Characteristics Of Meso- and Submeso-scale Features Used by Highly Migratory Marine Predators

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Zamon et al.
Paredes et al.
Biological enhancement at cyclonic eddies tracked with GOES thermal imagery in Hawaiian waters

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Comparative foraging ecology of planktivorous auklets in relation to ocean physics and prey availability

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Turtles on the edge: movement of loggerhead turtles (*Caretta caretta*) along oceanic fronts, spanning longline fishing grounds in the central North Pacific, 1997–1998

JEFFREY J. POLOVINA,¹,※ DONALD R. KOBAYASHI,¹ DENISE M. PARKER,² MICHAEL P. SEKI¹ AND GEORGE H. BALAZS¹
Dynamic Eddies of the SE Bering Sea and Alaska Peninsula

Gaube et al.
Northern Fur Seal

- Diving species
- Sensitive to horizontal changes in prey distribution

Nordstrom et al. 2013

Sterling et al.
Black-legged Kitiwake Foraging in the Bering Sea

- Surface-feeding species
- Sensitive to vertical changes in prey distribution
Kittiwake Foraging Trips
Foraging in Association With Eddies

Paredes et al. 2014 PLoS ONE
Eddy data from Chelton, Schlax, and Gaube, OSU, CEOAS (Chelton et al. 2011 Prog. Ocn, 2011 Science)
Foraging in Association With Eddies

Paredes et al. 2014 PLoS ONE
Eddy data from Chelton, Schlax, and Gaube, OSU, CEOAS (Chelton et al. 2011 Prog. Ocn, 2011 Science)
Eddy Kinetic Energy Varies Among Years

- 2008 St. Paul
- 2009 St. Paul
- 2010 St. Paul

EKE = > use of basin

Paredes et al. 2014 PLoS ONE – Eddy data from Carol Ladd, NOAA, PMEL
Core areas for individually-tracked Red-Legged Kittiwakes
(Orben et al 2015 J. Bio. Geogr., unpubl data)

(Belkin and Cornillon 2005 Pac. Ocn.)
Tidally & Topographically Driven Meso-Scale Features Used by Short-tailed Albatross
ROMS Simulation 2km Resolution
Temperature & surface currents - tides included

http://ingria.coas.oregonstate.edu/news/Amukta_pass.html

Scott Durski, Coastal Ocean Modeling, Oregon State University
Juvenile Walleye pollock

Myctophid or Lanternfish

39 Days!!

Flood

Ebb

39 Days!!
1 Individual Short-tailed Albatross tracked for 5 years
Brownian Bridge distribution of Short-tailed Albatrosses – Gulf of Alaska

2009
Brownian Bridge distribution of Short-tailed Albatrosses – Gulf of Alaska

2010
Brownian Bridge distribution of Short-tailed Albatrosses – Gulf of Alaska

2011
Brownian Bridge distribution of Short-tailed Albatrosses – Gulf of Alaska

2012
Brownian Bridge distribution of Short-tailed Albatrosses – Gulf of Alaska

2013
Brownian Bridge distribution of Short-tailed Albatrosses – Gulf of Alaska

2009-2013
(Belkin and Cornillon 2003 Phys. Ocn.)
Vessel-based Observations
Heceta Bank – Marine Important Bird Area

Ainley et al. 2005
Deep-Sea Research II

Barth et al. 2005 Deep-Sea Research II
Seabird Abundance and Distribution at Prominent Meso-scale Features Offshore of Oregon

Columbia River Plume

Heceta Bank

Birds/km²
- 0 – 5
- 5 – 10
- 10 – 25
- 25 – 50
- 50 – 75
- 75 – 100
- 100 – 250
- 250 – 500
- 500 – 1,000
- 1,000 – 10,000+

2013 2014 2015 2016
Columbia River Plume Front
Inter-annual Variability in Abundance at Prominent Features

![Bar Chart showing mean bird abundance from 2013 to 2016 for Columbia River Plume and Heceta Bank.](chart.png)
Conclusions

- Predators extensively use both persistent and ephemeral meso- and sub-meso scale features throughout the Pacific.

- Species we studied primarily targeted features in neritic zones along continental shelf margins, but....

- Considerable annual variability in use of prominent features. Topographically and tidally influenced = least variable.
Looking Forward

- Focal studies of specific features to quantify time-varying patterns of use by predators during formation through deterioration
- Energy transfer with/without features
- Approaches include:
  1) Use of extensive animal tracking datasets
  2) *In situ* and remotely sensed observations
  3) ROMS models

Process Studies
Acknowledgements