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# Integrated biological, geological and cultural diversity of river basins with hydroelectric potential

Thorleifur Eiríksson  
*University of Iceland*

Sigmundur Einarsson  
*Rorum ehf.*

Tómas Grétar Gunnarsson  
*University of Iceland*

Skúli Skúlason  
*Hólar University College*

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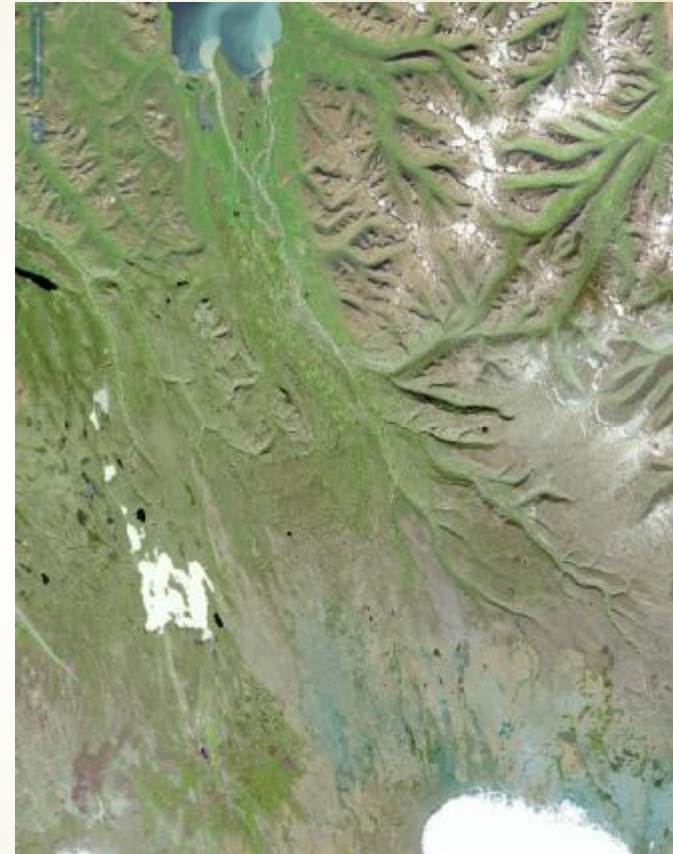


# Integrated biological, geological and cultural diversity of river basins with hydroelectric potential

Thorleifur Eiríksson, Sigmundur Einarsson,  
Tómas Grétar Gunnarsson and Skúli Skúlason

## The subject area

- ✦ The river Héraðsvötn/ Austari Jökulsá/ Vestari Jökulsá
- ✦ Two rivers combine into one and divide again into two rivers
- ✦ Begins in the highland plateau, goes down the mountain slope into a valley and then flood plains
- ✦ Large area
- ✦ High total diversity



# Assessment

- Reference for rating in estimate of value. Example of higher plants.
- Values are absolute and not relative to local conditions.

<u>Enrichment/diversity</u>	<u>Rarity</u>
1 Very little species diversity . All species common; no species with high conservation value	1 no species with high conservation value
4 Species diversity just below average	4 at least one endangered or vunrable species (not critically endangered) rare species / localized finding place
8 Species diversity average	8 2-3 endangered species /rare species / localized finding place
13 Species Diversity just above average. Several endangered/rare species / localized finding place	13 Several endangered species /rare species / localized finding place
20 Great species diversity	20 Several endangered species /rare species / localized finding place

## The problem

- Using absolute assessment over large areas with a diversity gradient underestimates the value of subareas with low diversity even if the area represents important natural or cultural elements.

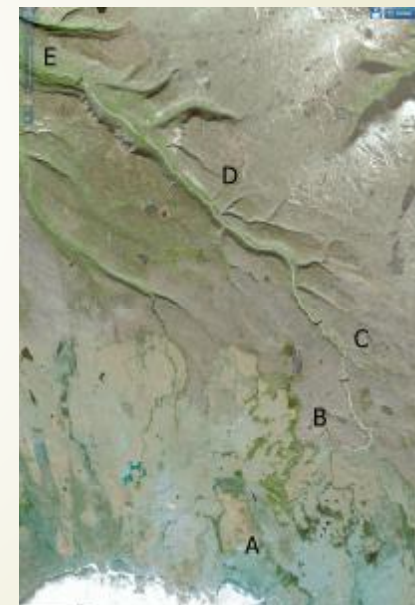
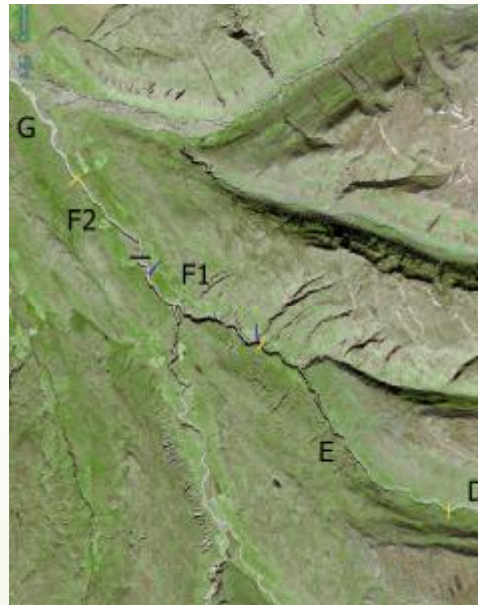
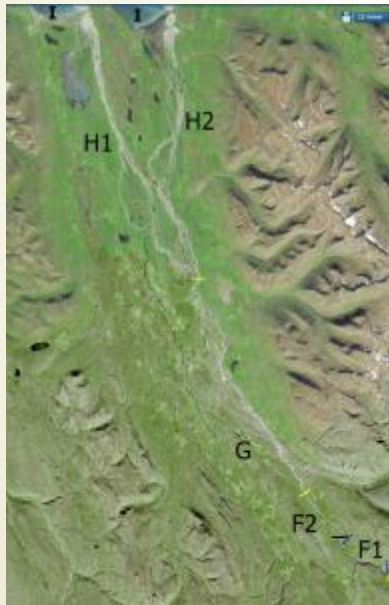
## Development of method

- ✦ The method was developed in a specialist group estimating the value of land and impact from powerplants on different aspect of natural history or cultural heritage.
- ✦ The group: geology, plant ecology, zoology (birds), fresh water ecology, zoology (fish), microorganism (bacteria), archaeology, landscape.
- ✦ The idea was to use the same estimate on the different aspects of the subject even if they were considered not comparable.
- ✦ Use relative estimate.
- ✦ Divide the area in different zones with parameters independent from the subject.
- ✦ Use the zones as a basis for relative estimate



# Erosional surfaces

- the process of eroding or being eroded by wind, water, or other natural agents.
- Zonation of the river Héraðsvötn/ Austari Jökulsá/ Vestari Jökulsá.



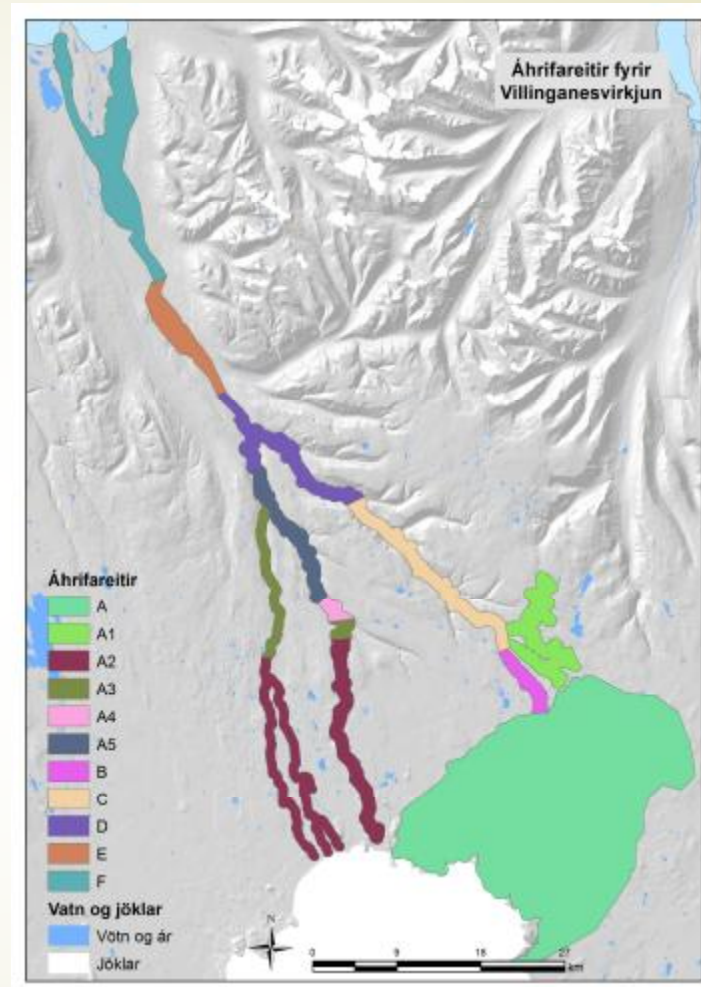
# Zonation parameters (geomorphology)

Zones	Distance	Elevation	Fall	Slope	Riverbed		Grain size	Stratum on bank	Stratum on bank	Changes
	km	m	m	%	Single/multiple	Width (m)		Right	Left	
<b>A</b>	10	800-750	50	5	Multiple (sand) – outwash plain/Lichenes	Undefined	Clay-coarse gravel	Sand, moraine, tuff	Sand, moraine, tuff	None
<b>B</b>	90	750-660	90	4,3	Single/multiple outwash plain	30-50 (300)	Clay-Cobblestones	Moraine	Moraine	Land goes under water reservoir, ground water level rises
<b>C</b>	7	660-560	100	14,3	Single rock/outwash plain	30-40 (150)	Hnullungamöl	Rock	Rock	Chanced appearance – lesser flow(%) – erosion lessens
<b>D</b>	30	560-250	310	10,3	Multiple outwash plains/Lichenes	100-200	Gravel - cobblestones	Outwash plain, rock, talus	Outwash plain, rock, talus	Chanced appearance – lesser flow(%) – erosion exceeds accumulation
<b>E</b>	4,5	250-160	90	20	Single Rock	10-30	Boulders	Rock	Rock	Chanced appearance – lesser flow(%) – erosion lessens
<b>F1</b>	7	160-90	70	10	Roc/ outwash plain		Cobblestones	Rock	Rock	Chanced appearance – flow
<b>F2</b>	7	90-80	60	8,5	Single rock/ outwash plain		Gravel - cobblestones	Rock	Rock	Chanced appearance – lesser flow (%) – erosion lessens
<b>G</b>	80	80-0	80	1	Multiple outwash plains/ Lichenes		Clay - Gravel	Flood plain	Flood plain – partial canyon	Chanced appearance – lesser flow (%) – flood lessen
<b>H1</b>										
<b>H2</b>										
<b>I</b>	0	0	0	0	Sandy beach – river outlet		Sand-gravel	–	–	Soil erosion (?)



## The Zones

Zonation of the river  
Héraðsvötn/ Austari Jökulsá/  
Vestari Jökulsá and the river  
Fossá.



## Diversity classes

Fish communities is divided in to four diversity classes:

- ✦ 1. Landlocked Arctic charr populations.
- ✦ 2. Land locked salmonid populations with access to streams (i.e. small local charr).
- ✦ 3. Anadromous charr
- ✦ 4. Salmon and brown trout.

Cultural heritage is divided in to three diversity classes:

- ✦ 1. Nucleated settlement (settlement relatively stable up to the 20. century).
- ✦ 2. Rural settlement (unstable and/or seasonal settlement).
- ✦ 3. Wilderness (no settlement and no records of a settlement).

# Comparisons of zones

- Skatastadir power development. 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	1	1	1	1	4	4	4	4	4
	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									
	Information value									

- No fish passage into area D

## The process

- ✓ 1. Specification of the subject area to be rated.
- ✓ 2. Division of subject area into zones in consideration to geomorphology.
- ✓ 3. Definition of diversity classes of different subjects.
- ✓ 4. Rating of subjects in different zones.
- ✓ 5. Summary of score for the zone.

## Compatible estimate method

- ✓ Different subjects: geology, biology or cultural heritage
- ✓ Same method to estimate e.g. diversity or richness
- ✓ Therefore comparable
  
- ✓ Estimate of different subjects in an area accumulative
- ✓ Different areas therefore comparable
  
- ✓ Therefore ranking possible

# Thank you

- ✓ Thanks to the others in the working group:
- ✓ Ása Lovísa Aradóttir - plant ecology
- ✓ Birna Lárusdóttir – cultural heritage
- ✓ Gísli Már Gíslason - fresh water ecology
- ✓ Kristján Jónasson - geology
- ✓ Sólborg Una Pálsdóttir - cultural heritage
- ✓ Sólveig K. Pétursdóttir – microorganism (bacteria)
- ✓ Thorvaldur Thórdarson - geology
- ✓ Thorvardur Árnason - landscape