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Identifying cumulative impact thresholds: implications for marine spatial planning

Selina Agbayani

Fisheries and Oceans Canada, selina.agbayani@dfo-mpo.gc.ca

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IDENTIFYING CUMULATIVE IMPACT THRESHOLDS

Implications for Marine Spatial Planning

Selina Agbayani and Cathryn Clarke Murray

The global oceans are increasingly affected by human activities



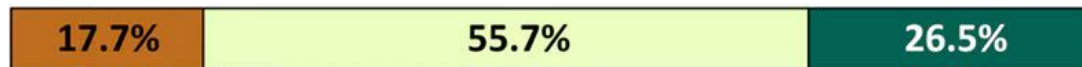
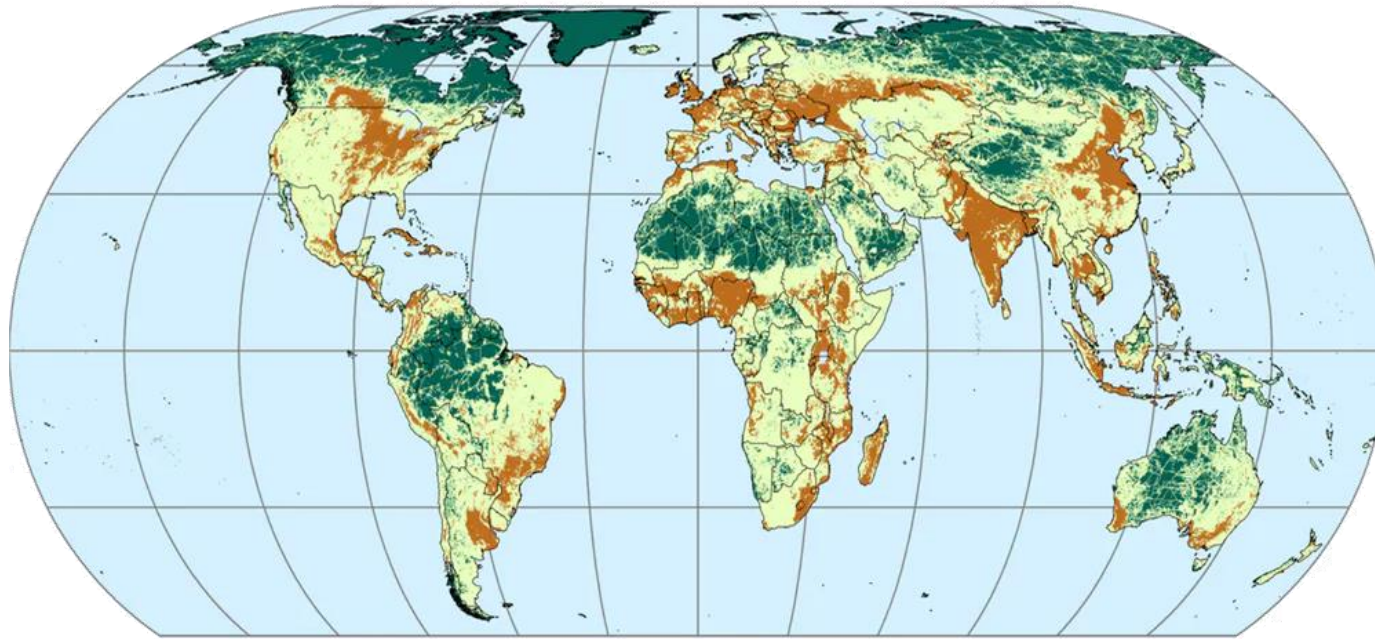
Image credit: Safety4Sea.com

How do we decide which areas to prioritize for restoration / management / protection?

We might begin by identifying different classes of marine area by their levels of impact:

Degraded vs **Shared** vs **Wild**

Locke et al. (2019) proposed a way to identify **Three Global Conditions** for conserving terrestrial systems:



Cities and Farms

Shared Lands

Large Wild Areas

Cities and Farms are more than half covered by intensive agriculture and cities, **Large Wild Areas** are scarcely altered, and **Shared Lands** have a level of use somewhere in between. Each landscape condition requires a different conservation strategy. Locke et al. (2019), CC BY-ND

They also presented a framework for **Three Global Conditions** for biodiversity conservation in the oceans: (Locke et al. 2019)

Estuaries & coasts

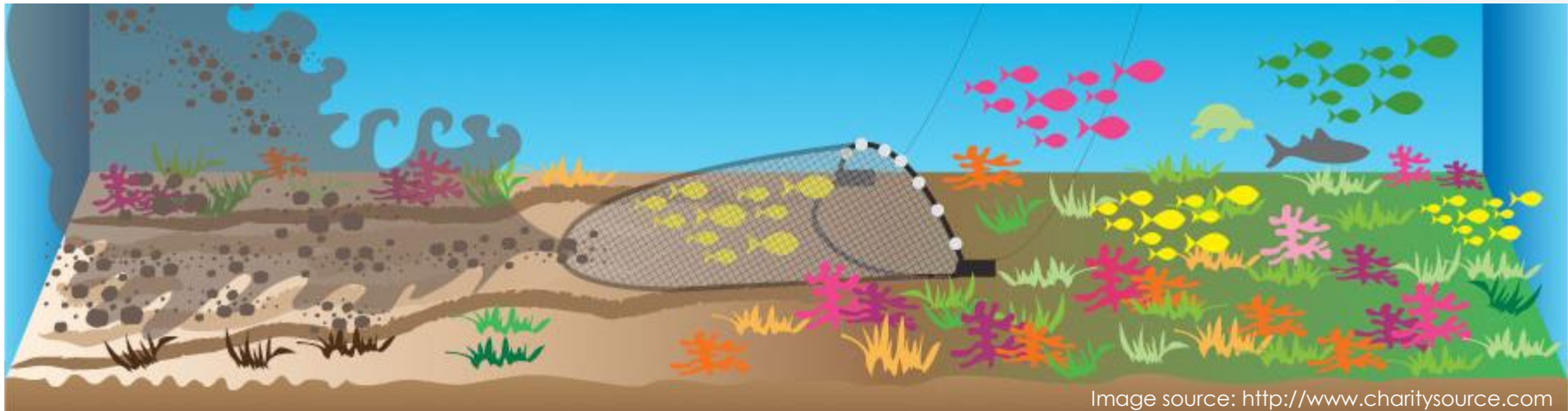
Coupled to cities and farms, high biodiversity, fragmented ecosystems (e.g. mangroves), ecological restoration and protection (lower percentages possible)

Nearshore shared seascapes

Ecologically representative and well-connected systems of protected areas, compatible sustainable industrial practices outside Protected Area networks

Offshore large wild areas

Large, interconnected protected areas, few nodes of industrial development in a wild matrix, ecological processes prioritized, remove anomalies and utilize Indigenous Knowledge

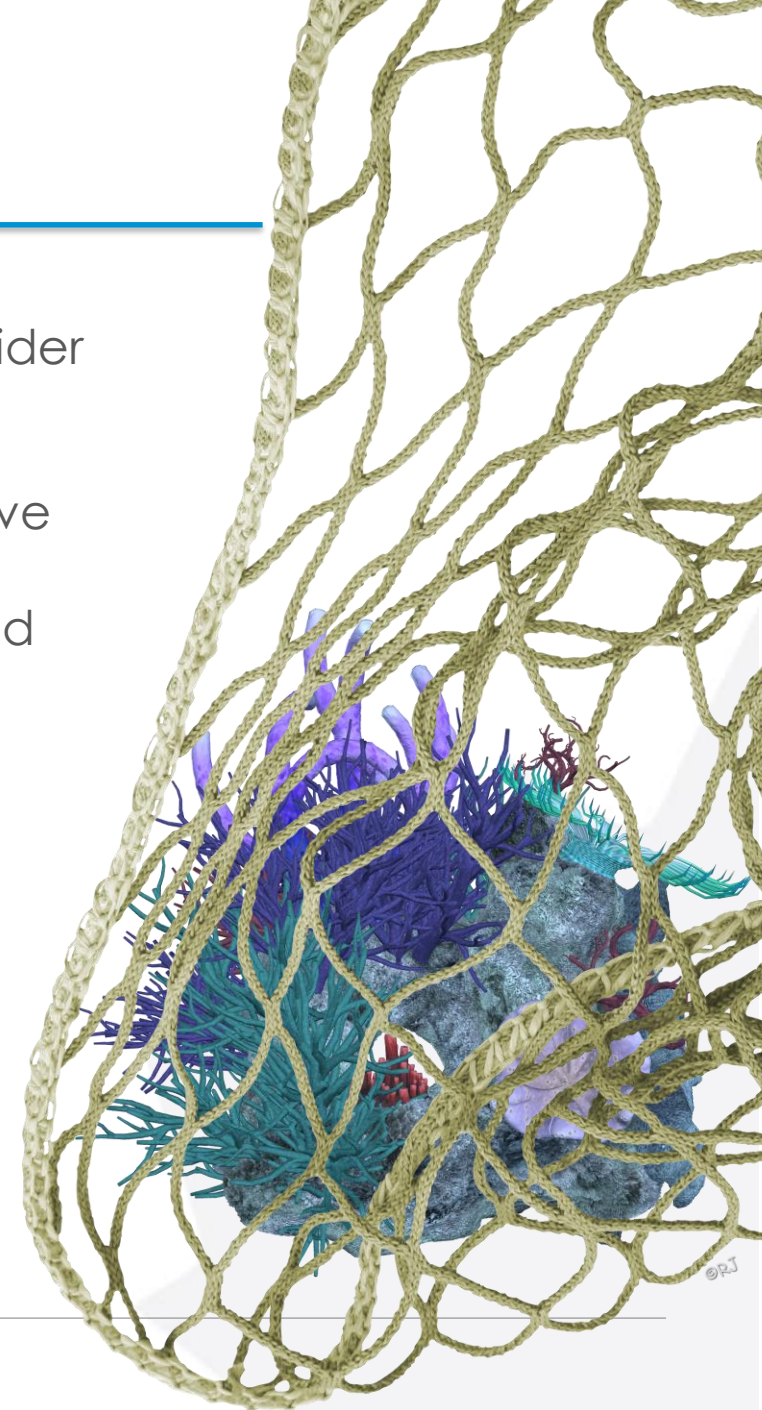


Considering Vulnerability

Conditions for conservation should also consider **vulnerability** or **sensitivity** to activities.

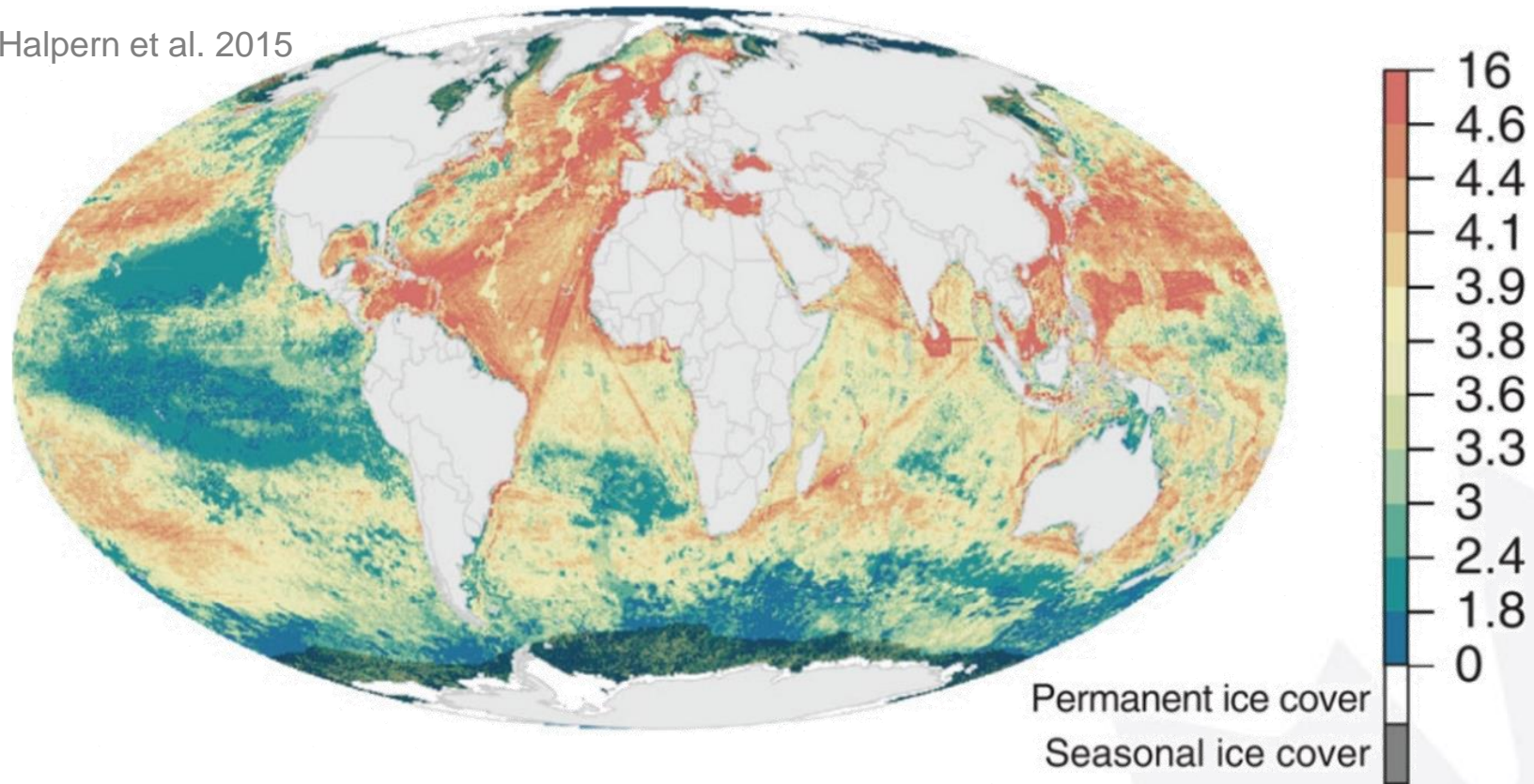
Vulnerability is a component of the cumulative impact mapping model (Halpern et al. 2008) and has been implemented in regions around the world.

Deep sea corals and sponge reefs, for example, are highly sensitive to trawling despite their location on the coast.



Can we use Cumulative Impact Mapping scores to define the three global conditions?

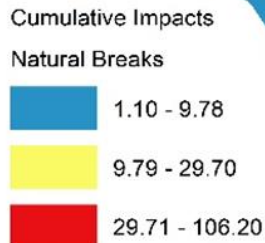
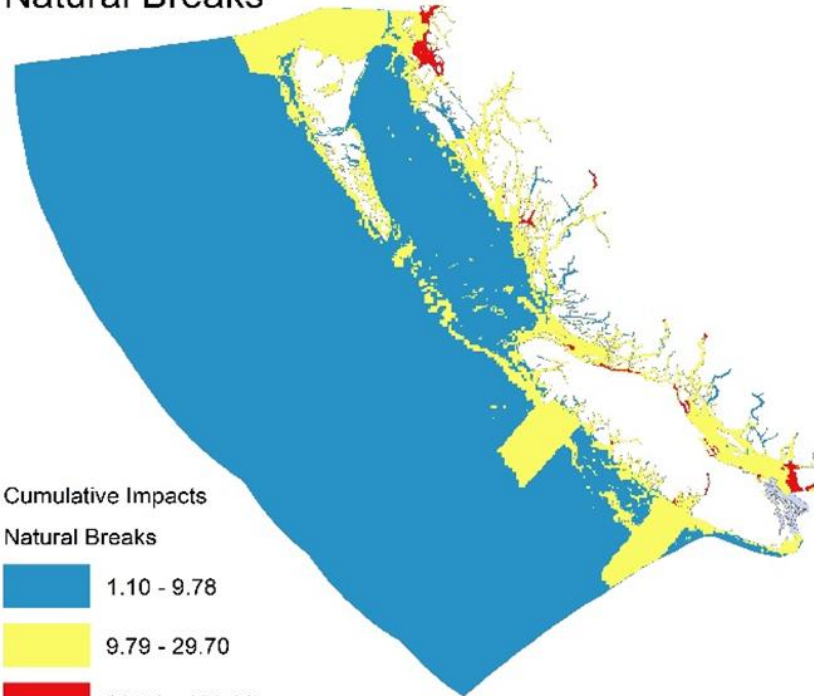
© Halpern et al. 2015



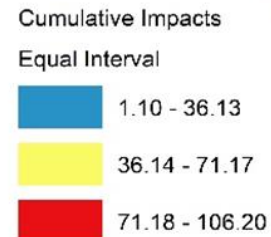
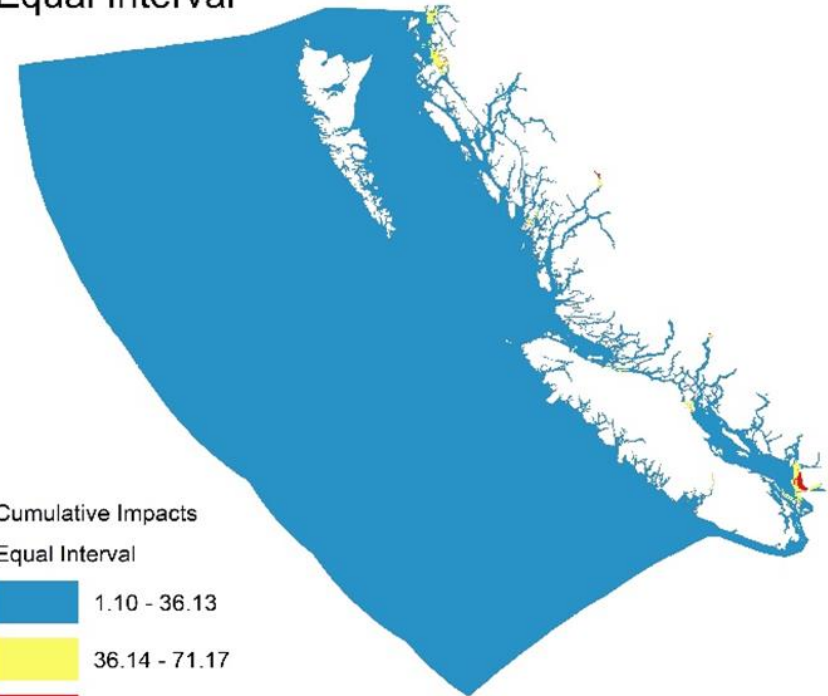
Do offshore wild areas fall neatly into a particular impact class?
And are all near-shore areas degraded?

Different classification methods can result in wildly different maps

Natural Breaks



Equal Interval



Statistically relevant breaks

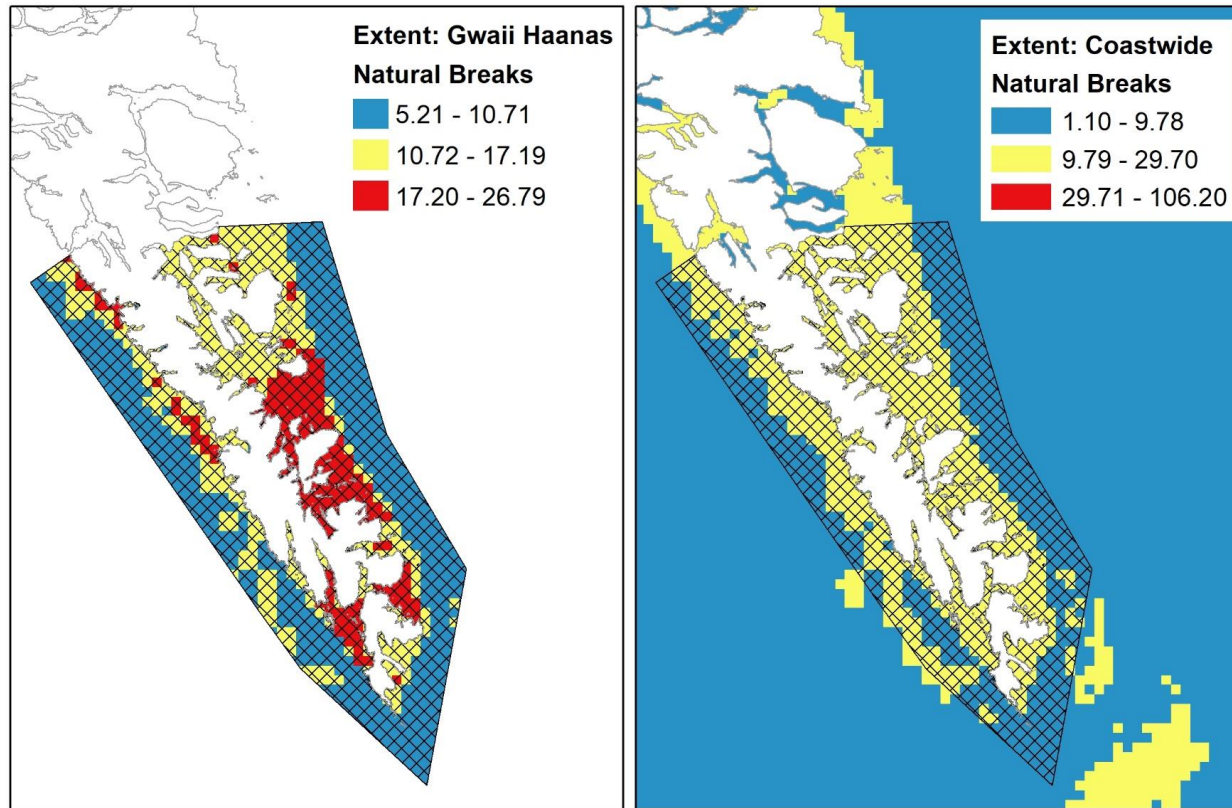
(absolutely accurate, in terms of the representation of data's spatial attributes, uniform distribution of error across mapped surface)

More intuitive for general public

(the range for each class is equal, so that each change in class represents the same amount of change in impact)

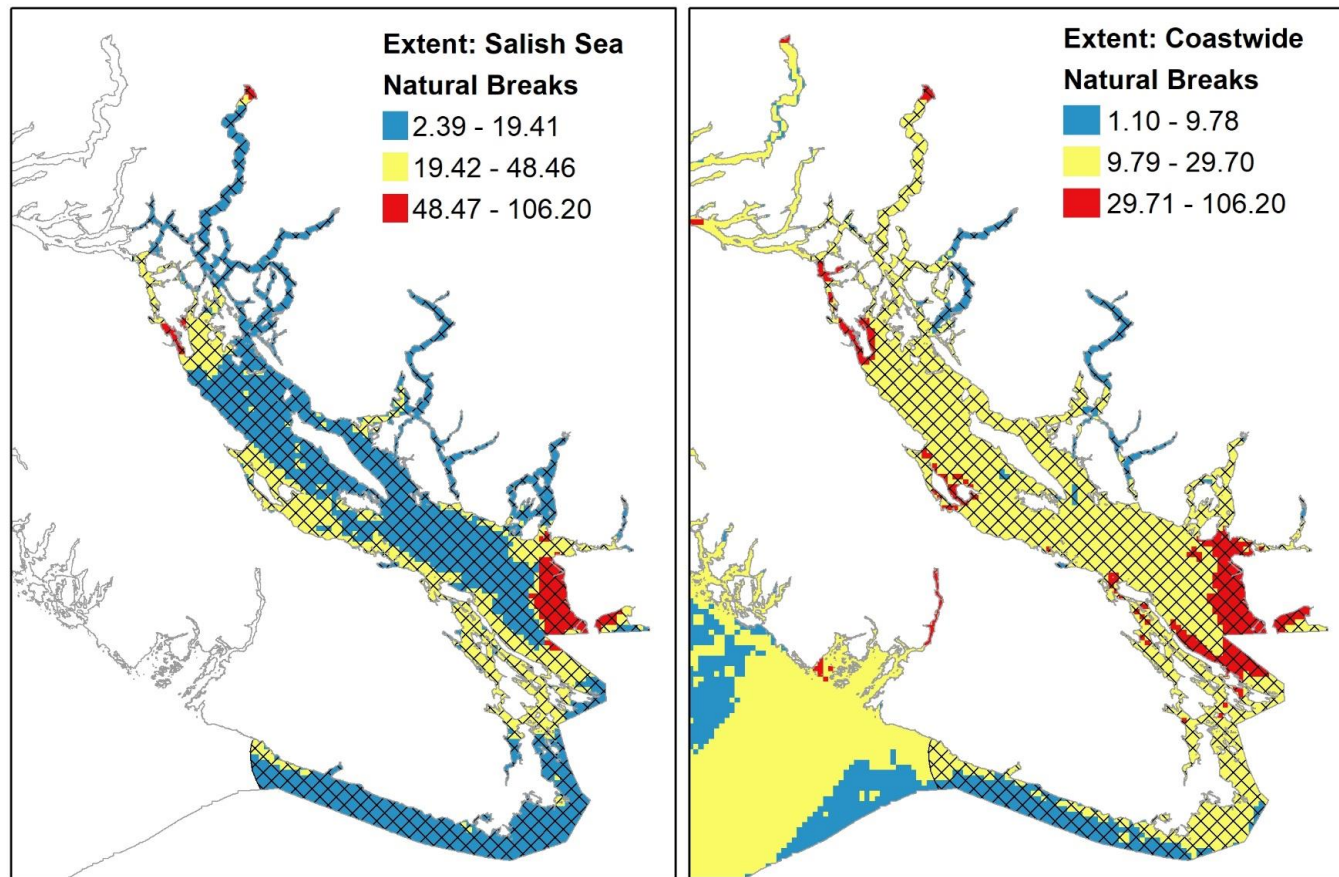
Moreover, scale matters...

Classifications for specific areas can differ depending on the extent of the study area.



On the left, where the study area is limited to the Gwaii Haanas National Marine Conservation Area (NMCA), nearshore areas show up as “**Degraded**”. On the right, the analysis was extended coastwide, and those same areas fall into the “**Shared**” class.

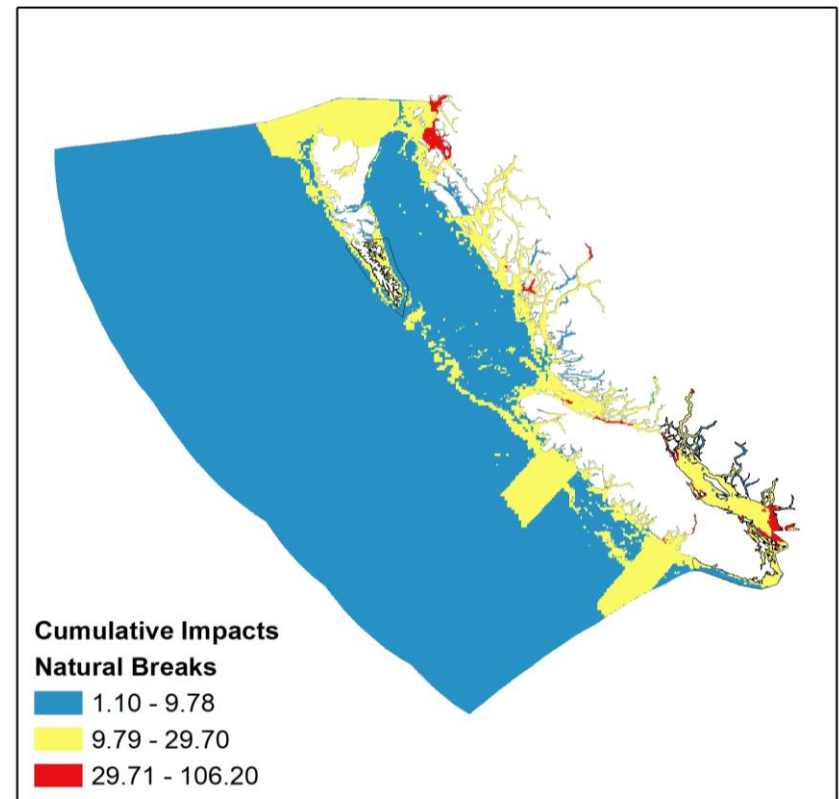
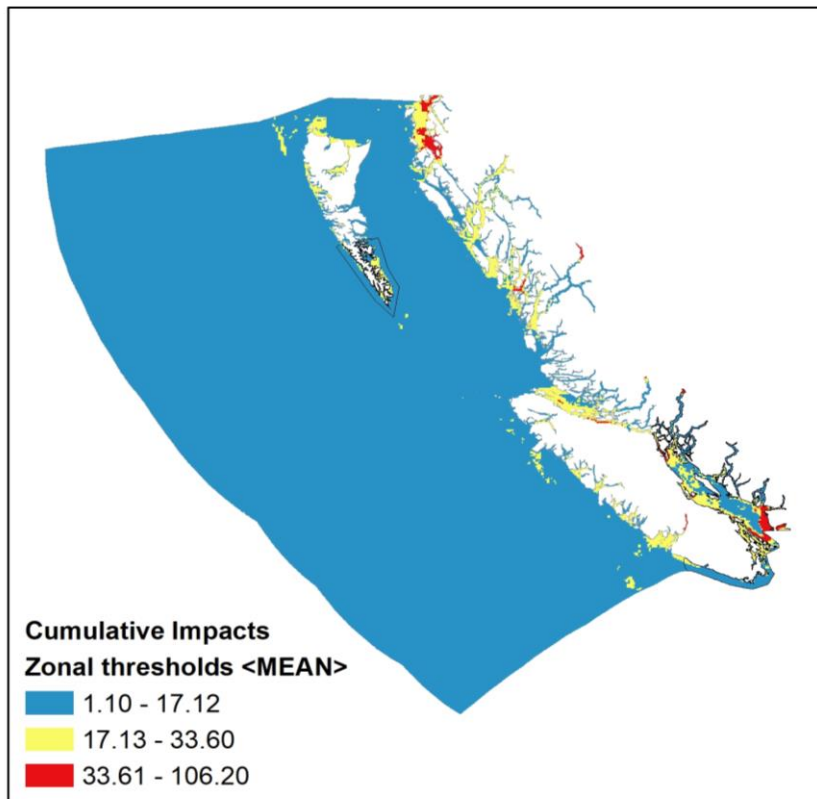
Or the opposite can occur...



On the left, where the study area is limited to the Salish Sea, the Strait of Georgia jumps out as **“wild”**. However, on the right, where the analysis was extended coastwide, the same area is highlighted as **“shared”**.

How do we define “wild” areas?

If **Gwaii Haanas** were considered a low impact area, and the **Salish Sea** a high impact area, the classification would result in the map on the left, as opposed to the usual map generated by natural breaks (on the right).



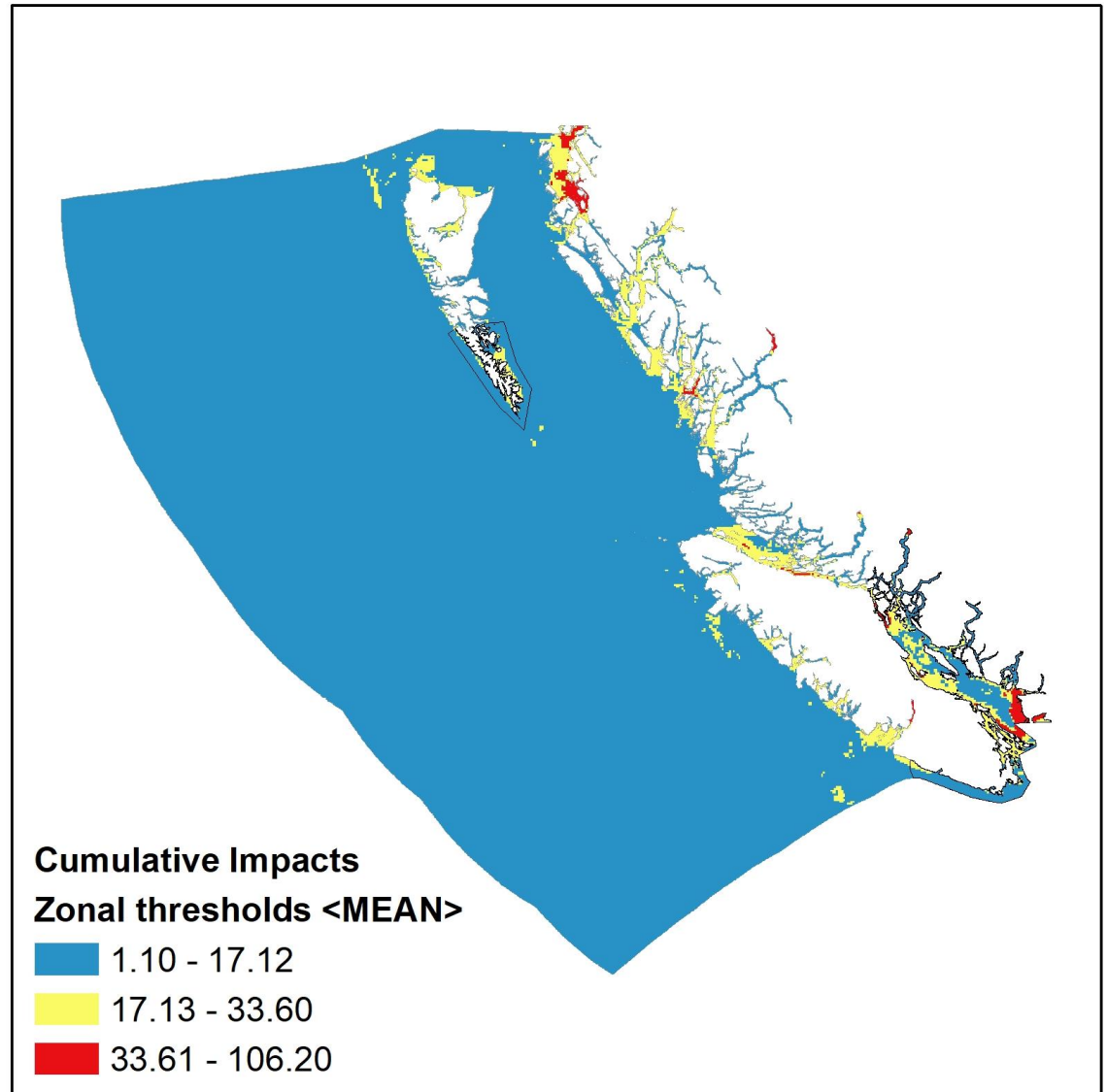
ZONE	Impact Levels	MIN	MAX	RANGE	MEAN	STD
Gwaii Haanas NMCA	LOW	5.21	26.79	21.58	11.90	5.22
Salish Sea	HIGH	2.94	106.20	103.26	19.50	14.10

Are these impact classes useful?

Notice the small pockets of “degraded” areas. Some coastal regions are considered “shared”, and large tracts offshore are “wild”.

Do these match stakeholder perceptions / knowledge of impact?

Wild?
Shared?
Degraded?



We are actively looking for opportunities to ground-truth and refine thresholds for

- Other marine regions of Canada
- Shared seas
- Other international areas

Please contact us:

Cathryn Murray
Selina Agbayani

cathryn.murray@dfo-mpo.gc.ca
selina.agbayani@dfo-mpo.gc.ca



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