

Climate Change, Water Environment and Freshwater Ecosystems in Korea

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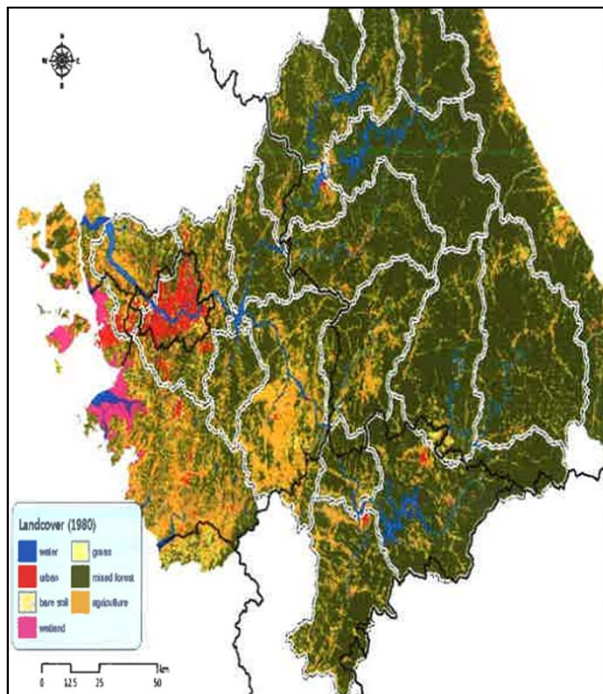
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OVERVIEW

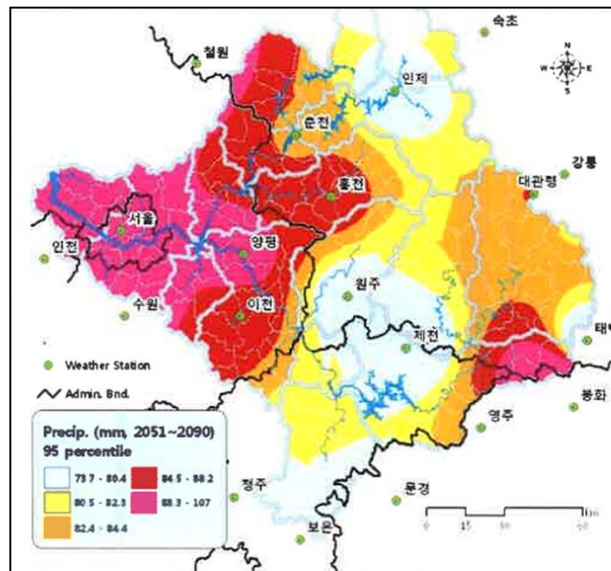
- Effect of Climate Change on Sediment Loading Coupled with Heavy Rainfall
- Effect of Climate Change on Water Temperature
- Effects of Increased Water Temperature on Habitats of Riverine Fishes (Preliminary Results)

Effect of CC on Sediment Loading (Kim et al. 2009)

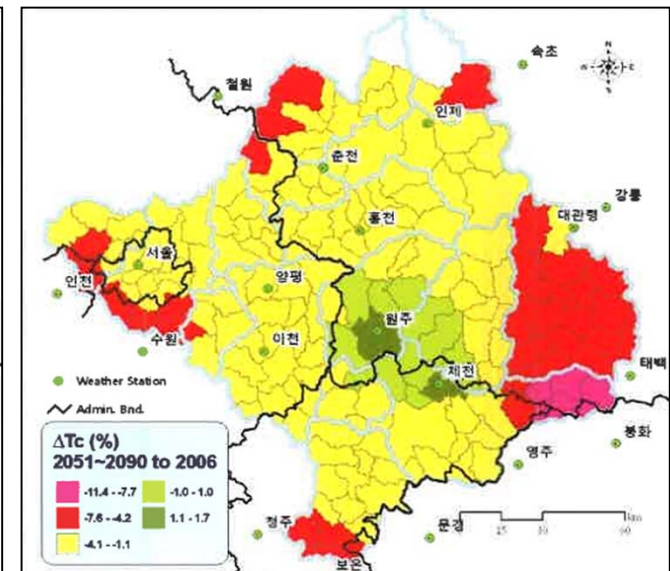
- * Torrential rain causes heavy sediment loading from farm lands, destroying stream ecosystem health.



Land Use



Rainfall (95 pt)



Sediment Load

Effect of CC on Water Temperature (Kim et al. 2009)

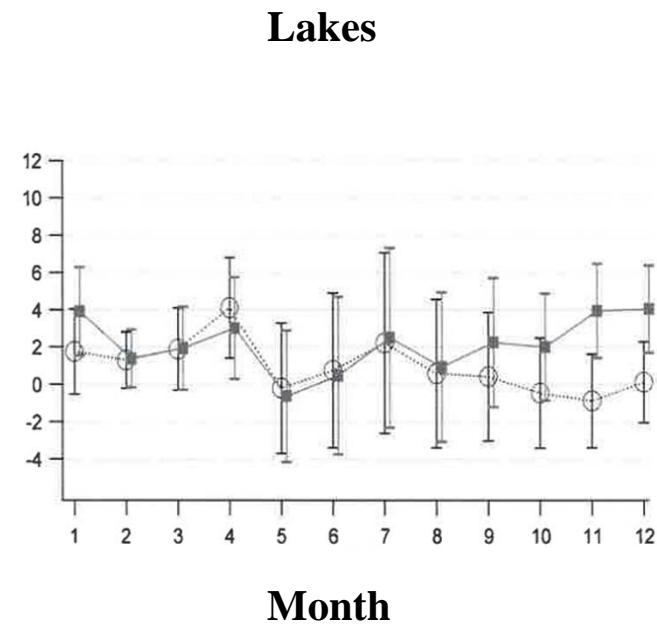
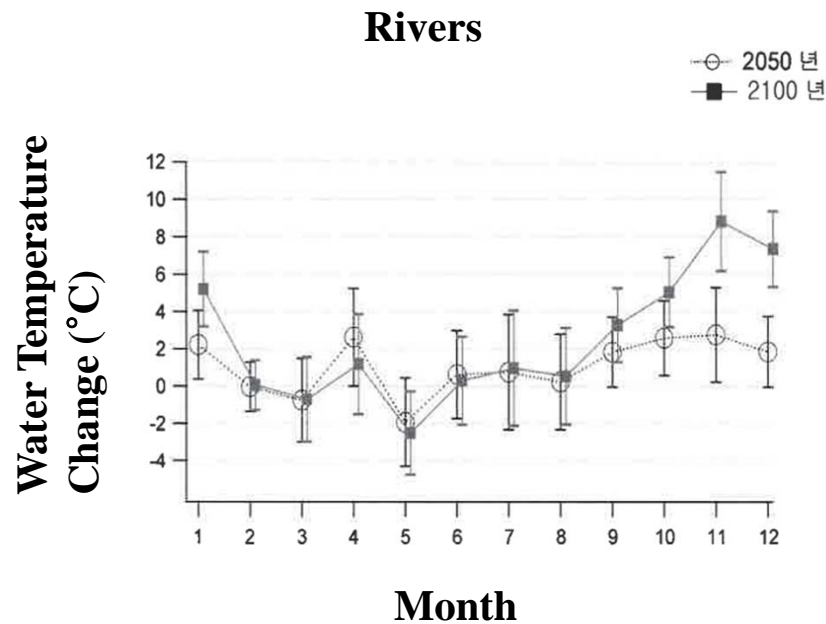
- * Climate Model (A1B) predicts water temperature increases.
- * Higher increases in rivers than lakes.

(Unit: °C)

	Watershed	Year 2050	Year 2100
Rivers	Han R.	1.87 ± 0.30	3.16 ± 0.46
	Nakdong R.	1.01 ± 0.29	2.39 ± 0.43
	Geum R.	0.59 ± 0.31	2.07 ± 0.50
	Seomjin/Yeongsan R.	0.59 ± 0.31	2.03 ± 0.47
	Overall	1.06 ± 0.16	2.45 ± 0.24
Lakes	Han R.	0.43 ± 0.44	1.59 ± 0.45
	Nakdong R.	1.02 ± 0.52	2.17 ± 0.51
	Geum R.	-0.10 ± 0.81	1.20 ± 1.00
	Seomjin/Yeongsan R.	2.09 ± 0.72	3.33 ± 0.69
	Overall	0.95 ± 0.30	2.14 ± 0.30

Effect of CC on Water Temperature (Kim et al. 2009)

- * Predicted water temperature change is greater in Rivers than Lakes.
- * Greater increase in winter than summer.



Potential Impact of Increased Water Temperature on Fish Habitats

- * Fish Community data: 2007–2009, Ecosystem Health Assessment Project, Ministry of Environment
- * Water Temperature data: Water Environment Information System, National Institute Environmental Research (<http://water.nier.go.kr>)
- * Streams of Han River Watershed (208 Sites)
- * 51 Rheophilic Fish spp. classified into 4 habitat reaches (upstream, up-/midstream, midstream, mid-/downstream)
- * Supposed Water Temperature Increases: 1°C, 2°C and 3°C

Maximum Thermal Tolerance of Fish

– Fish & Temperature Data Matching System (*Eaton et al. 1995*)

Species	Max Them Tol (°C)	Species	Max Them Tol (°C)
Upstream		Up-/midstream	
<i>Cottus koreanus</i>	25.0	<i>Coreoleuciscus splendidus</i>	28.1
<i>Gobiobotia brevibarba</i>	29.0	<i>Gobiobotia macrocephala</i>	29.0
<i>Iksookimia koreensis</i>	28.0	<i>Hamibarbus mylodon</i>	28.0
<i>Koreocobitis rotundicaudata</i>	28.7	<i>Liobagrus andersoni</i>	28.0
<i>Liobagrus mediadiposalis</i>	26.8	<i>Microphysogobio longidorsalis</i>	28.0
<i>Ladislabia taczanowskii</i>	26.0	<i>Odontobutis platycephala</i>	29.0
<i>Oncorhynchus masou masou</i>	26.2	<i>Orthrias toni</i>	27.9
<i>Orthrias nudus</i>	28.1	<i>Pseudopungtungia tenuicorpa</i>	28.0
<i>Phoxinus phoxinus</i>	26.2	<i>Rhinogobius brunneus</i>	29.0
<i>Rhynchocypris kumgangensis</i>	27.0	<i>Zacco koreanus</i>	28.0
<i>Rhynchocypris oxycephalus</i>	28.0		
<i>Rhynchocypris steindachneri</i>	28.0		
<i>Silurus microdorsalis</i>	28.0		

Species	Max Them Tol (°C)
Midstream	
<i>Acheilognathus lanceolatus</i>	28.0
<i>Acheilognathus signifer</i>	28.0
<i>Coreoperca herzi</i>	29.0
<i>Gnathopogon strigatus</i>	29.7
<i>Hamibarbus longirostris</i>	29.0
<i>Microphysogobio yaluensis</i>	29.0
<i>Pungtungia herzi</i>	29.0
<i>Pseudobagrus koreanus</i>	29.0
<i>Rhodeus uyekii</i>	29.0
<i>Squalidus gracilis majimae</i>	29.0
<i>Siniperca scherzeri</i>	28.0
<i>Sarcocheilichthys variegatus</i>	29.0

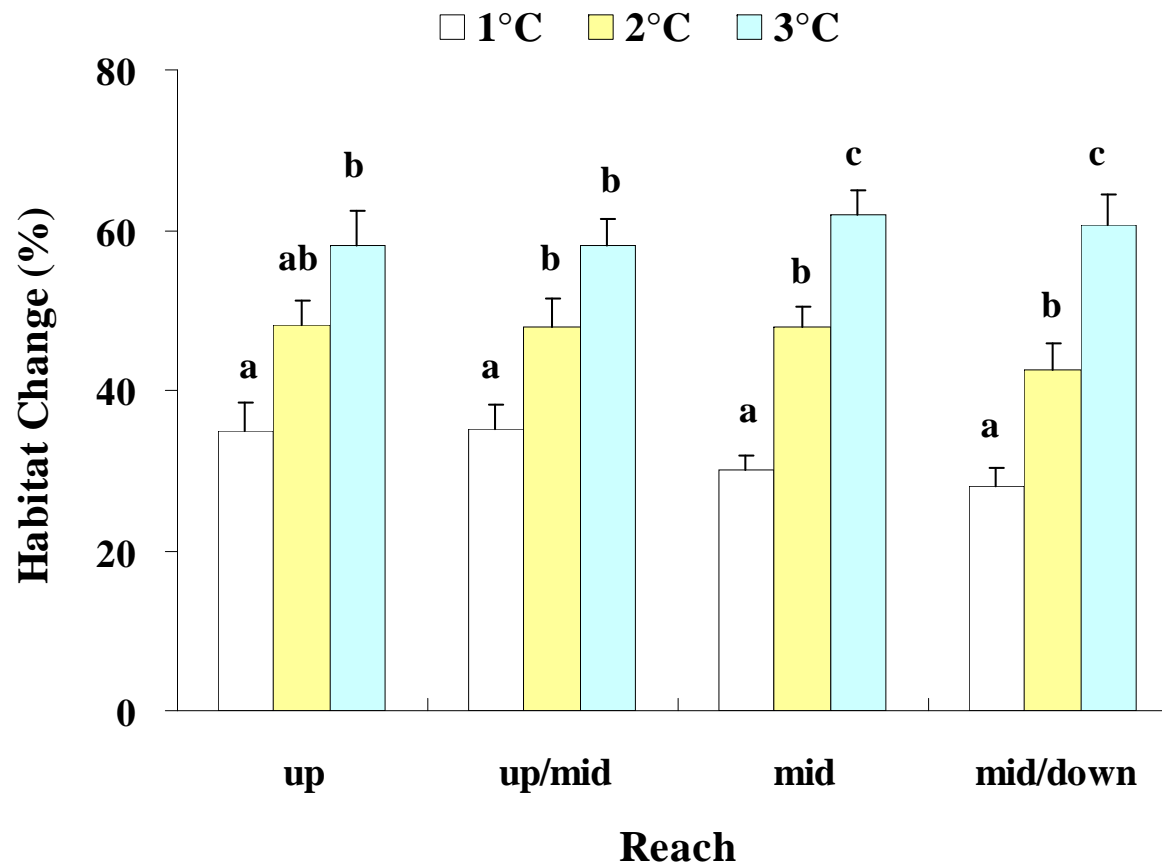
Species	Max Them Tol (°C)
Mid-/downstream	
<i>Acheilognathus rhombeus</i>	29.0
<i>Abbottina rivularis</i>	29.0
<i>Abbottina springeri</i>	28.0
<i>Cobitis pacifica</i>	28.0
<i>Hemiculter eigenmanni</i>	31.0
<i>Hemiculter leucisculus</i>	30.0
<i>Misgurnus anguillicaudatus</i>	29.0
<i>Microphysogobio jeoni</i>	27.0
<i>Misgurnus mizolepis</i>	28.2
<i>Odontobutis interrupta</i>	29.0
<i>Pseudogobio esocinus</i>	29.0
<i>Pseudobagrus fulvidraco</i>	29.0
<i>Rhodeus notatus</i>	29.0
<i>Sarcocheilichthys nigripinnis</i>	29.0
<i>Tridentiger brevispinis</i>	28.0
<i>Zacco platypus</i>	29.0

* Increased as habitat reaches move from upstream to downstream.

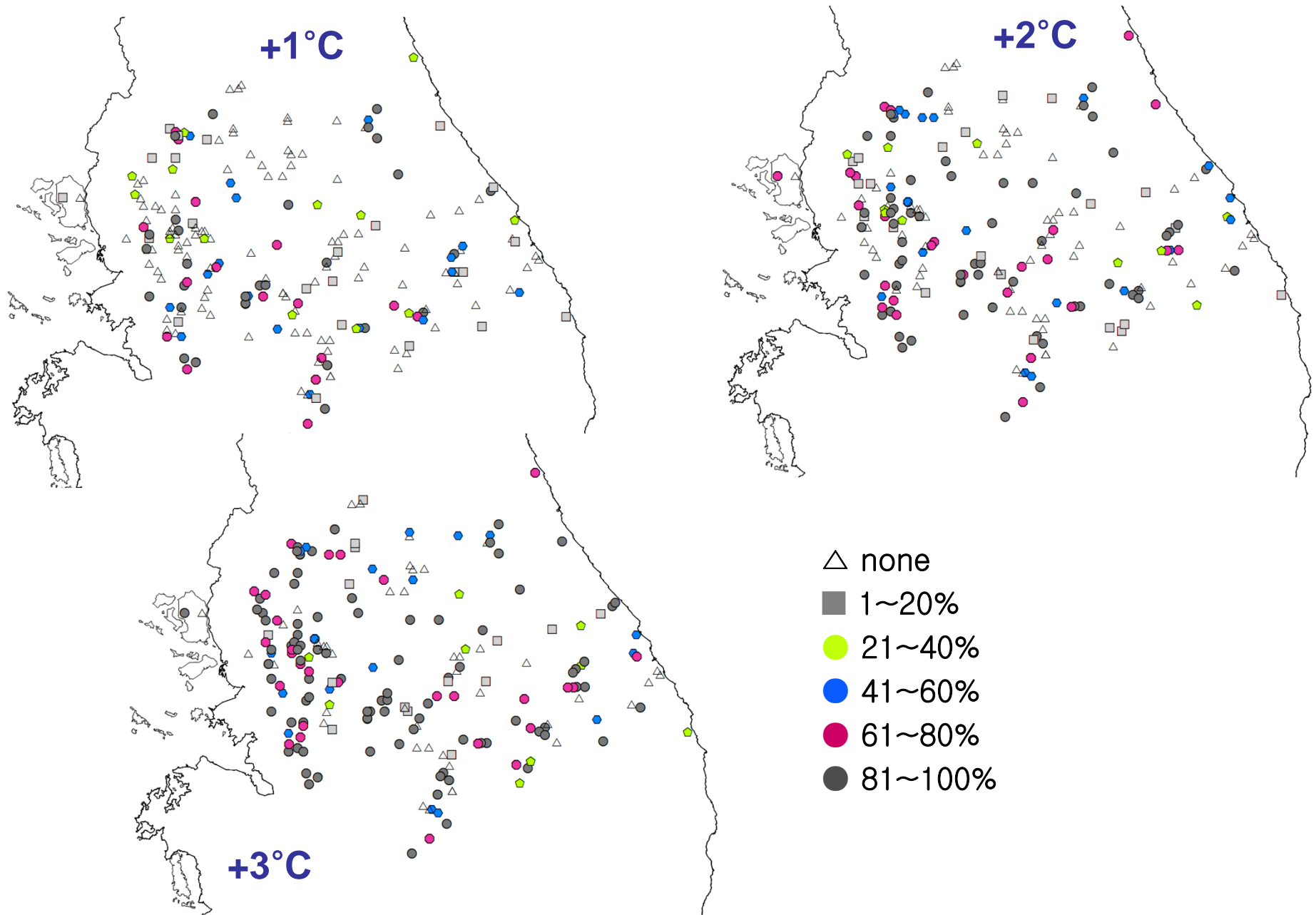
* $\mu_{up} < \mu_{up/mid} = \mu_{mid} = \mu_{mid/down}$ ($P < 0.05$)

Suitable Fish Habitat Change

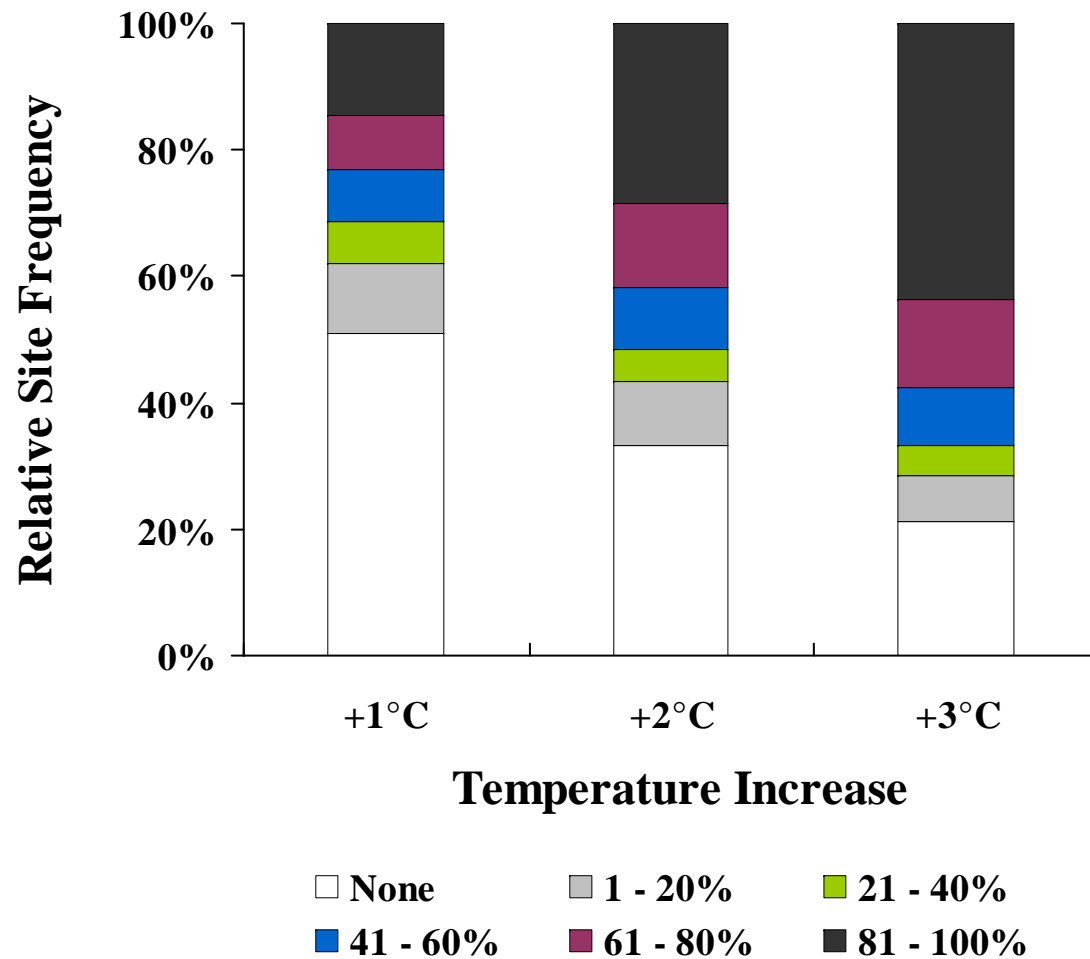
- * Increased Water Temperature decreased Suitable Habitats for Fishes
- * -32% (+1°C), -46% (+2°C), -60% (+3°C)



Fish Species Number Change



* Percent changes in # spp. in overall sampling sites were different according to the level of water temperature increase.



Further Research

To predict changes in the geographical distribution of freshwater fishes more precisely

- Detailed analysis and modeling of fish habitats
- 2) Thermobiological information including Minimum Thermal Tolerances of each sp.
 - 3) Coupled with the results of climate modeling, regarding to hydrology, water quality, and water temperature

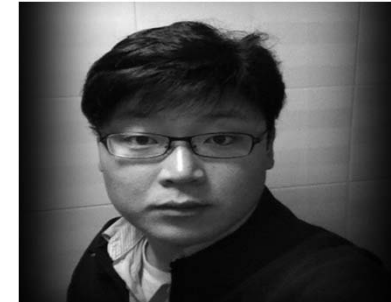
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