

Jun 20th, 4:10 PM - 4:30 PM

# The use of aquatic organisms in ecosystem evaluation and how they are affected by potential hydropower development

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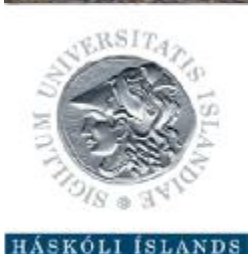
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Gíslason, Gísli Már; Skúlason, Skúli; Eiríksson, Thorleifur; and Einarsson, Sigmundur, "The use of aquatic organisms in ecosystem evaluation and how they are affected by potential hydropower development" (2017). *International Conference on Engineering and Ecohydrology for Fish Passage*. 16.  
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# The use of aquatic organisms in ecosystem evaluation and how they are affected by potential hydropower development

Gísli Már Gíslason, Skúli Skúlason,  
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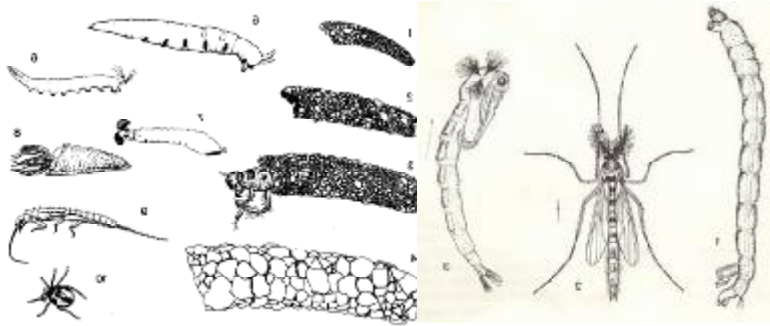
# Potential hydroelectric development

- With increased technology more rivers can be developed.
- Most rivers have been evaluated for power development.
- Only a portion of rivers has been evaluated regarding other values

Examples in my talk  
2 hydropower  
developments:  
Skatastadir (large)  
and Villinganes  
(small)



# Organisms



Stream invertebrates



Brown Trout,  
Atlantic salmon  
Arctic charr



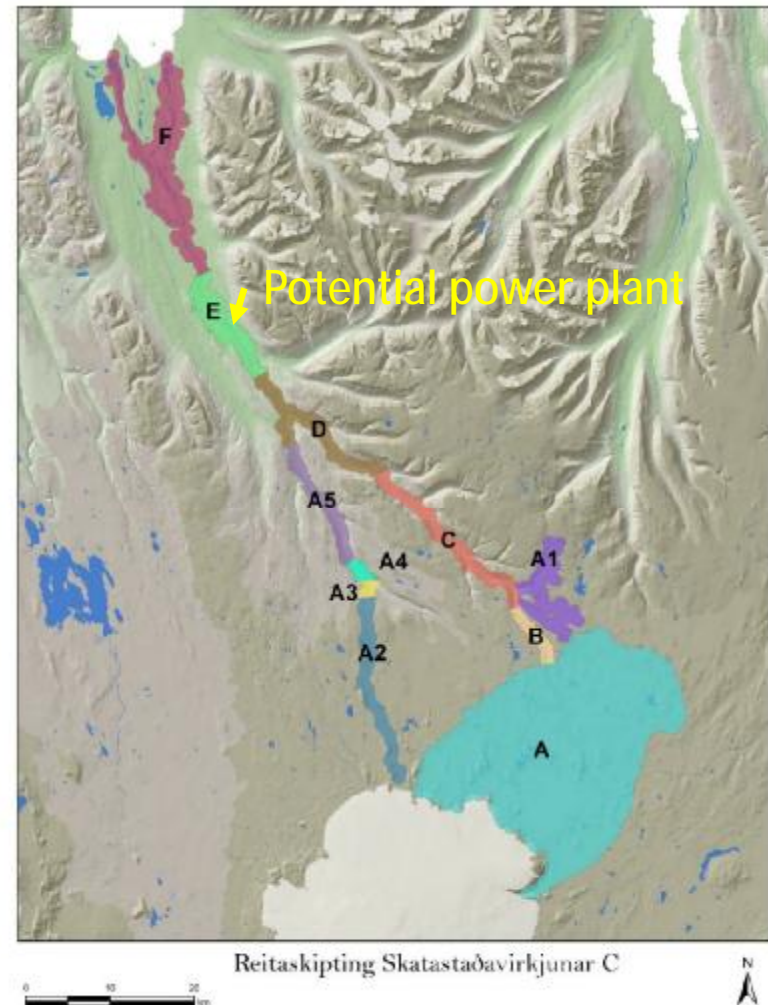
- Which species are dominating in the area?
- Which species are rare in the area, in Iceland or in the world?
- Which species are endangered, in the area, in Iceland or in the world?

• Assessment of organisms:  
*richness/diversity*  
*rarity*  
*size, completeness,*  
*pristineness,*  
*international responsibility*  
*information value*

# Example – higher and lower impact potential hydropower developments in the same river: Skatastadir and Villinganes

- Skatastadir: Impacts the entire catchment areas with reservoirs, dams, dykes, diversion of water
- Villinganes: Impacts the catchment just above the dam, (area D), and areas below the dam (E-F)

Zones of river, based on topography



## Assessment of value zones - fish

Aquatic life		Zone A1	Zone A2	Zone B	Zone C	Zone D	Zone E	Zone F	Zone F1	Zone F2
Fish	Diversity class	1	1	1	1	4	4	4	4	4
	Richness- diversity	13	13	13	13	13	20	20	20	20
	Rarity	13	13	8	8	8	8	8	8	8
	Size, completeness, pristineness	13	13	8	8	13	13	13	13	13
	International responsibility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Information value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

### Comments

## Fish – value assessment

Attributes	Assessment	Reasoning
Knowledge	B-C	4 publications
Richness/diversity	20	Arctic charr, salmon, brown trout, three spined stickleback and eals. Local populations and morphs of Arctic charr. Diverse fish communities (populations and morphs) in the highlands. High diversity of fish populations and morphs.
Rarity	13	Very rare that anadromous arctic charr and trout reaches the central highlands (800 m asl). Also rare that arctic charr occurs in the highlands. Salmon adapted to the coldest river in Iceland. Diverse communities in the highlands.
Size, completeness, pristineness,	13	Arctic charr average sized compared with other regions, but salmon below average size. Large area/ecosystem/community.
Information value	N/A	
International responsibility	N/A	
Scenic value	N/A	

## Assessment of value

### Zonation – aquatic invertebrates

Aquatic life		Zone A1	Zone A2	Zone B	Zone C	Zone D	Zone E	Zone F	Zone F1	Zone F2
Invertebrates	Diversity class	2	2	3	3	3	3	3	3	3
	Richness- diversity	13	8	4	4	4	8	13	20	20
	Rarity	20	1	1	1	1	1	4	8	8
	Size, completeness, pristineness	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	International responsibility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Information value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

### Comments



# Invertebrates – value assessment

Attributes	Assessment	Reasoning
Knowledge	B-C	8 publication
Richness/diversity	13	Great diversity (glacial river, direct run-off river, and spring-fed rivers) and <i>Carex</i> flood planes. Considerable diversity within and between communities.
Rarity	13	Special communities in the highlands, in the wetland trunda and in the <i>Carex</i> flood plains.
Size, completeness, pristineness,	N/A	
Information value	N/A	
International responsibility	N/A	
Scenic value	N/A	

# Skatastadir (large). Impact assessment Zonation - Fish

Aquatic life		Zone A1	Zone A2	Zone B	Zone C	Zone D	Zone E	Zone F	Zone F1	Zone F2
Fish	Diversity class	2	2	3	3	3	3	3	3	3
	Richness- diversity	13	8	13	13	8	4	13	13	13
	Rarity	13	13	8	8	4	4	4	4	4
	Size, completeness, pristineness	13	13	8	8	8	4	8	8	8
	International responsibility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Information value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

## Comments

No fish passage in area D

## Skatastadir (large). Fish – impact assessment

Attributes	Assessment	Reasoning
Richness/diversity	13	Great disturbance due to changes in diversity of composition and connection of running waters, lakes and ponds because of the formation of the reservoir. Disrupts the communities and ecosystems. Community changes due to changes in discharge and silt content.  Less, especially among morphs and populations of Arctic charr in the Central Highlands.  Continuity and completeness disrupted.
Rarity	13	
Size, completeness, pristineness,	13	
Information value	N/A	
International responsibility	N/A	
Uncertainty	N/A	

# Skatastadir (large). Impact assessment Zonation – Aquatic invertebrates

Aquatic life		Zone A1	Zone A2	Zone B	Zone C	Zone D	Zone E	Zone F	Zone F1	Zone F2
invertebrates	Diversity category	2	2	3	3	3	3	3	3	3
	Richness- diversity	13	8	4	4	4	8	13	20	20
	Rarity	20	1	1	1	1	1	4	8	8
	Size, completeness, pristineness	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	International responsibility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Information value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Comments

## Skatastadir (large). Invertebrates – impact assessment

Attributes	Assessment	Reasoning
Richness/diversity	13	Great disturbance due to changes in connectivity between systems, e.g. with the formation of the reservoir. Disconnects the communities and ecosystems. Great disturbance due the changes in discharge and silt content, especially in the <i>Carex</i> flood plains..  Great disturbance in pond communities in the Tundra permafrost palsa mounds, because of changed groundwater level and water level changes in the <i>Carex</i> floodplanes downstream.
Rarity	13	
Size, completeness, pristineness,	N/A	
Information value	N/A	
International responsibility	N/A	
Uncertainty	N/A	

# Villinganes (smaller). Impact assessment

## Zonation - Fish

Aquatic life		Zone A	Zone A1	Zone A2	Zone A3	Zone A4	Zone A5	Zone A6	Zone A7	Zone A8	Zone B	Zone C	Zone D	Zone E	Zone F	Zone F1	Zone F2
Fish	Diversity class		2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	Richness-diversity		13	1	1	1	1	1	1	1	1	1	4	8	13	20	20
	Rarity		20	1	1	1	1	1	1	1	1	1	1	1	4	8	8
	Size, completeness, pristineness		0	0	0	0	0	0	0	0	0	0	8	8	8	4	8
	International responsibility		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Information value		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Comments

## Villinganes (smaller). Fish impact assessment

Attributes	Assessment	Reasoning
Knowledge	13	4 references
Richness/diversity	13	Great impact because of the reservoir at Villinganes. Disturbs communities and fish ecosystems. Impacts the glacial rivers below the dam by changing the discharge and silt content.  Deminishes, especially regarding morphs and populations of Arctic charr in the highlands.  Continuity and completenss disrupted.
Rarity	13	
Size, completeness, pristineness,	N/A	
Information value	N/A	
International responsibility	N/A	
Uncertainty	Small	

# Villinganes (smaller). Impact assessment

## Zonation - invertebrates

Aquatic life		Zone A	Zone A1	Zone A2	Zone A3	Zone A4	Zone A5	Zone A6	Zone A7	Zone A8	Zone B	Zone C	Zone D	Zone E	Zone F	Zone F1	Zone F2
Invertebrates	Diversity class		2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	Richness- diversity		0	0	0	0	0	0	0	0	0	0	4	8	13	20	20
	Rarity		0	0	0	0	0	0	0	0	0	0	1	1	4	8	8
	Size, completeness, pristineness		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	International responsibility		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Information value		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

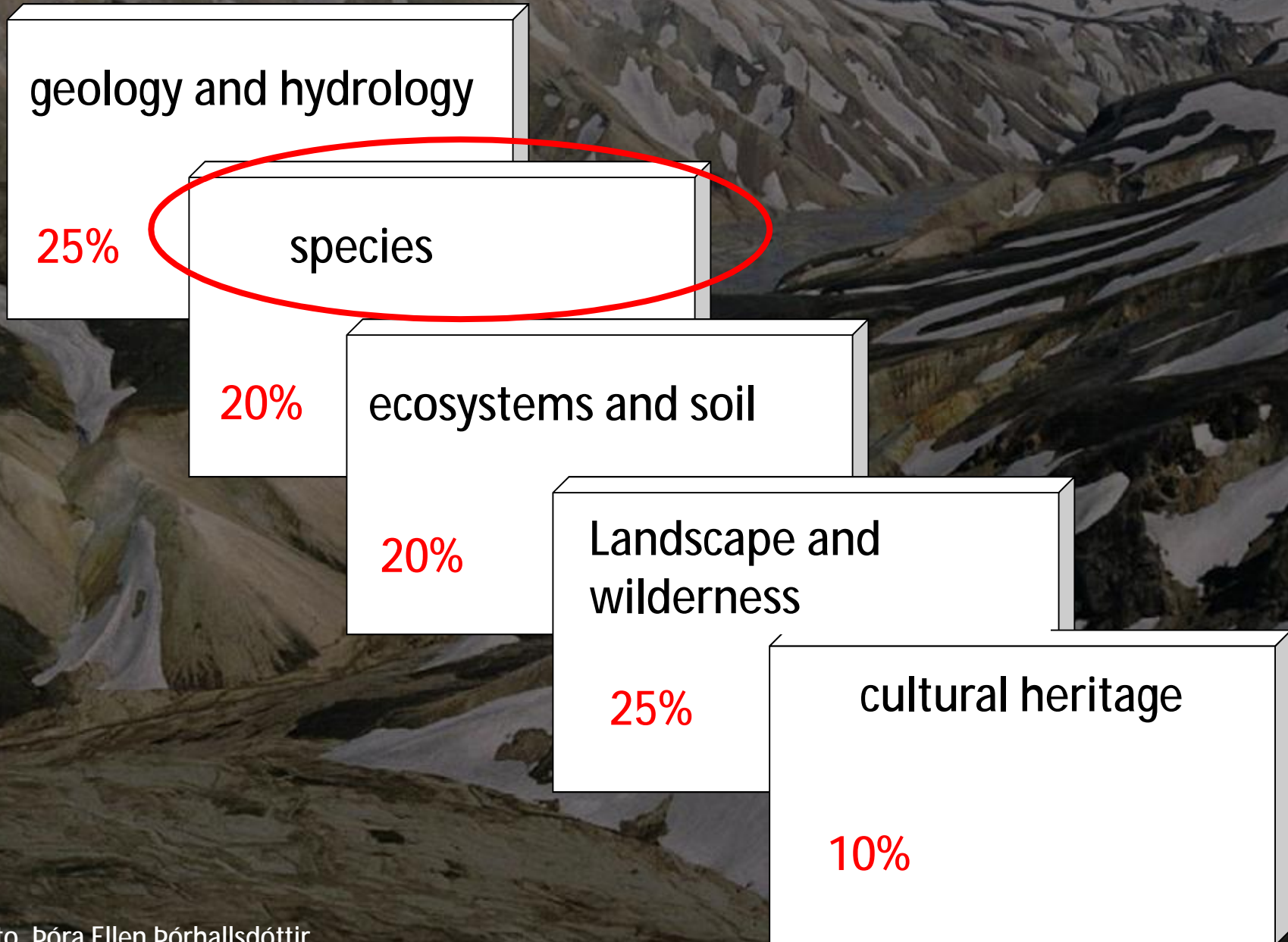
### Comments



## Villinganes. Invertebrate impact assessment

Attributes	Assessment	Reasoning
Richness/diversity	13	8 references
Rarity	13	Great impact because of changes in continuity between systems, e.g. by the construction of the reservoir – disrupts communities and ecosystems. Greatly Impacts the glacial rivers below the dam by changing the discharge and silt content, which affects the <i>Carex</i> flood plains. Greatly affects the invertebre life in the <i>Carex</i> flood plains.
Size, completeness, pristineness,	N/A	
Information value	N/A	
International responsibility	N/A	
Uncertainty	Small	

Species account for 20% of the total value



# Results of the assessment

Both versions of hydropower utilization lead to the whole area was placed into conservation category mainly because of the:

- a. impact of the larger version would destroy the catchment area above the dam
- b. impact of both potential developments on species (fish, aquatic invertebrates, plants and birds) below the dam (the flood plains) would be very great, as such floodplains are now rare in Iceland.

ØGíslason GM 2016. Is it possible to reach a consensus on the utilization of catchment and geothermal areas for energy production? *Aquatic Conservation. Marine and Freshwater Ecosystems* 26, 619-622

# Thanks

Thanks to the others in the working group:

Ása Lovísa Aradóttir - plant ecology

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Kristján Jónasson - geology

Sólborg Una Pálsdóttir - cultural heritage

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Thorvaldur Thórðarson -geology

Thorvarður Árnason - landscape

Tómas Grétar Gunnarsson - birds

Photo Þóra Ellen Þórhallsdóttir