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Human utility of marine ecosystem services and behavioral intentions for marine conservation

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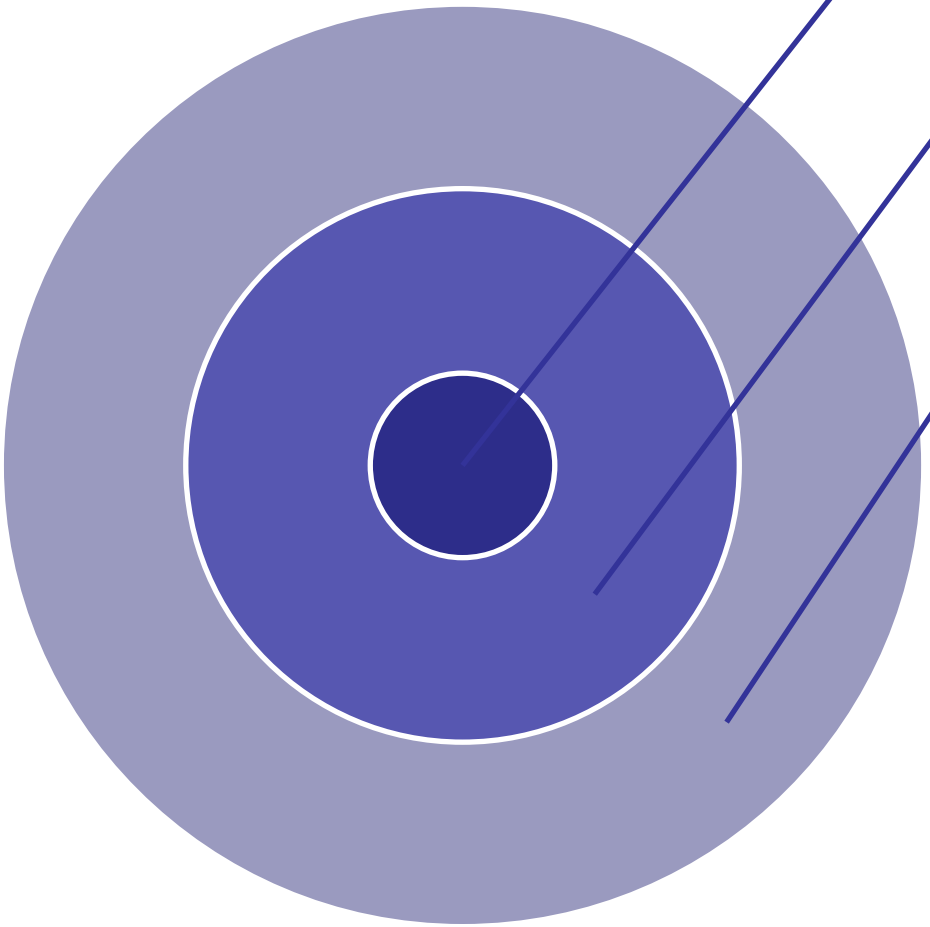
Ecosystem services



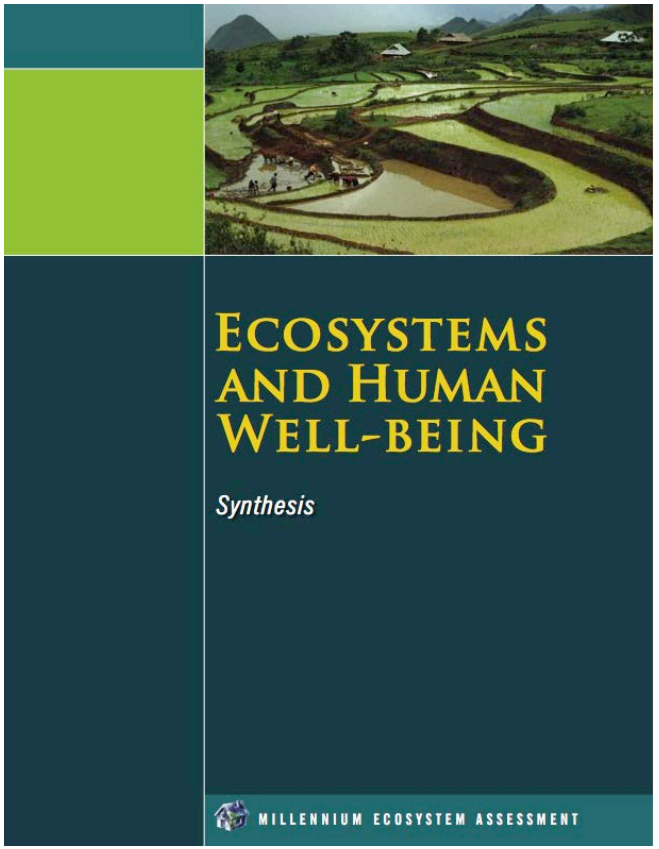
Products obtained from ecosystems

Benefits such as nutrient cycling

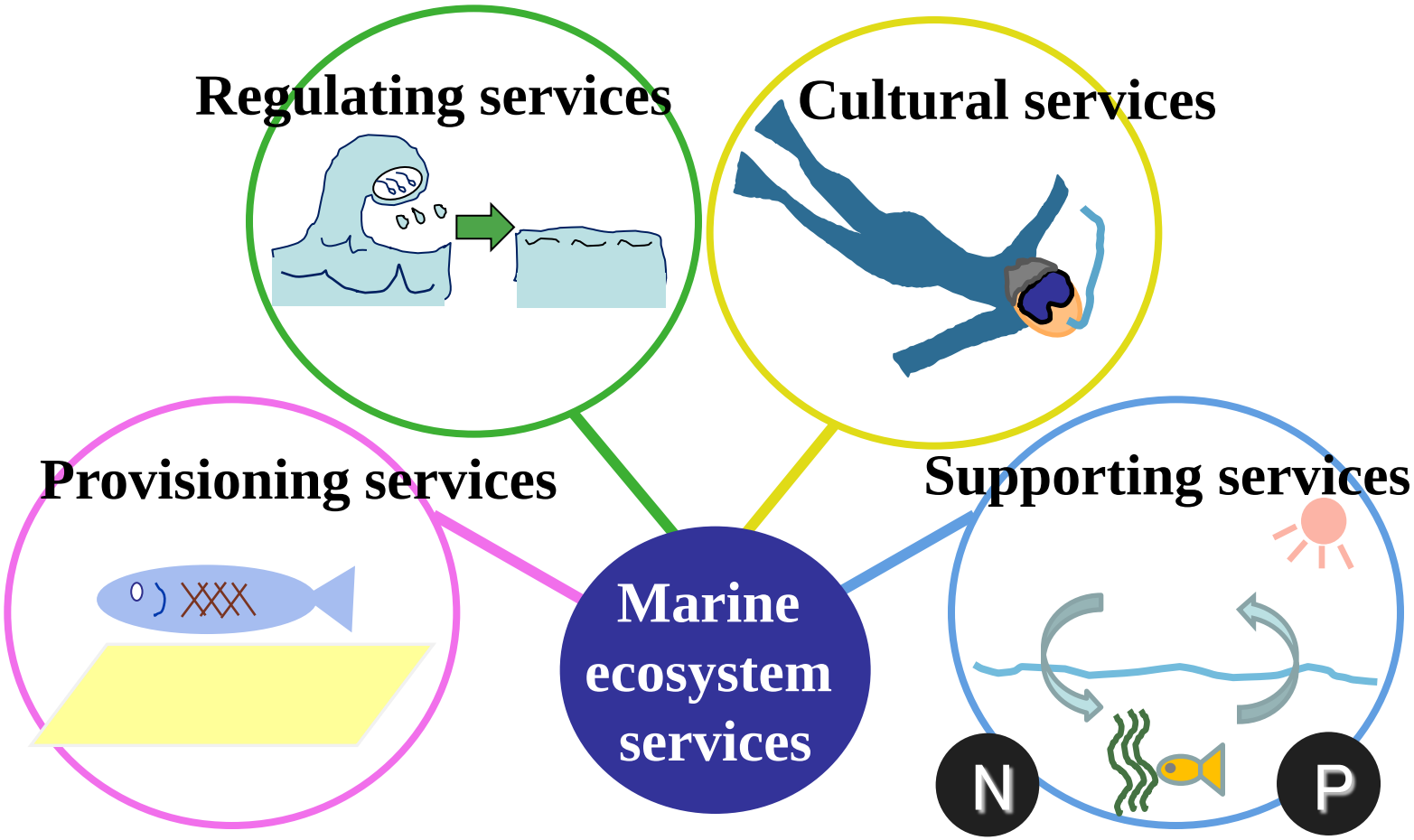
Cultural services

Four groups of ecosystem services at Millennium Ecosystem Assessment in 2005 and other previous publications

- Supporting (Nutrient cycling, primary production)
- Provisioning (food, fresh water)
- Regulating (Climate regulation)
- Cultural (Aesthetic, recreational)



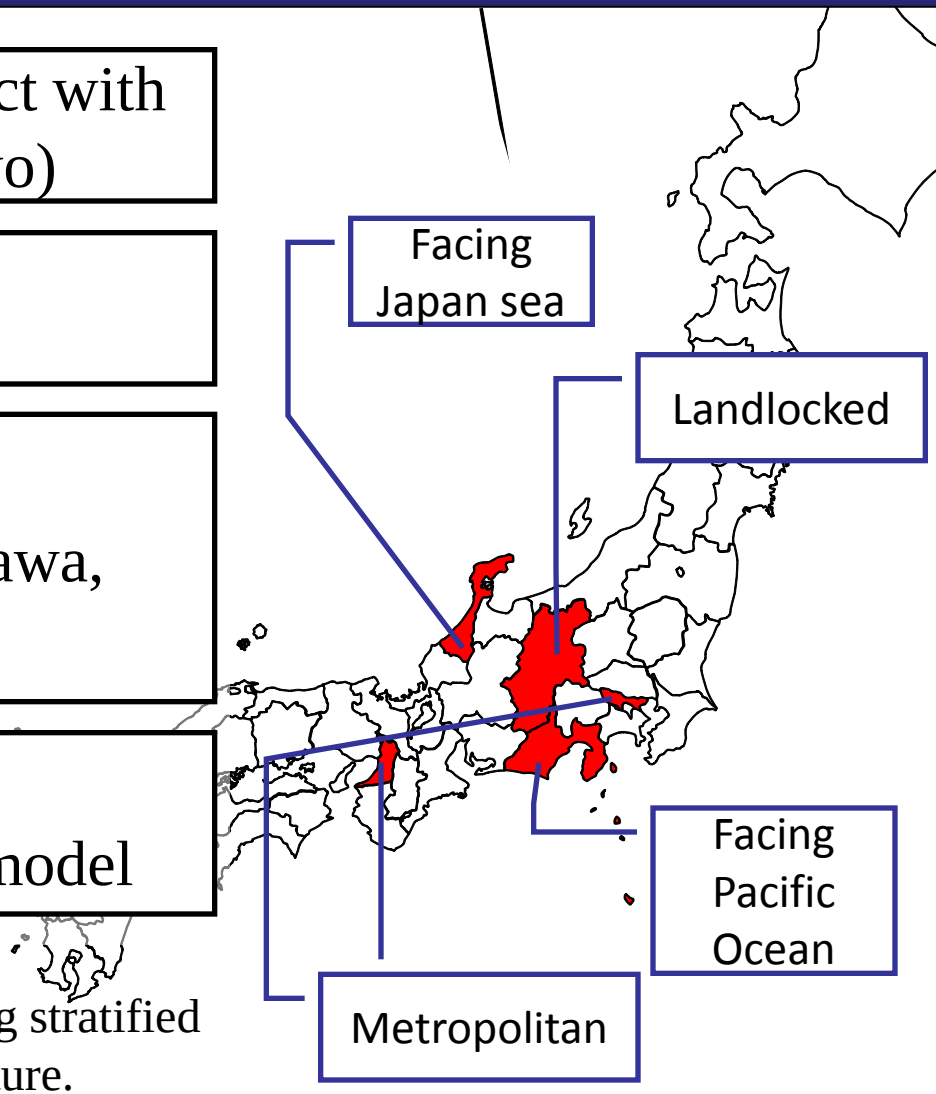
Our question: How people prioritize these services?



Marine ecosystem services: benefits to people

An online survey was conducted on human utility of marine ecosystem services and behavioral intentions for marine conservation

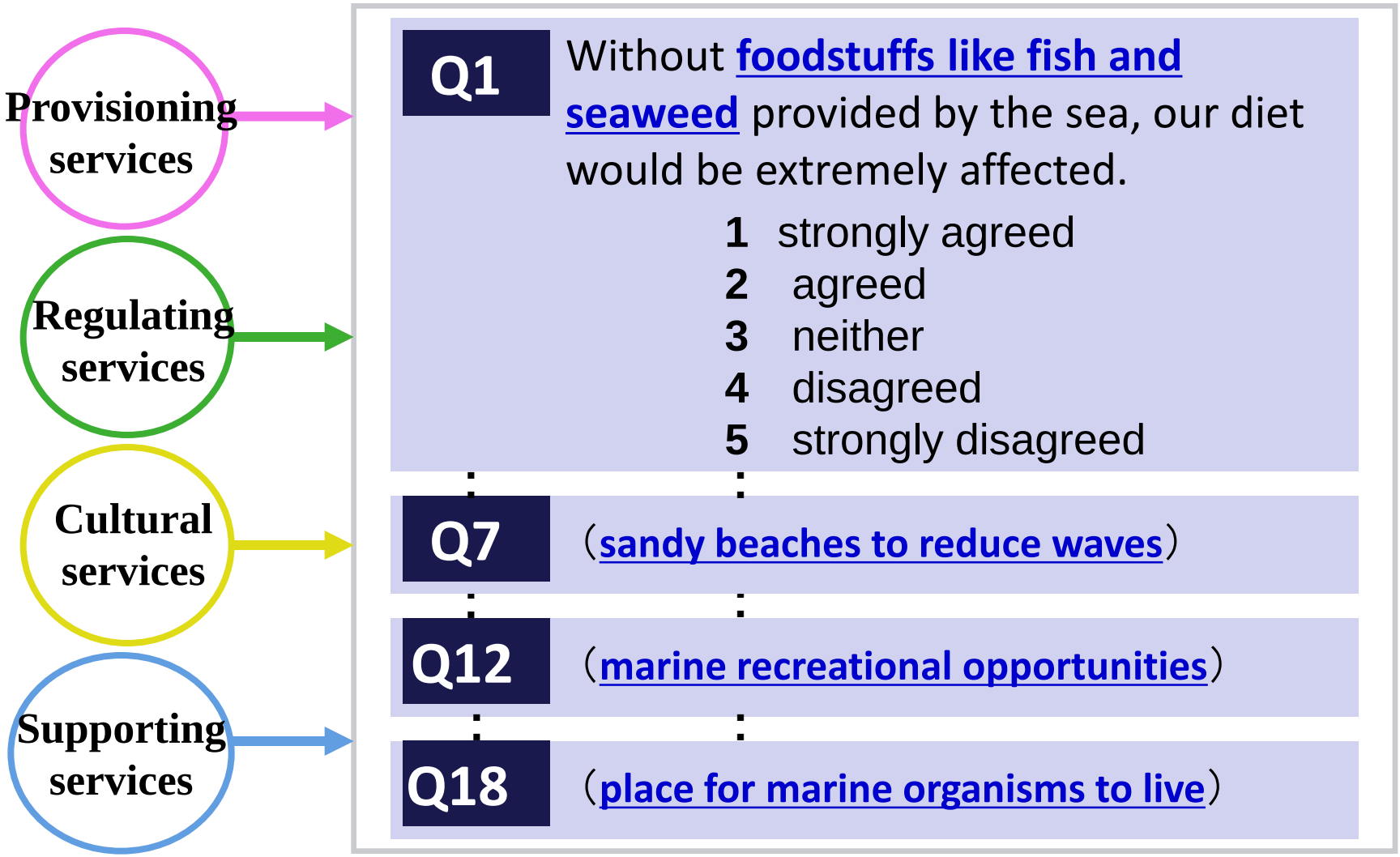
Survey method	Online survey (contract with Macromill and UTokyo)
Survey period	February 15-17, 2013
Respon-dents	1,100 residents * (Tokyo, Osaka, Ishikawa, Nagano, Shizuoka)
Analysis methods	- Factor analysis - Structural equation model



* Ultimately 814 responses were used after being stratified according to the gender and age per each prefecture.

Chapter 2: Human utility of marine ecosystem services and behavioural intentions for marine conservation (3)

- **18 questionnaire items on marine ecosystem services developed ← based on a review of existing literature**



Results of factor analysis

Variable	Factor 1	Factor 2	Factor 3
	Explained variance		
	7.44	46.25	5.46
	Rotated loadings		
P_{food}	**0.52**	0.33	-0.12
P_{med}	-0.14	**0.80**	0.13
$P_{mineral}$	0.00	**0.82**	-0.06
P_{energy}	0.10	**0.75**	-0.10
P_{water}	-0.09	**0.72**	0.10
R_{beach}	0.13	**0.64**	0.05
R_{reef}	0.18	**0.59**	0.08
R_{tidal}	0.37	**0.47**	-0.01
R_{cd}	0.21	**0.52**	0.07
$C_{religion}$	-0.12	0.26	**0.60**
C_{rec}	-0.08	0.01	**0.68**
C_{health}	-0.16	0.02	**0.80**
$C_{culture}$	0.32	-0.11	**0.66**
$C_{scenery}$	**0.46**	-0.07	**0.48**
S_{life}	**0.90**	-0.07	0.00
S_{ncycle}	**0.81**	0.03	0.04
S_{place}	**0.90**	0.04	-0.16

* Rotated factor loadings above 0.4 retained.

Questions on provisioning services 1

- P food: Without foodstuffs like fish and seaweed provided by the sea, our diet would be extremely affected.
- P ornament: Without corals and beautiful shells, which can be used as ornaments, our lives would be extremely colorless.
- P med: Without marine resources, which can be utilized as medicine, our health would be extremely endangered in the future.

Questions on provisioning services 2

- P mineral: Without mineral resources such as cobalt and nickel in the seabed, high-tech industries would be extremely hampered.
- P energy: Without energy resources such as natural gas and methane hydrate in the seabed, supplies of energy would be severely limited.
- P water: Without water for human consumption and irrigation produced through desalination of seawater, our lives would be extremely inconvenient.

Questions on regulating services

- R beach: Without sandy beaches to reduce waves, we would be extremely vulnerable to high waves.
- R reef: Without coral reefs and mangroves to calm waves, we would be extremely vulnerable to high waves.
- R tidal: Without clams and other sea creatures living in tidal flats to purify the water, water quality would experience severe deterioration.
- R cd: Without the sea to contribute to carbon dioxide absorption, there would be severe advancement of global warming.

Questions on cultural services

- C religion: Without the sea to be utilized for religious and traditional events, our culture would be extremely impoverished.
- C rec: Without recreational opportunities such as swimming, diving, and surfing, our recreation opportunities would be far less interesting.
- C health: Without opportunities to spend time by the sea, our health would be considerably worsened.

Questions on cultural services 2

- C culture: Without the sea, our coastal cultures would be far less attractive and far more monotonous.
- C scenery: Without white sandy beaches, pine trees, and night views along the coasts, we would have far fewer opportunities to be moved by coastal scenery.

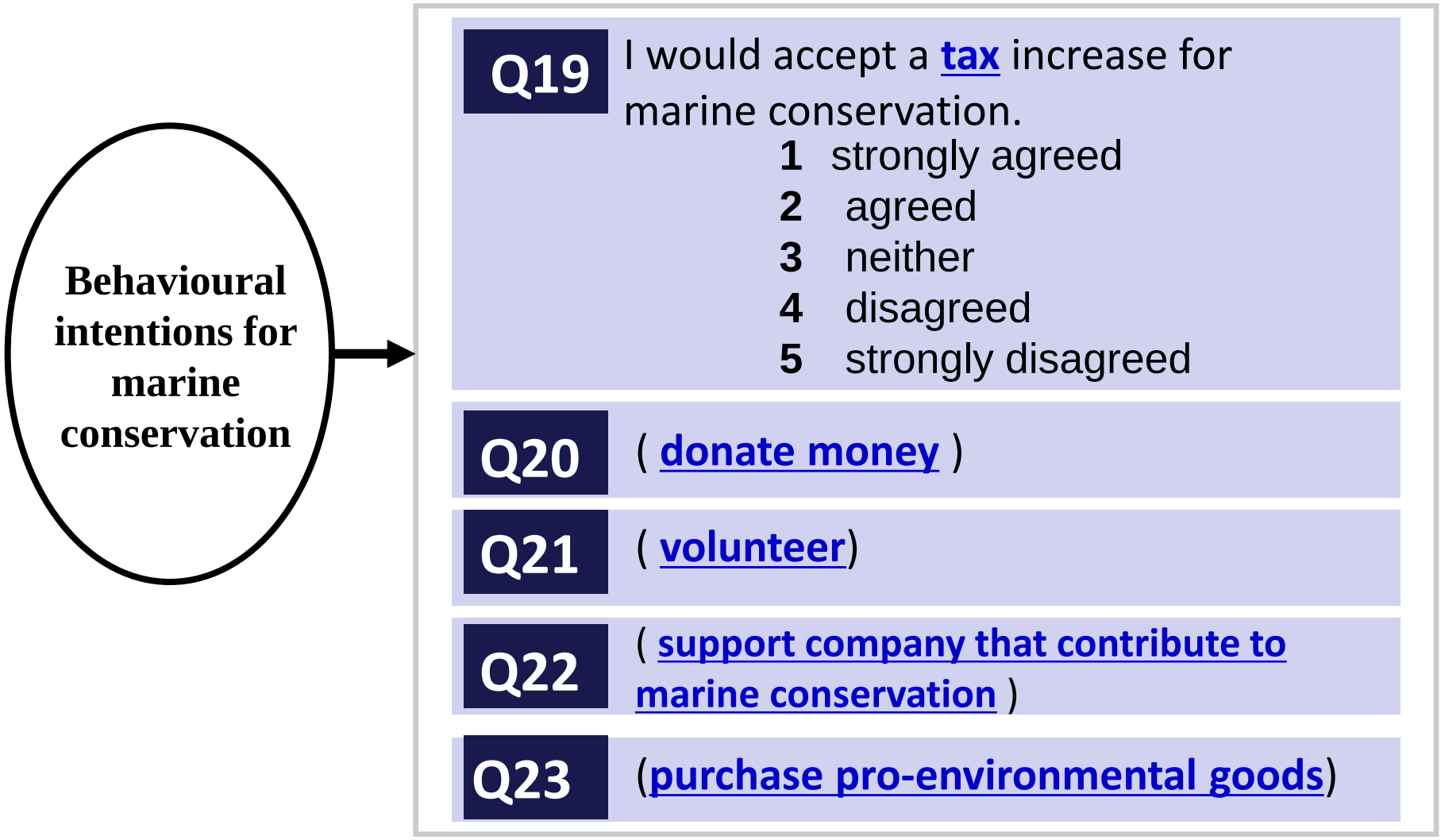
Questions on supporting services

- S life: Because the sea exists, life continues and nature is sustained.
- S n-cycle: Because the sea exists, the nutrient cycle of the earth is well regulated and nature is sustained. S place: Without the sea, there would be no place for marine organisms to live, causing fatal damage to the earth.

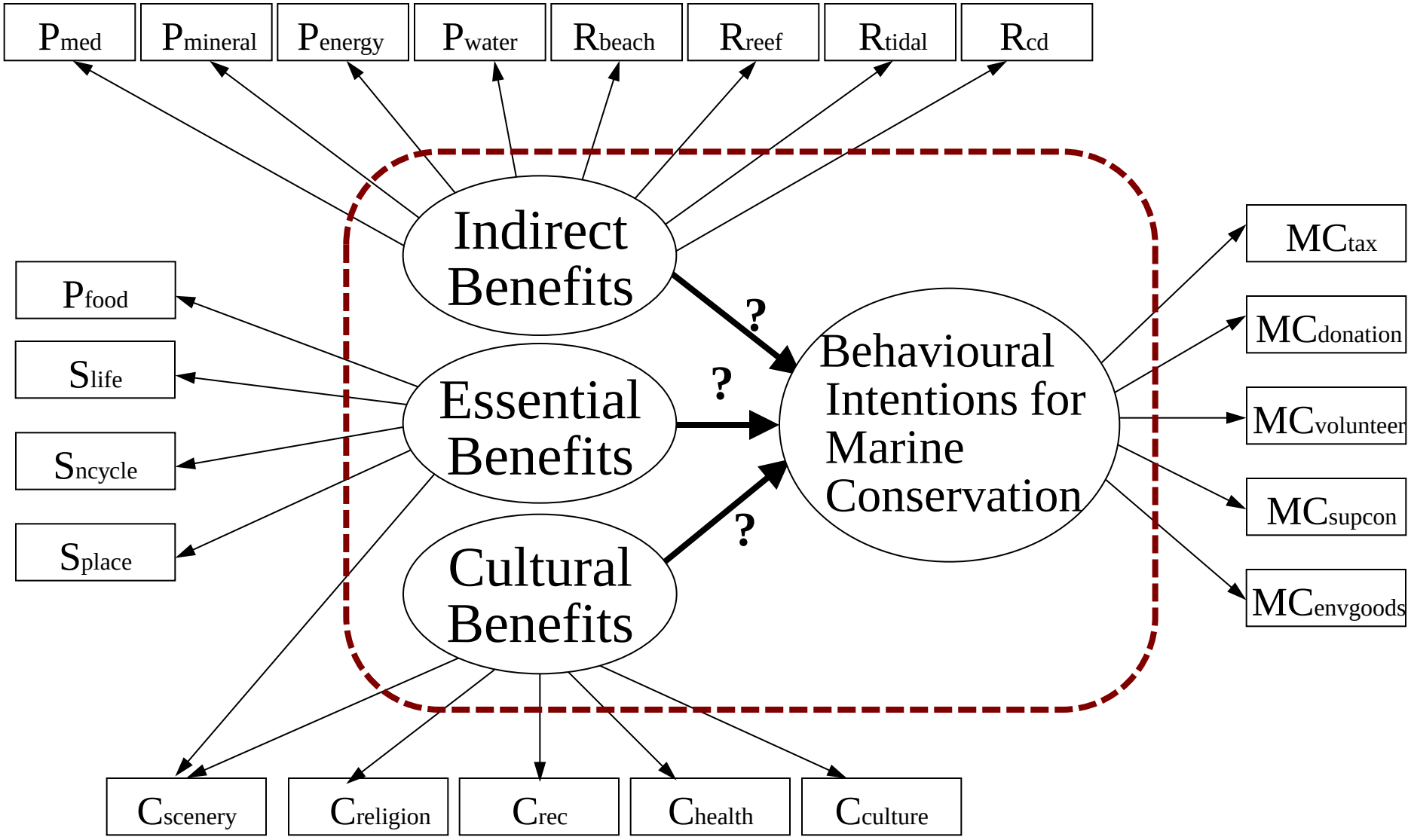
Composition and naming of latent constructs

Essential Benefits	$= P_{food} + S_{life} + S_{ncycle} + S_{place} + C_{scenery}$
Indirect Benefits	$= P_{med} + P_{mineral} + P_{energy} + P_{water} + R_{beach} + R_{reef} + R_{tidal} + R_{cd}$
Cultural Benefits	$= C_{religion} + C_{rec} + C_{health} + C_{culture} + C_{scenery}$

- **5 questionnaire items on behavioral intentions for marine conservation developed ← based on a review of existing literature**



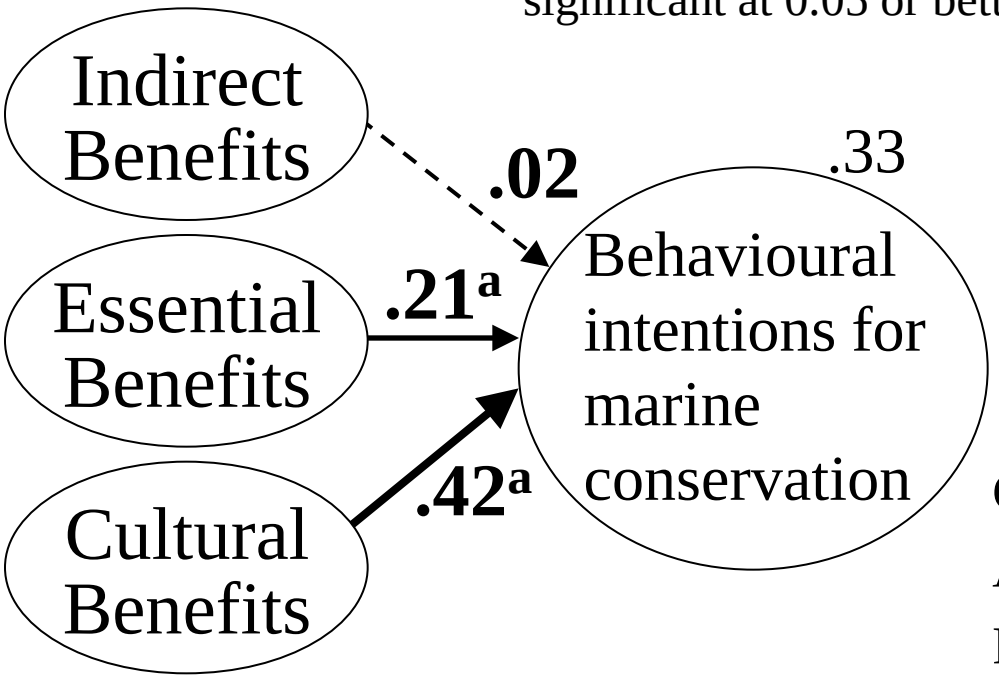
Latent variables and behavioral intentions in our hypothetical model (structural equation analysis)



Wakita et al, (2014) Human utility of marine ecosystem services and behavioural intentions for marine conservation in Japan

Standardized estimated hypothetical model

* “a” indicates significance at the 0.001 level. Dashed line indicates path that is not significant at 0.05 or better.



GFI=0.846

AGFI=0.807

RMSEA=0.089

Behavioural intentions are most positively driven by “Cultural Benefits”.

Summary and Discussion (1)

Discussion 1: Three hidden factors have **relevance** to **categorization system by Millennium Ecosystem Assessment** (2003).

- Essential Benefits = $P_{food} + \underbrace{S_{life} + S_{ncycle} + S_{place}}_{\textit{Supporting services by MA}} + C_{scenery}$
- Indirect Benefits = $\underbrace{P_{med\text{-}gene} + P_{mineral} + P_{energy} + P_{water}}_{\textit{Provisioning services by MA}} + \underbrace{R_{beach} + R_{reef} + R_{tidal} + R_{cd}}_{\textit{Regulating services by MA}}$
- Cultural Benefits = $\underbrace{C_{religion} + C_{rec} + C_{health} + C_{culture} + C_{scenery}}_{\textit{Cultural services by MA}}$

Summary and Discussion (2)

- More attention is needed for cultural aspects of ocean ecosystem services if we want to obtain better support from citizens
- Economic tools such as payment for ecosystem services can be better designed using the result of this survey
- Research needs in other countries exit
- Consensus building on conservation of world marine ecosystems could go better if we have such data on various countries.

Acknowledgement

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http://ocean.fs.a.u-tokyo.ac.jp/research-e.html