Towards ecosystem-based management of Northeast Pacific herring fisheries

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Pacific herring

- energy conduit: zooplankton to larger predators
- food and income for many coastal communities
- stock declines, fishery closures, calls for EBFM
- **how to reconcile human, ecosystem needs?**

Food web modeling

- framework: Ecopath with Ecosim (EwE)
- basic principle: mass balance
- 80 functional groups
- study area: N British Columbia, SE Alaska

MSE in EwE

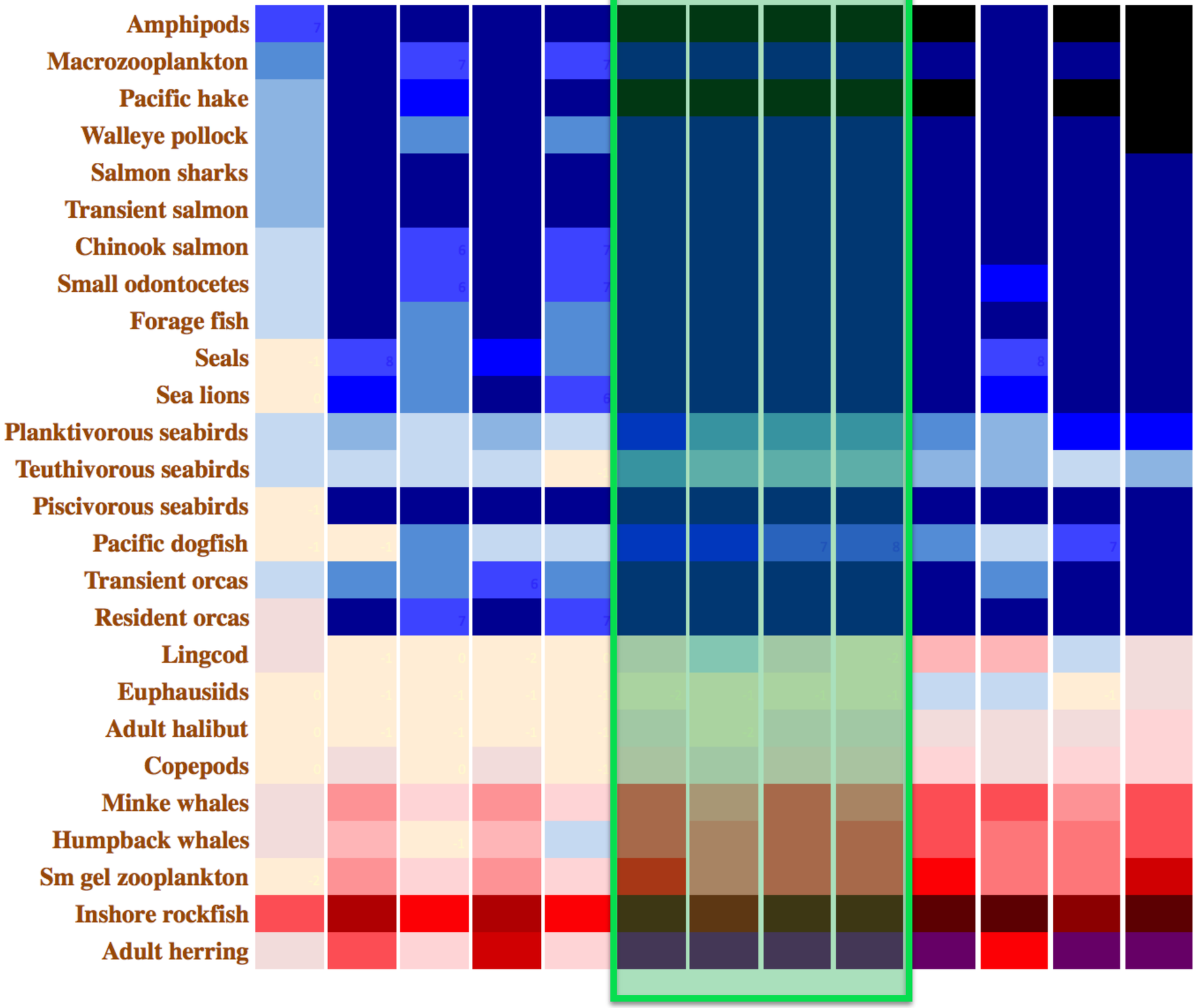
- simulates long-term strategy implementation
- compares impacts of management strategies
- places herring & fisheries in food web context
- can use ecological & socioeconomic criteria

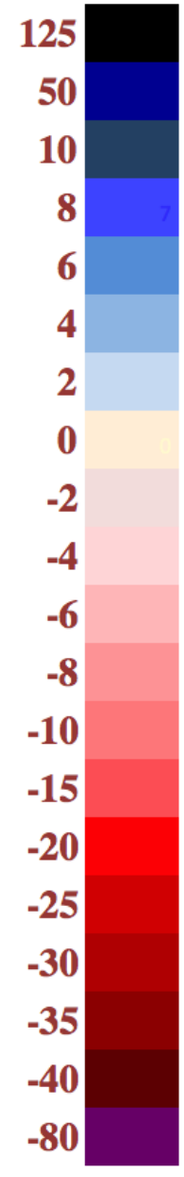
Cefas EwE MSE tool

- ecosystem parameter uncertainty
- stochastic stock assesment error
- stochastic realized fishing mortality

CURRENT

SCENARIO	SOK	LF1	LF2	LF3	LF4	AK1	AK2	BC1	BC2	BC3	BC4	MSY	ATF
Herring B_{lim}	0	0.50	0.75	0.50	0.75	0.25	0.37	0.25	0.30	0.25	0.25	0.25	0
Herring B_{Fmax}	0	0.50	0.75	0.95	0.95	0.50	0.67	0.25	0.30	0.25	0.25	0.25	0
Herring F_{target}	0.01	$.5F_{MSY}$	$.5F_{MSY}$	$.5F_{MSY}$	$.5F_{MSY}$	0.20	0.20	0.20	0.20	0.10	0.05	F_{MSY}	0.20





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EBFM

SCENARIO	SOK	LF1	LF2	LF3	LF4	AK1	AK2	BC1	BC2	BC3	BC4	MSY	ATF
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Amphipods
Macrozooplankton
Pacific hake
Walleye pollock
Salmon sharks
Transient salmon
Chinook salmon
Small odontocetes
Forage fish
Seals
Sea lions
Planktivorous seabirds
Teuthivorous seabirds
Piscivorous seabirds
Pacific dogfish
Transient orcas
Resident orcas
Lingcod
Euphausiids
Adult halibut
Copepods
Minke whales
Humpback whales
Sm gel zooplankton
Inshore rockfish
Adult herring

%

125
50
10
8
6
4
2
0
-2
-4
-6
-8
-10
-15
-20
-25
-30
-35
-40
-80

Surma (2019)

SCENARIO	SOK	LF1	LF2	LF3	LF4	AK1	AK2	BC1	BC2	BC3	BC4	MSY	ATF
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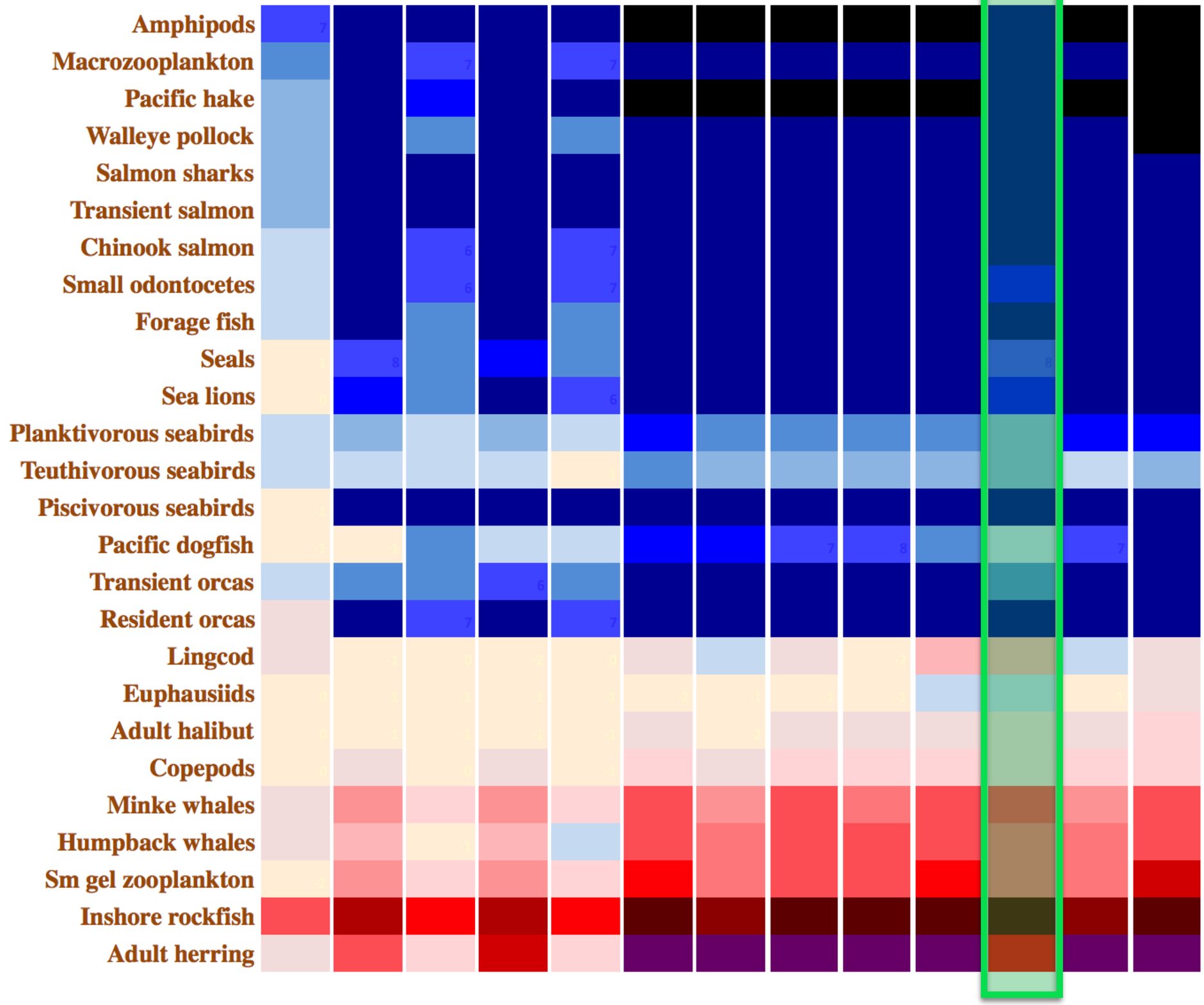
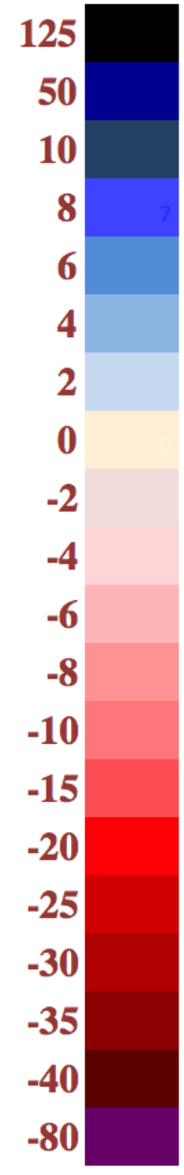
LOW F





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Median catch

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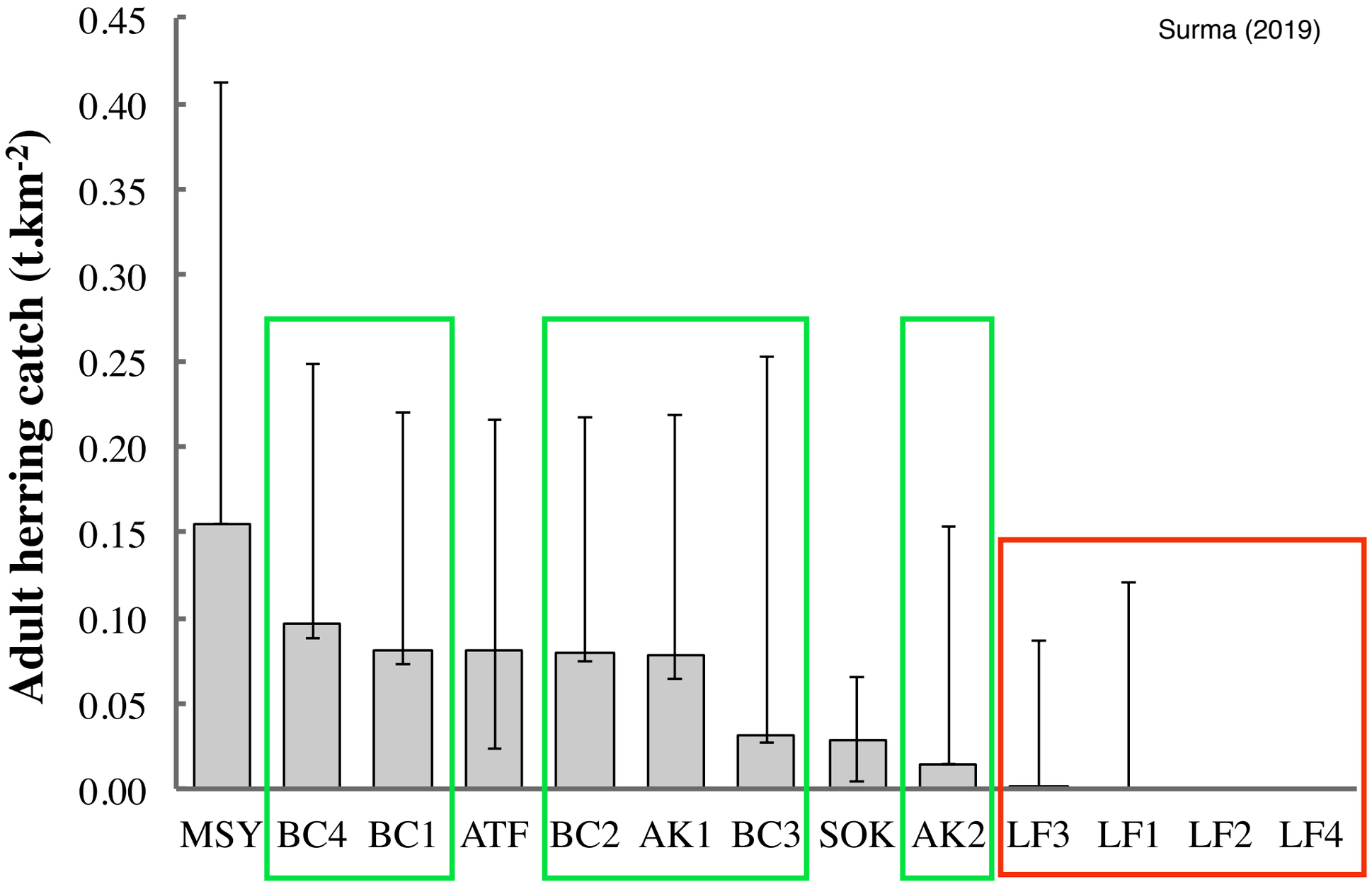

Closure probability

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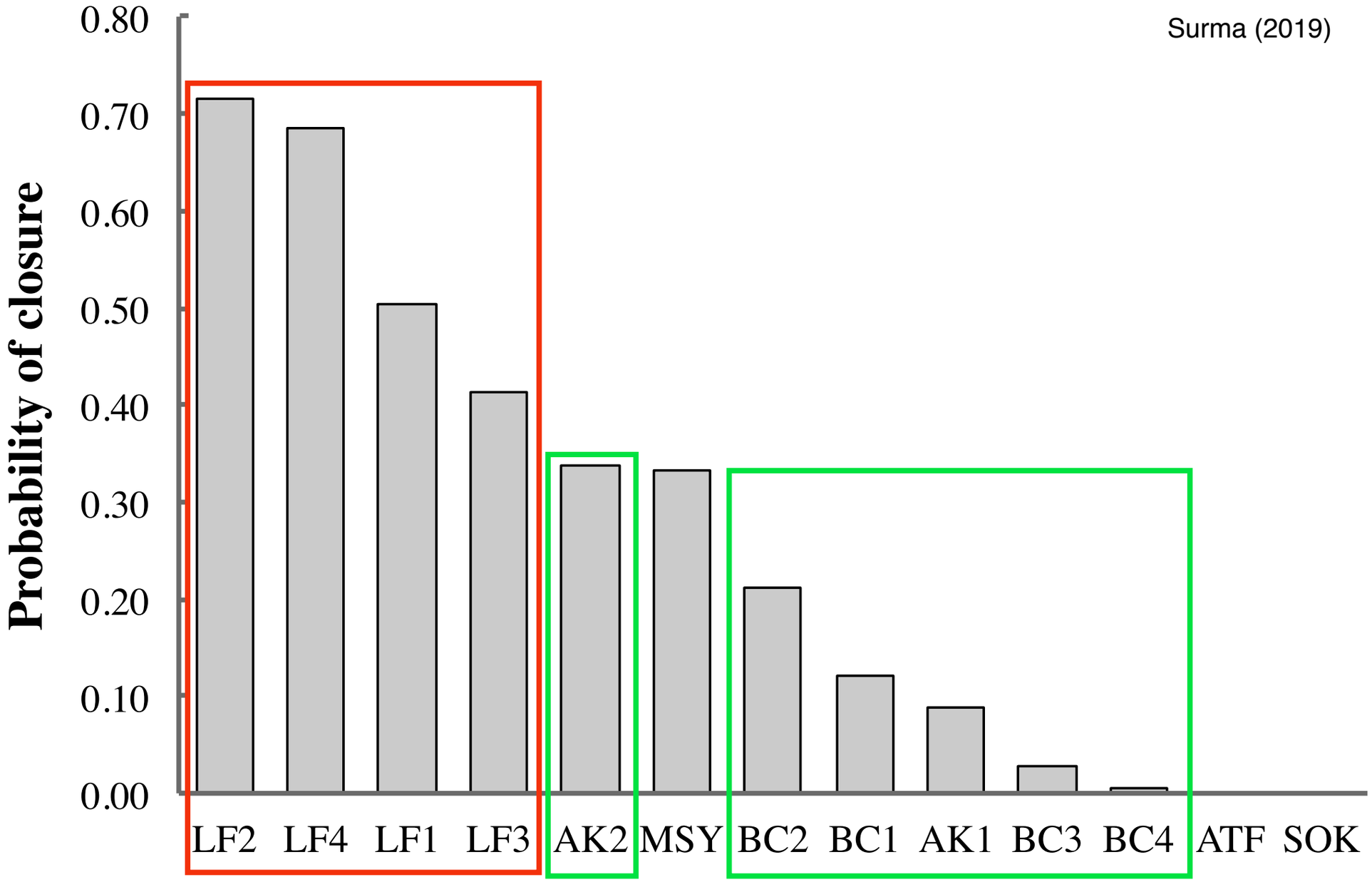

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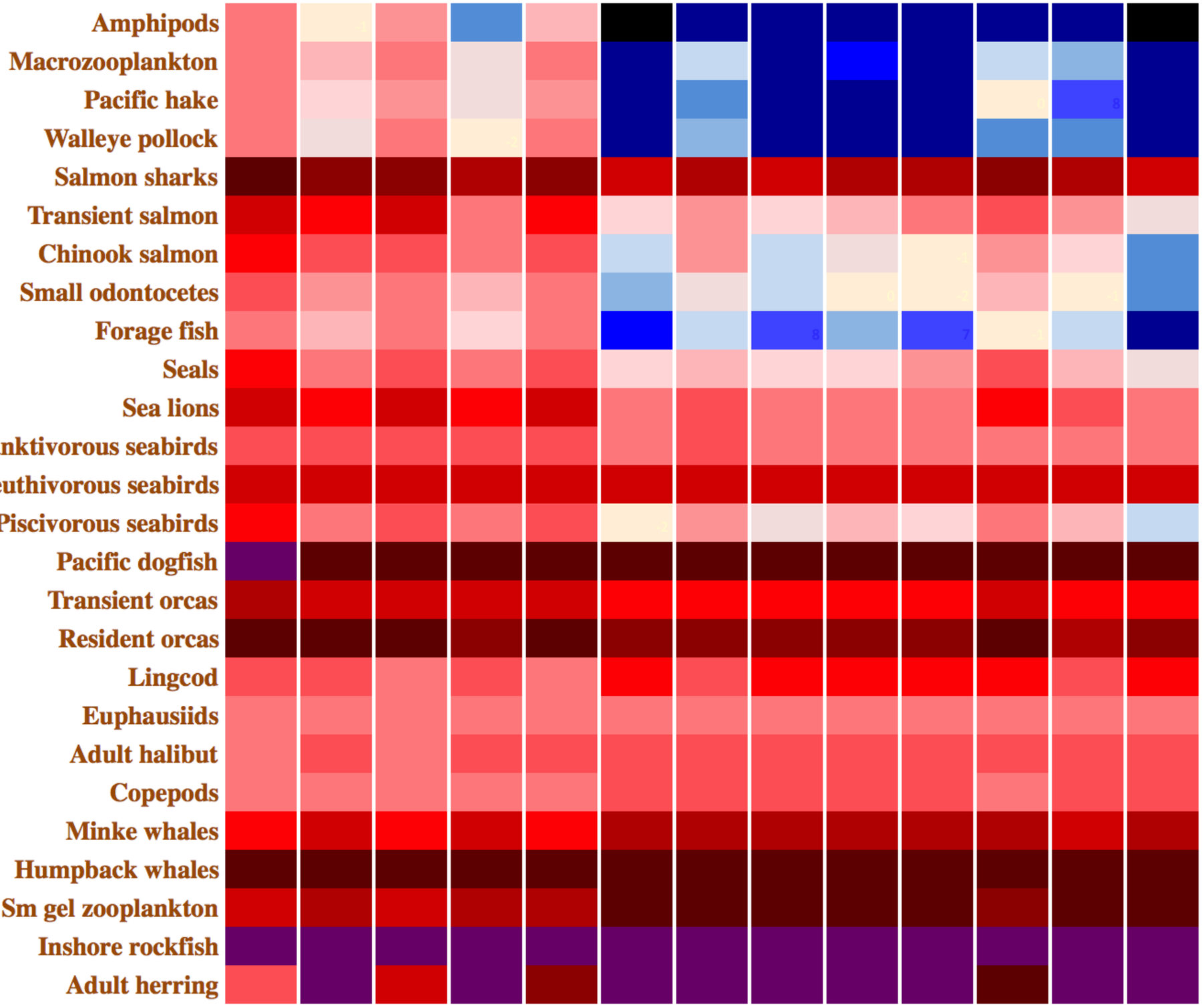

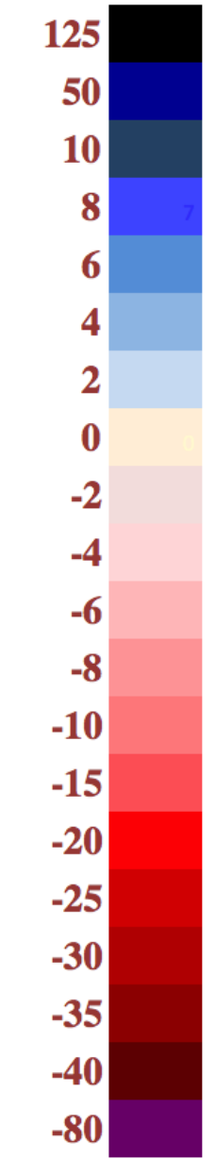

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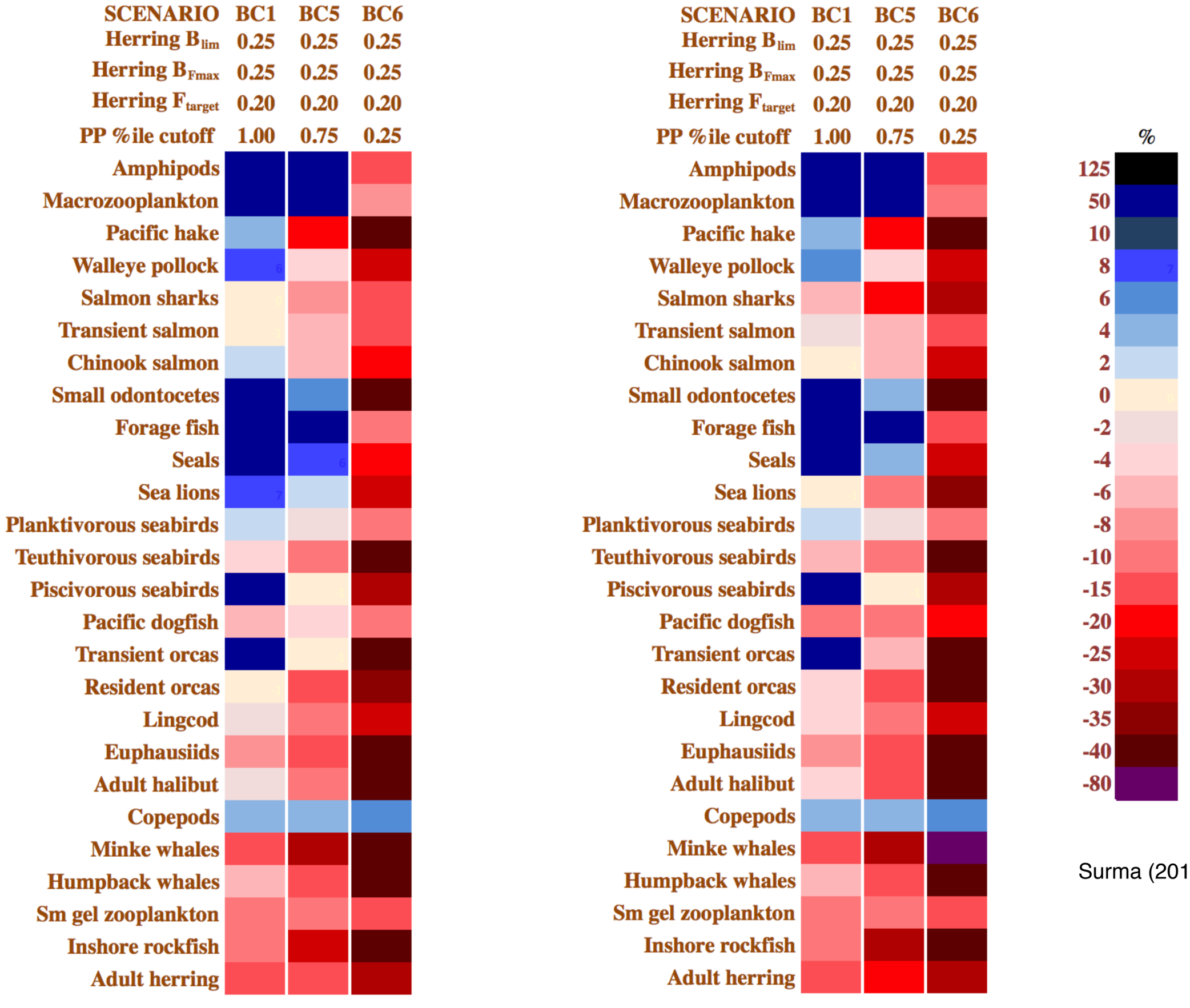
Bottom-up scenarios

- performance under reduced primary productivity
- BC5: no “good” production years (below 75%ile)
- BC6: only “bad” production years (below 25%ile)
- results relative to base productivity, herring $F = 0$

a

b



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Conclusions

- ecosystem impacts of current strategies moderate
- tradeoff between ecological & socioeconomic goals
- strategy spectrum (current BC & AK, low F, EBFM)
- low predator biomass possible under all strategies

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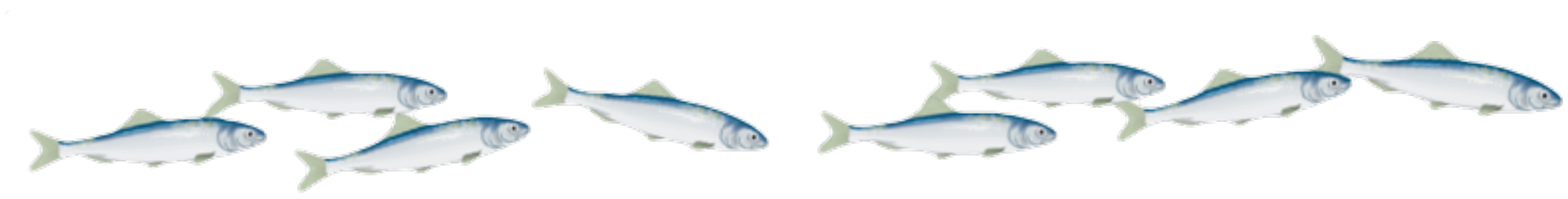
- PERF lab members

NSERC CRSNG




Thank you!