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Prioritizing zonal planning in protecting key habitats under baseline information insufficiency

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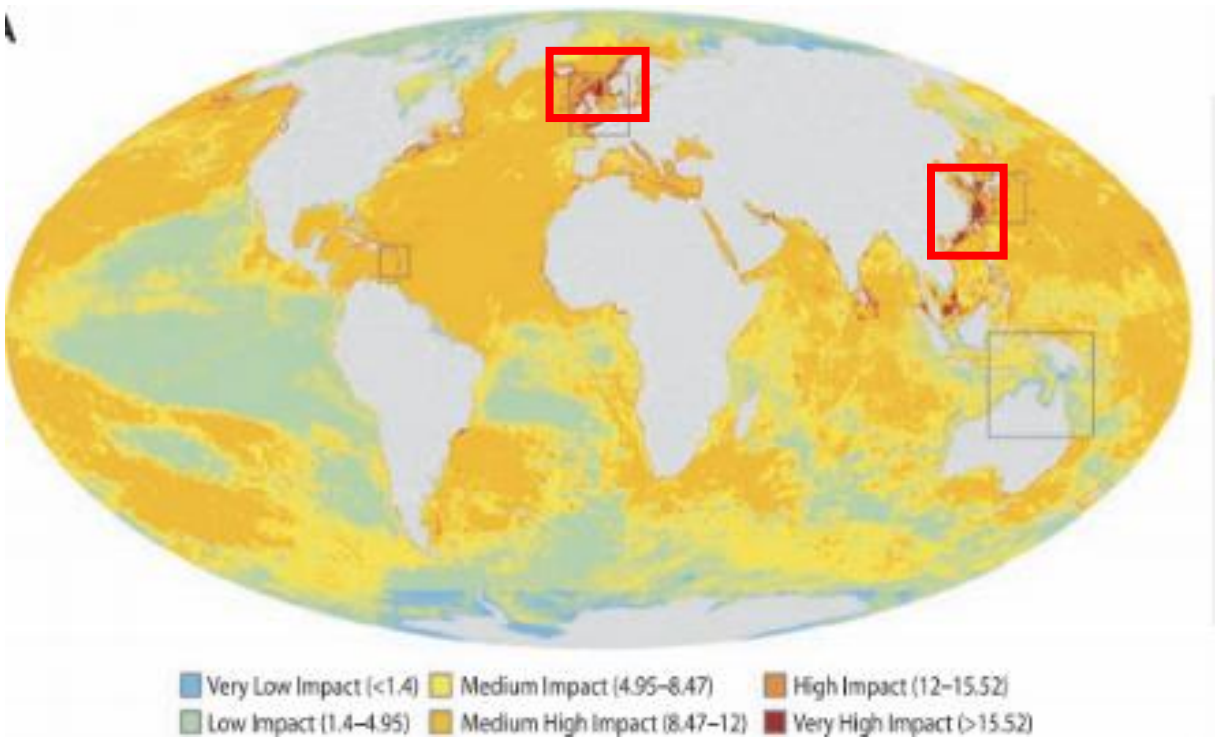
The anthropogenic activity affects the ocean ecosystem

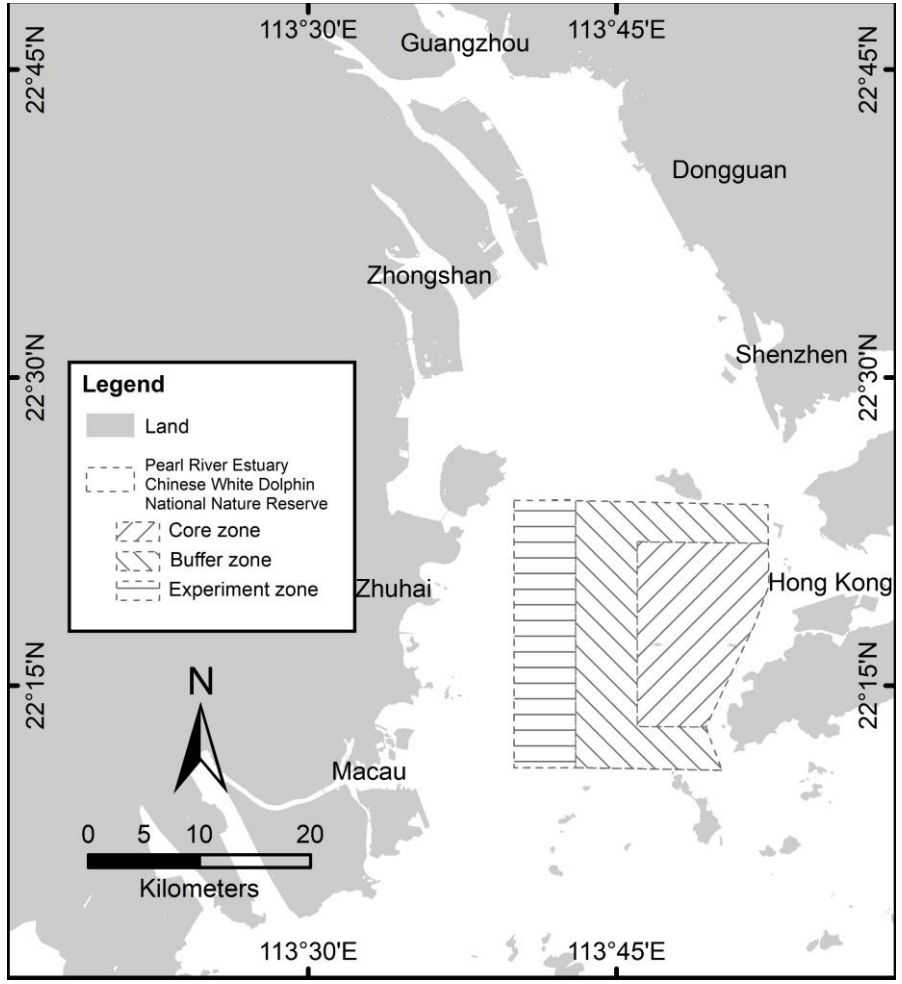


Global map of cumulative human impact across 20 ocean ecosystem types (**Halpern *et al.* 2008**)

- The cumulative impact
  - across 20 ocean ecosystem types;
  - over a third (41%) affected;
  - due to anthropogenic activities;
  - highest: continental shelf and slope;
  - land- and ocean-based anthropogenic drivers.

Marine Protected Area (MPA)

- Clearly defined geographical space; regulate anthropogenic activity.
- Main reasons: (IUCN,1999)
  - To protect habitat and biodiversity;
  - Suitable fishery;
- **Too few MPAs and not many of them are effectively managed** (IUCN,1999)



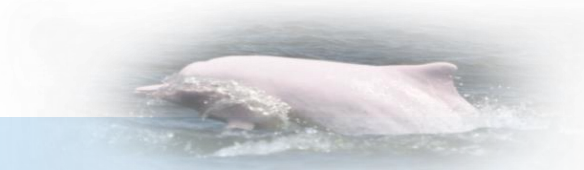
Map of Pearl River Estuary Chinese White Dolphin National Nature Reserve, China

How to improve management effectiveness?

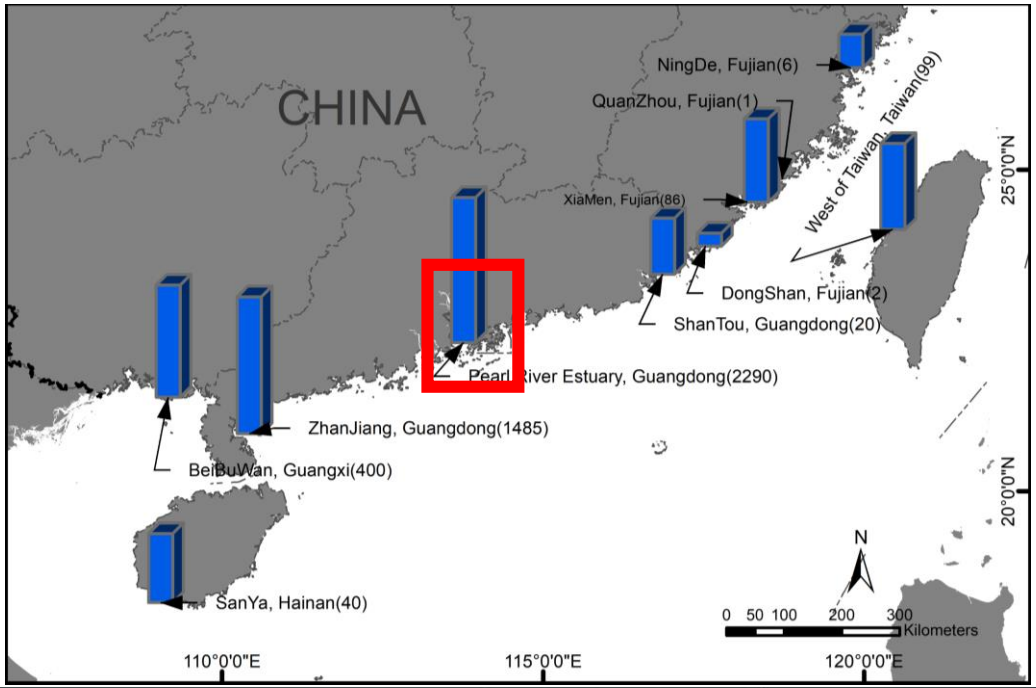
- Three Contributions (Margules & Pressey 2000; Salafsky Nick et al. 2002; Karin et al. 2008; Wiens et al. 2008; Josie et al. 2009)
  - Suitable conservation targets
  - Explicit conservation goals
  - Effective spatial management

- Information (targets and goals) (Margules & Pressey 2000; Sahotra et al. 2004; Karin et al. 2008; Huang et al. 2018)
  - Published research articles and reports, expert opinions, local ecological knowledge, the needs of social-economic development for human

- Challenged by the information gaps (Spatial management) (Halpern et al. 2008; Hoffmann et al. 2010)
  - threat identification
  - spatial detail of threats
  - impacts and cumulative impacts

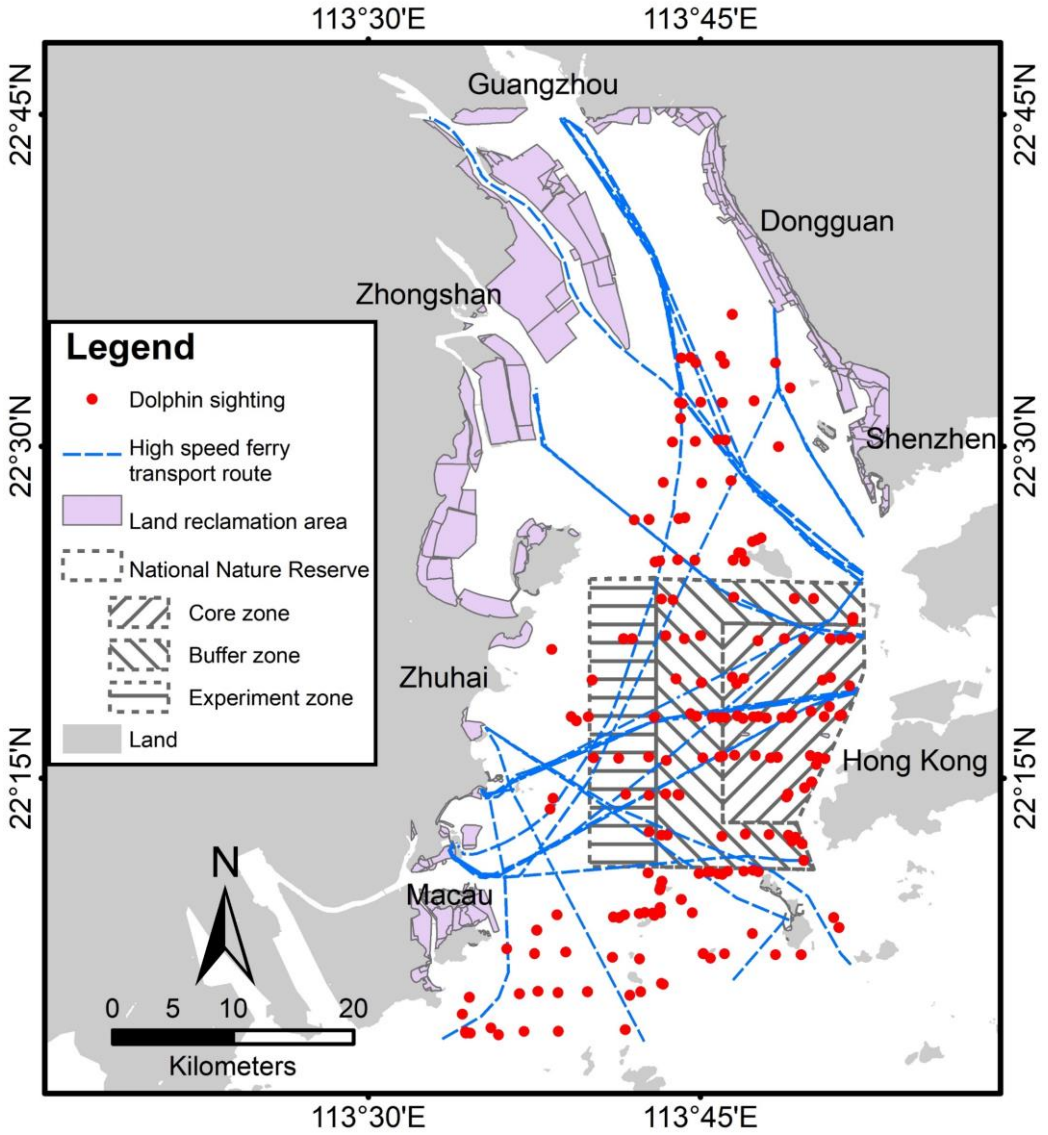


Conservation status of Indo-humpback dolphin (*Sousa Chinensis*) in China



- National key protected wild animal (level I) (China);
- 9 places;
- 2 national nature reserve;
- 3 provincial nature reserve;
- Lacking effectively management
  - Information insufficiency
    - the dolphin population
    - the anthropogenic activity detail
    - the impacts due to the activity

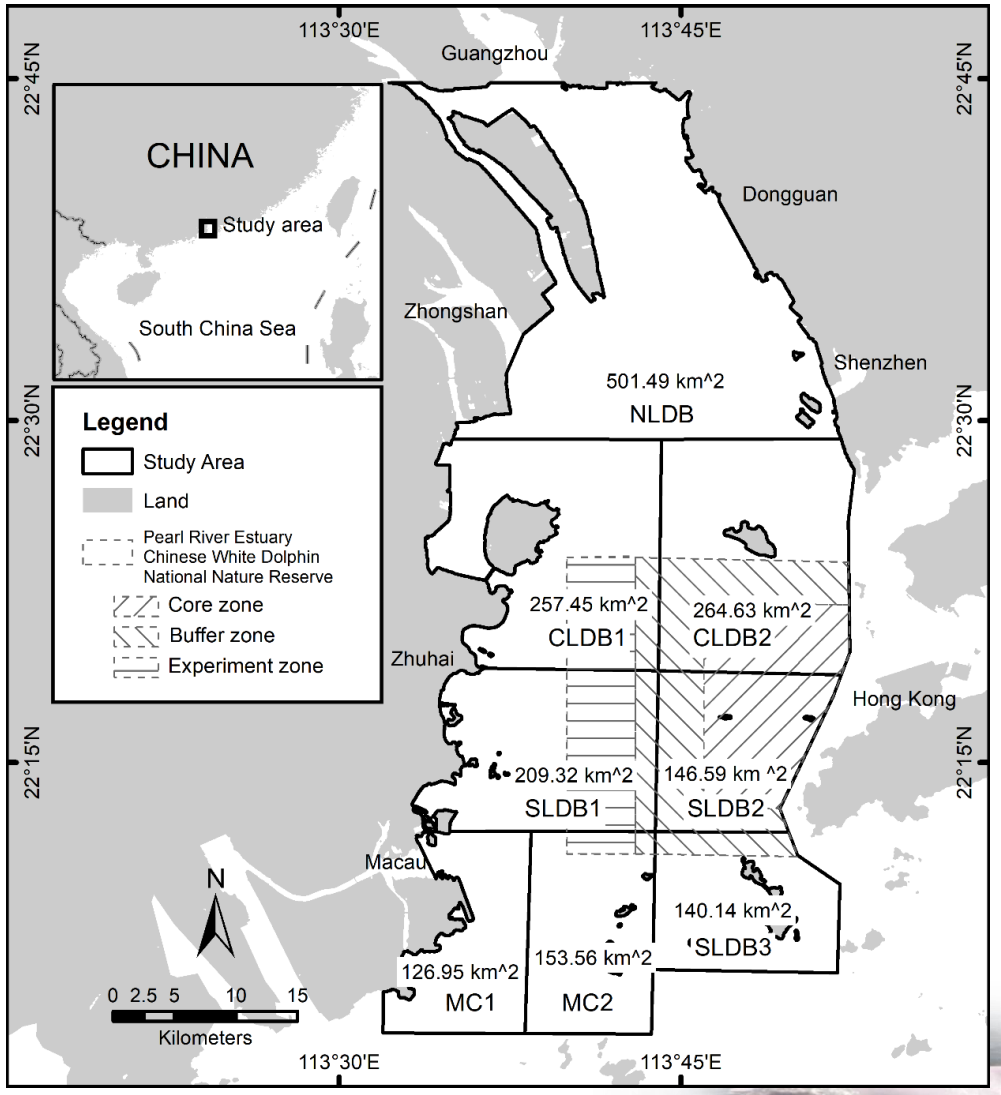
Base information in/around the reserve



- Pear River Estuary Chinese White Dolphin National Nature Reserve
- Pear River Estuary(PRE):
  - High population density;
  - 287.63 km^2 Land reclamation (1990-2013);
  - 1621 ferry routes per day;
- The reserve cover part of the dolphin distribution.
- Does the reserve enough?
- How to improve the spatial management?

Study area, zonation, and impact identification

- The inner part of PRE enclosed in 22˚03' ~ 22˚45' N and 113˚30' ~ 113˚53’ E.
- Divided into 8 sectors based on Chen et al. (2010).
- Anthropogenic coast alterations (ACA)
- High speed ferry transport (HSFT)
- Pollution stress (PS)
- Fishery activities (FA)



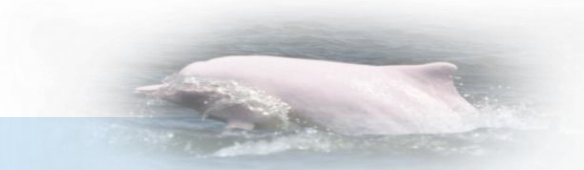
Estimation of Exposure – Sensitivity Analysis (ESA)

Potential vulnerability (*V*) (Patrick et al. 2009) : potential impacts of the anthropogenic activities on population viability and habitat use of the humpback dolphin. (Score: $0 - 2\sqrt{2}$)

Exposure (*E*) represented the interaction between species and anthropogenic activities. (Score: 1-3)

Sensitivity (S) represented the capability of species to react to impacts caused by anthropogenic activity. (Score: 1-3)

$$V = \sqrt{(E-1)^2 + (S-1)^2}$$



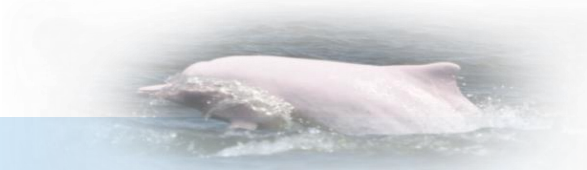
Estimation of Exposure – Sensitivity Analysis (ESA)

Criteria	Low (1)	Moderate (2)	High (3)
Exposure			
Extent of spatial overlap	Low overlap (<=25%)	Moderate overlap (25~75%)	High overlap (>=75%)
Duration of temporal overlap	Low overlap (<= 4 months)	Moderate overlap (4~8 months)	High overlap (>= 8 months)
Intensity of sympatric	e_i = 1 (Low) - 3 (High)		
Mitigation measure	implemented measures encompassing entire region, or/and whole year	partially implemented measures implemented in parts of region or/and months of a year	un-implemented without measures
Sensitivity			
Habitat use rate	s_i = 1 (Low) - 3 (High)		
Ratio of calf	Low (<1%)	Medium (1-2%)	High (>2%)
Group size	Low (<3)	Medium (3-6)	High (>6)
Forage ratio	Low (<40%)	Medium (40%~80%)	High (>80%)

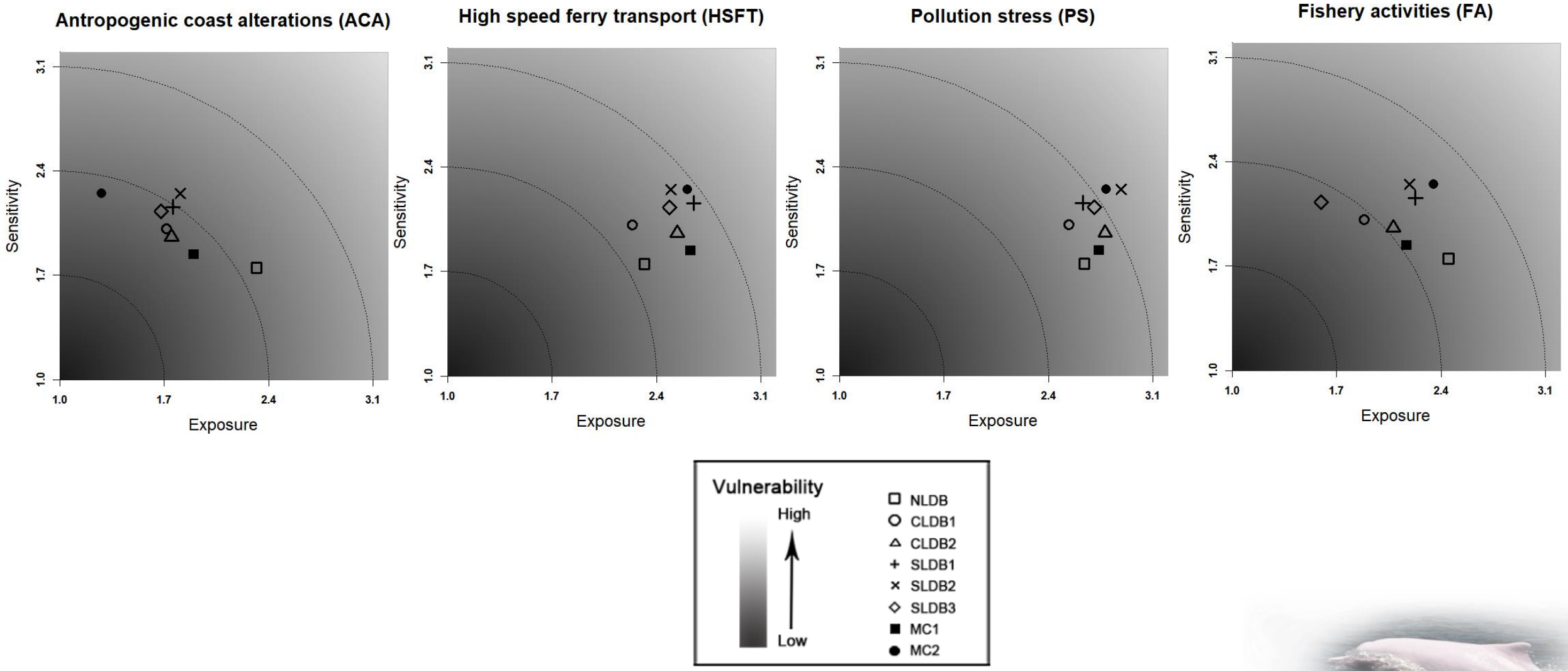
Data collection

- Earlier/preliminary researches;
- Published papers;
- Government reports;
- NGO documents.

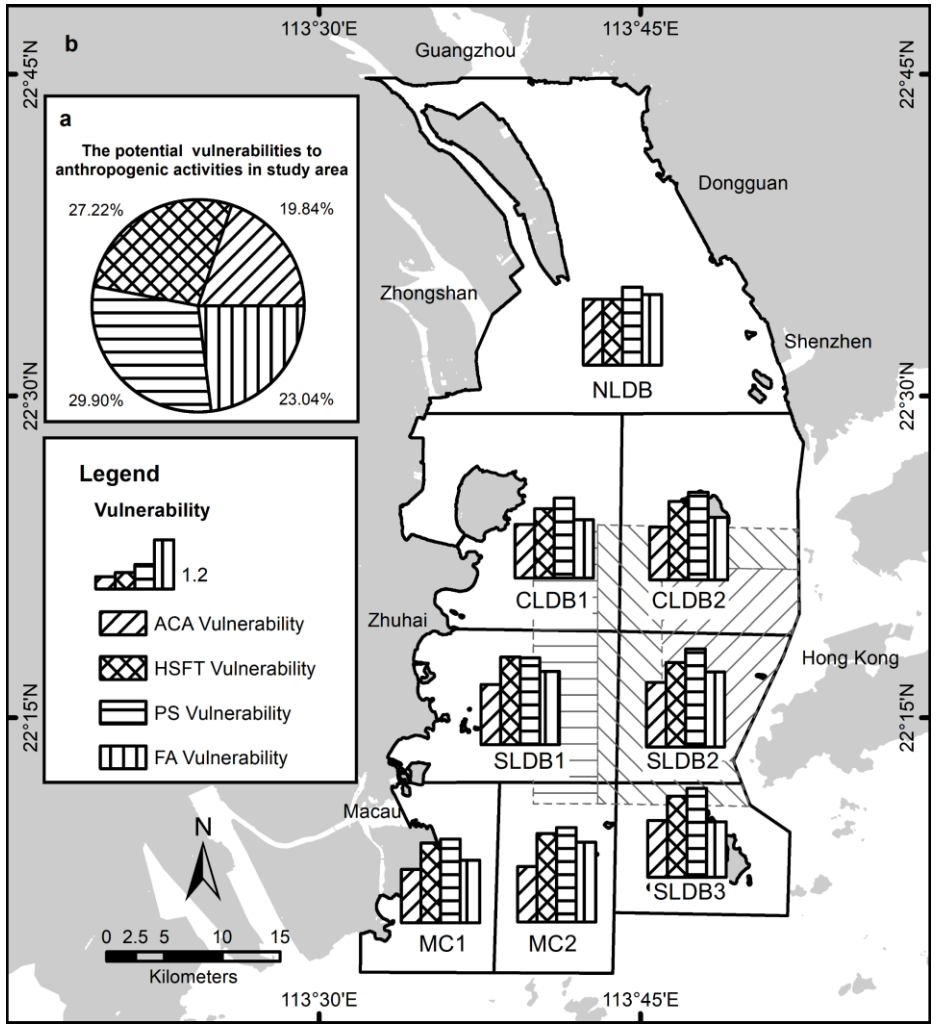
Data Quality Score	Category	Definitions
4	Best Data/ Highly confident	Direct investigation in the study site; Sector-specific information can be extractable; Journal article
3	Reliable Data	Direct observation over the study site; Regional information without sector-specific variation; Journal article
2	Plausible Data	Observations in/over the study site; Technical report, conference presentation or public database Observation on humpback dolphin from other habitats;
1	Best guess	Recommendation of conservation action planning in/on government reports Expert opinion based on similar taxa

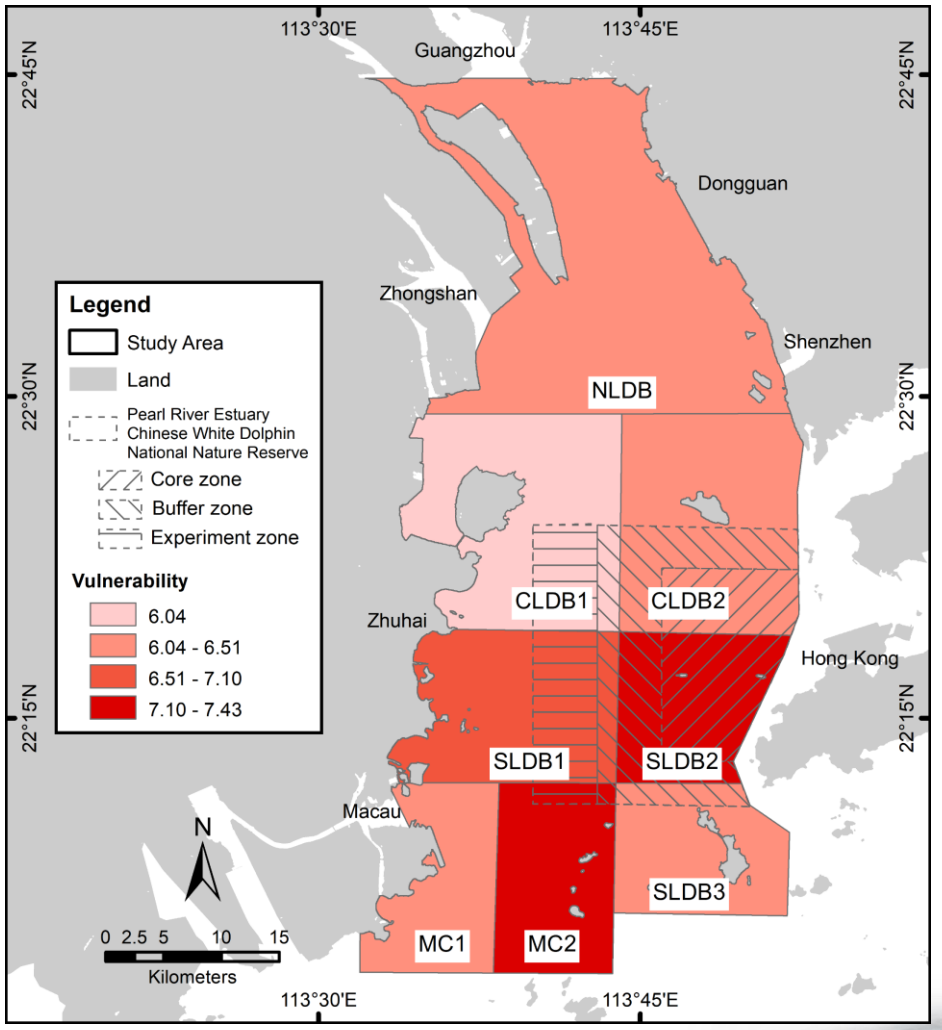


Insights to sector-specific impacts



The simple conclusions





The simple conclusions

- Feasibility to bridge information gaps while planning effective spatial management under baseline information insufficiency by applying the semi-quantitative ESA.
- Apply this approach to particularly environment impact assessments on coastal and estuarine waters where large-scaled environment development program is immediate.

Thank You