

Small Pelagic Fish International Symposium 2026

A new method for identifying key prey using predator-prey preferences and ecosystem-specific thresholds

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Presented by Andre Boustany²

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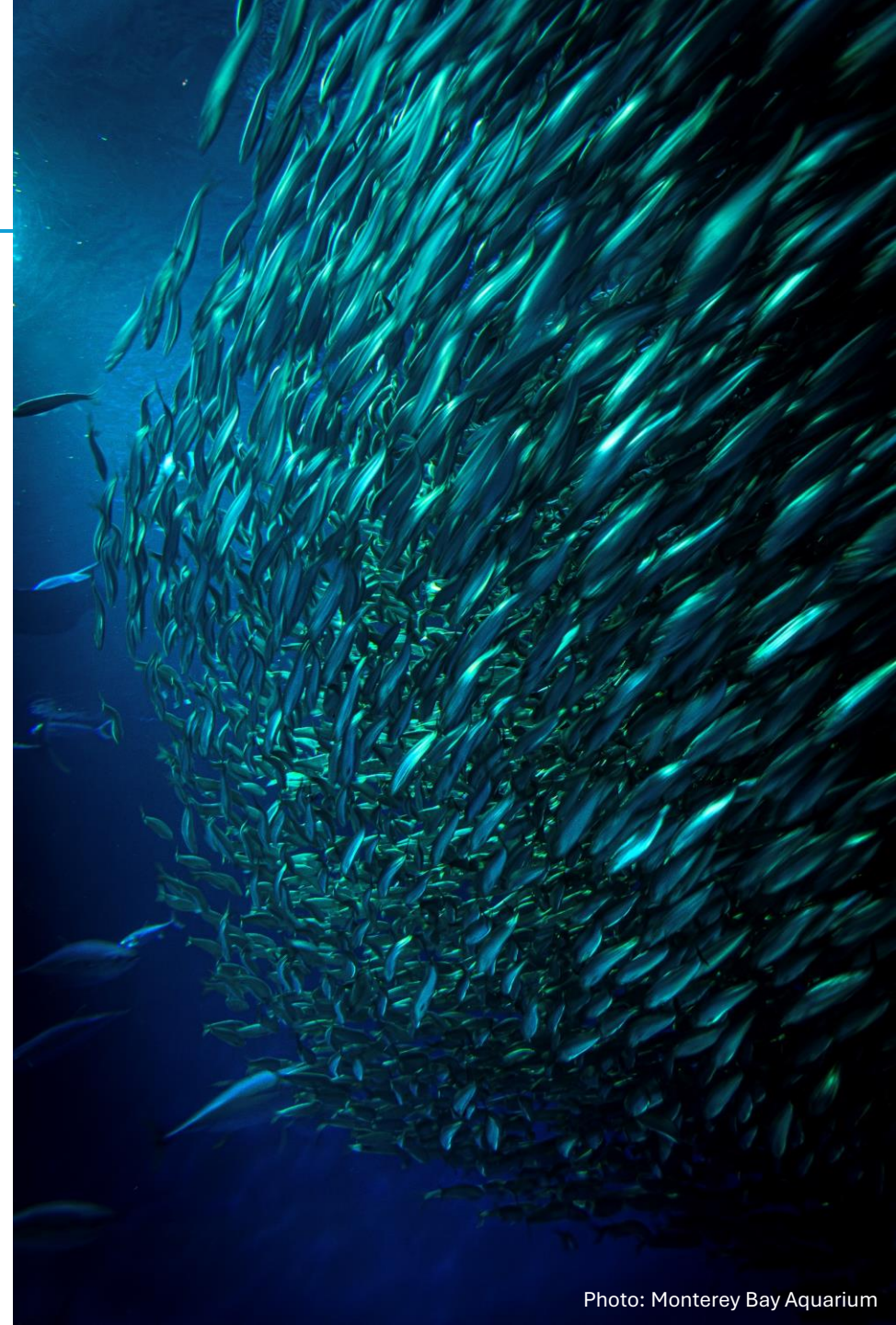
Background

“Key” prey species:


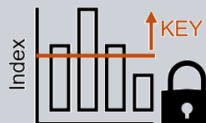
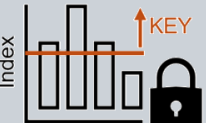
- Most important to **food web structure** & **ecosystem functioning**
- Often small pelagics (forage species and similar)

Why identify key prey species:

1. Inform **targeted ecosystem-based management**
 - reduce risk of stock collapse & cascading impacts
2. Enable robust assessments of **fisheries’ sustainability**




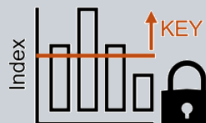
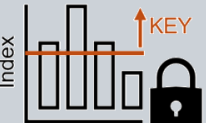
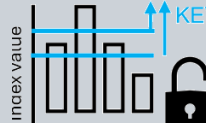
Methods for identifying key prey

Importance prey	Connectance ¹ index	SURF* (mass) ² index	SURF (energy) ³ index
# Trophic links	✓	✓	✓
Predator reliance	✗	✓	✓
Energy density	✗	✗	✓
Pred. selectivity Preference ← → Avoidance	✗	✗	✗
Threshold			

* Supportive Role to Fishery ecosystems (SURF) index

1. Smith, A. D., Brown, C. J., Bulman, C. M., Fulton, E. A., Johnson, P., Kaplan, I. C., ... & Tam, J. (2011). Impacts of fishing low-trophic level species on marine ecosystems. *Science*, 333(6046), 1147-1150.
2. Plagányi, É. E., & Essington, T. E. (2014). When the SURFs up, forage fish are key. *Fisheries Research*, 159, 68-74.
3. Surma, S., Pakhomov, E. A., & Pitcher, T. J. (2022). Pacific herring (*Clupea pallasii*) as a key forage fish in the southeastern Gulf of Alaska. *Deep Sea Research Part II: Topical Studies in Oceanography*, 196, 105001.

Methods for identifying key prey

Importance prey	Connectance ¹ index	SURF* (mass) ² index	SURF (energy) ³ index	SURF ID index
# Trophic links	✓	✓	✓	✓
Predator reliance	✗	✓	✓	✓
Energy density	✗	✗	✓	✓
Pred. selectivity Preference ← → Avoidance	✗	✗	✗	✓
Threshold				

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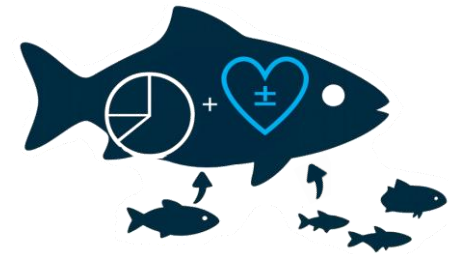
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SURF Integrated Diagnostic (SURF ID) index



Uses:

- Unbalanced **biomass & diet** estimates Ecopath ecosystem models
- **Energy density**



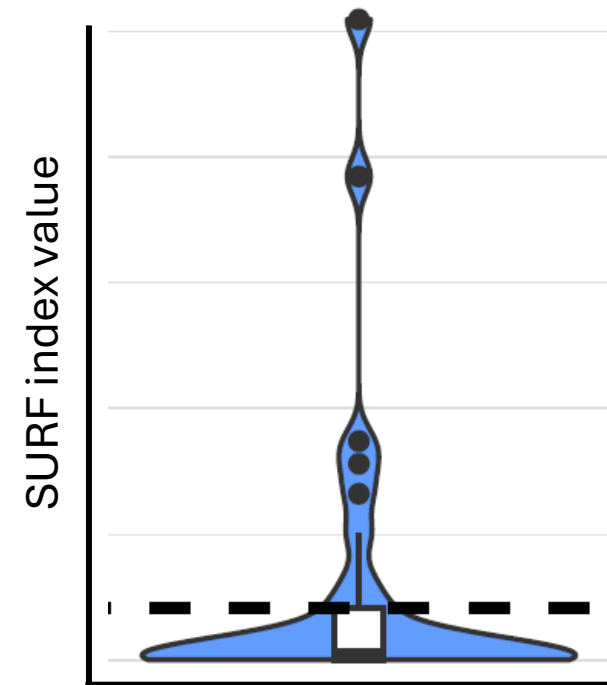
Calculates:

1. **Predator selectivity** for prey (energy-based):
Prey contribution predator diet ÷ Prey availability environment
2. **Predator diet composition** (contribution energy + predator selectivity)
3. **Index** (like SURF mass & energy):
 - Sum of squared contributions across predators
 - Scaled by total trophic links in food web

Ecosystem-specific threshold

Identifying “key” species

- Distribution **SURF index** values: many low values, few high values (**right-skewed**)
- Data-driven threshold: **75th percentile** (upper quartile)
- Interpretation:
 - Below → ‘typical’
 - Above → relatively **high importance**



Preliminary results – 75th percentile threshold

Results available soon in Roos et al. in review

Preliminary results – key prey

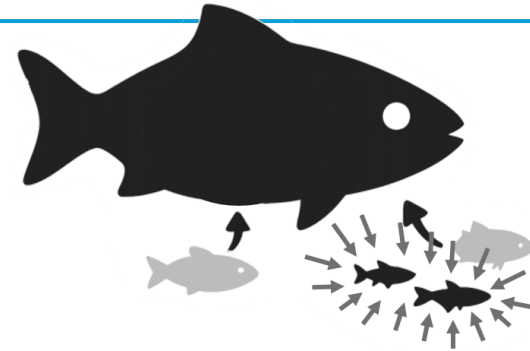
SURF mass:	predator diet composition
SURF energy:	predator diet composition + prey energy density
SURF ID:	predator diet composition + prey energy density + predatory-prey preference

Results available soon in Roos et al. in review

Implications

SURF ID index + 75th percentile threshold:

1. Identifies **prey** that **drive food web**, not just those that are abundant
2. Reveals **“hidden” key species** that other SURF indices may overlook
3. Helps **target management** where ecosystem risk highest (cascading effects)
4. Provides more **ecosystem-relevant** basis for precautionary decision-making
5. Supports fisheries **sustainability assessments** by translating food-web dynamics



Method limitations

1. Output quality directly depends on **input quality**
2. **More input parameters** → higher sensitivity to input quality
3. **Limited availability energy density** values species/ecosystems
4. 75th percentile threshold less reliable for **low-resolution ecosystem models**

Results should be interpreted in context of:

1. Quality of input parameters
2. SURF mass and energy index outputs
3. Ecological information and observations ecosystem

Next steps



1. **Expand application** to more 'high-quality' ecosystem models
2. Develop **rating system** based on input quality
3. Conduct **sensitivity analysis** on input and threshold uncertainty
4. ...

Acknowledgements

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Questions?

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