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Comprehensive application of environmental DNA for species monitoring and protection

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- 一、 Introduction
- 二、 Operational standards for eDNA technology
- 三、 Case studies— specific species monitoring
- 四、 Case studies— species diversity assessment
- 五、 Challenges and recommendations

一、Introduction



Overfishing



Environment pollution

- ◆ Traditional fishery resources have been severely depleted;
- ◆ The structure of fishery resources has undergone noticeable changes;
- ◆ Biodiversity is declining
- ◆ ...



Climate changes



Fishery resources depletion

It is urgent to strengthen the monitoring of organisms and biodiversity.

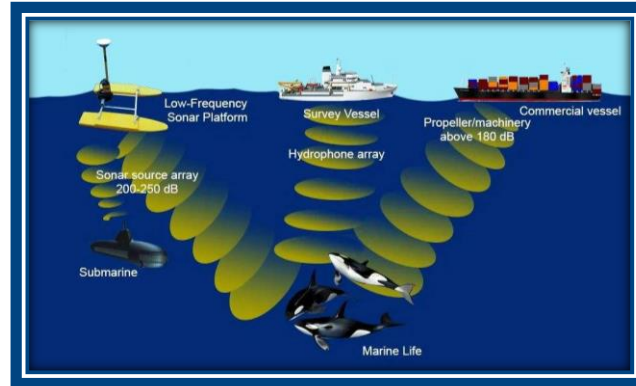
一、Introduction



Traditional Methods for Marine Fishery Resources Monitoring in China



Bottom trawl



Sonar echo
sounding



Visual surveys



Gill nets

Limitations:

- Time consuming
- Costly
- Taxonomic expertise needed
- Species-specific bias
- Environmental impact
-

一、Introduction

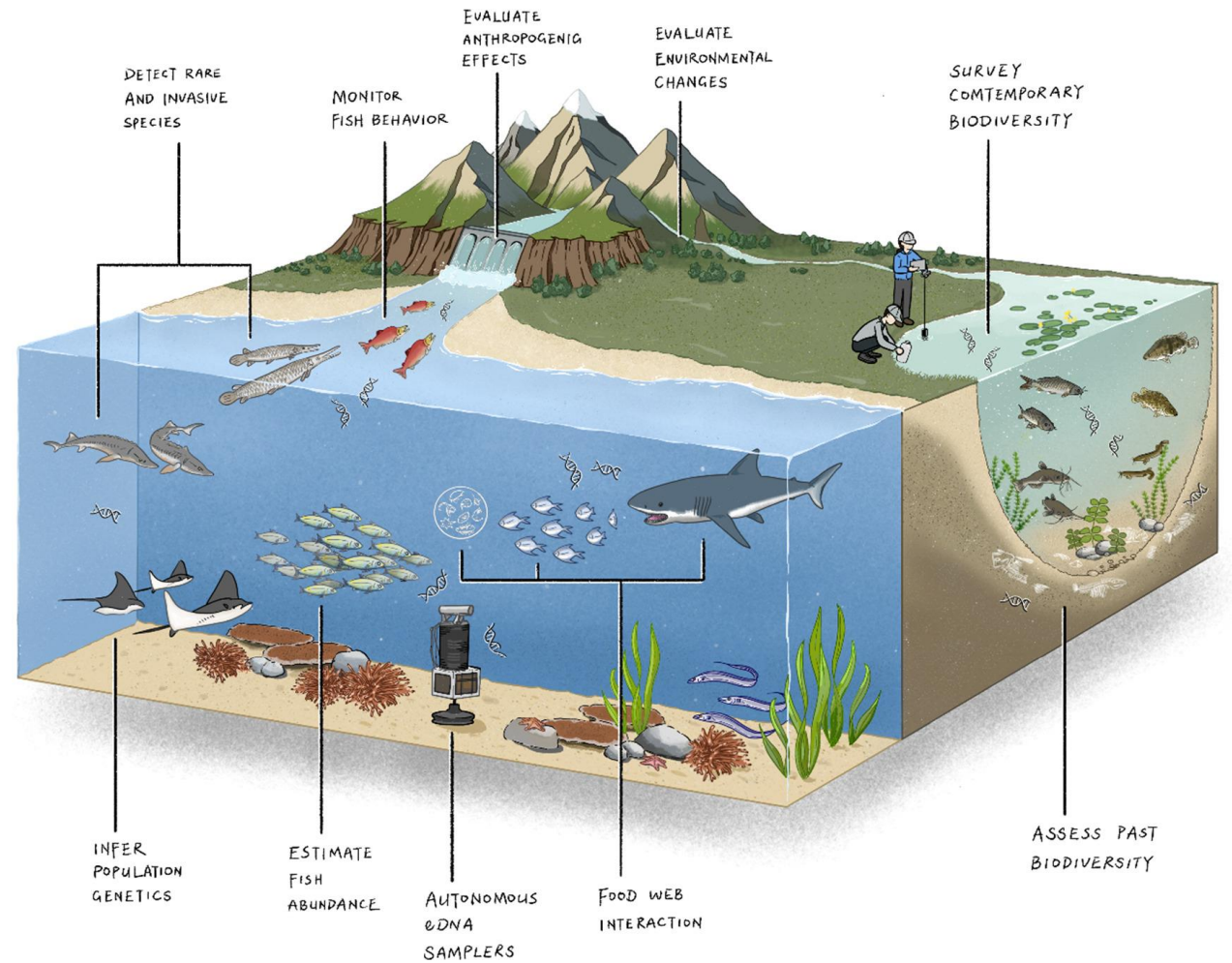
- Environmental DNA (eDNA) refers to the sum of DNA fragments released by organisms into the environment.

- tissues
- cells
- metabolites
- ...

Sources

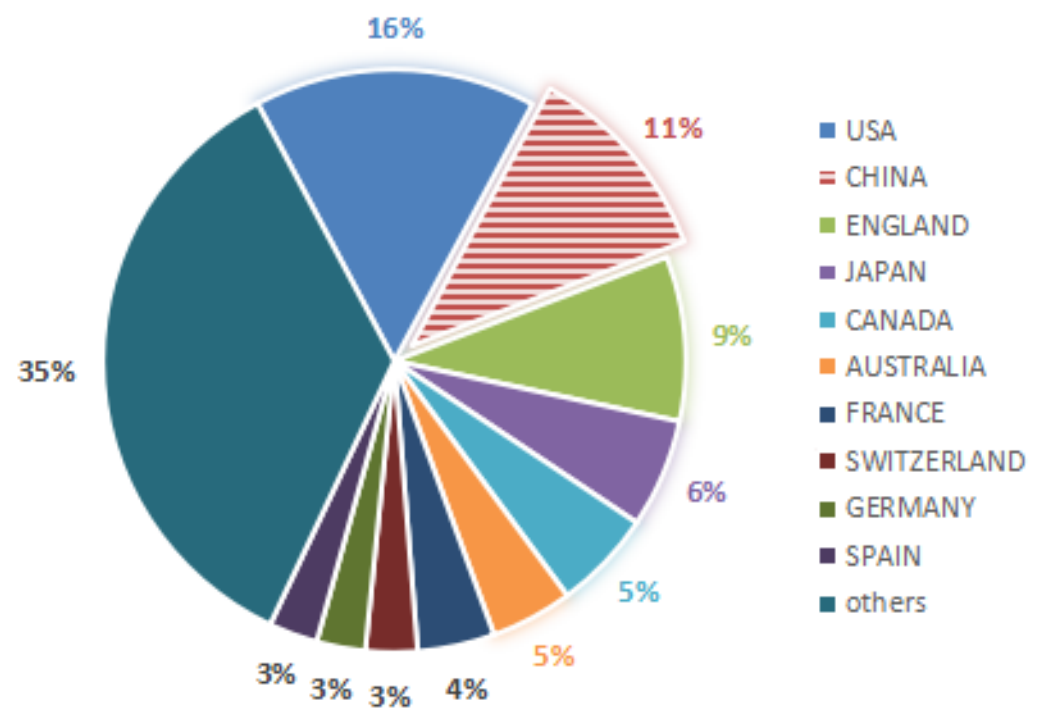
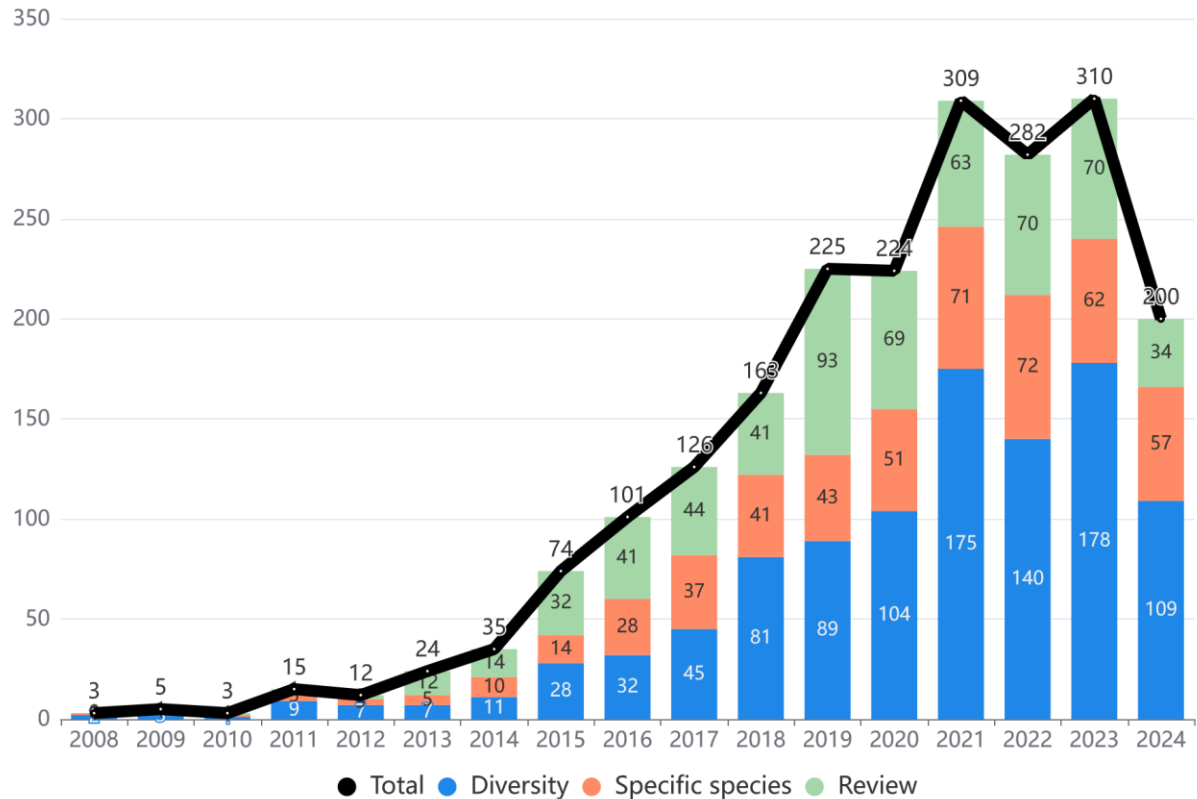
- Water
- Sediments
- Air
- ...

Mediums



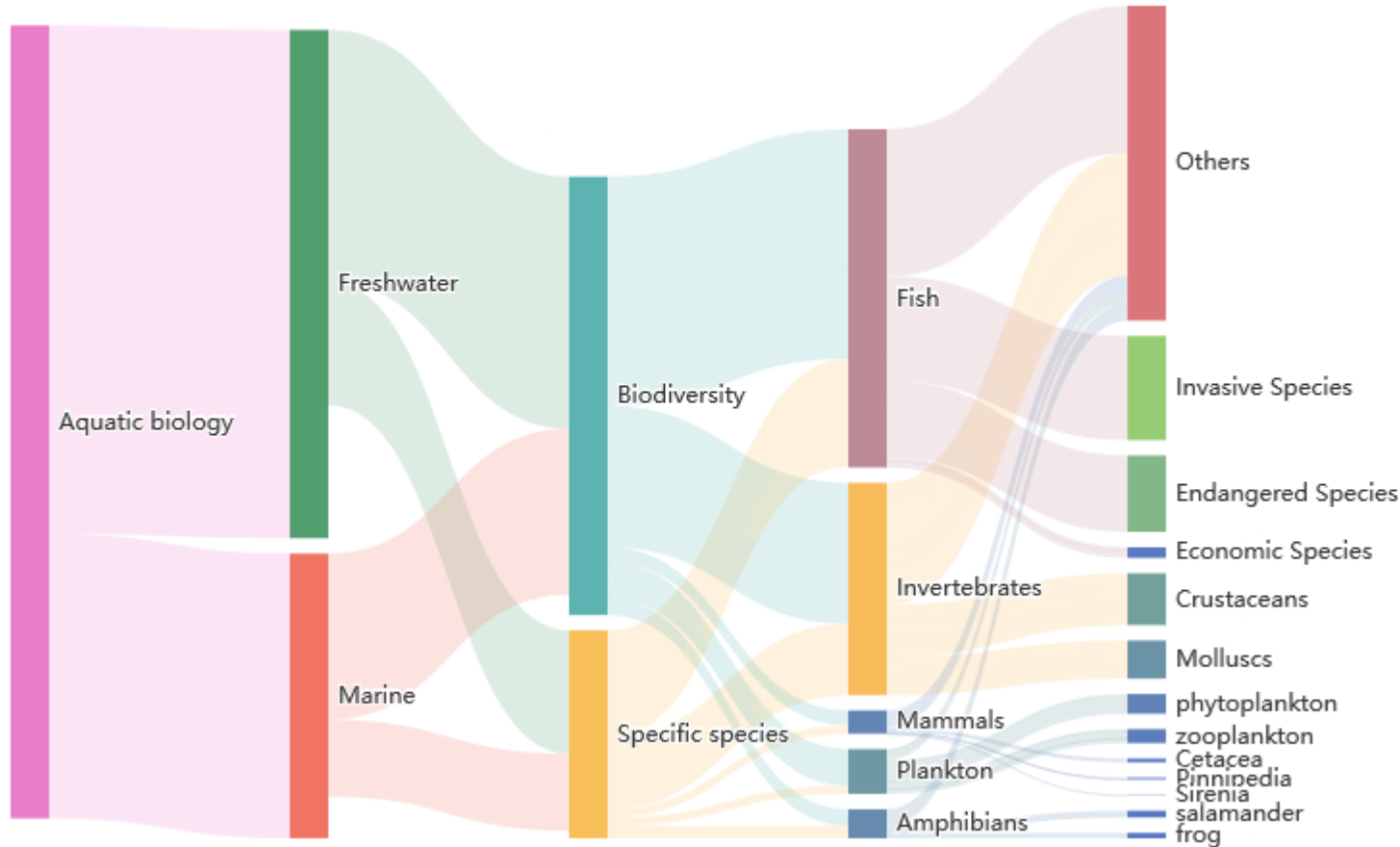
(Yao, et al. 2022)

一、Introduction



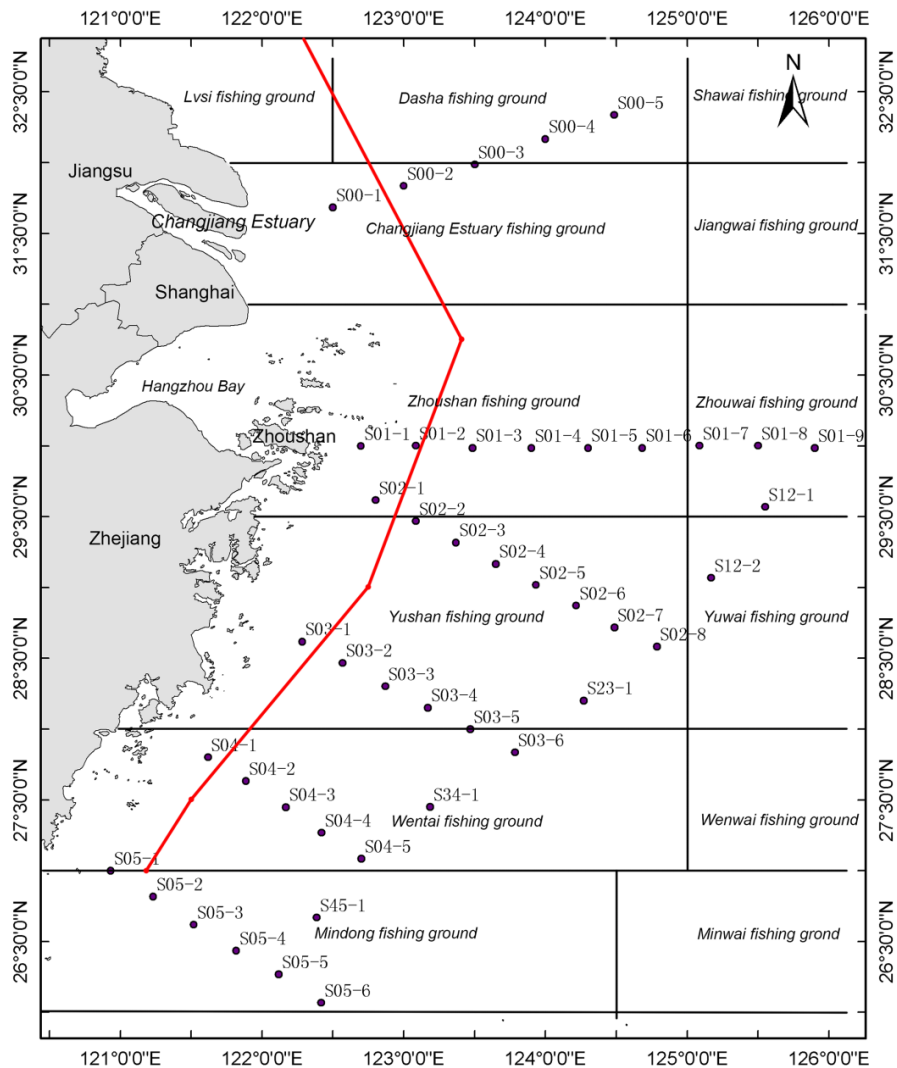
◆ the number of eDNA-related articles has continued to increase. ◆ the Top 10 countries publishing eDNA-related articles

一、Introduction



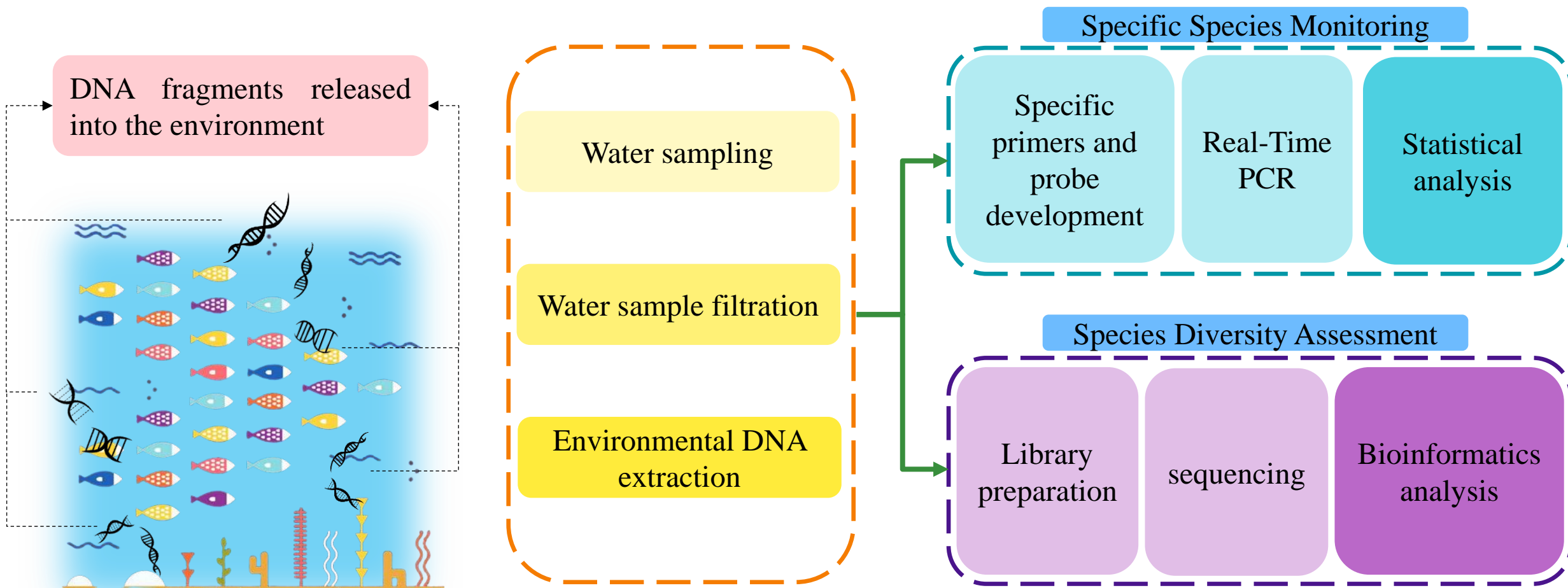
- ◆ The eDNA-related researches is mainly focus on freshwater ecosystems (such as lakes, rivers, and streams).
- ◆ Biodiversity related researches are relatively more than specific-species related studies.
- ◆ Fish and invertebrates are the main subjects of eDNA-related research.

一、Introduction



- ◆ The East China Sea coastal water and the Changjiang Estuary are essential habitats for many fish species;
- ◆ The Zhoushan fishing ground is the largest and most famous fishing ground in China.

二、Operational standards for eDNA technology



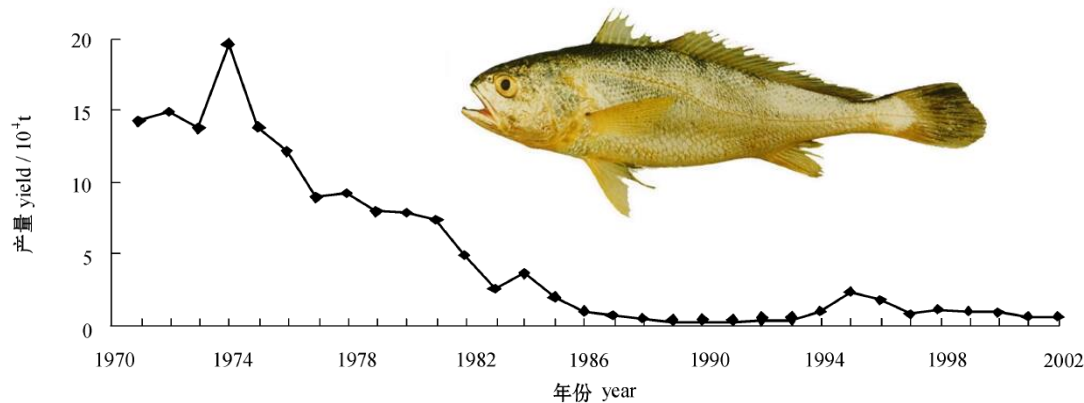
三、Case studies

——specific species monitoring

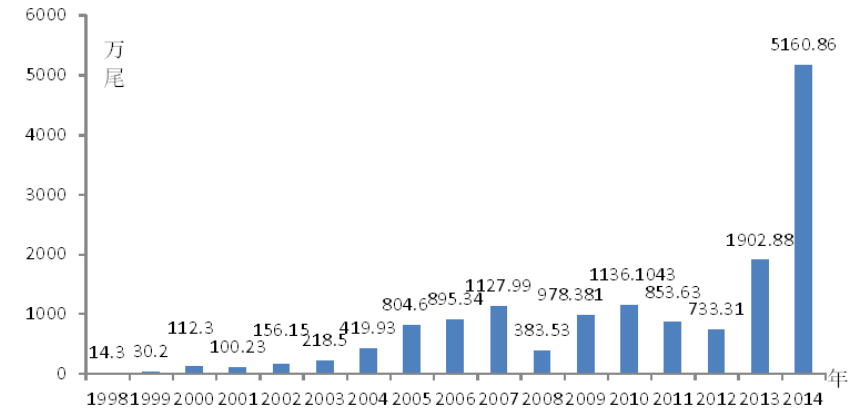


case study 1: the large yellow croaker (*Larimichthys crocea*)

- The large yellow croaker was once considered one of the four economic species in traditional marine fisheries in China;
- Approximately 98 % of China's total *L. crocea* catch came from the East China Sea;
- No spawning or overwintering aggregations have been observed within the geographic range of *L. crocea* since the mid-1980s through surveys of **traditional methods**.



catch production of large yellow croaker



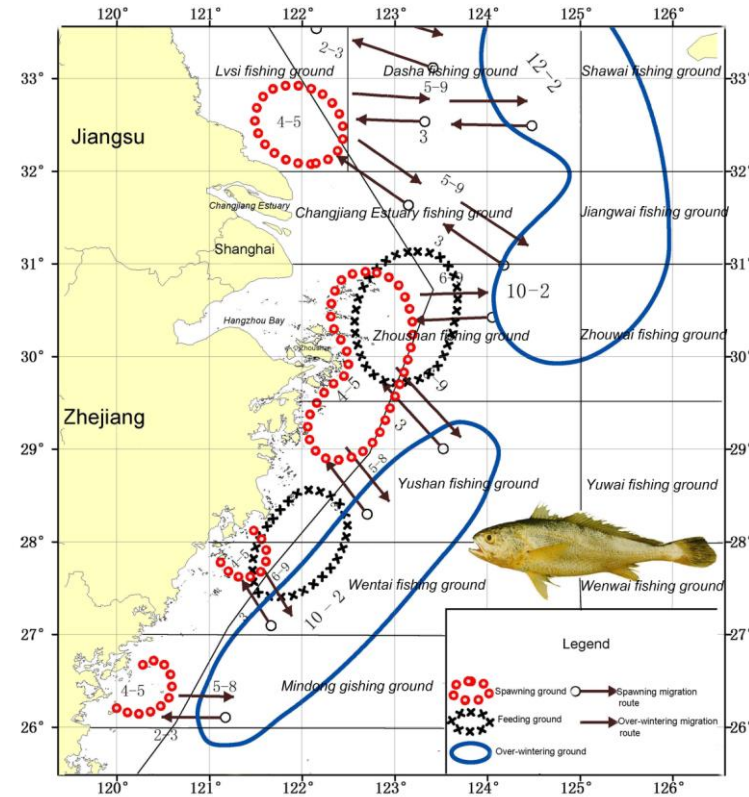
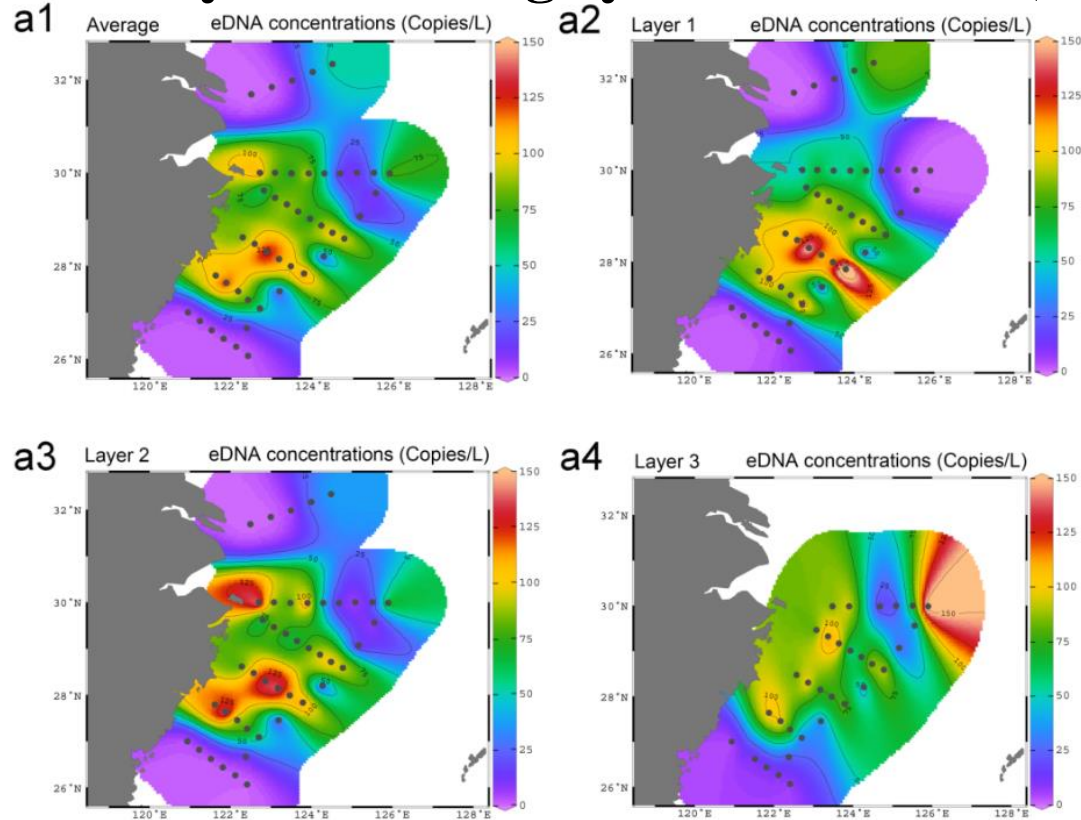
stock enhancement

三、Case studies

——specific species monitoring



case study 1: the large yellow croaker (*Larimichthys crocea*)



- ◆ Significant differences in eDNA concentrations were found among different stations;
- ◆ High eDNA signals were found in the surrounding area of Zhoushan Archipelago, which is consistent with the traditional spawning areas;
- ◆ eDNA hotspots were also found in the Yushan fishing ground, which suggesting an **offshore spawning ground** might have been established.

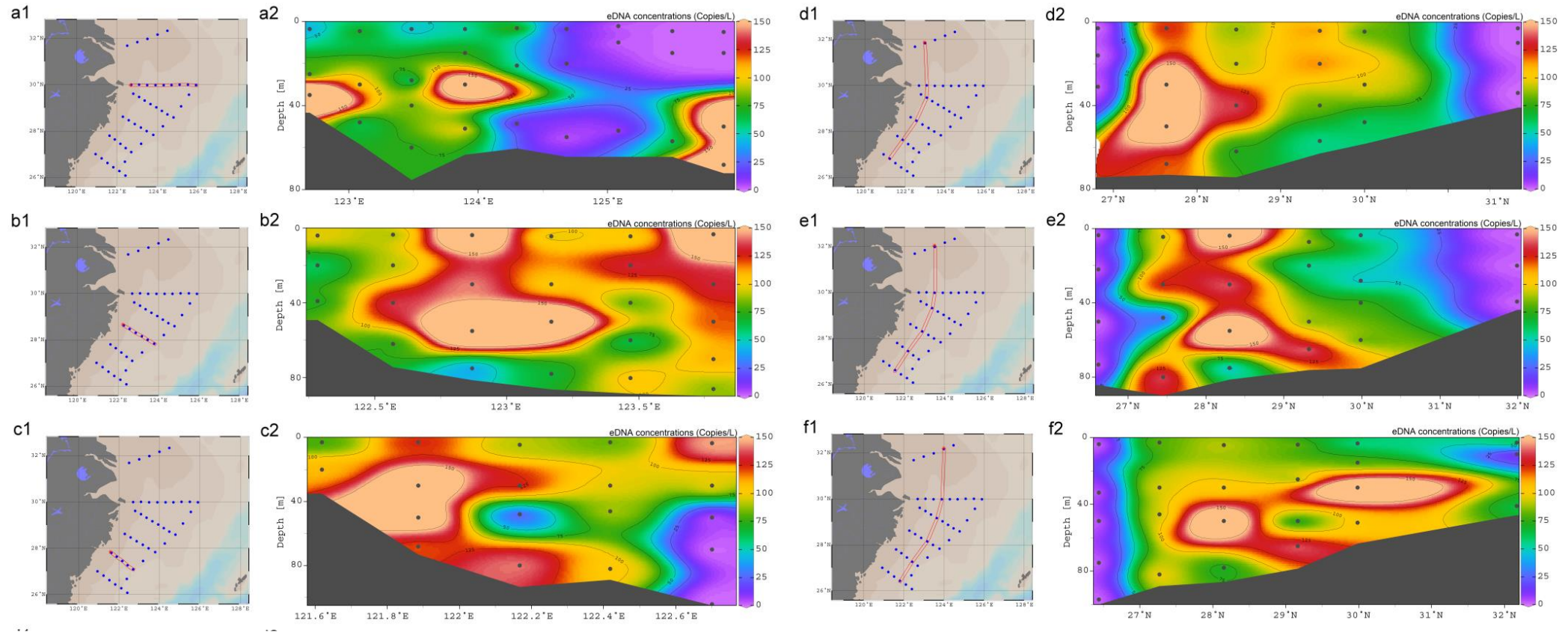
(Wang et al., 2021)

三、Case studies

——specific species monitoring



case study 1: the large yellow croaker (*Larimichthys crocea*)



- ◆ No significant differences were found in the eDNA concentrations of *L. crocea* among different water layers;
- ◆ The eDNA signals in water depths around 40 m and the bottom were found at multiple stations.

(Wang et al., 2021)

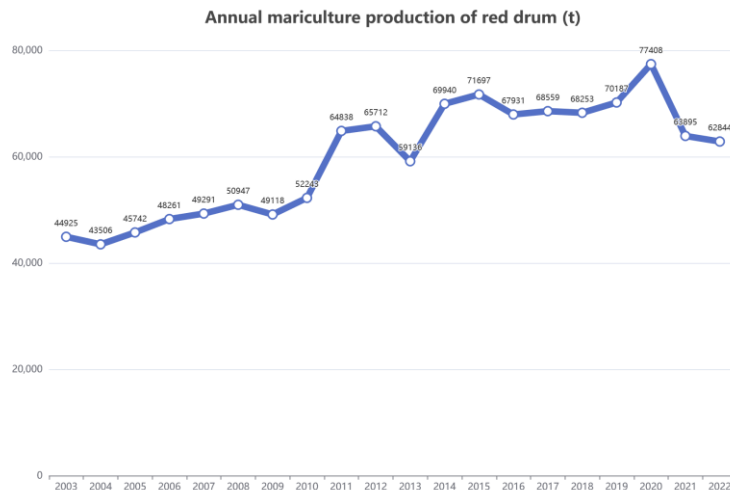
三、Case studies

——specific species monitoring



case study 2: the red drum (*Sciaenops ocellatus*)

- The red drum was introduced for marine aquaculture in 1991 and has become a commercially important maricultural fish species in China and was widely cultured across the coastal areas in mainland China;
- After two decades of maricultural activities, the red drum has been consecutively recorded as escapees along the entire coastal waters of China.

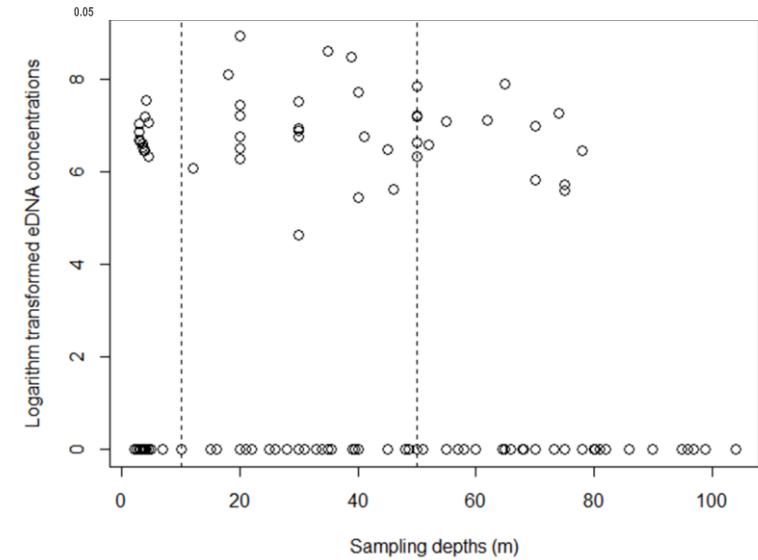
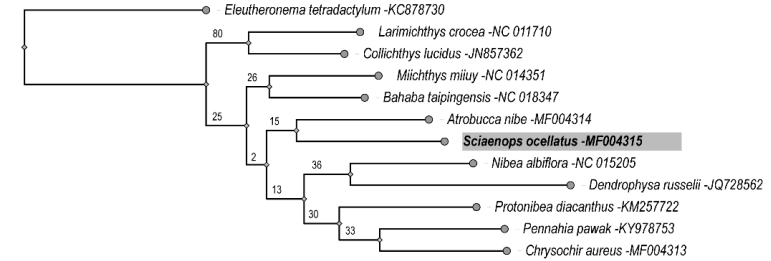
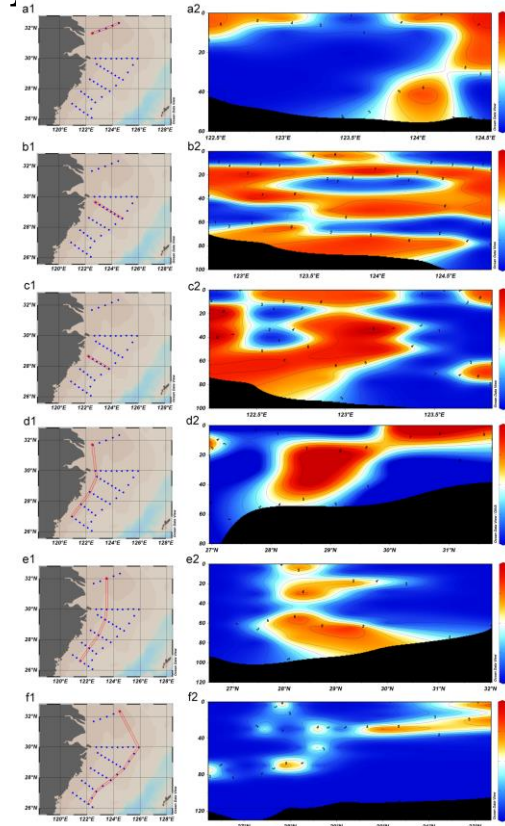
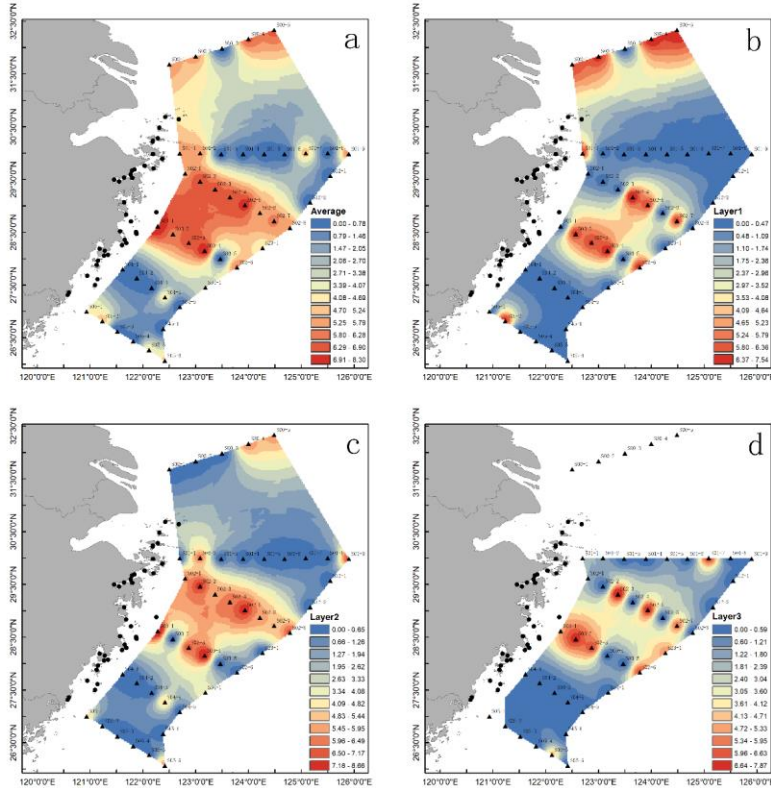


三、Case studies

——specific species monitoring



case study 2: red drum (*Sciaenops ocellatus*)



- ◆ There were significant differences among different stations;
- ◆ There were also significant differences in the presence and detection of eDNA among stations;
- ◆ The distribution of eDNA hotspots is mainly concentrated in the central part of the East China Sea, especially near the Estuary and Bay.

(Wang et al., 2022)

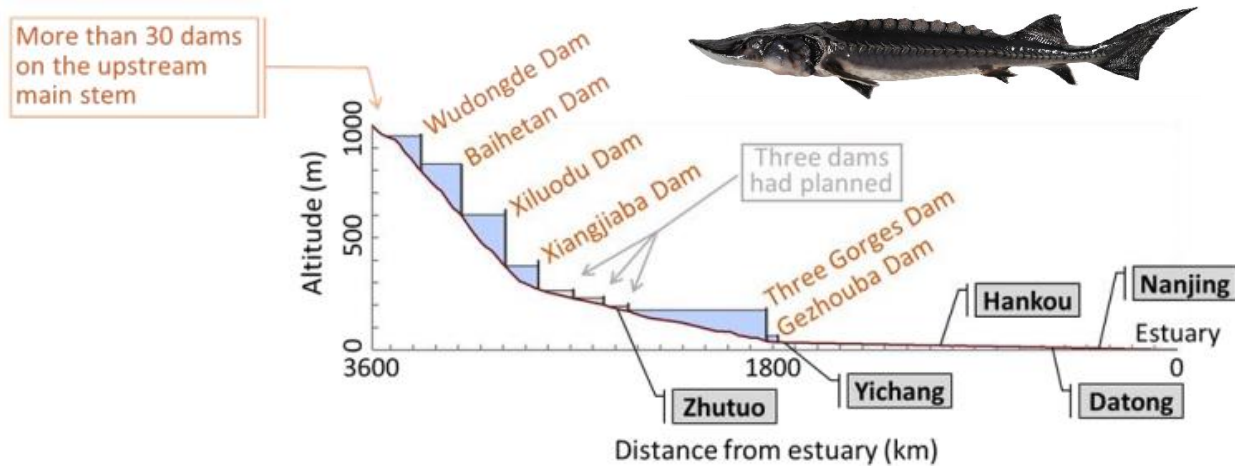
三、Case studies

——specific species monitoring

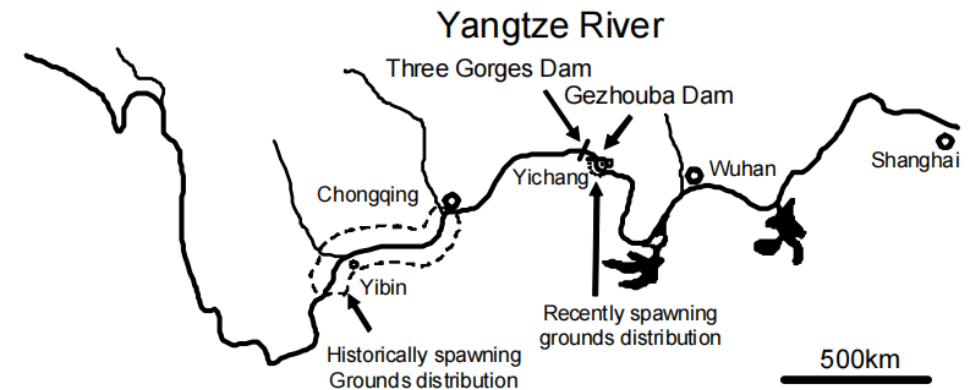


case study 3: the Chinese sturgeon (*Acipenser sinensis*)

- The Chinese sturgeon is an **anadromous** species that spends most of its life (more than 90%) at sea and migrates to spawn in the upper Yangtze River;
- It was listed as an **Critically Endangered** species in the Red list of the IUCN;
- Marine bycatch and pop-up satellite archival tag have been the main methods used to locate Chinese sturgeon in the ocean.



(Zhang et al., 2019)



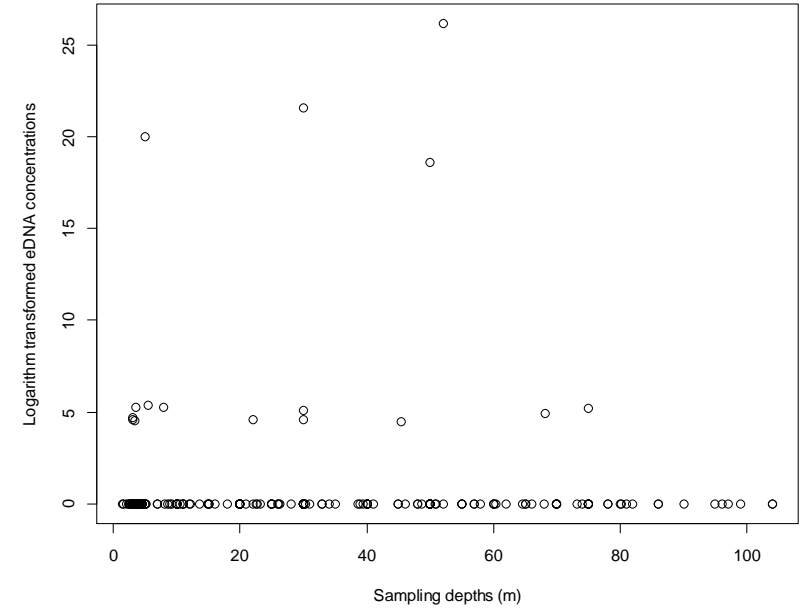
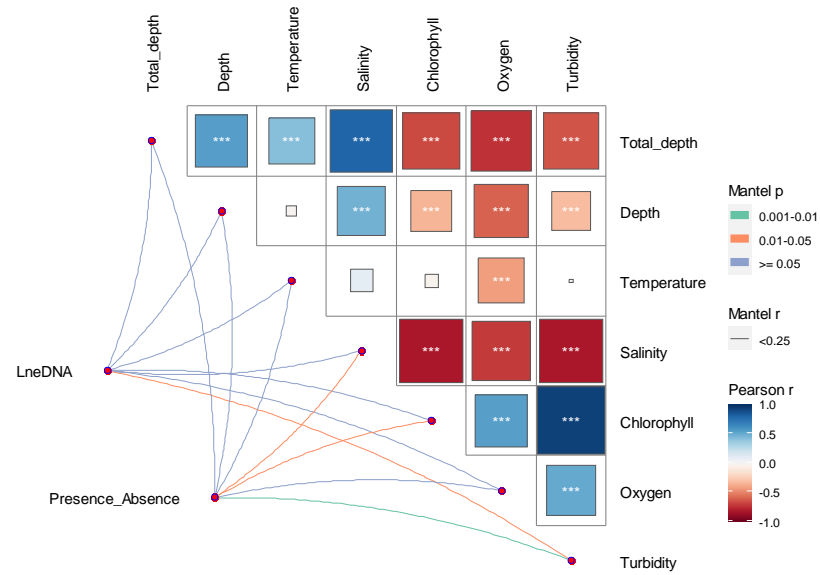
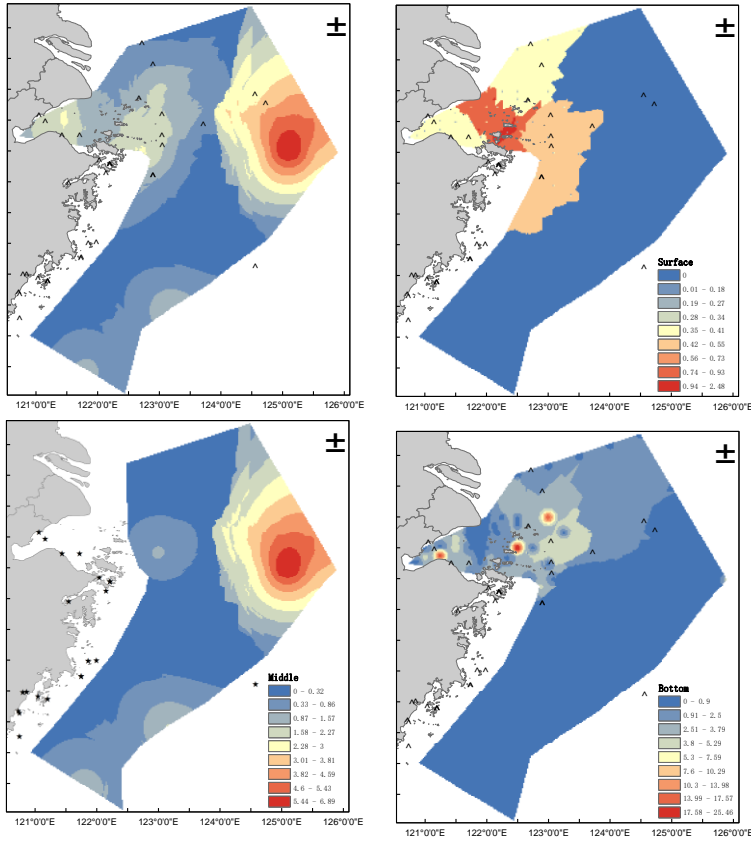
(Qiao et al., 2006)

三、Case studies

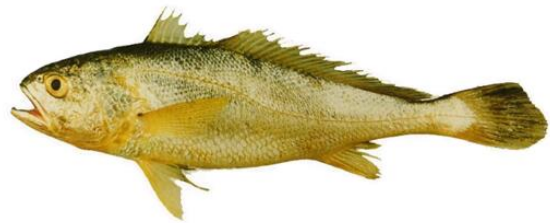
——specific species monitoring



case study 3: the Chinese sturgeon (*Acipenser sinensis*)



- ◆ The Chinese sturgeon eDNA hotspots are mainly concentrated in the Hangzhou Bay and Zhoushan Archipelagos;
 - ◆ The distributions of the Chinese sturgeon using eDNA methods were highly consistent with the bycatch records;
 - ◆ The Chinese sturgeon eDNA is significantly correlated with turbidity, salinity and chlorophyll, which can reflect its habitat preference.
- (unpublished)

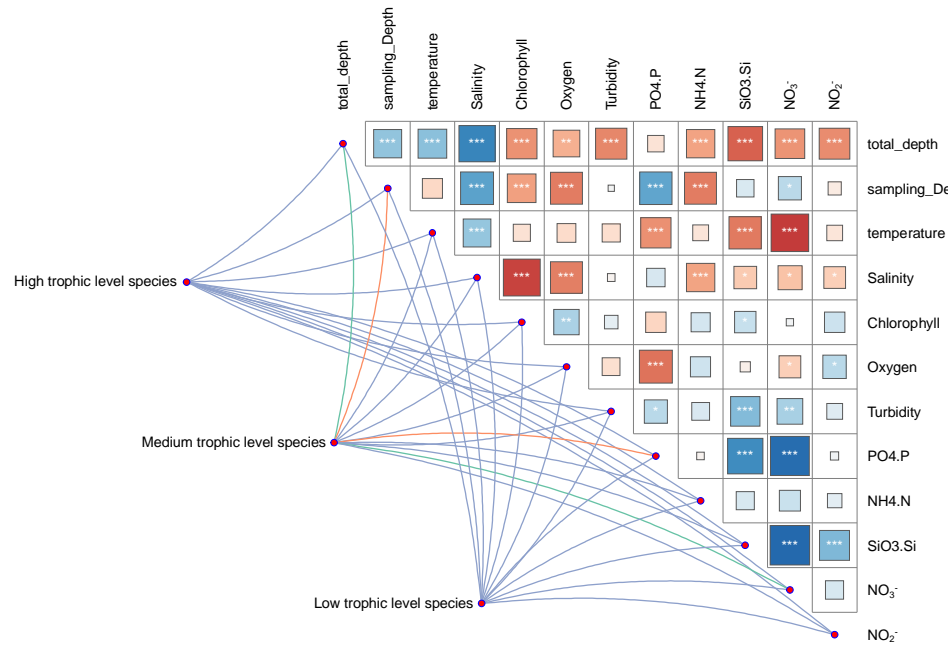
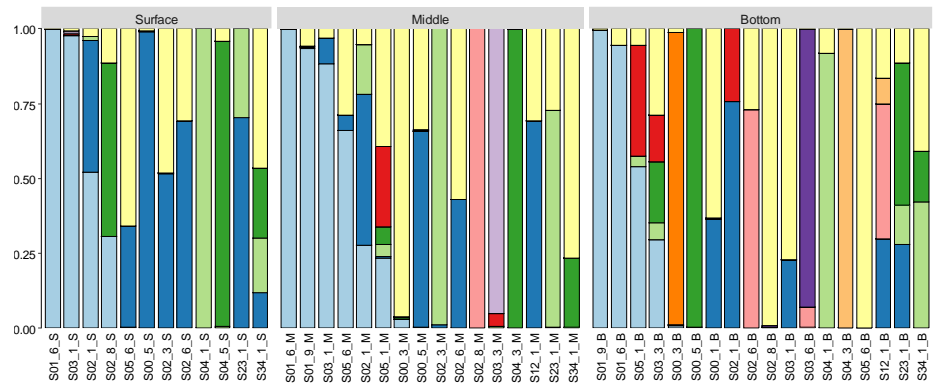


四、Case studies

— species diversity assessment



case study 4: the East China Sea



- ◆ A total of 81 fish species were detected, belonging to 20 orders, 44 families and 72 genus;
- ◆ The fish diversity index is high in the nearshore area in horizontal groups;
- ◆ The surface water exhibited a higher level of fish diversity than other water layers.

(Wang et al., 2024)

五、Challenges and recommendations

——the use of eDNA technology



- ◆ False positive (contaminations);
- ◆ False negative (reference database; primer selection; sequence similarity);
- ◆ Real-Time monitoring (combine eDNA with eRNA?)
- ◆ ...

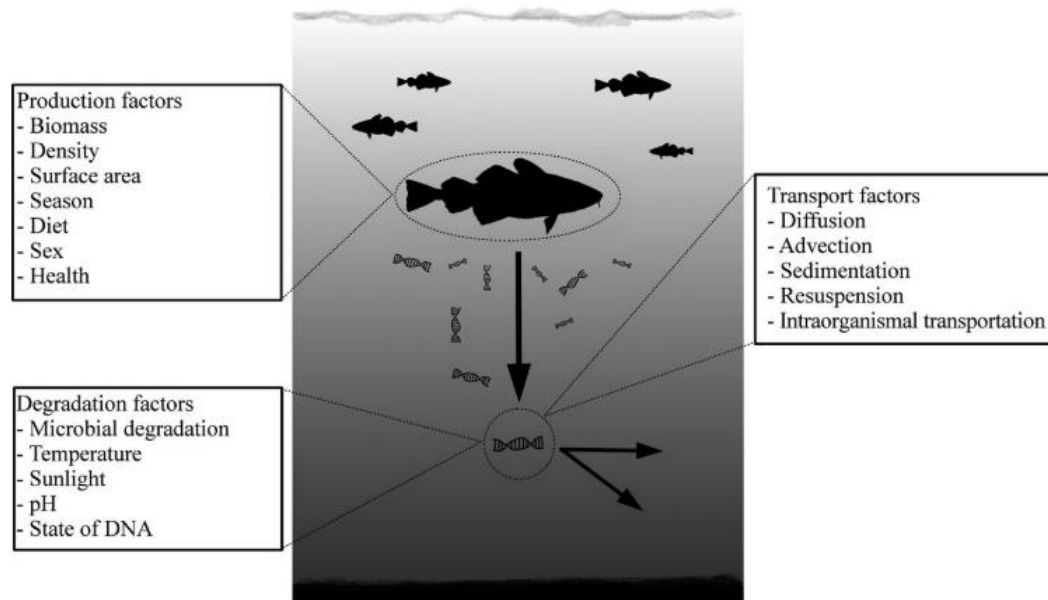


FIGURE 2 Conceptual diagram of factors likely to influence eDNA particle production and removal processes from a given water body

(Hansen et al., 2018)

Species	Coverage	Similarity
1: <i>Sebastes ruberrimus</i>	100%	100%
2: <i>Sebastes pachycephalus</i>	100%	100%
3: <i>Sebastes ventricosus</i>	100%	100%
4: <i>Sebastes schlegelii</i>	100%	100%
5: <i>Sebastes thompsoni</i>	100%	100%
6: <i>Sebastes steindachneri</i>	100%	100%
7: <i>Sebastes taczanowskii</i>	100%	100%
8: <i>Sebastes owstoni</i>	100%	100%
9: <i>Sebastes inermis</i>	100%	100%
10: <i>Sebastes hubbsi</i>	100%	100%
11: <i>Sebastes mentella</i>	99%	99%

五、 Challenges and recommendations

——for future cooperation



- ◆ Sample collections
 - targeted and its closely related species's tissue or blood samples (especially for endangered species);
 - water samples;
 - environmental parameters
- ◆ Fundings
- ◆ Cooperation for species monitoring and conservation using multiple technologies.



Thank you for your attention!



 王晓艳
浙江 舟山



扫一扫上面的二维码图案，加我为朋友。