Anticyclonic eddies aggregate pelagic predators in a subtropical gyre

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Mesoscale Eddies

- "Weather" of the ocean
- Coherent, rotating features (10s-100s km)
- Targeted by diverse pelagic predators



Loggerhead Turtle

Chambault et al. 2019 Prog Oceanogr



King Penguin

Cotté et al. 2007 Proc Royal Soc B



Melon-Headed Whale

Woodworth et al. 2011 Mar Mamm Sci

Hawaiian Longline Fishery

- Logbook data
 - >220,000 longline sets (~500,000,000 hooks)
 - Co-located to >4,700 unique eddies
 - 14 pelagic predator species (~6,500,000 individuals)
 - Ecologically diverse predator community





Hurdle Models

Odds Ratio

• <u>Odds of capture in Anticyclones</u> Odds of capture in Cyclones



Rate Ratio

• <u>Magnitude of catch in Anticyclones</u> Magnitude of catch in Cyclones



<u>Catch Metrics</u> Higher in Anticyclones (>1) Higher in Cyclones (<1) No significant difference (=1) No eddy effect in model (N/A)

Hurdle Models

Odds Ratio

• <u>Odds of capture in Anticyclones</u> Odds of capture in Cyclones



- A. <u>Catch odds greater in inner and outer</u> <u>core of Anticyclones</u>
- B. <u>Catch odds not significantly different</u> in inner periphery among polarities
- C. <u>Catch odds greater in outer periphery</u> of *Cyclones*

<u>Catch Metrics</u> Higher in Anticyclones (>1) Higher in Cyclones (<1) No significant difference (=1) No eddy effect in model (N/A)



Anticyclones 11-12 species

Cyclones 1-3 species

Mean Catch Odds

Inner Core: +20% Outer Core: +13% Higher in *Anticyclones*

Mean Catch Rate

Inner Core: +15% Outer Core: +9% Higher in *Anticyclones*

Deep Scattering Layer Biomass

- Greater mesopelagic biomass in anticyclones than cyclones or outside eddies
- Presents increased foraging opportunity at depth during day and near-surface at night



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Foraging Benefits

Anticyclones

More food for deep, daytime foragers

- e.g., bigeye tuna, albacore, swordfish, pomfret, escolar
- Consume mesopelagic resources at deepest point of DVM
- More food for shallow, nighttime foragers
 - e.g., wahoo, shortbill spearfish, skipjack tuna
 - Consume mesopelagic resources at shallowest point of DVM



Bigeye tuna – Howell et al. 2010 Prog Oceanogr



Shortbill spearfish – Arostegui et al. 2019 Fish Res





Conclusions

- Pelagic predators aggregate in anticyclones

 Tunas, billfishes, assorted epi- and mesopelagics
- Anticyclones offer increased foraging opportunity to both shallow- and deepforaging species due to diel vertical migration
- Increased predator abundance increases catch in anticyclones

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