

**Economic Valuation of Changes of Biodiversity  
Caused by Climate Change in the Arctic**

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**Hyo-Sun Kim and Ho Il Yoon  
Korea Polar Research Institute**

# List of Contents

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- Why Biodiversity in the Arctic?
- Biodiversity in the Arctic
- Conceptual Framework
- Design of Survey
- Results
- What is left for future studies?



# Winners



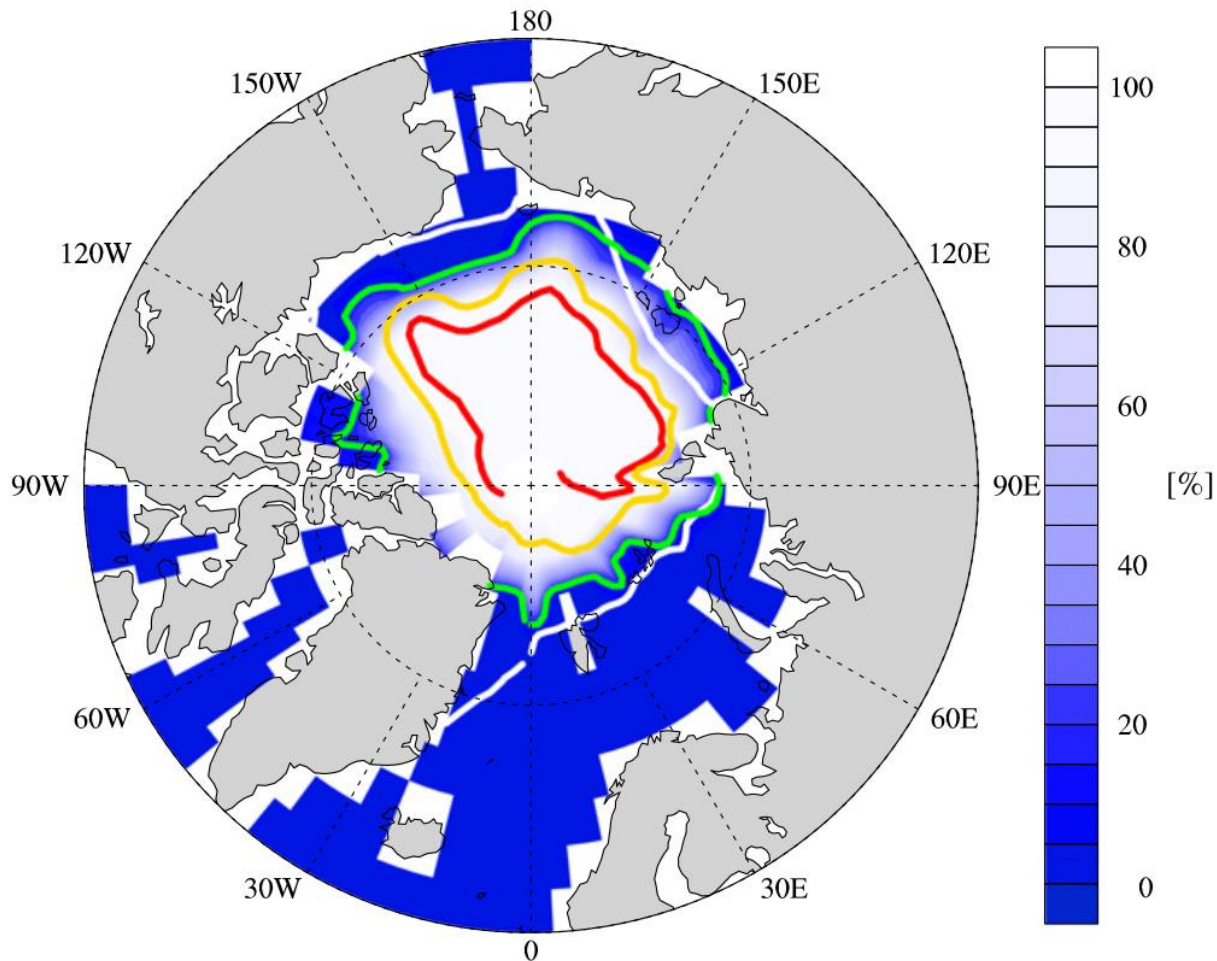
Domestic reindeer. Photo: Alexey Solodov/Shutterstock.com

# Losers

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# Sea-Ice Loss in the Arctic



# Increasing Human Activities in the Arctic

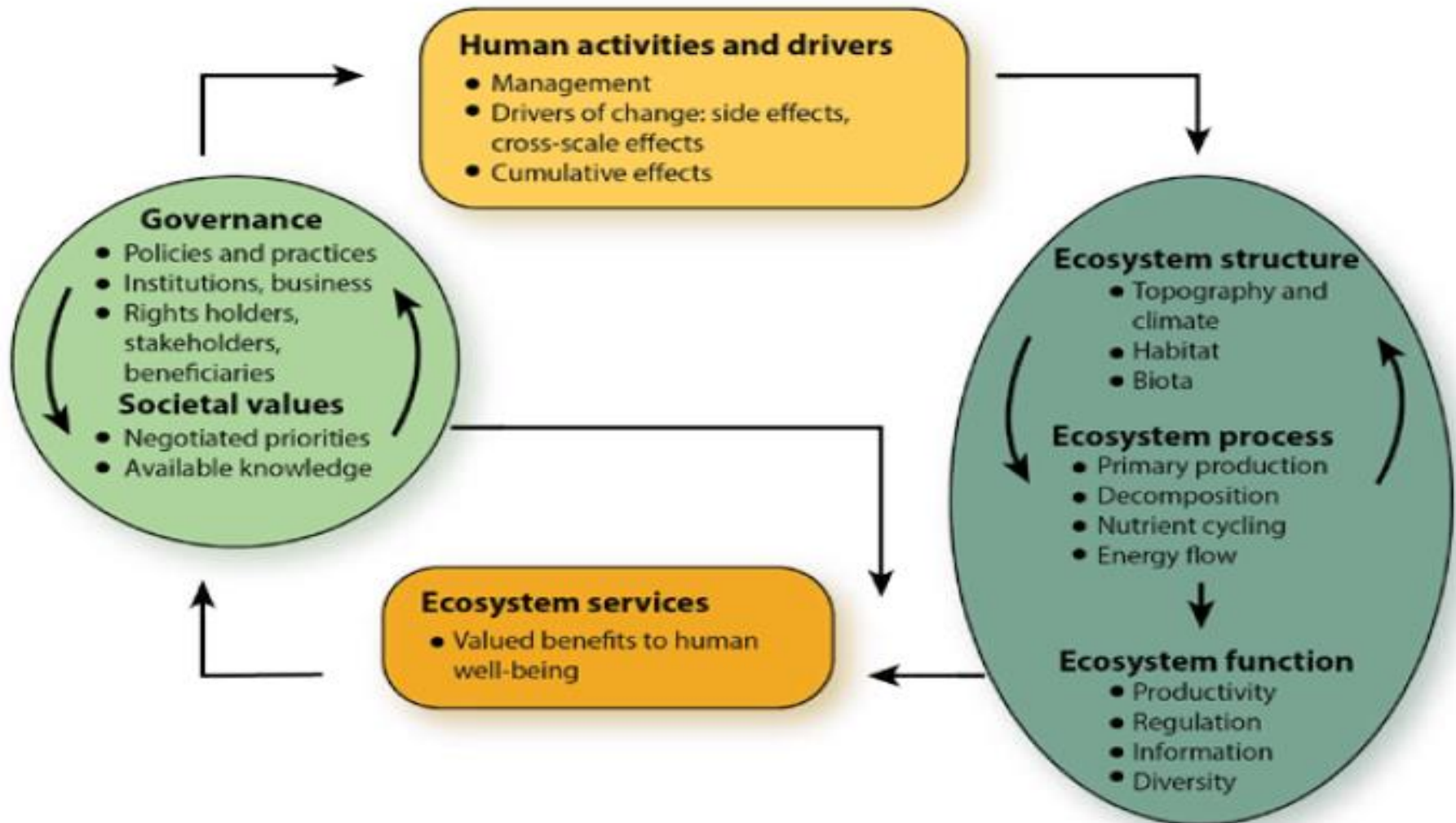
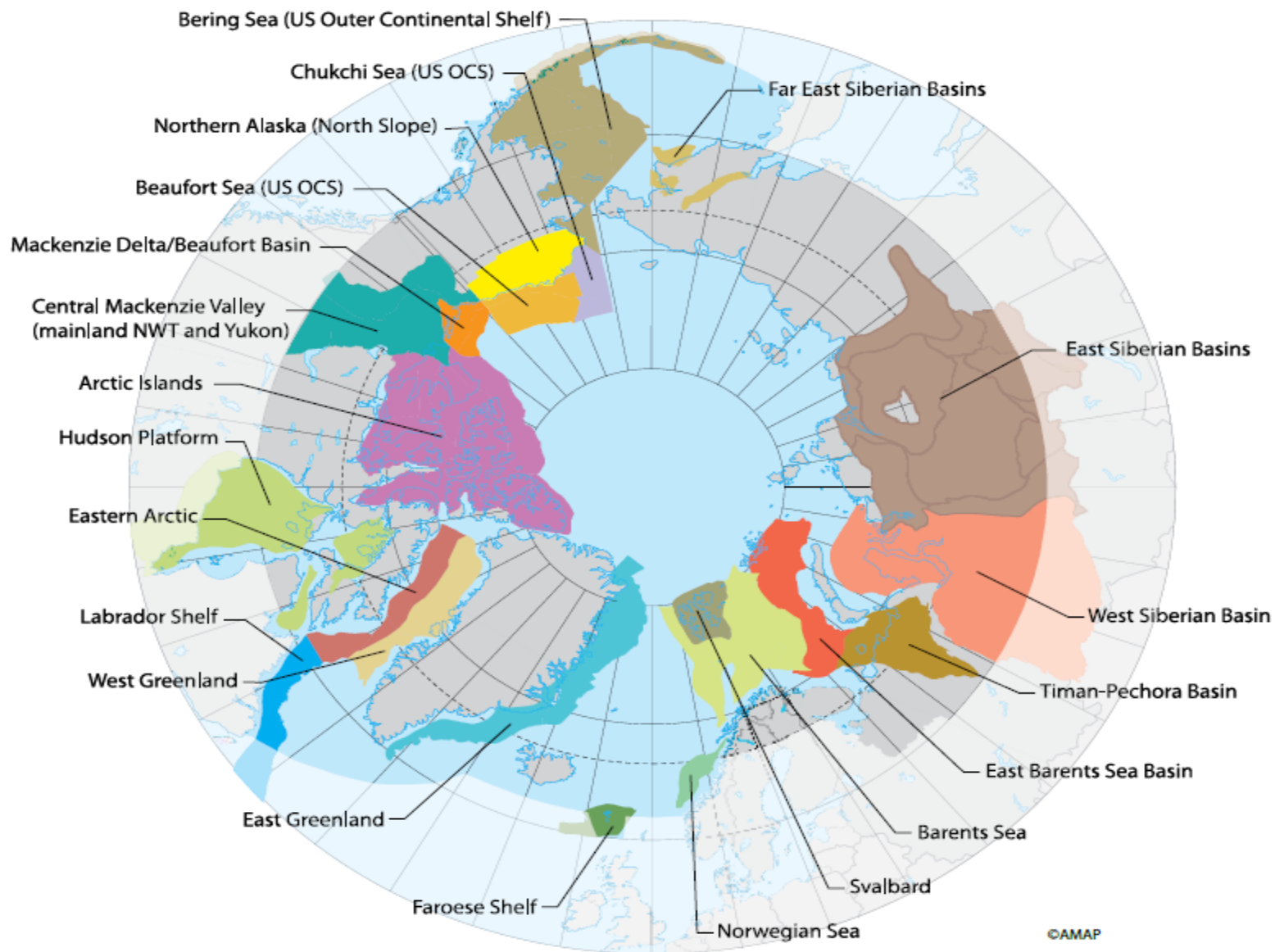
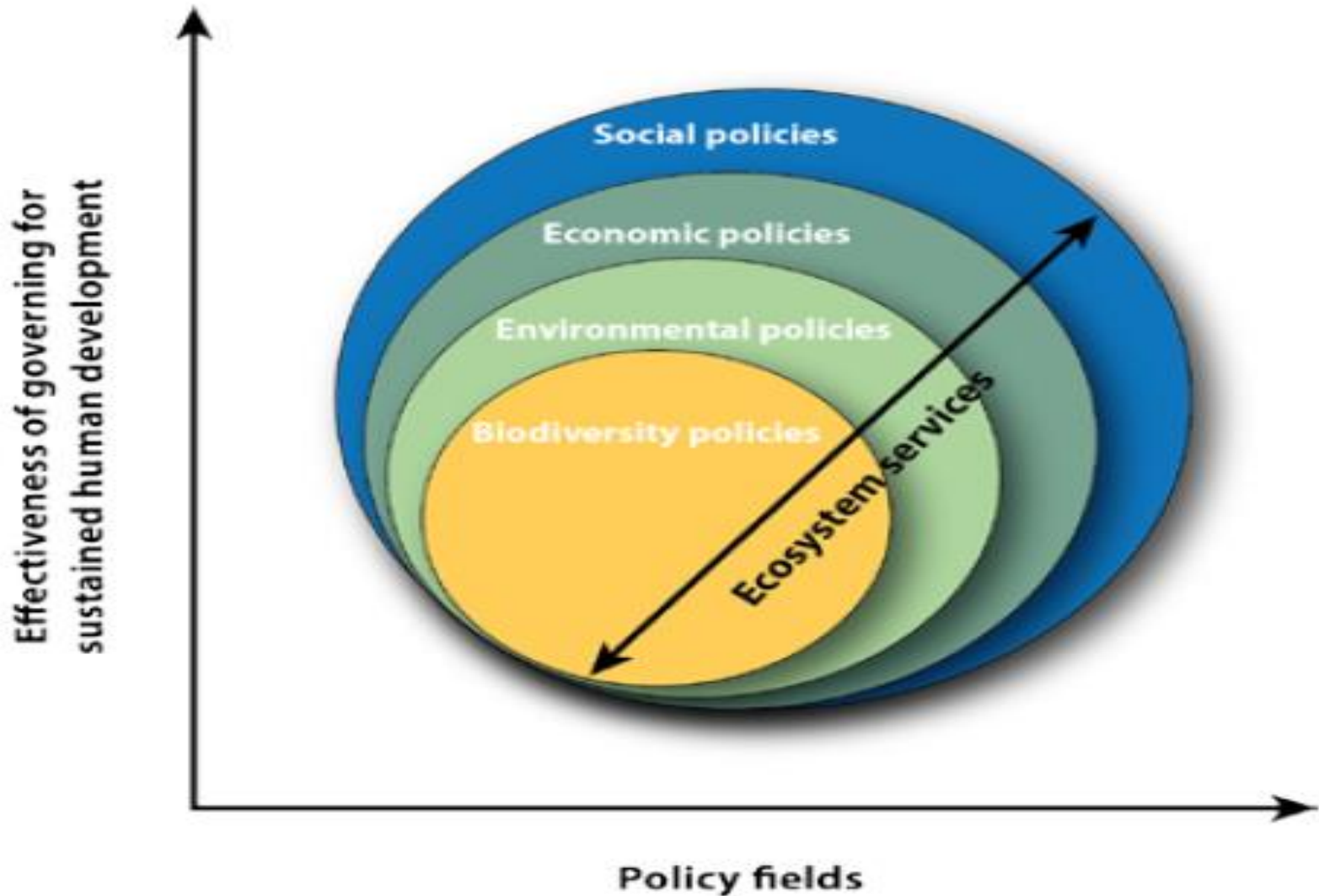


Figure A3.2. Major oil and gas provinces and basins around the Arctic (AMAP 2010a)

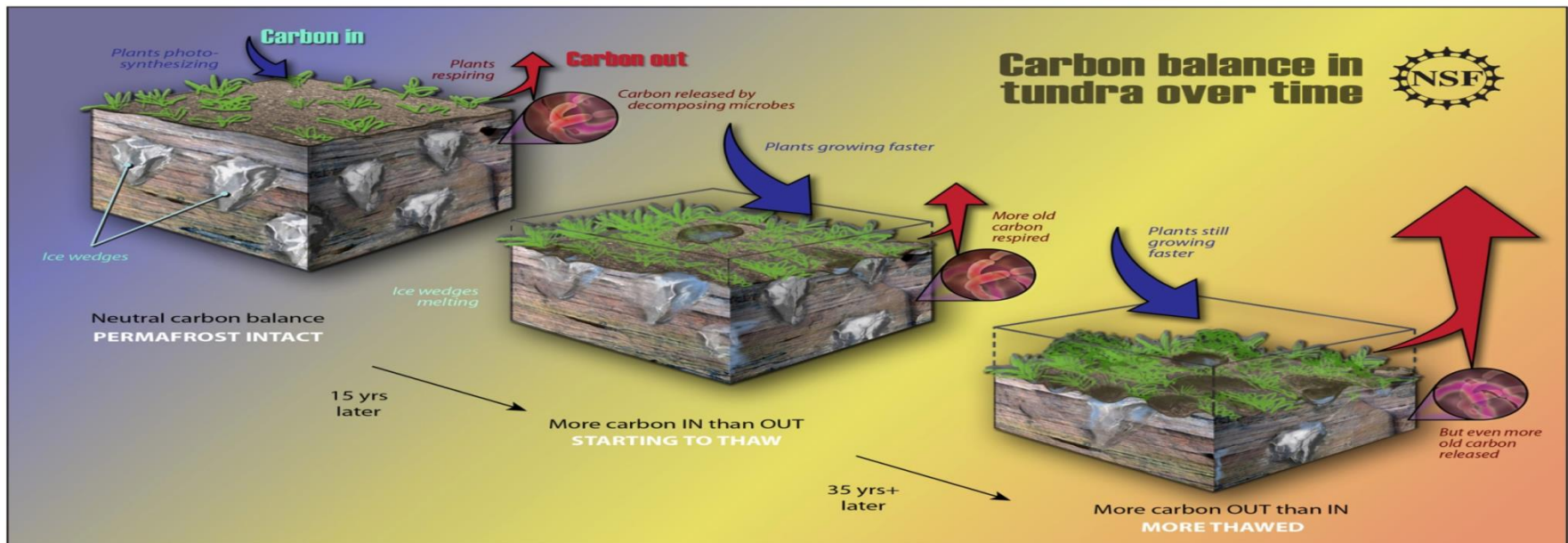




# Policy Framework: Integrating Issues

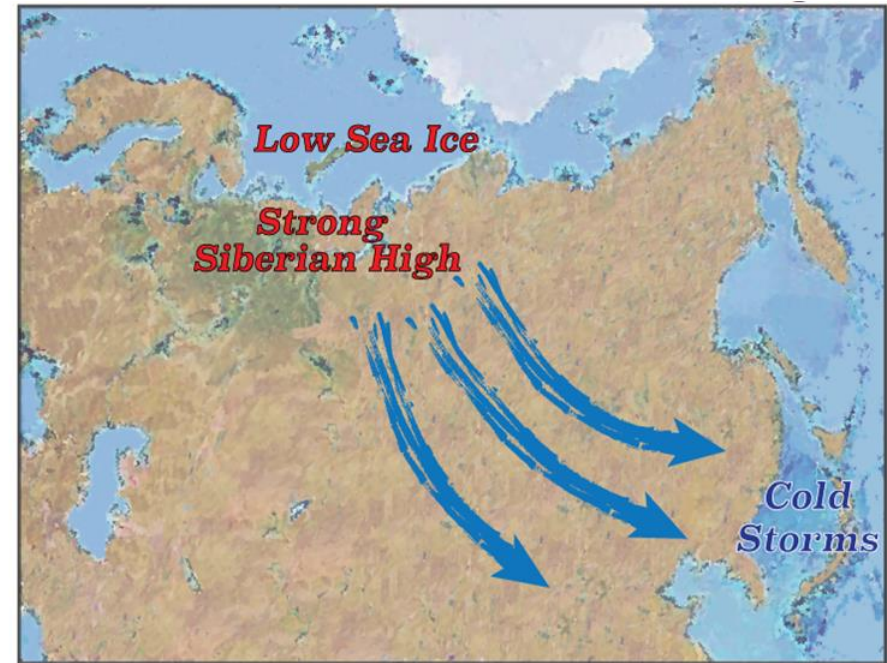
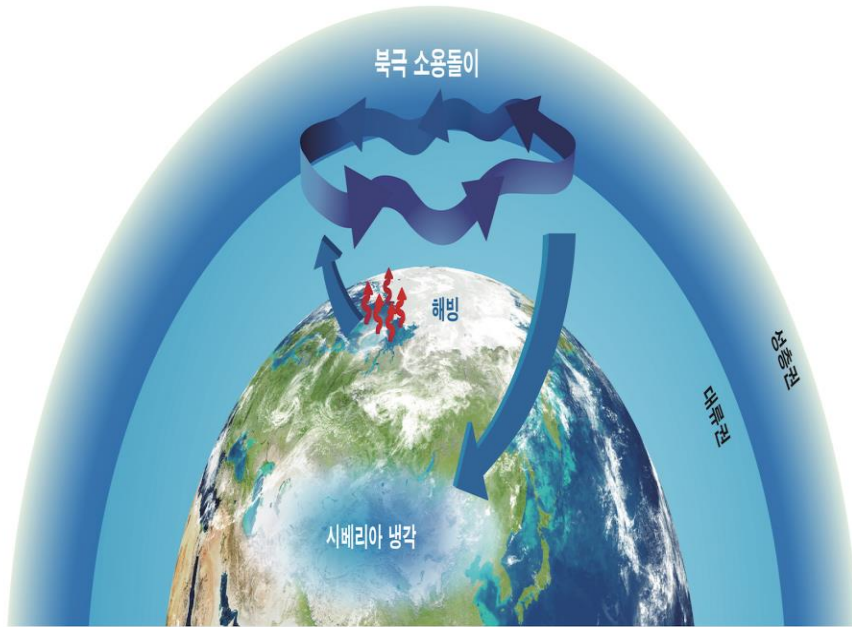


# Ecosystem and Biodiversity: Carbon balance



- Supportive service
- Provisioning service
- regulating service
- cultural service

# What does climate change in the Arctic mean to Korean citizens?



From James Overland at NOAA/PMEL

# Fact sheets: Arctic Biodiversity

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- Negative effects on non-migratory Arctic species
- Decreased reproductive success in Arctic seabirds
- Range shift of some Arctic marine species
- Ocean acidification
- Changing relationships among species
- Increase in marine primary productivity
  - increase by 20% from 1998 to 2009, driven by a 45-day increase in the open-ice period and a reduction in summer ice cover of 27% - not spatially homogeneous

# Case studies using CVM

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- Bille T.(1998): Royal theater in Copenhagen
- Brave. M, F. Scarpa and G. Sirchia (1998): Museum in Italy
- Rollins and Lyke (1998): Wild animal park
- Berstrom et al. (1990): Value of Water

# Conceptual Framework



- Hanemann(1984) suggested dichotomous choice question
  - Yes/No: incentive-compatible
  - Using pre-test
  - Less starting point bias
  - Less incentive for strategic behavior
- Face-to-face interview
- WTP, not WTA
- Trade-off between WTP and other expenditure

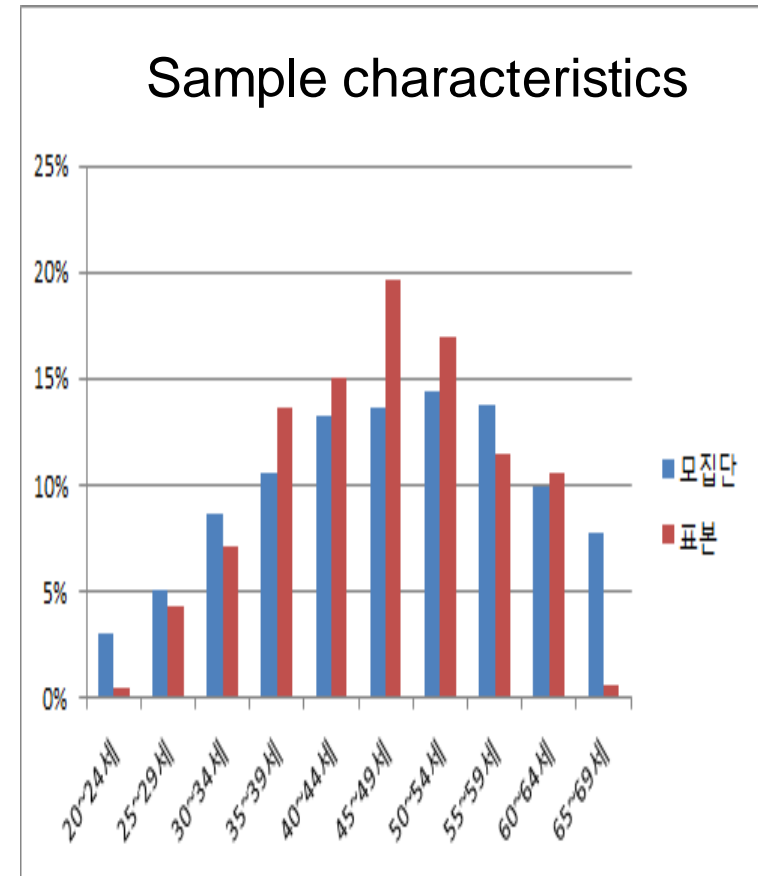
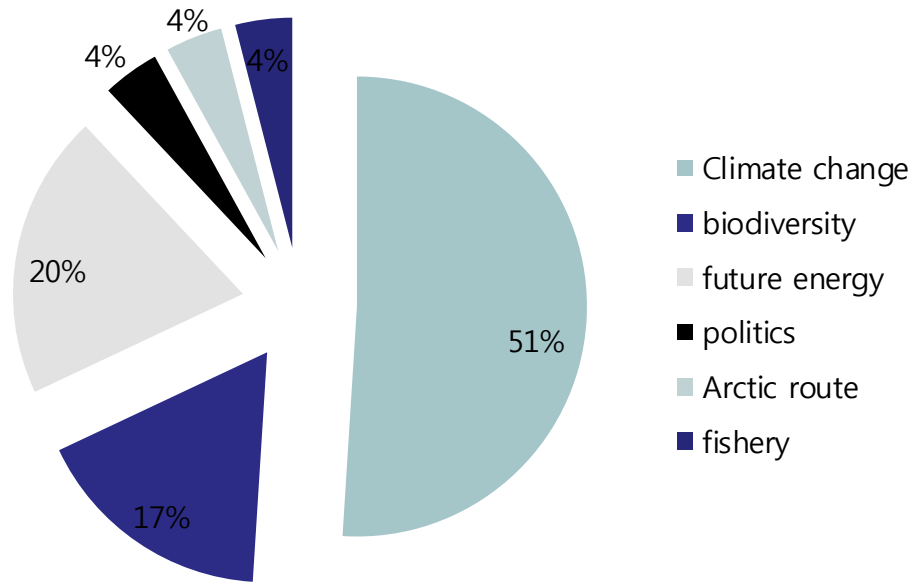
- WTP: 
$$\ln L = \sum_{i=1}^N \{I_i^Y \ln[1 - G_C(A_i)] + I_i^N \ln G_C(A_i)\}$$

# Design of Survey

WTP	SAMPLE	%
\$1	125	12.5
\$2	125	12.5
\$3	125	12.5
\$4	125	12.5
\$5	125	12.5
\$7	125	12.5
\$10	125	12.5
\$15	125	12.5
TOTAL	1,000	100

AREA	# of household	(%)	Pre-survey	survey
Total	15,662,083	100.0	100	1,000
Seoul	3,577,497	22.8	23	229
Pusan	1,217,765	7.8	8	78
Daegu	817,159	5.2	6	53
Incheon	901,704	5.8	6	58
Gwangju	518,742	3.3	3	33
Daejun	536,297	3.4	3	34
Ulsan	312,478	2.0	1	19
Kyunggi	3,807,859	24.3	25	244
Kangwon	416,388	2.7	2	26
Chung1	369,921	2.4	2	23
Chung2	507,261	3.2	3	32
Jeon1	540,621	3.5	3	34
Jeon2	365,742	2.3	2	23
Kyung1	801,271	5.1	6	51
IKyung2	971,378	6.2	7	63

# Sample distribution





# Results

1 <sup>st</sup> WTP (\$X)	2 <sup>nd</sup> WTP		PEOPLE
	'YES' (\$2X)	'NO' (\$1/2X)	# of Sample
\$1	\$2	0.5	125
\$2	\$4	\$1	125
\$3	\$6	\$1.5	125
\$4	\$8	\$2	125
\$5	\$10	\$2.5	125
\$7	\$14	\$3.5	125
\$10	\$20	\$5	125
\$15	\$30	\$7.5	125
<b>Total</b>			<b>1,000</b>

WTP (\$)	Willing to Pay	
	Yes	No
\$1	80(64.0%)	45(36.0%)
\$2	67(53.6%)	58(46.4%)
\$3	53(42.4%)	72(57.6%)
\$4	47(37.6%)	78(62.4%)
\$5	33(26.4%)	92(73.6%)
\$7	33(26.4%)	92(73.6%)
\$10	24(19.2%)	101(80.8%)
\$15	16(12.8%)	109(87.2%)
<b>total</b>	<b>353(35.3%)</b>	<b>647(64.7%)</b>

# Conclusions

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- Total willingness to pay from Korean citizen ranges from 0.319 billion dollars per year to 0.716 billion dollars per year: 5 billion dollars for 100 years
  - Alvarez et al.(2015) and Whiteman and Wadham(2013) predict the social costs of climate change in the Arctic reach 6 trillion dollars
- As Perrings(2010) pointed out, climate change is a cause and at the same time, effects of biodiversity

# What is left for future studies?

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- Collaboration with different stakeholders with diverse backgrounds is critical to reflect the gap between Arctic and Non-Arctic community
- Sharing biodiversity information among researchers: climate change is a cause, as well as a consequence
- Science-based leadership is getting more important to avoid underestimation of climate change: IPCC needs solid and well-distributed data set covering Arctic to Antarctic information





ARACON  
아라온









Thanks You!

