Kushiro Wetland Nature Restoration Project And Impact Of Climate Change

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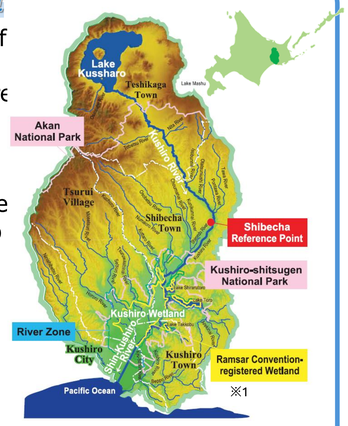
Abstract: The government is promoting nature restoration projects in Kushiro wetland, but there are concerns about the effects of climate change. We evaluated the future impact on the wetland and selected a menu of nature restoration projects to focus on as adaptation measures.

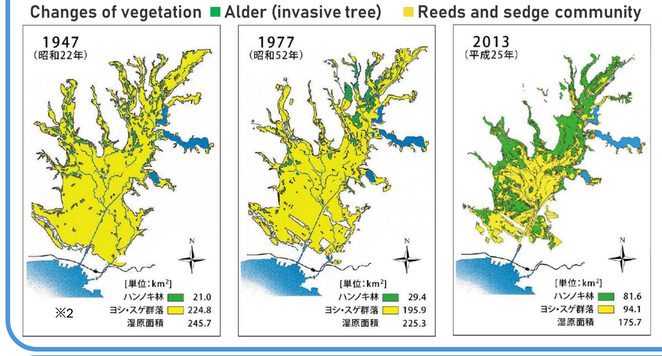
1.Kushiro Wetland Nature Restoration Project

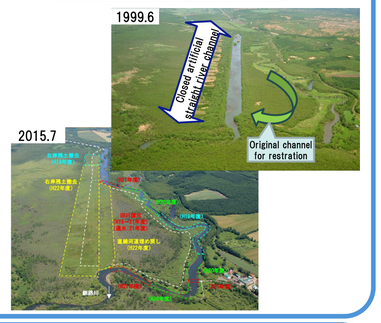
Kushiro wetland, located in the eastern part of Hokkaido, is one of the most famous wetlands in Japan.
Kushiro wetland is characterized by its neighboring Kushiro city are which is the main city of the region.
Settlement of the area has progressed since the Meiji era (1868-1912). Artificial straightening of rivers for settlement caused the wetland to shrink and the ecosystem was damaged by invasive tre
Thus, the government has initiated a nature restoration project to exterminate trees that have increased due to desiccation.
This project has some menu:

- Reconstruct the original natural river channel
- Add sediment trap
- Forced flooding by excavation



Changes of vegetation ■ Alder (invasive tree) ■ Reeds and sedge community





Flowchart of this evaluation

Climate change projection model Hokkaido-5kmRCM
Present condition
4K future projections
6 research Institutes
↓
Hydrologic model
Tank model for entire ensemble
SWAT model for detail analysis
↓
Compare river discharge /Sediment/Ground water
Present wetland
Future wetland
↓
Observed impact response relation in occurred flood
Insight of projects ongoing
→ Climate change impact assessment in wetland
↓
Discussion in Kushiro Wetland Restoration Committee
・Indicators of wetland condition
・Next vision for project

Try virtual experiences of Kushiro wetland by 3D view from UAV.

2.Climate change adaptation for wetland

In recent years, there have begun to be concerns about the effects of climate change on the natural environment and ecosystems in Kushiro wetland.
There are concerns that the wetland will be buried due to unprecedented typhoon landfalls, worsening floods, and increased sediment inflow. On the other hand, there are concerns about desiccation due to global warming and reduced number of rainy days.
The government is considering to expand ongoing natural restoration projects as a climate change adaptation measure.
To this end, it is necessary to evaluate the impact of climate change on the wetlands and the effectiveness of menu in the nature restoration project .

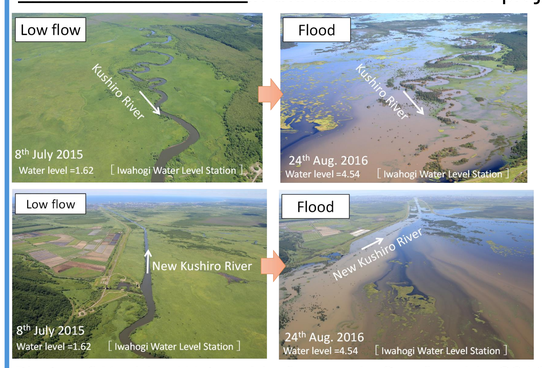
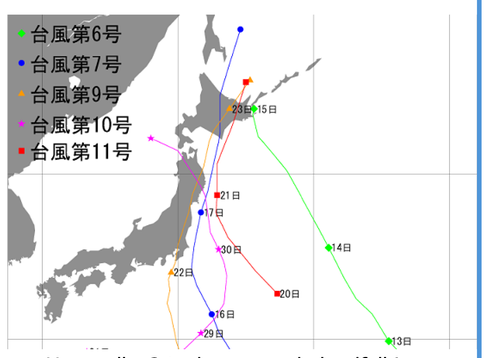


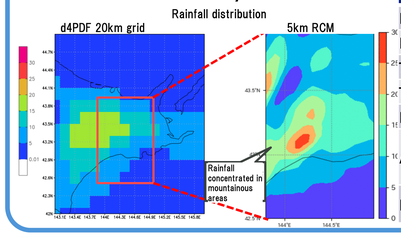
Photo of Kushiro Wetland before and after flood in 2016
The increase and worsening of such flooding is a concern



Unusually, 3 typhoons made landfall in eastern Hokkaido in 2016. ※3

3.Projection model and Impact assessment model

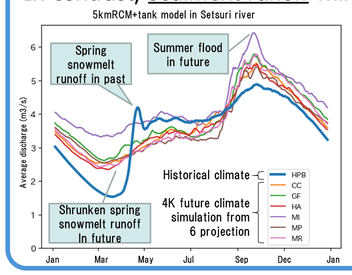
We input the climate change projection data into a hydrologic model as an impact assessment model to evaluate the effects on the wetland.
Climate change projection models have a trade-off between the number of ensembles and fineness of time-space resolution essential for reproducibility.
Both of two projection models were bias corrected for observation by TR3S developed by Nippon Koei Research and Development center.
Long-term continuous data of 5km RCM was generated by Markov processes, eliminating discontinuities and bias of large rainfall samples.
Traditionally, detailed models such as the SWAT model have been used in nature restoration project in Kushiro wetland. However, detailed models are difficult to process a large amount of ensemble data, so a tank model was set up that can process the entire ensemble data for several thousand years.

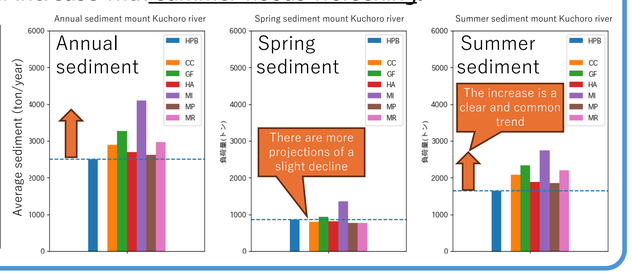


	d4PDF-RCM	Hokkaido-5kmRCM
Developer	MEXT/JAMSTEC	Hokkaido University
Resolution	20km	5km
Target region	Around the Japanese Islands	Hokkaido island
Target age	past/+2K/+4K	past/+4K
Ensembles	60years x over 50members	1 year x about 1000 member
Advantage	Long-term continuity Uniform distribution Large number of ensembles	Capable of reproducing topographic rainfall
Disadvantage	Limitation of reproducing topographic rainfall	Discontinuous individual years data Prioritize the heavy rain year

4.Impact assessment in future wetland

Year-round warming greatly affects the hydrological cycle. Warming in fall will cause to reduce snowfall and snowpack. Warming in spring will cause that snowmelt runoff (which contributes to water resources and the environment in northern Japan) is expected to be scaled down and brought forward.
The ability of mountain soils and wetlands to store water has been found to help maintain river flows and make them resistant to aridity.
In contrast, sediment runoff will increase with summer floods worsening.





5.Adaptation for future wetland

The observed relation between the impact of the flood in recent years and the response of the wetland, insight from the ongoing project, and climate change impact assessment were integrated, and the countermeasure to be focused concretely was selected.
Even with uncertain climate change projections, it is realistic to deal with phenomena common to several models.
The strengthening of facilities to trap sediment from river channels is a concrete option to deal with the situation where climate change increases flooding and sediment runoff in summer.

Example of a sediment trap facility

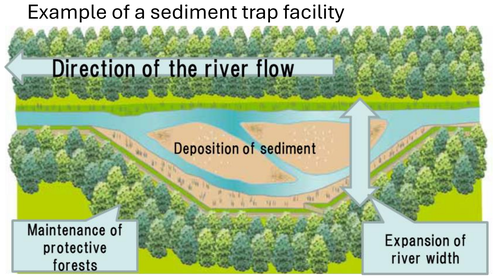


Photo of sediment trap after flood in 2016 ※4

Fences called "artificial kelmi" prevent sediment from entering the wetland. ※4

Acknowledgments:
We thank the Construction Department Hokkaido Regional Development Bureau for providing the data and materials.
We thank the Hokkaido University for providing 5km climate change projection model.

Sources of Charts ※1 MLIT Kushiro River Pamphlet https://www.hkd.mlit.go.jp/ks/tisui/ksriver_english.pdf
※2 MLIT Kushiro River Improvement Plan https://www.hkd.mlit.go.jp/ks/tisui/c86hsb000000bu22-att/c86hsb000000bu59.pdf
※3 JMA Record rainfall caused by typhoons and fronts (August 2016) https://www.data.jma.go.jp/cpd/j_climate/hokkaido/kencho_summer2016.html
※4 MLIT Nature Restoration in the Kushiro Wetland (WWD2022: Wetlands Action for People and Nature)