



The Environment Research and Technology Development Fund (ERTDF)  
Strategic R&D Category  
Ministry of the Environment, Japan

# Nationwide evaluation of Marine Ecosystem Services of Japan: achievements from the PANCES project

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Saito et al. (2021): PANCES Synthesis Summary for Policy Makers (SPM).

[https://www.nies.go.jp/pances/en/policybrief/img/PolicyBrief2021\\_SPM\\_en06.pdf](https://www.nies.go.jp/pances/en/policybrief/img/PolicyBrief2021_SPM_en06.pdf)

T. Yamakita (2022) Distribution of Coastal Ecosystem Services in Japan and Future Scenarios of the Ocean, Bulletin on Coastal Oceanography, 60(1)75-79,

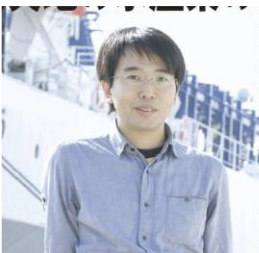
<https://doi.org/10.32142/engankaiyo.2022.8.009>,

(in Japanese with English figure and abstract and figures)

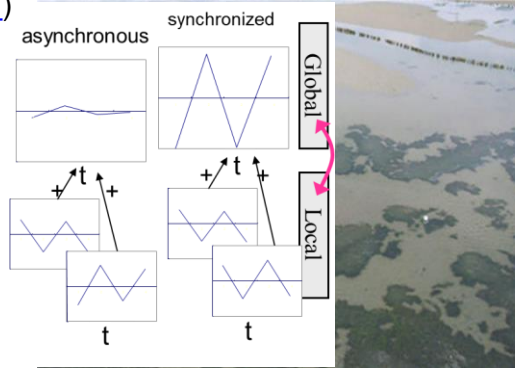




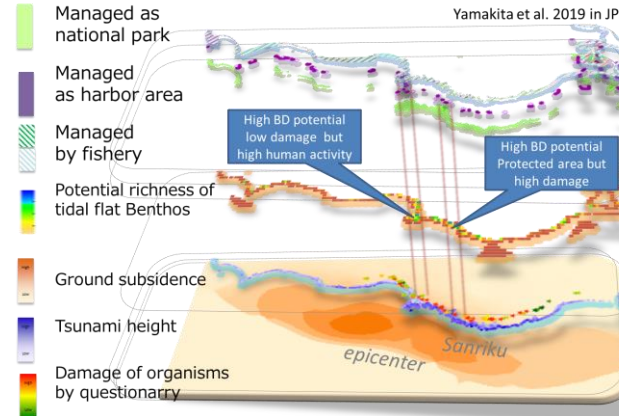
# Takehisa YAMAKITA



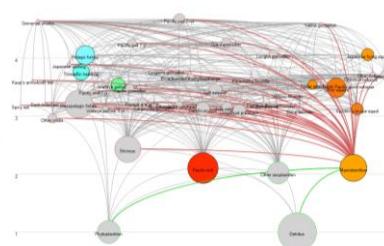
## Asynchrony-Stability relationships at a seagrass bed in Tokyo Bay (Yamakita et al. 2011)



## Species distribution modelling of benthic organisms and management planning (Yamakita et al. 2018)

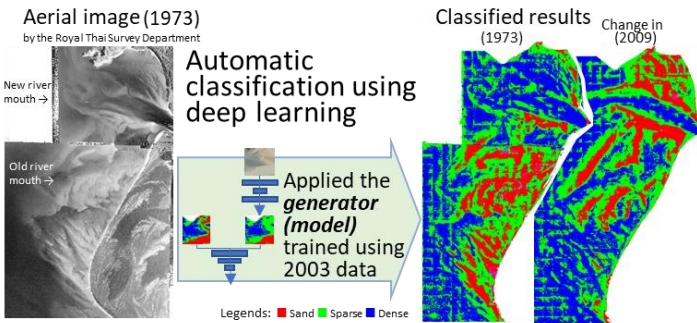


(Yamakita et al. 2018)

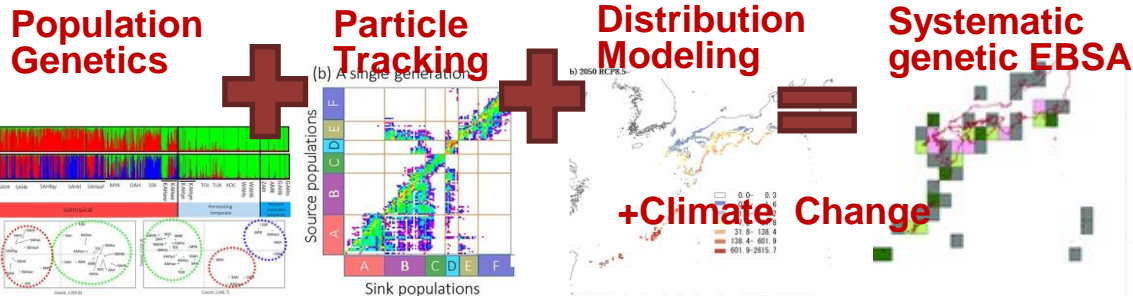


X @Yamakita\_lab

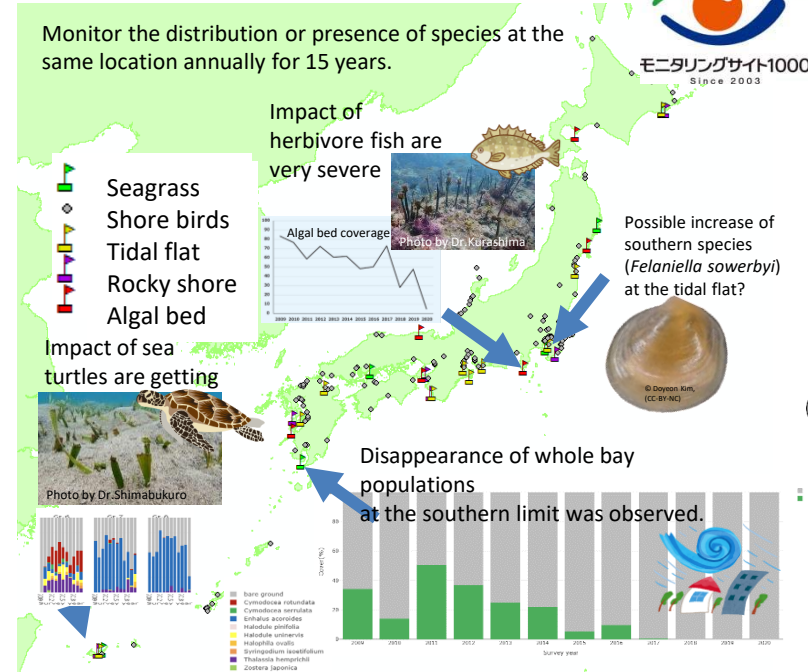
## Seagrass extraction from B/W photo using deep learning (Yamakita et al. 2019)



## Population genetics criteria on EBSA (important marine area of CBD) (Yamakita et al. 2022)



## Monitoring 1000 of Japan



Correspond to Essential Ocean Variables of GEOBON MBON/ GOOS/ APBON as APMBON



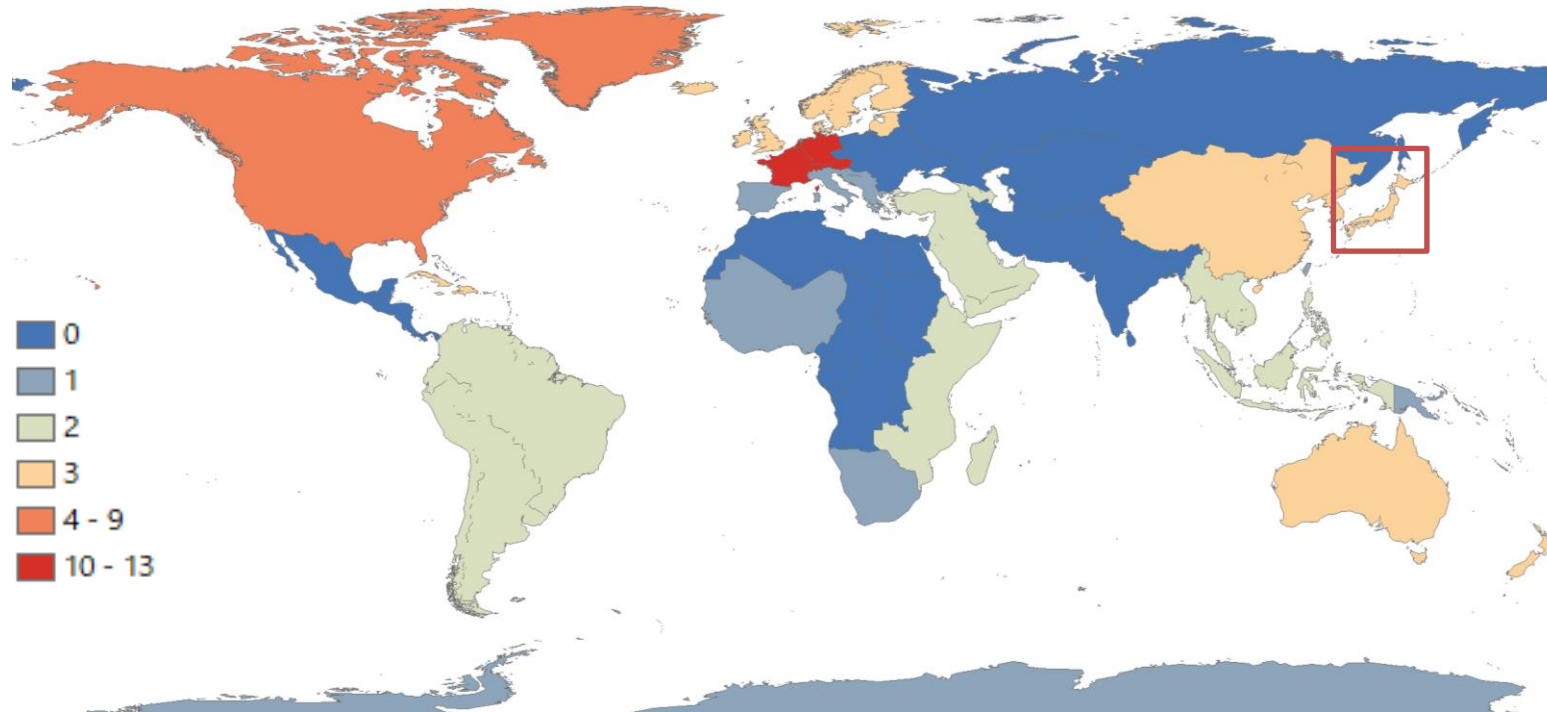
# Background: International Status of MES (Marine and Coastal Ecosystem Services) Assessment

## Distribution of studies

→ heavily skewed towards Europe

(「Marine Ecosystem Service\*」  
「Coastal Ecosystem Service\*」  
Search results in ISI web of Science)  
([Yamakita 2022](#))

Number of papers per UN subregion (N=69 2016)



# History of MES

Distribution of shell mounds in the Jomon Period (13,000 years ago to 2300 years ago)

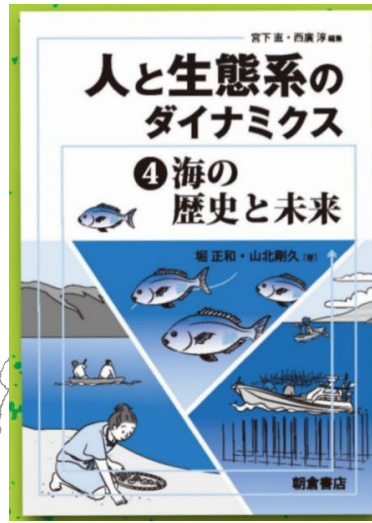


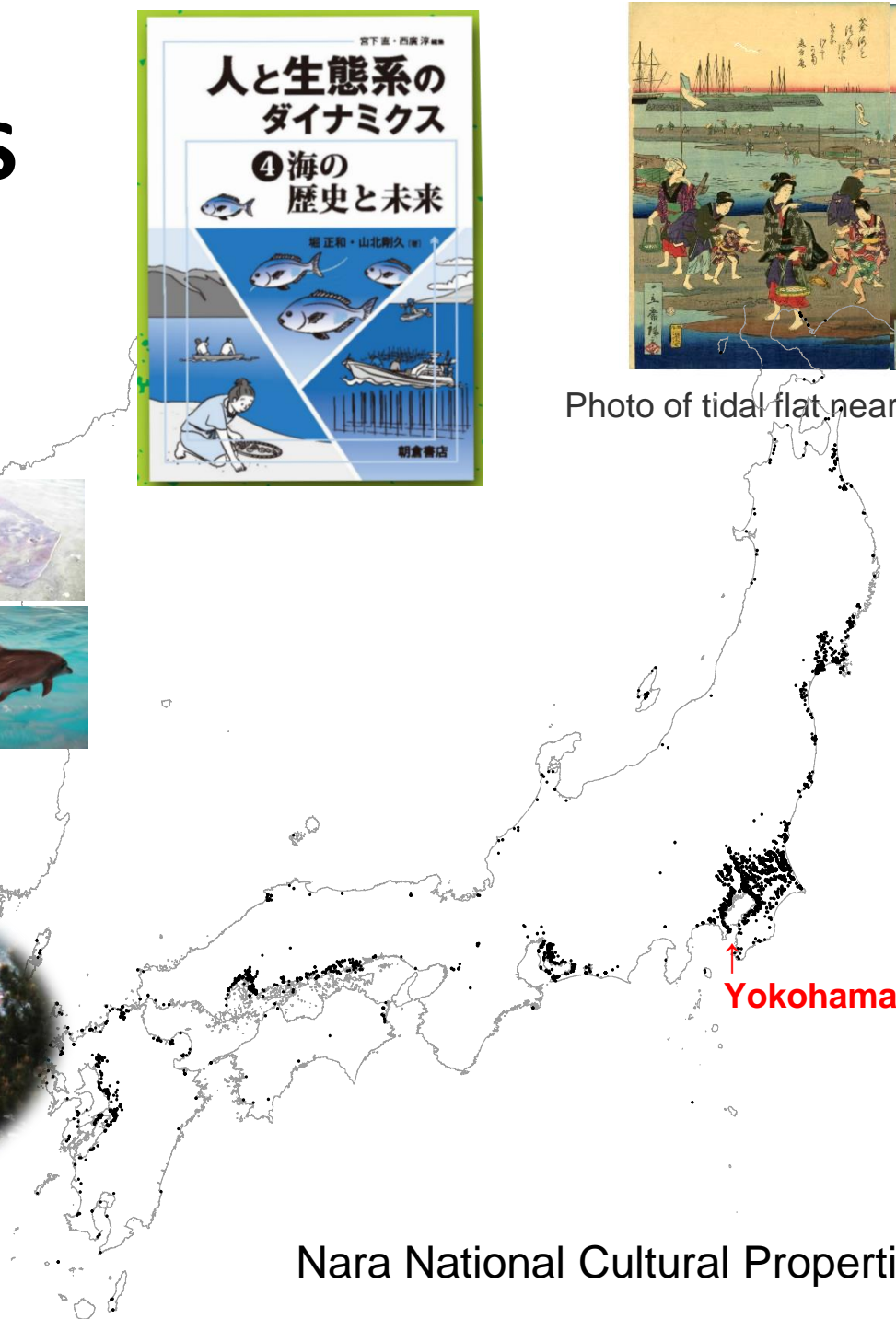
Photo of tidal flat near Tokyo Tower (Shinagawa) 1861.



[http://www.taharamuseum.gr.jp/info/hic/pdf/hic\\_026.pdf](http://www.taharamuseum.gr.jp/info/hic/pdf/hic_026.pdf)



2015 Spring Holiday at Yokohama Sea Park (Shellfish gathering)



Nara National Cultural Properties Research Institute (2017)

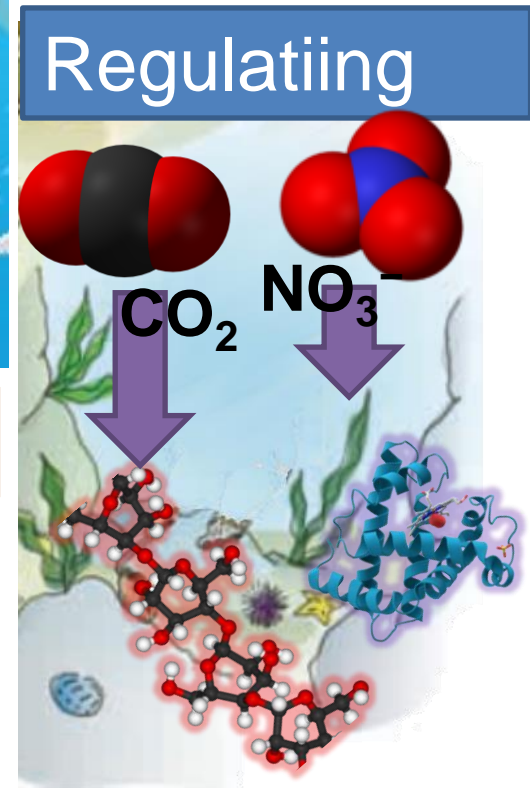
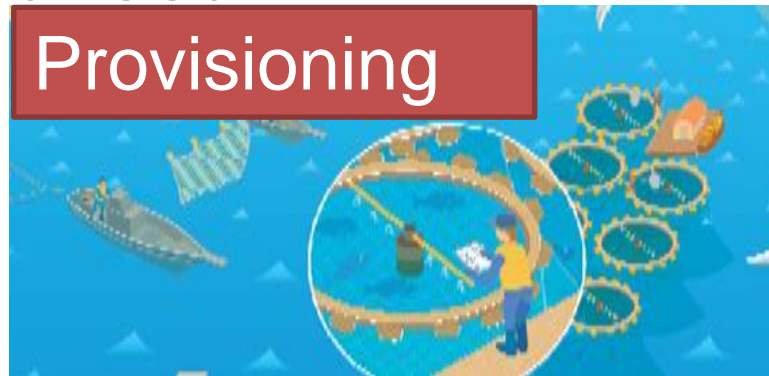
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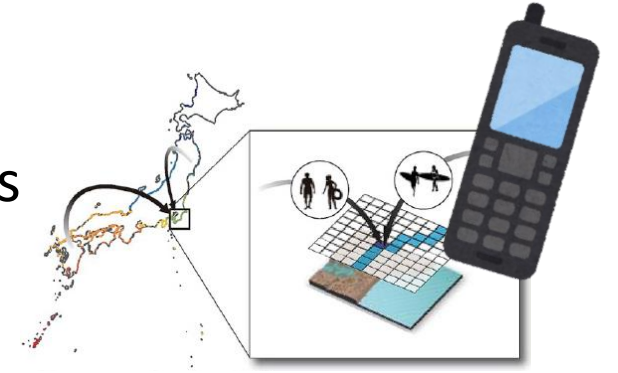
→ high in recreation  
and food

	Total
Food.provision	56
Water.storage.and.provision	17
Biotic.materials.and.biofuels	28
Water.purification	44
Air.quality.regulation	11
Coastal.protection	33
Climate.regulation	34
Weather.regulation	6
Ocean.nourishment	17
Life.cycle.maintenance	42
Biological.regulation	20
Symbolic.and.aesthetic.values.	47
Recreation.and.tourism	66
Cognitive.effects..educational.values	37



## Methods and Data

- 1) Current Status of Major Marine ES
  - Diverse species catch of coastal species in temperate regions
  - Carbon sequestration based on ecosystem area
  - Daytime population in coastal areas based on cell phones
- Downscaled climate model
  - Change in sea surface temperature
  - Change in sea water height
  - →Comparison of synergies by correlation
- 2) Current and Near-Future Status of Integrated Marine Ecosystem Services Assessed Using OHI
- 3) Example of future scenario development and study

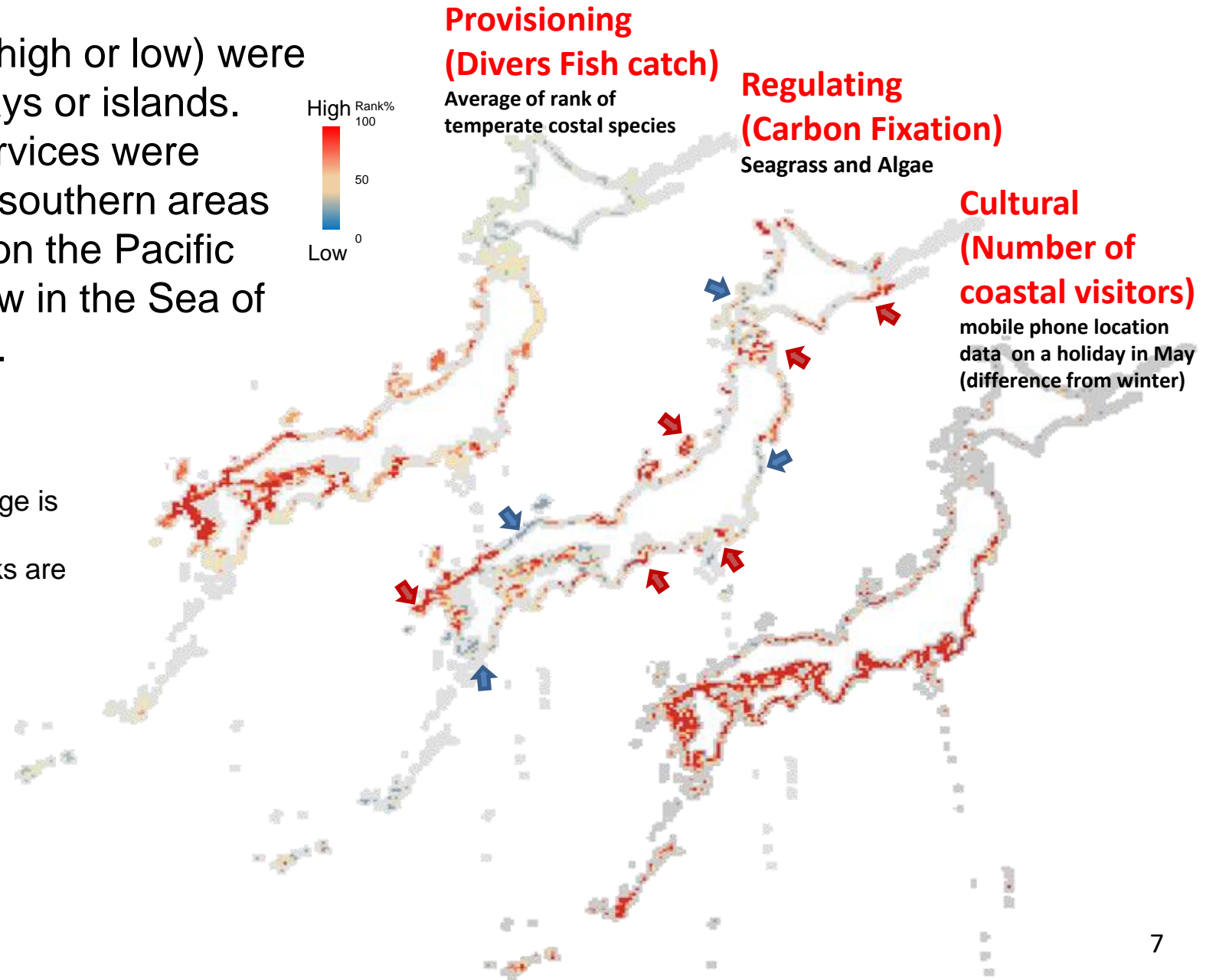


[Kubo et al. 2020](#)  
[Tourism Management](#)

# 1:Current Status of Major Marine ES



- Hot spots (high or low) were found at bays or islands.
- Cultural services were high in the southern areas especially on the Pacific side, but low in the Sea of Japan side.



\*The catch of each city, town, or village is allocated proportionally per area of seagrass/seaweed bed, and the ranks are averaged.

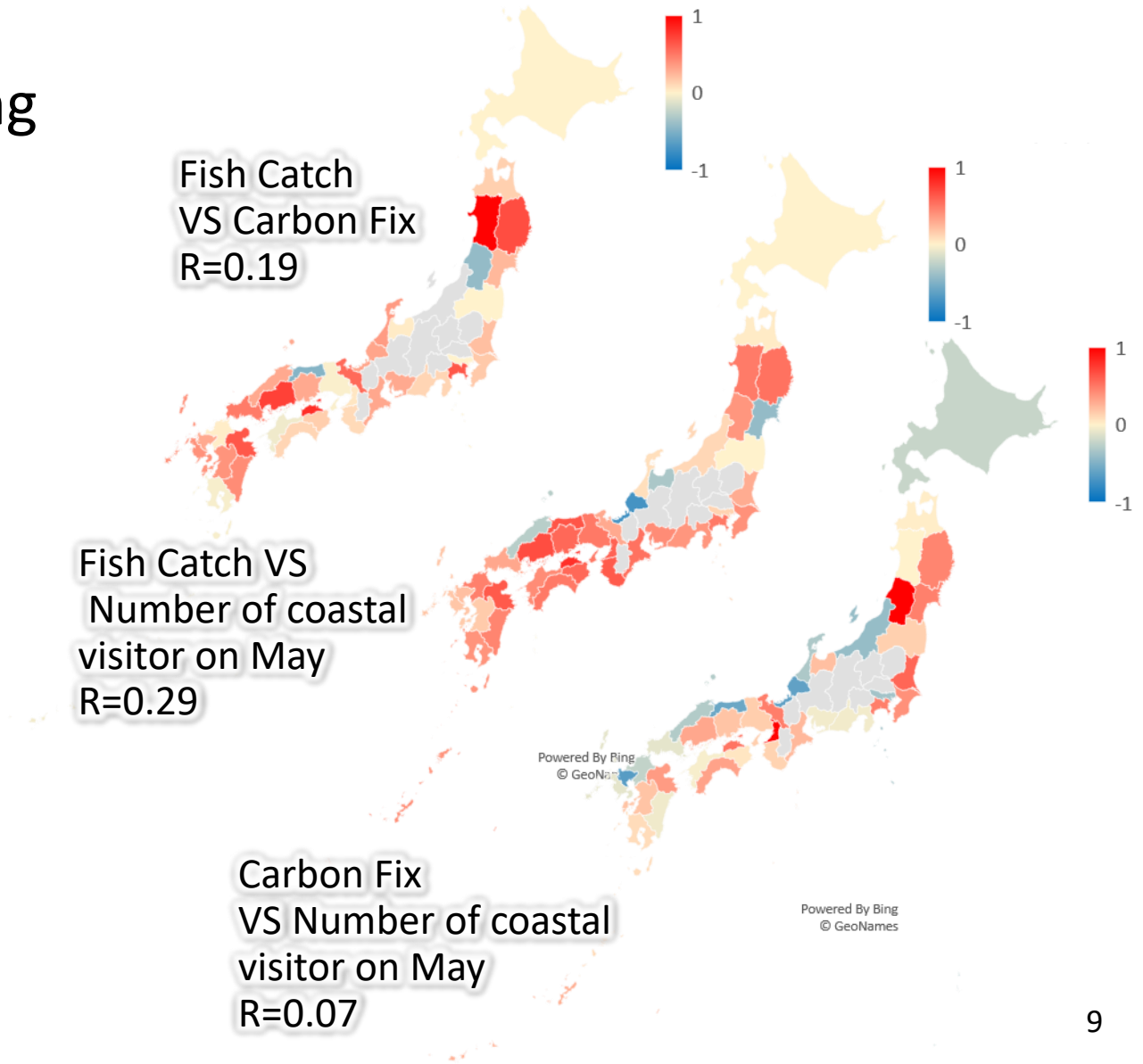




# Regional variation of Relationship



- Correlation coefficients among ESs elucidated regional differences
- Negative correlations (i.e. trade off) were observed in some locations

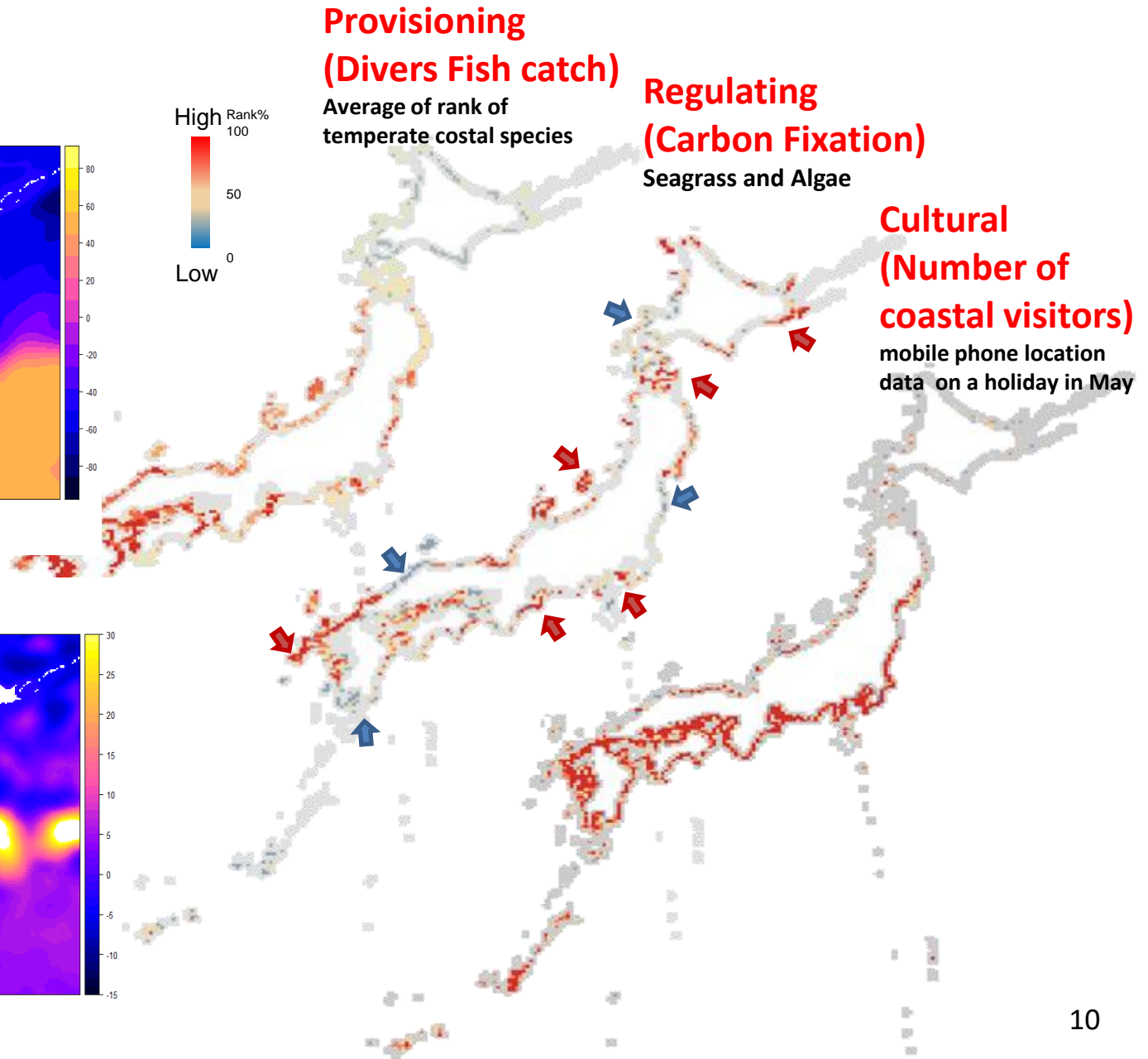
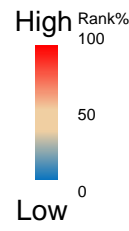
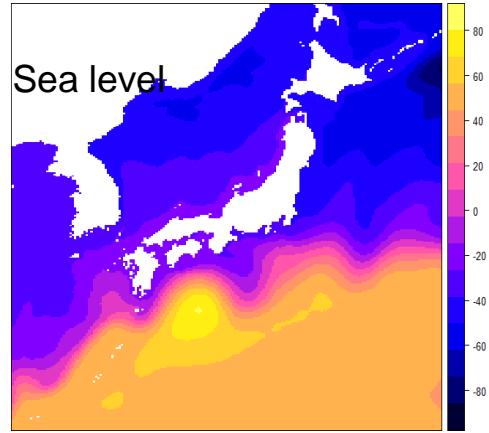
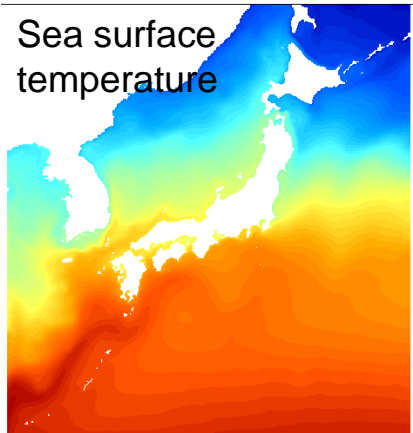


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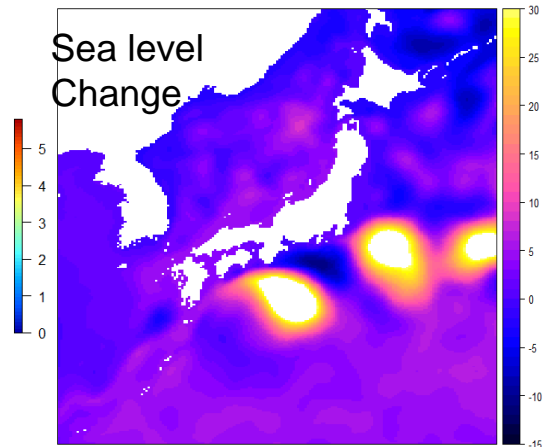
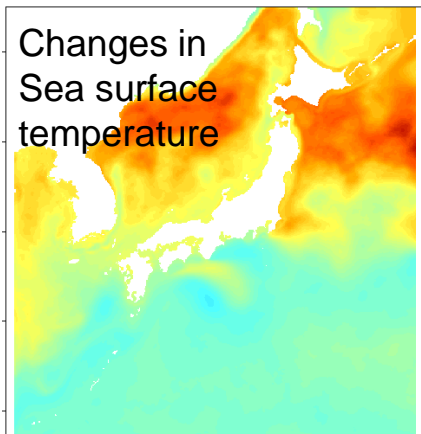
# 1: Current Status of Major Marine ES



2000

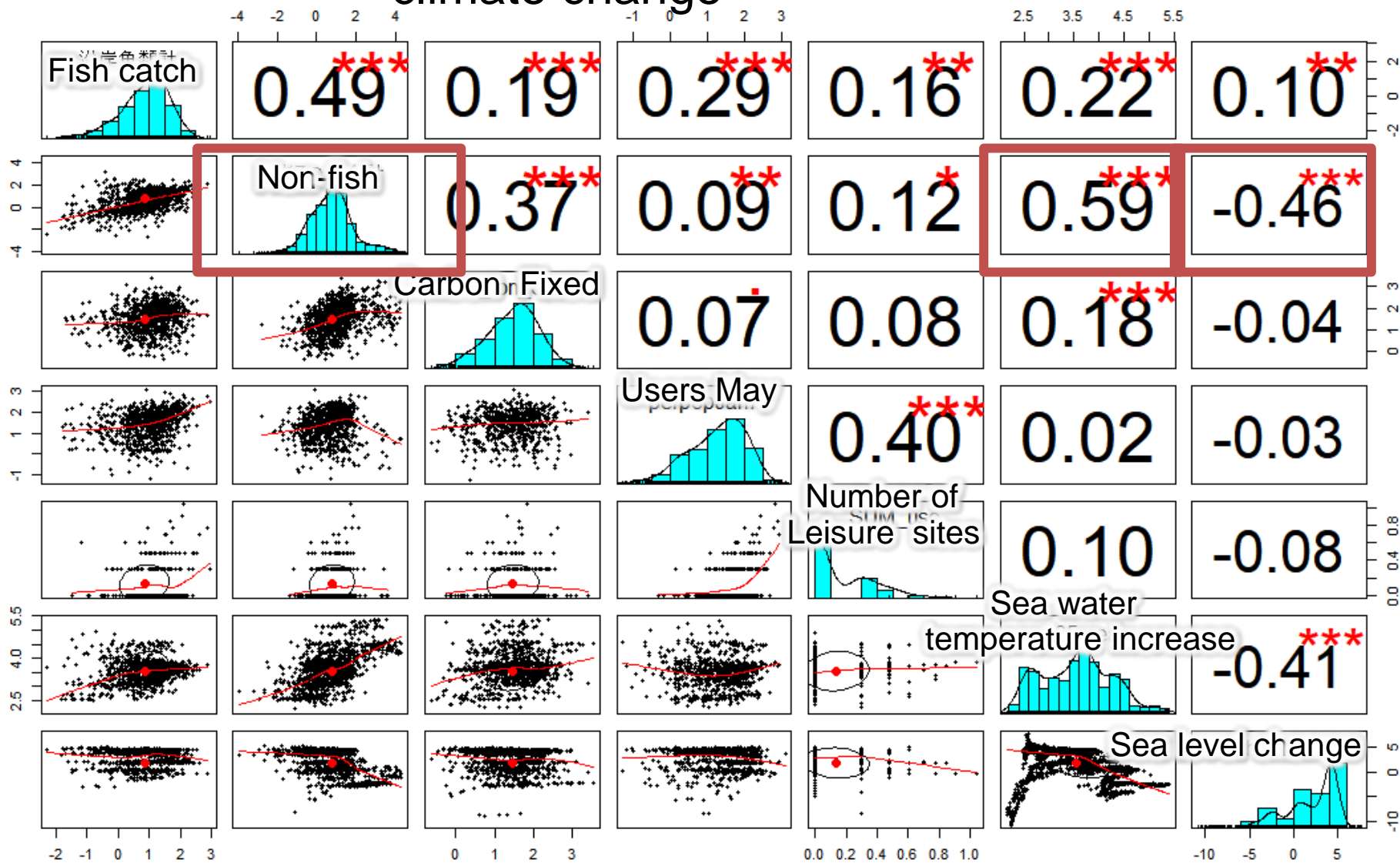


RCP8.5 2100

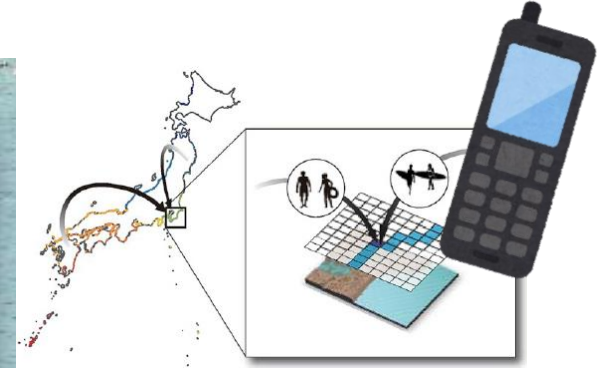
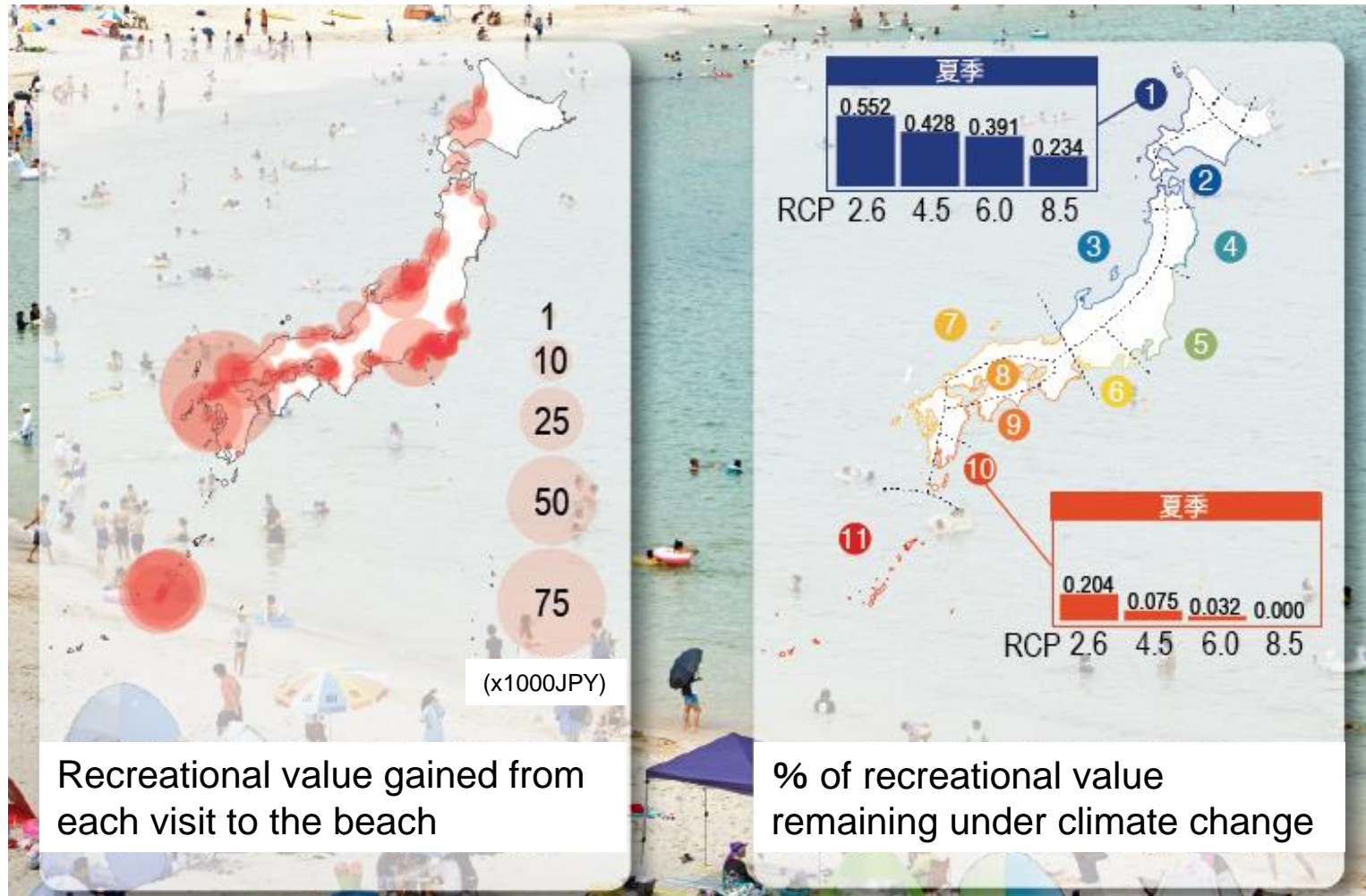


Pearson's R  
On the 10 km grid

# Correlation between non-fish catches and climate change



# Economic evaluation of coastal tourism (swimming/sea bathing) using cell phone data



[Kubo et al. 2020](#)  
[Tourism Management](#)

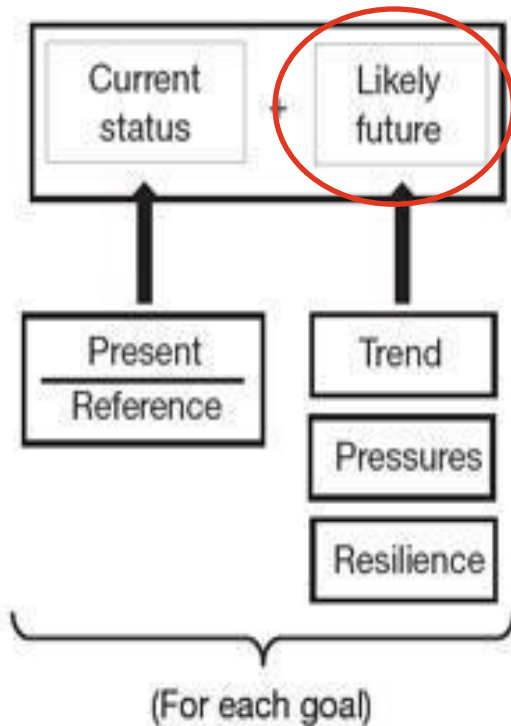
Kubo, Yamano, Yamakita, Shirayama et al. (2020) Tourism Management

There is more impact of sea-level rise than the absolute value in some places.

# 2 : Current and Near-Future Status of Integrated Marine Ecosystem Services Assessed Using OHI



## Calculation of each Target



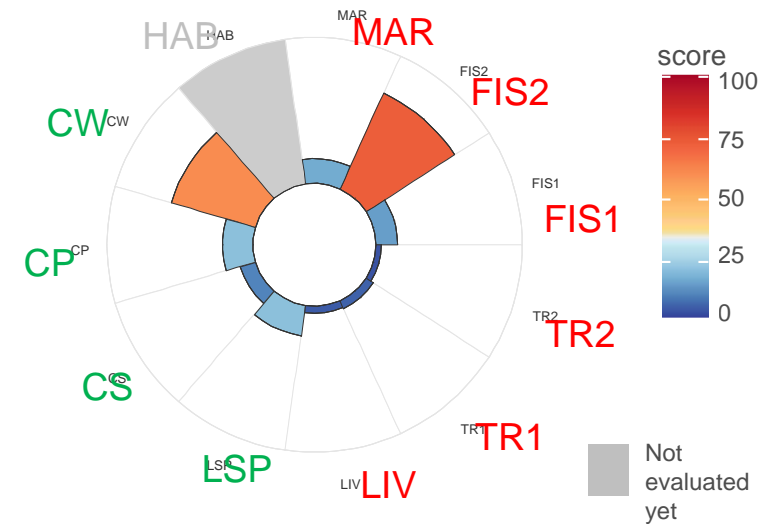
## Targets in Original version (Halpern et al. 2012,2017)

Food provision	Fisheries Mariculture
Artisanal fishing opportunity	
Natural products	
Carbon storage	
Coastal protection	
Tourism and recreation	
Coastal livelihoods and economies	Livelihoods Economies
Sense of place	Iconic species Lasting special places
Clean waters	
Biodiversity	Habitats Species



## Japanese version

(prefecture level by average of city)



\*Biodiversity and habitat were not evaluated yet, because so many indicators and taxon to be consider and need more discussion to decide

### Ecological Target

HAB: Habitat\*  
 CW: Clean Water  
 CP: Coastal Production  
 CS: Carbon Storage

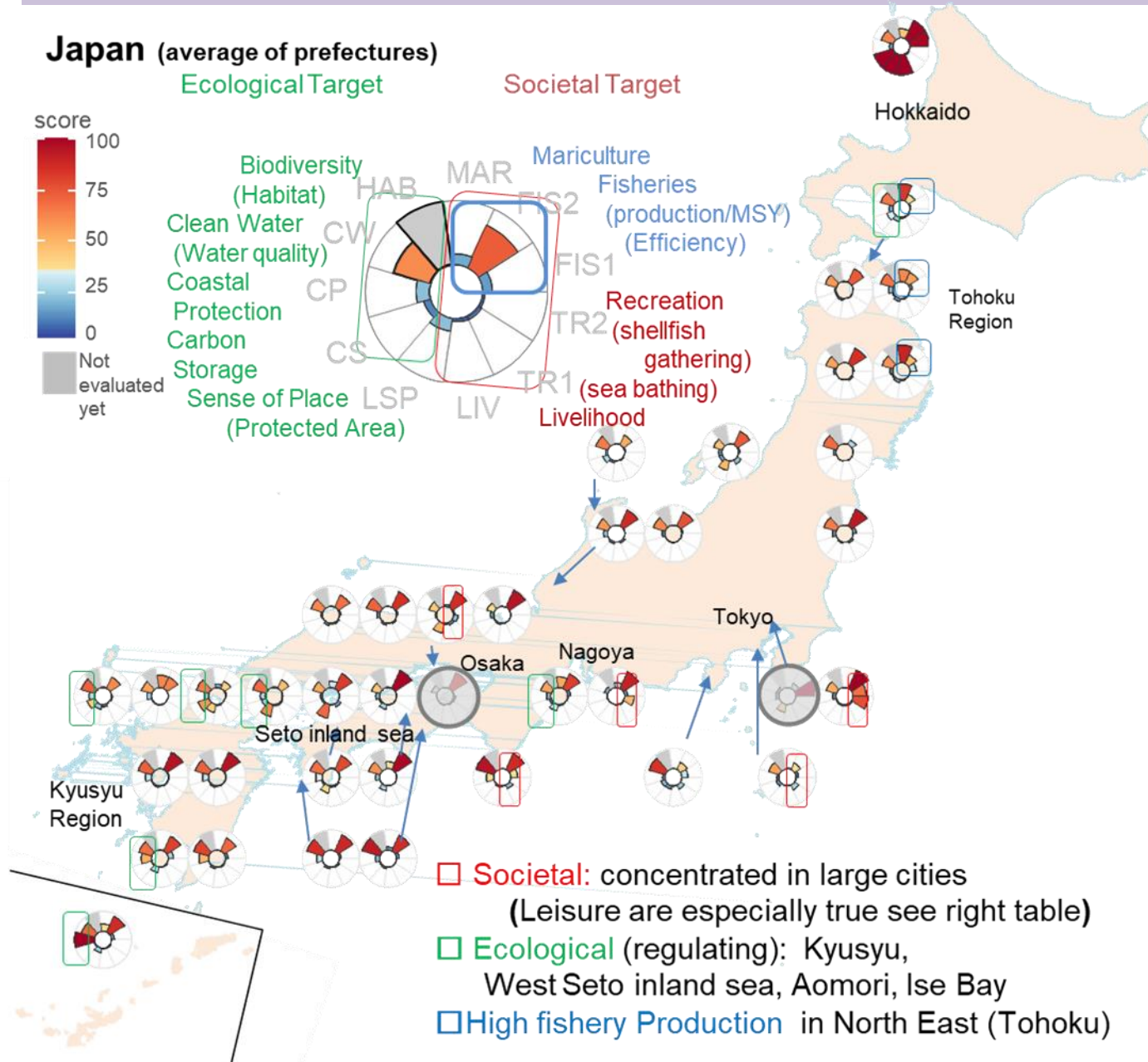
LSP: Legal Sense of Place

### Societal Target

MAR: Mariculture  
 FIS2: Fisheries Production  
 FIS1: Fisheries Efficiency  
 TR2: Tourism  
     Shellfish collection  
 TR1: Tourism  
     Sea bathing  
 LIV: Livelihood

Temporal change (past and future) was taken into account using Ocean Health Index (OHI)

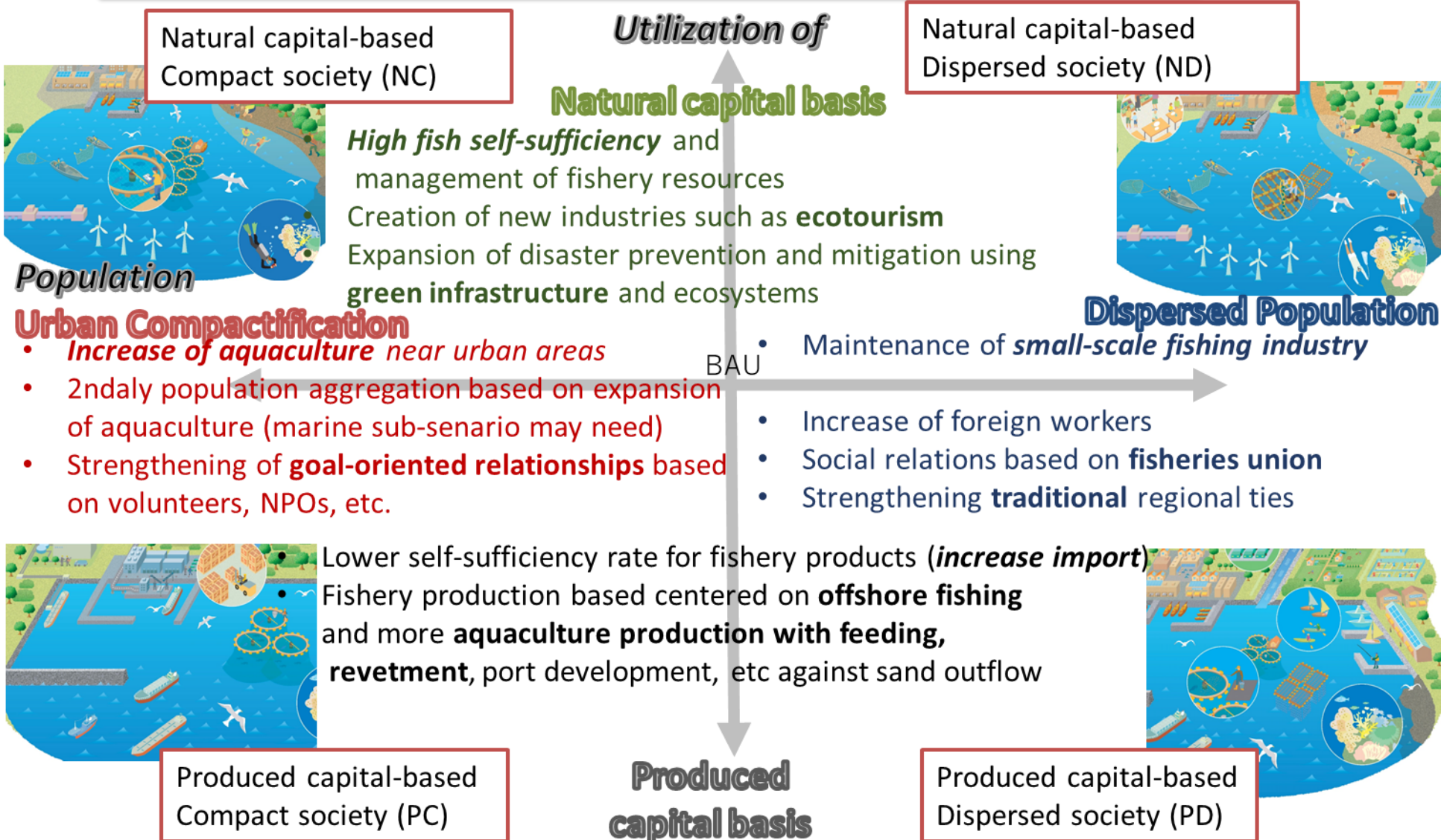
# Result of PANCES-Coastal OHI JP by Prefecture ver 0.47



Example of regional difference

	sea-bathing	Carbon fixation
Hokkaido	5	100
Aomori	4	33
Iwate	3	6
Miyagi	1	9
Akita	3	5
Yamagata	9	0
Fukushima	1	0
Ibaraki	10	0
Chiba	7	3
Tokyo	0	0
Kanagawa	26	16
Niigata	22	17
Toyama	0	1
Ishikawa	4	27
Fukui	10	3
Shizuoka	23	20
Aichi	4	2
Mie	0	10
Kyoto	0	4
OSAKA	4	0
Hyogo	13	3
Wakayama	21	1
Tottori	7	1
Shimane	6	0
Okayama	2	5
Hiroshima	16	8
Yamaguchi	7	23
Tokushima	1	3
Kagawa	1	2
Hiroshima	6	9
Kochi	7	3
Fukuoka	0	56
Saga	0	2
Nagasaki	0	41
Kumamoto	1	10
Oita	3	4
Miyazaki	5	2
Kagoshima	3	3
Okinawa	5	3





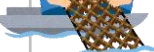

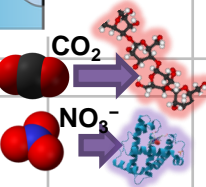


# 3: Marine Version of Socio-Economic Scenario based on Saito et al. 2019 Sust. Sci.



# Future Projection of Marine ESs under Different Socio-economic Scenarios: Summary


Difference of population was adopted as scenario frequently

Applied elements of scenarios

	2015	BAU	NC	ND	PC	PD	Population	Land use	Water quality	Others	Climate
<b>Provisioning</b>											
Fishing port persistence 		↘	↓	↘	↓	↘	<input checked="" type="checkbox"/>				
Fishing port production 		↘	↓	↘	↓	↘	<input checked="" type="checkbox"/>				
Oysters farming 		→	↗	→	↘	↘	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	
Oysters demand 		↘	↘	↘	↘	↘	<input checked="" type="checkbox"/>				
Seaweed farming 		→	↘	→	↘	→			<input checked="" type="checkbox"/>		
<b>Regulating</b>											
disaster impact 			↓	↓	↓	↓	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
Water quality and carbon absorption 											
Eelgrass beds area 		→	↘	→	→	→	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Seaweed biomass 		→	→	→	↘	↘			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>



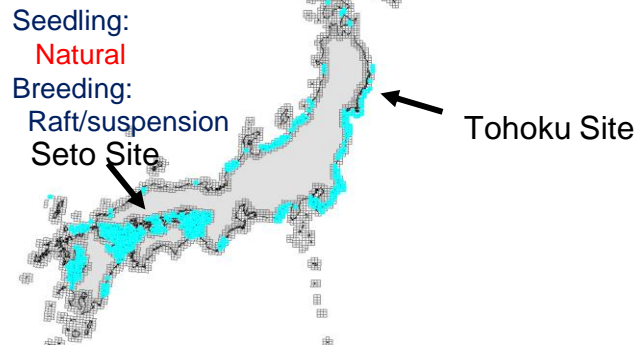
## Suitable Oyster Cultivation Sites by Region & Methods and Correspondence to the Marine Scenario

Provisioning		2015	BAU	NC	ND	PC	PD
Oyster farming			→	↗	→	↘	↓
Qualitative adjustment by marine scenario		Demand (policy)		↗	→	→	→
		Concentration of demand		↗	↘	↗	↘
		Increase of Import		→	almost no import	→	↗

Potential aquaculture area based on existing environment distribution of the types of cultivation

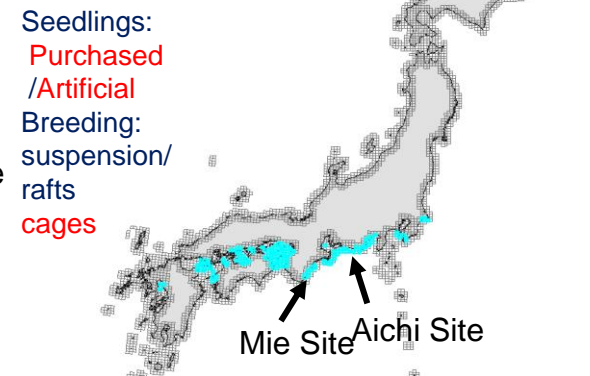
### NC: Mass production type

Environmental potential will be broad area  
 Mass production will be expected near city



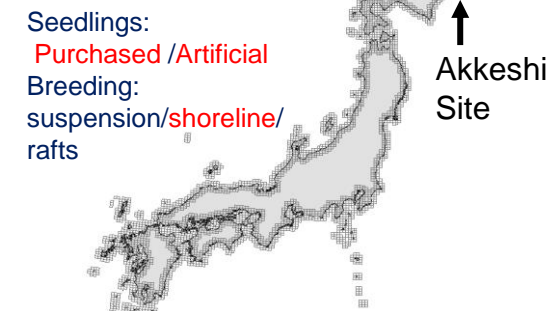
### PC: Local production near city type

Intensive agriculture in **limited area near city** such as Ise Bay



### PD: Special brand type (case of Akkeshi)

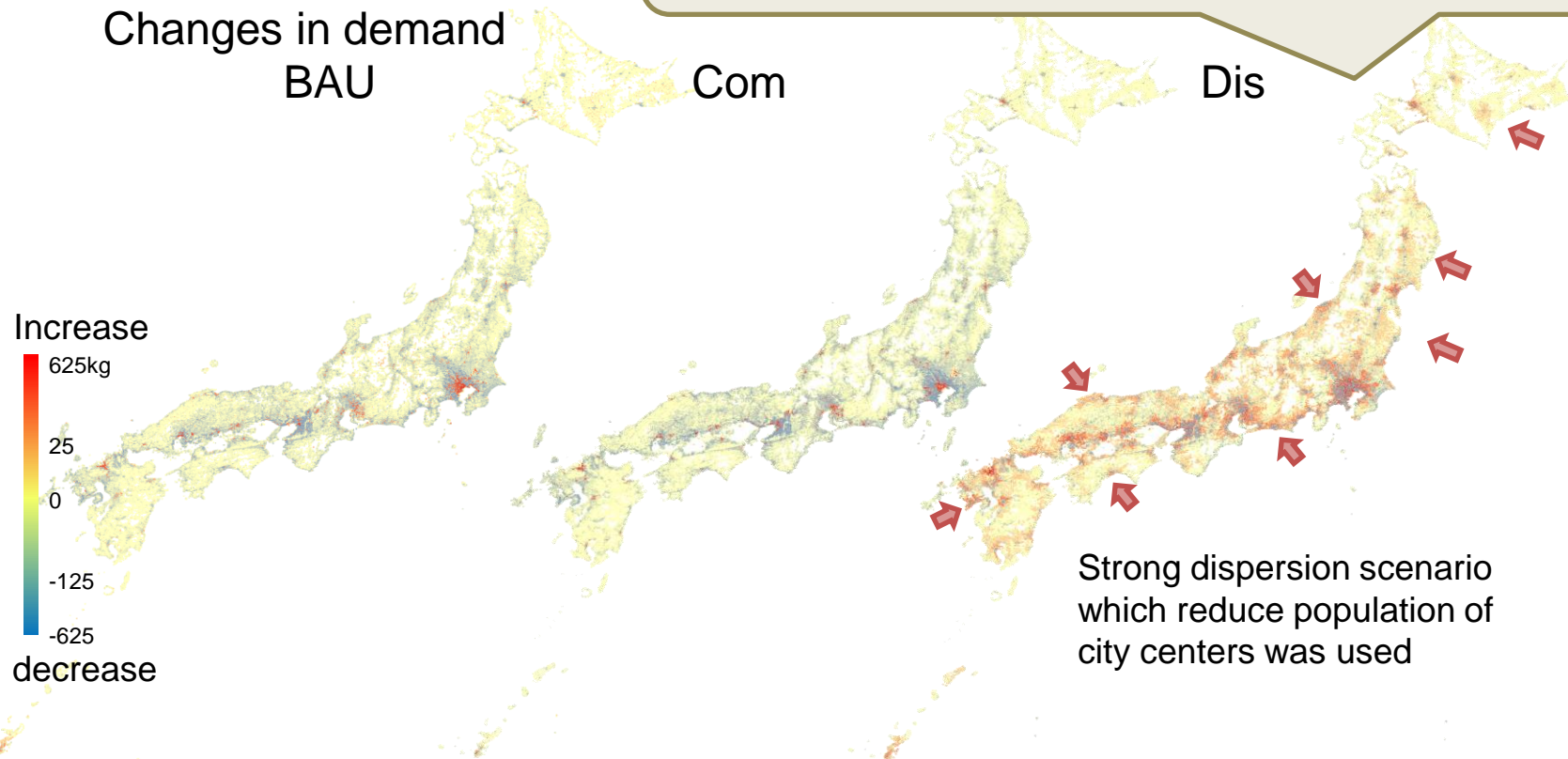
**High quality unique product** available only in a limited area  
 (Basically, satisfy demand through imports.)



## Change in Demand for Oysters Due to Population Change

Provisioning	2015	BAU	NC	ND	PC	PD
<b>Oysters demand</b>		↘	↘	↓	↘	↓
Reduction by the population ratio	19267593	16075011	16081927	15979104	16081927	15979104
cf) Oyster farming	-	→	↗	→	↘	↓

Geographical distribution showed **increase of demand at some locations in dispersion scenario** though overall tendency was decrease

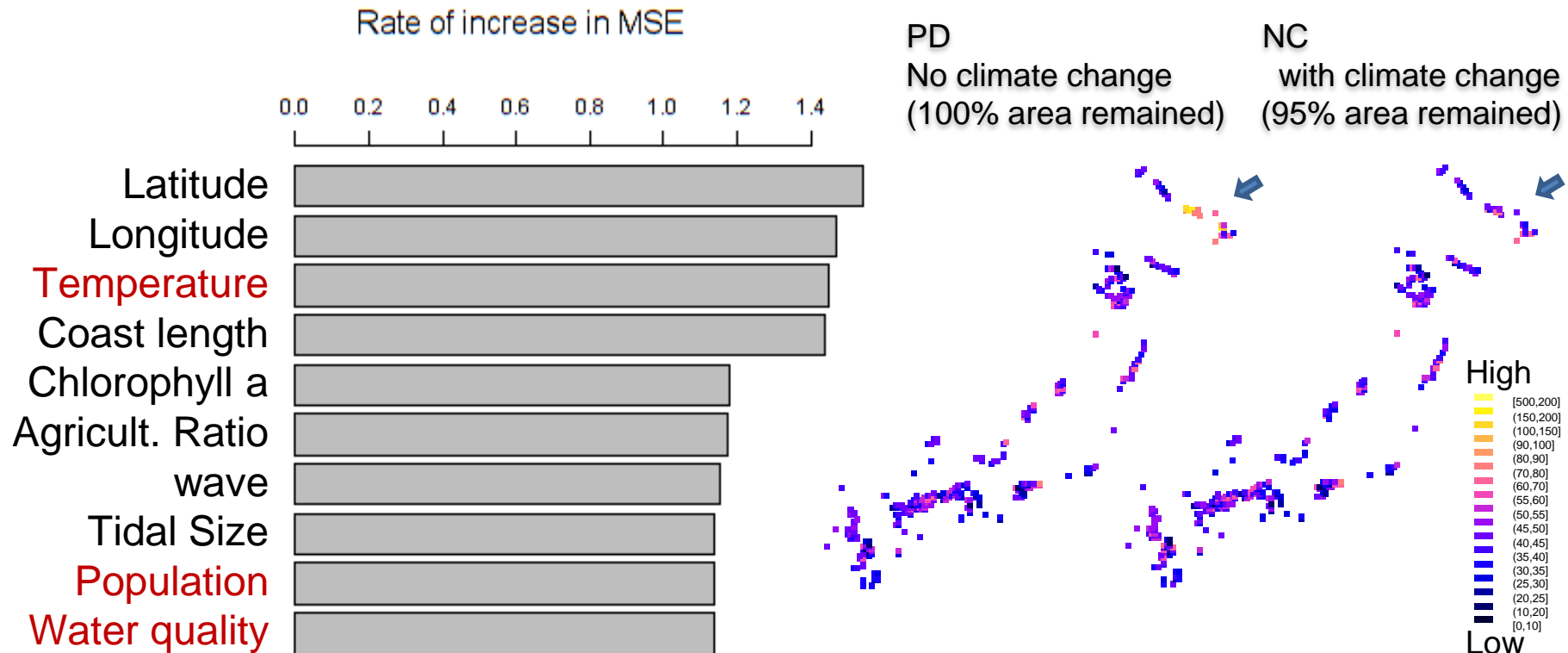
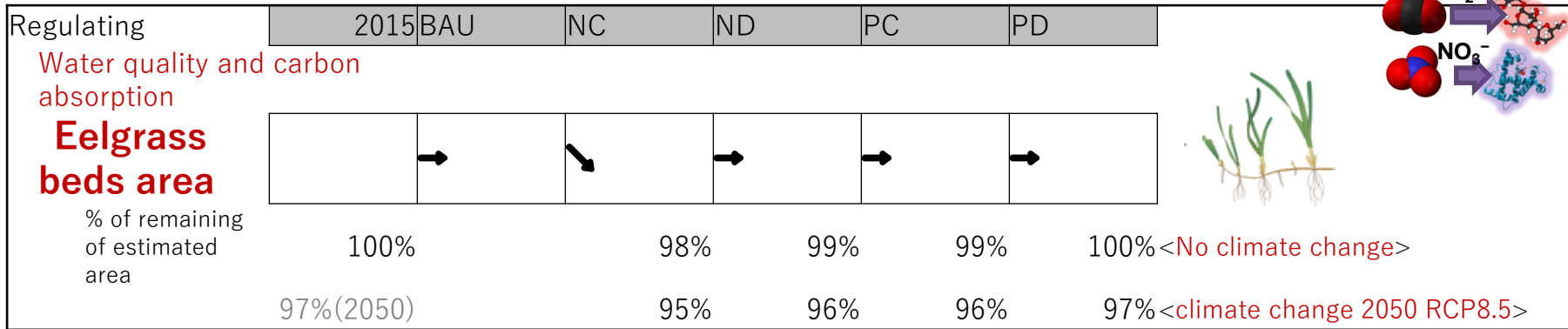


# Evaluation of Regulating Services by Scenario :

## Impacts of Terrestrial Land Use Change on Coastal Ecosystems Based on Future Scenarios

In [Kumagai et al. 2022](#)





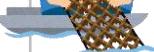

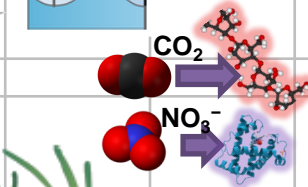

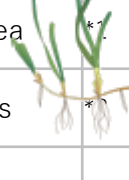
### Estimation of the area of eelgrass beds by 10km grid (Secondary mesh)



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Fishing port production		↘	↓	↘	↓	↘	☑				
Oysters farming		→	↗	→	↘	↘	☑			☑	
Oysters demand		↘	↘	↘	↘	↘	☑				
Seaweed farming		→	↘	→	↘	→			☑		
<b>Regulating</b>											
disaster impact			↓	↓	↓	↓	☑	☑			☑
Water quality and carbon absorption											
Eelgrass beds area		→	↘	→	→	→	☑	☑	☑		☑
Seaweed biomass		→	→	→	↘	↘			☑		☑

# Key Messages



- Current status of major marine ecosystem services (ES) were evaluated
  - Large regional differences of ecosystem services were observed.
  - OHI suggested the difference will remain in the near future.
- Marine socio-economical scenarios were developed, and future projections of ES under different scenarios were evaluated.
  - Differences in the impact among scenarios (especially types of population decline) were elucidated.
- It is crucial to consider the interaction between climate change and societal adaptation to the change at the local scale for the sustainable use of marine ecosystem services.



- Perspectives:

- Ecosystem change assessment used for TNFD and its implementation **(open call for applications! ask me if interested)**

Linking with IPCC's SSP assessment models will be a focus of the successive project of PANCES, S21(i-AM-B) <https://iam-b.jp/en/>

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X @Yamakita\_lab

# References



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[https://www.nies.go.jp/pances/en/policybrief/img/PolicyBrief2021\\_SPM\\_en06.pdf](https://www.nies.go.jp/pances/en/policybrief/img/PolicyBrief2021_SPM_en06.pdf)
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- Yamakita T. (2018) Cultural Ecosystem Services of Temperate Coastal Areas of Japan: Uses of Tidal Flats, Sandy Beaches, and Rocky |Coral Areas. 8th Asian Wetland Symposium 2017 Proceedings 290-293 Published by Asian Wetland Symposium 2017 Executive Committee [https://researchmap.jp/takehisa\\_yamakita/misc/17412709](https://researchmap.jp/takehisa_yamakita/misc/17412709)
- Kubo T, Uryu S, Yamano H, Tsuge T, Yamakita T and Shirayama Y (2020) : Mobile phone network data reveal nationwide economic value of coastal tourism under climate change. *Tourism Management*, 77, 104010. <https://doi.org/10.1016/j.tourman.2019.104010>.
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<https://doi.org/10.1007/s11625-020-00891-x>