Benguela CURRENT COMMISSION

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

Overview of the underlying concepts of systematic planning:
irreplaceability, best design, and conflict avoidance




Dr Linda Harris

NELSON MANDELA UNIVERSITY

What is Systematic Biodiversity Planning?

- Science-based, evidence-based, data-driven decision-support tool
- Overarching objectives
  1. representation
  2. persistence
- Key characteristic: complementarity rather than hotspots

Hotspots vs Complementarity

	Sp A	Sp B	Sp C	Sp D	Sp E	Sp F	Sp G	TOTAL
Site 1	✓	✓		✓		✓	✓	5
Site 2	✓	✓		✓		✓		4
Site 3	✓				✓		✓	3
Site 4				✓				1
Site 5			✓		✓			2
Site 6		✓			✓			2
Site 7	✓					✓		2

Hotspots vs Complementarity

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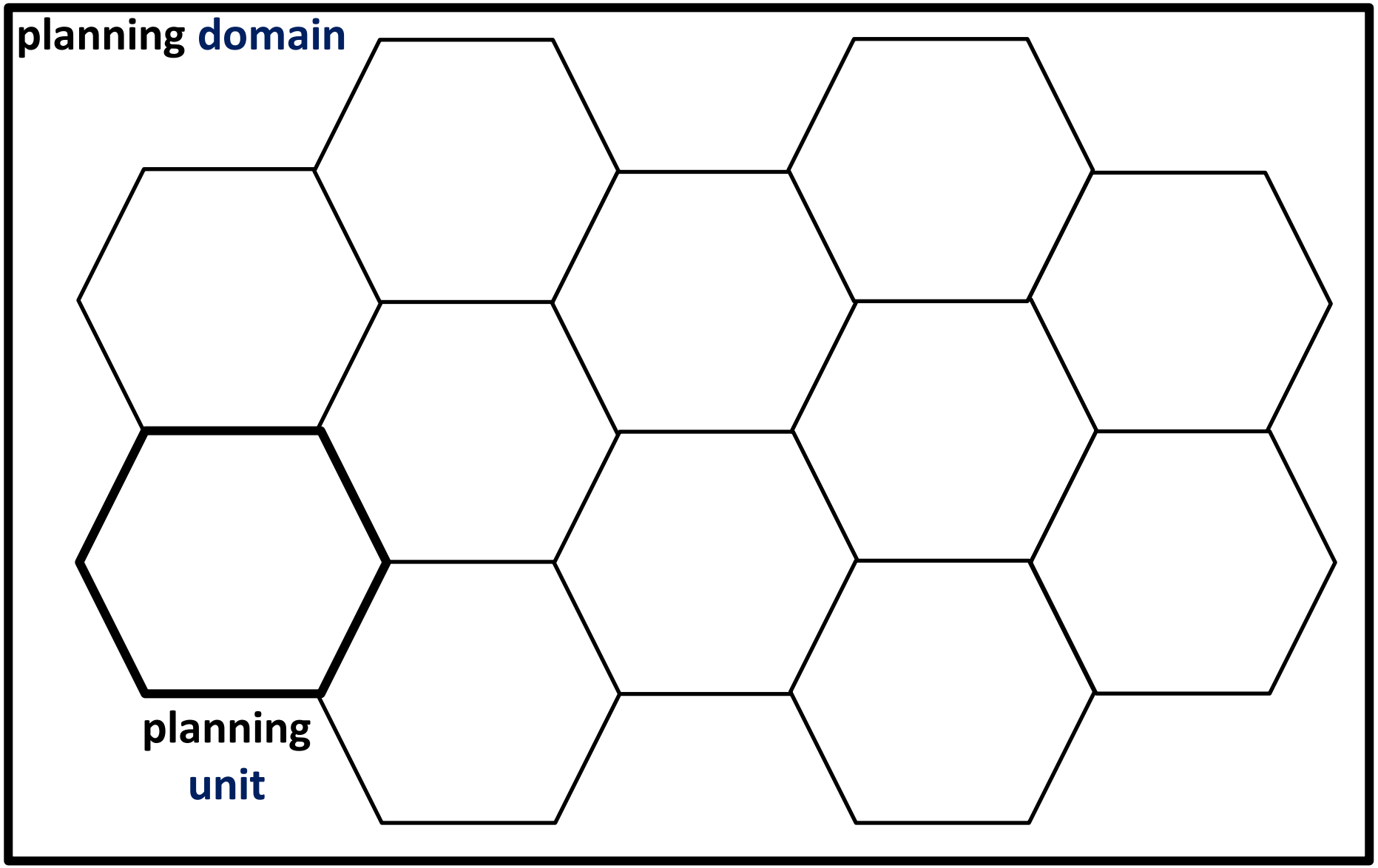
Site 6		✓			✓			2
Site 7	✓					✓		2

… complementarity

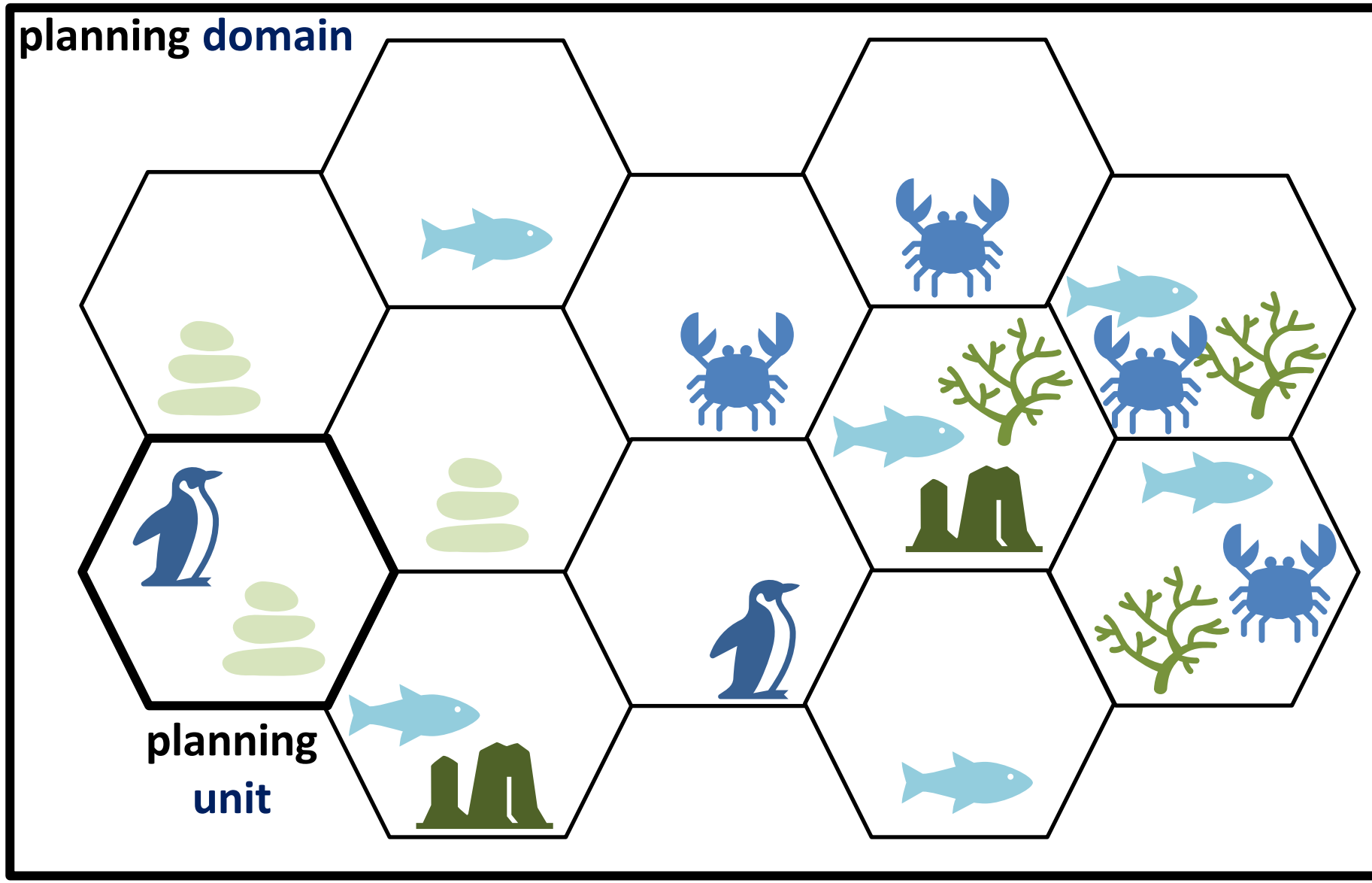
What does the planning problem look like spatially?



What does the planning problem look like spatially?

species

habitats

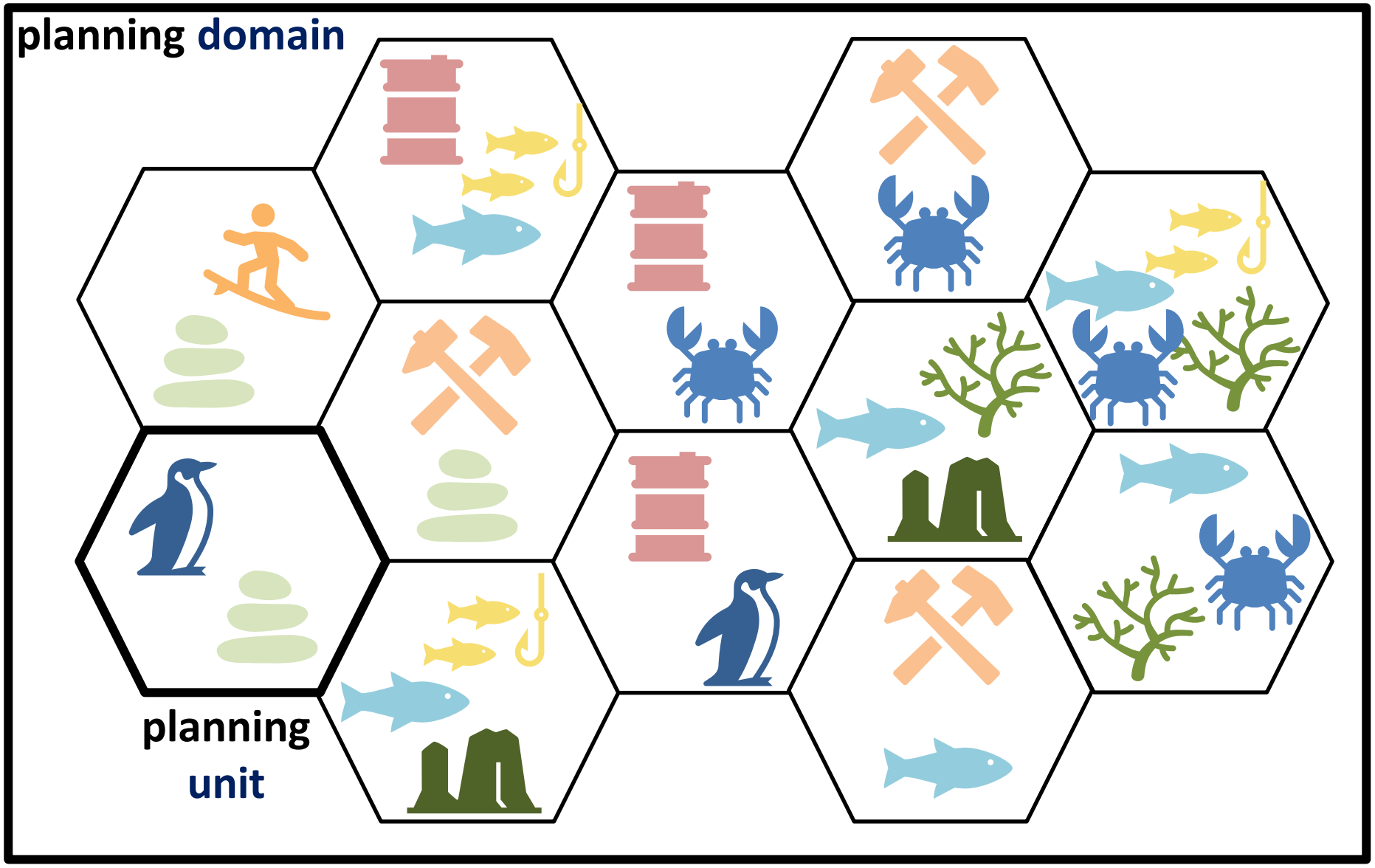


What does the planning problem look like spatially?

species

habitats

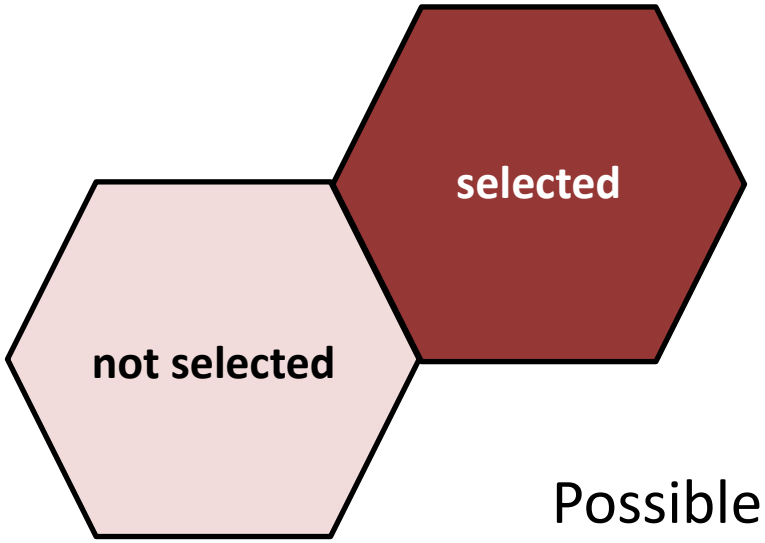
activities

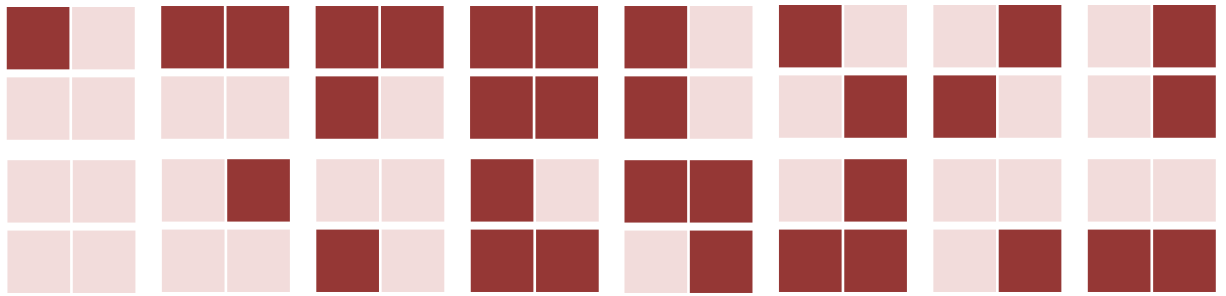


Biodiversity is not the only aspect to consider

The more proposed areas to secure biodiversity avoid areas of high interest for other activities, the higher the likelihood of more expedient implementation because there are fewer negotiations and compromises required

Why we need an algorithm





Possible solutions = [number of planning units]^2

4 planning units: 4^2 = 16 possible solutions

100 000 planning units: $100\,000^2$ = 10 billion possible solutions

… Need an algorithm to help us!

Takes a target-driven approach (representation and persistence)

50% of distribution

20% of distribution

20% of distribution

50% of distribution

20% of distribution

50% of distribution

40% of distribution

30% of distribution

Optimisation algorithm

$$\min \quad \sum_{i=1}^{N_s} c_i x_i$$

Minimize the cost of selected planning units (conflict with other activities)

given the constraints that

$$\sum_{i=1}^{N_s} x_i r_{ij} \geq T_j \qquad \text{for all features } j$$

… targets must be met for all features

$$\text{and} \quad x_i \in \{0,1\} \qquad \text{for all sites } i$$

… where each planning unit can be selected (1) or not selected (0)

where N_s is the number of sites, c_i is the cost of site i, r_{ij} is the occurrence level of feature j in site i, and T_j is the target level for each feature j. The Boolean control variable x_i has value 1 for selected sites, and value 0 for sites not selected.

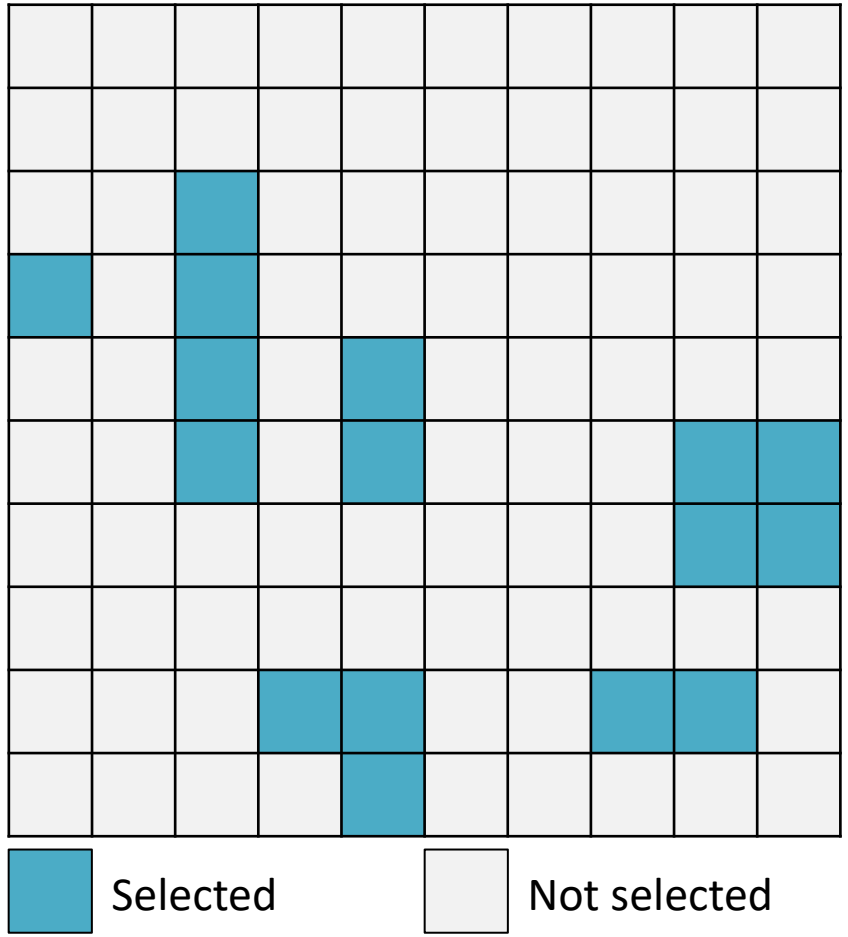
…with additional penalties for having fragmented solutions and for not meeting feature targets

How Marxan Works

Marxan explores the decision space by starting with a random design, and iteratively trying to improve it by finding portfolios of selected planning units that have lower scores

Meet targets

Lower cost (conflict)



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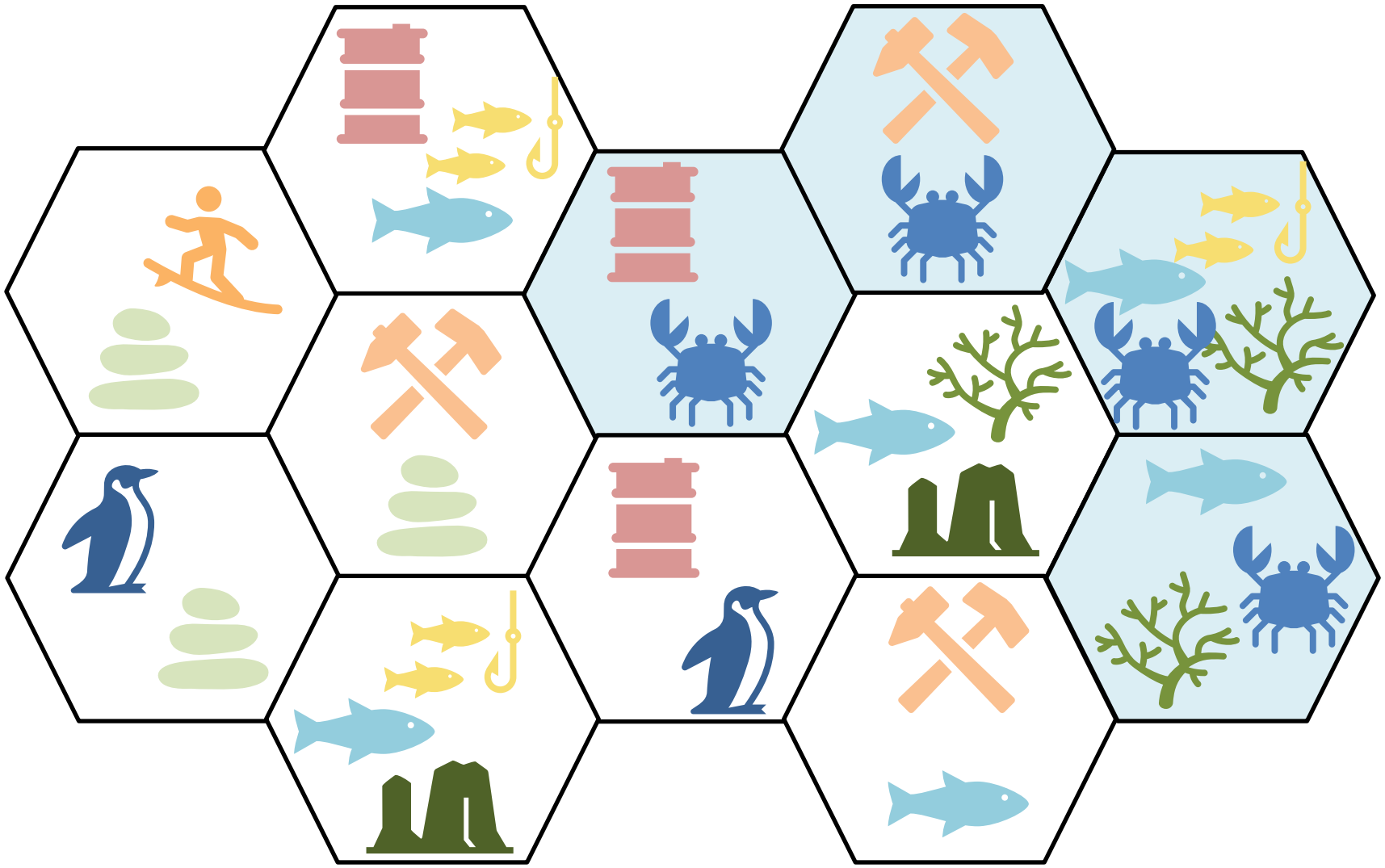
activities (cost)



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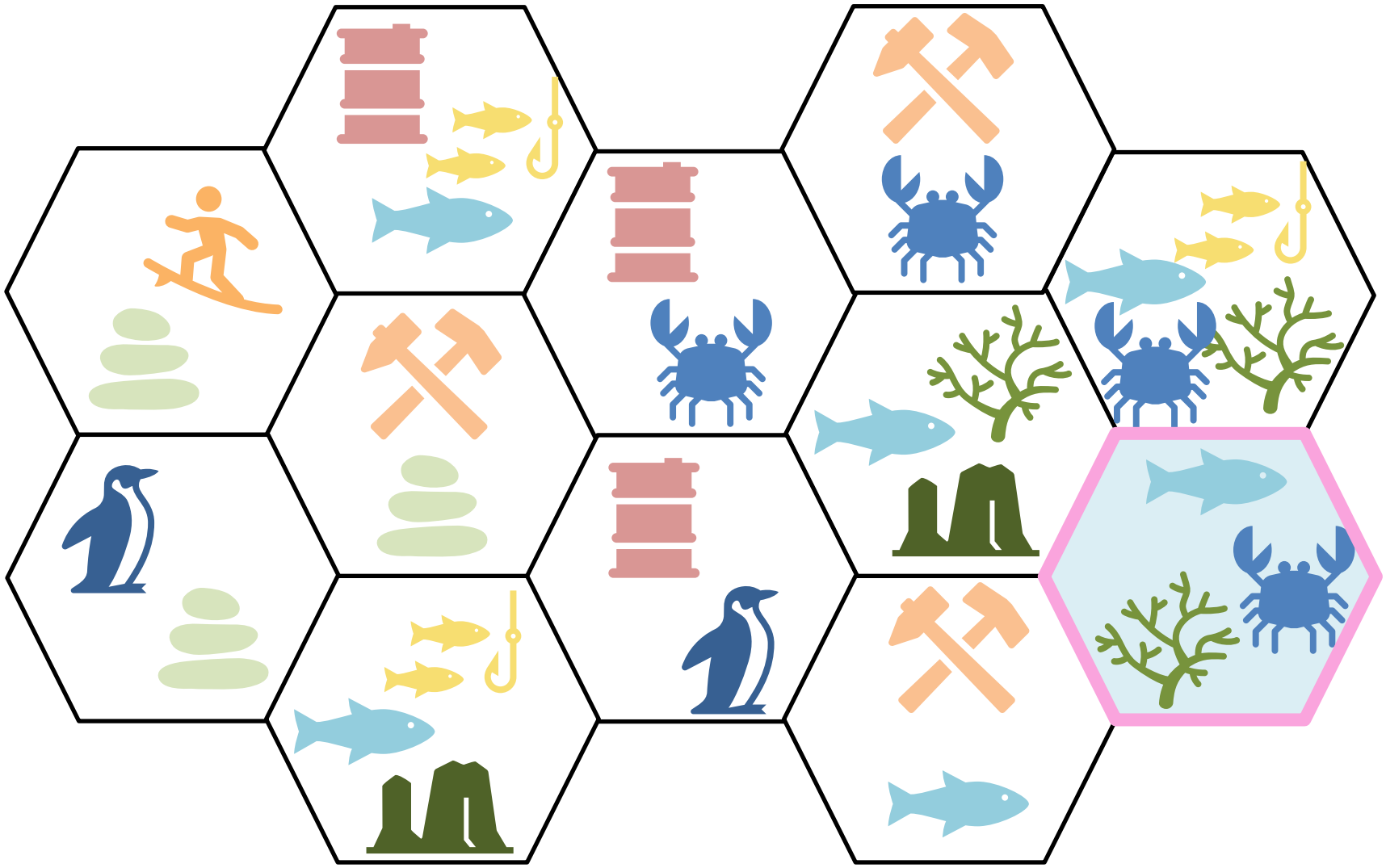
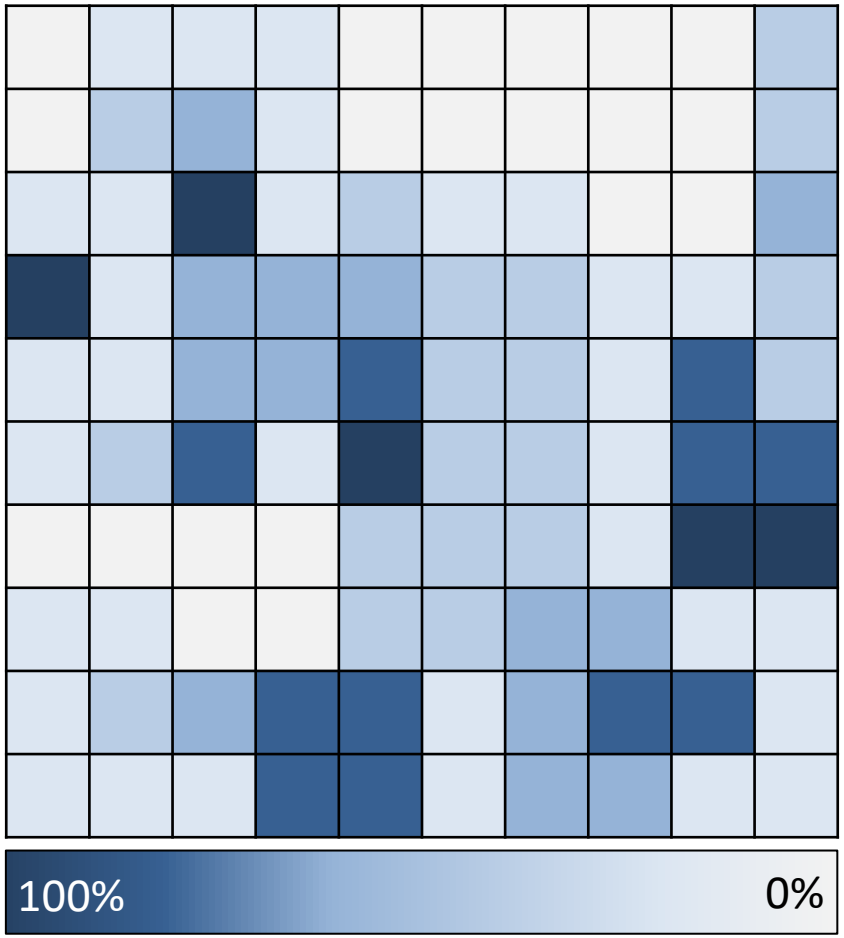
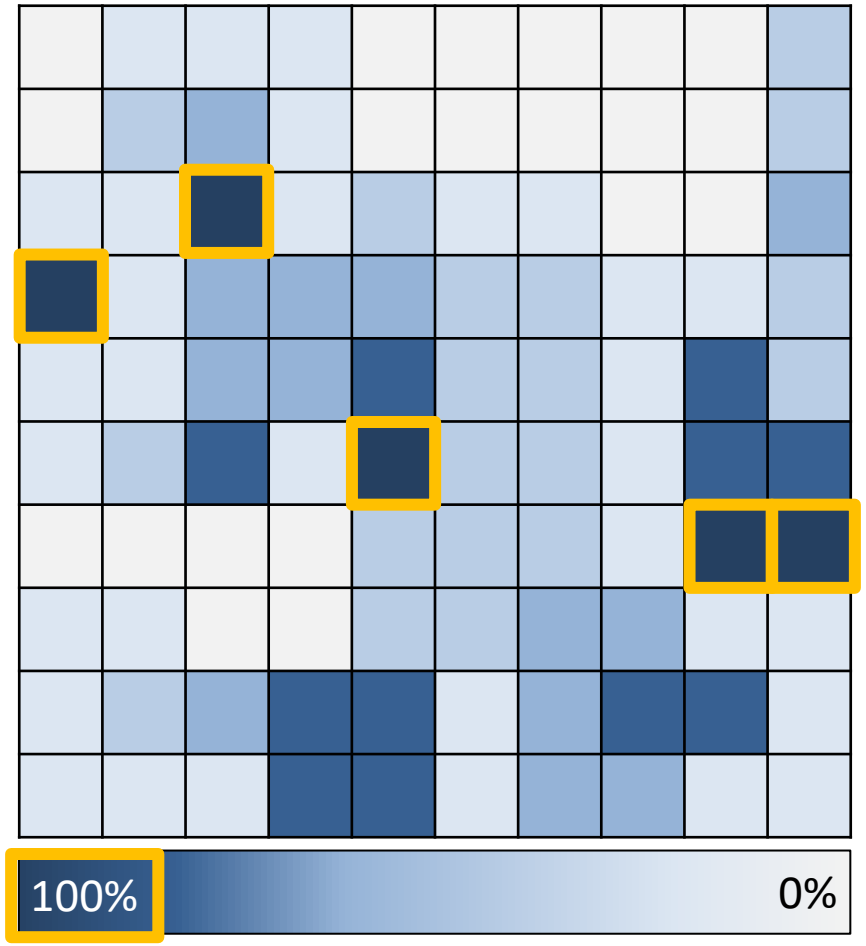


Selection frequency



Marxan outputs

Selection frequency



Irreplaceable

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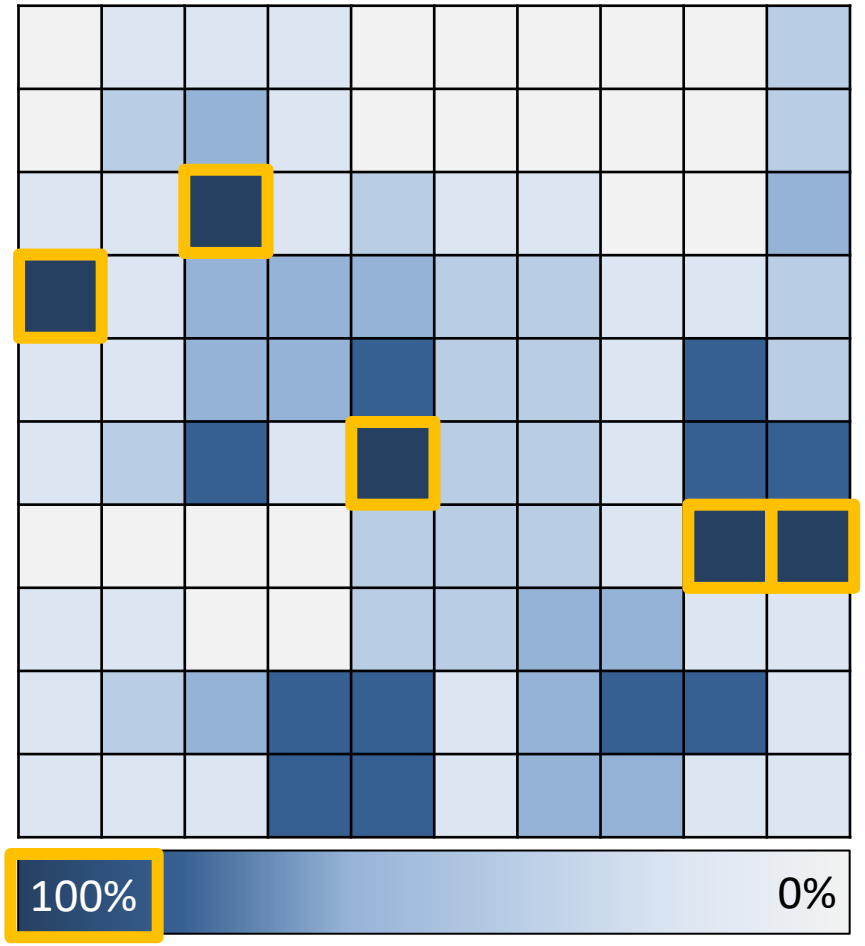
TOTAL	4	3	1	3	3	3	2

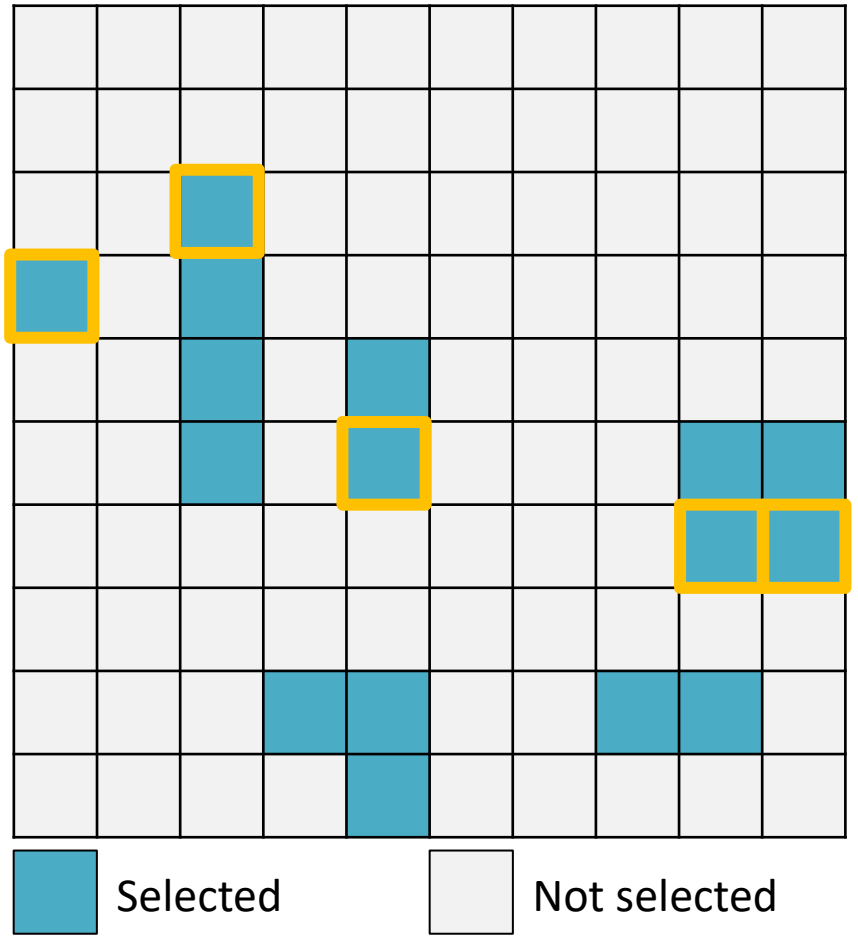
Marxan Outputs

Selection frequency



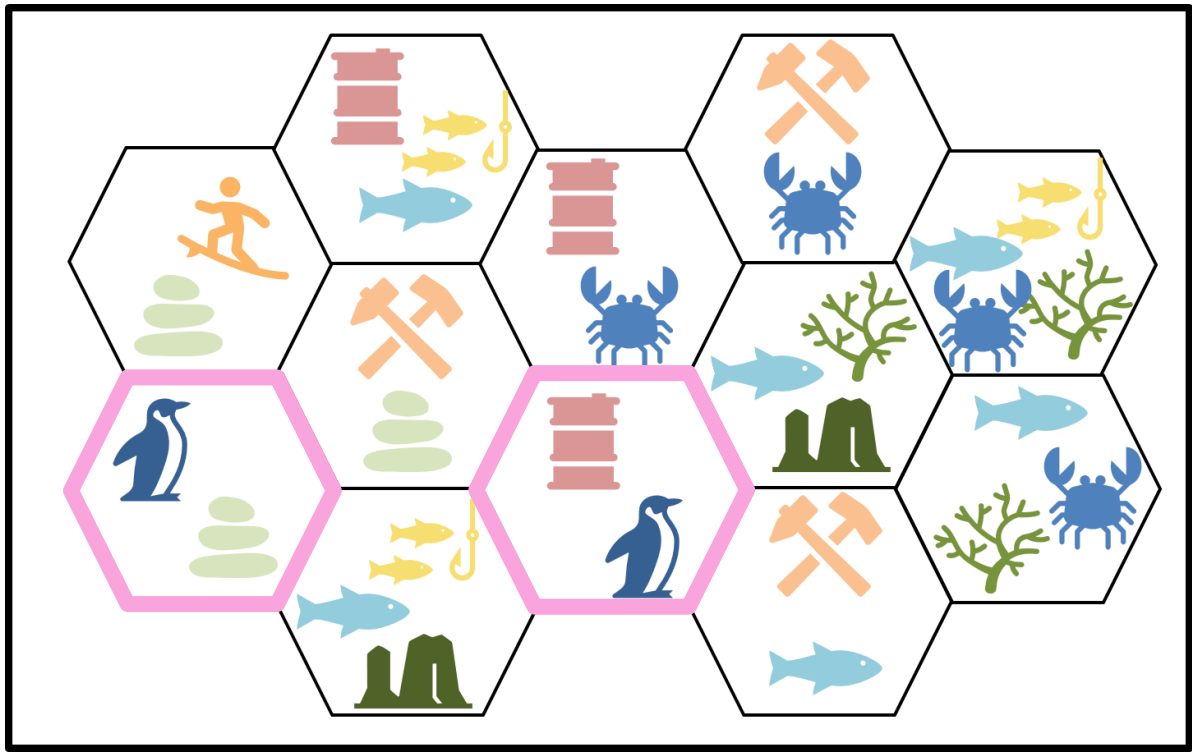
Irreplaceable

Best/optimal design



Opportunity to influence priorities lies in the input data

- Method is robust
- Obtaining the most optimal results requires best-available data
  - Biodiversity features
  - Other activities (costs)
- Ecosystem types as surrogates
- Needs to be supplemented with data for species that aren't well represented by ecosystem types or that need particularly careful management and/or protection
- Fine-scale cost information



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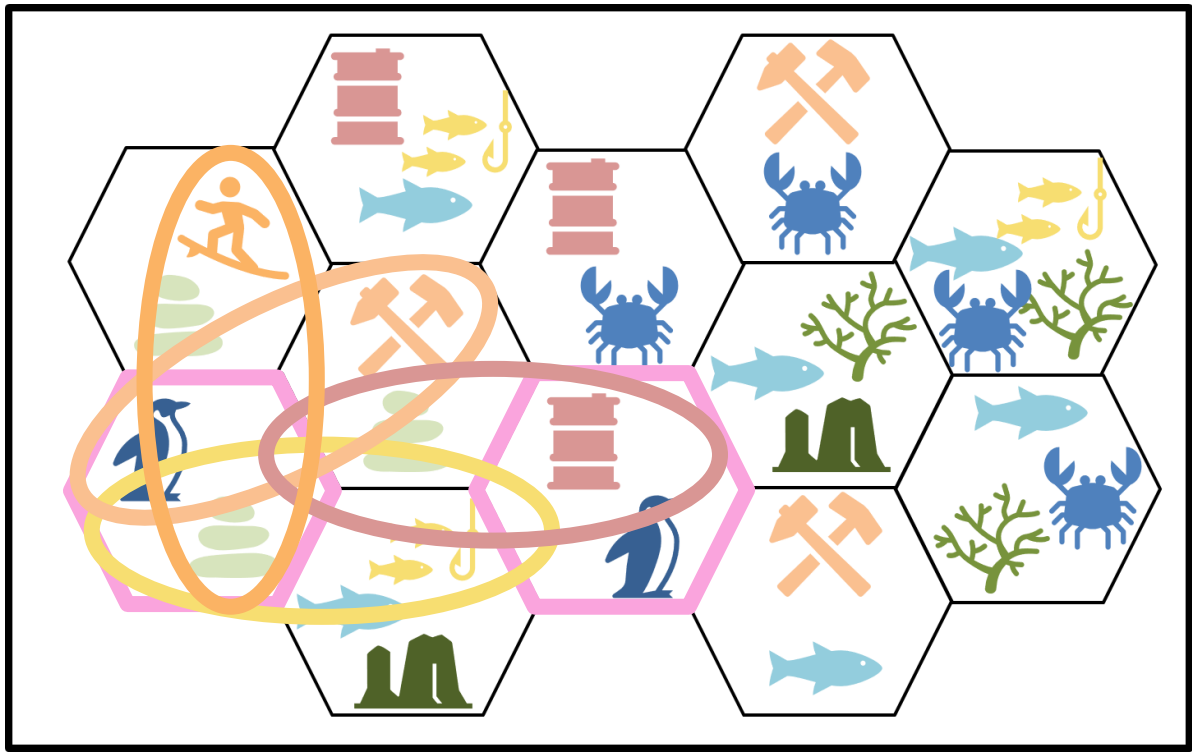

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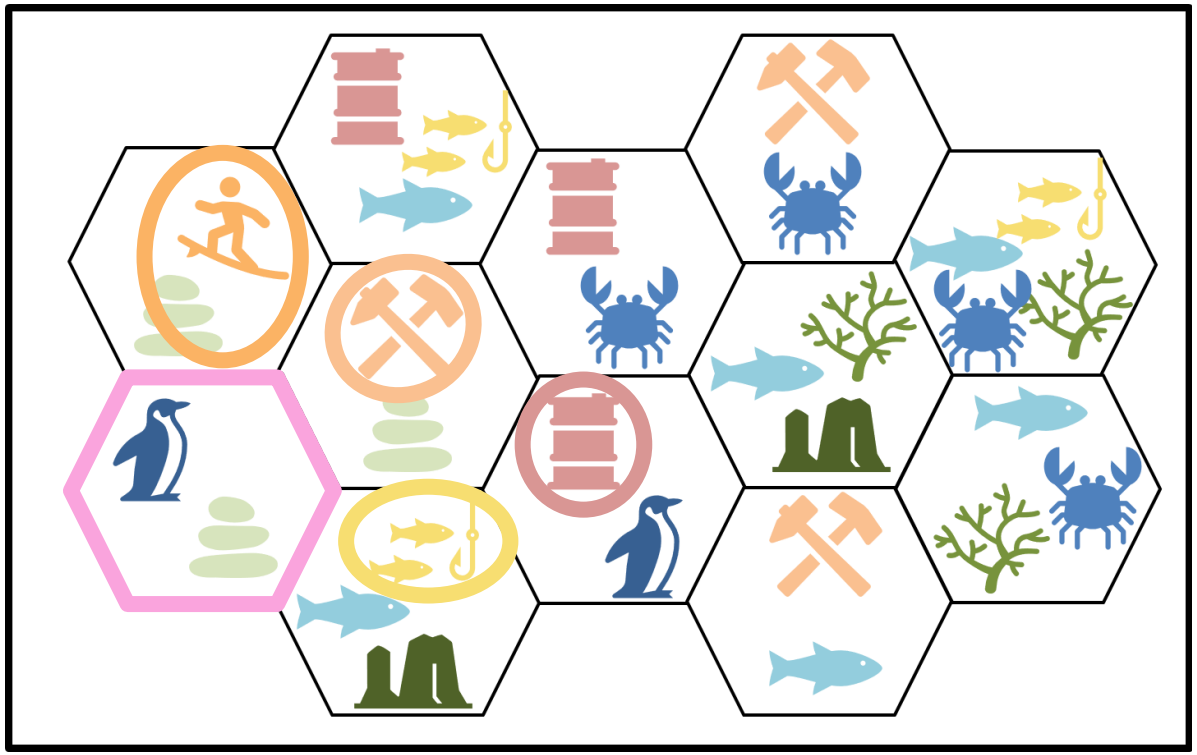

Streamline negotiations, and achieve more wins for more sectors

Thank you

http://marxansolutions.org

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