastal and regional sea processes, such as the coastal current, the warm current and the cold water mass in the Yellow Sea, are poorly represented in global climate models. Nonetheless, the overall projected trends in the Yellow Sea are still in line with global projected trends.

5 | CONCLUSIONS

The projected distribution of 34 warm water fish species in the Yellow Sea shifts to lower latitudes under the RCP2.6 and RCP8.5 scenarios in the Earth system models, including GFDL, IPSL, MPI and their ensemble average from 2000 to 2060. In addition, the corresponding maximum catch potential is decreased under the above climate change scenarios. The reasons are that the Yellow Sea is a semi-enclosed shelf sea, commonly influenced by the fluctuation of the coastal current, the warm current, the cold water mass and overfishing. Though there are no survey or observed data with which to test the results, the general trends revealed from the analysis are robust.

ACKNOWLEDGEMENTS

The research was funded by Nippon Foundation-Nereus Program, Key Special Project for Introduced Talents Team of Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou) (GML2019ZD0402), and the Fundamental Research Funds for the Central Universities (SCUT).

CONFLICT OF INTEREST

The authors declare there are no competing interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Science at https://doi.org/10.1126/science.aag2331, reference (Cheung, Reygondeau, et al., 2016). The data that support the findings of this study are openly available in Sea Around Us Project at https://www.seaaroundus.org, FishBase at https://www.fishbase.org, SeaLifeBase at https://www.seallifebase.org, and the Oceanic Biogeographic Information System at http://iobis.org.

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**BIOSKETCHES**

Yugui Zhu is interested in studying how climate change will impact fish distribution, biodiversity and maximum catch potential and their socio-economic implications in China.

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Author contributions: All authors designed the study. Y.Z. conducted the analysis and wrote the manuscript, with contributions from J.C. and W.W.L.C. Z.Z. plotted the figures based on the analysed data. G.R. extracted the data set. X.H. and Y.W. participated in discussion and contributed their brightness. All authors contributed to the writing of the manuscript and reviewed the manuscript.

How to cite this article: Zhu Y, Zhang Z, Reygondeau G, et al. Projecting changes in the distribution and maximum catch potential of warm water fishes under climate change scenarios in the Yellow Sea. Divers Distrib. 2020;26:806–817. https://doi.org/10.1111/ddi.13032