RED FLAGS OR RED HERRINGS?

Using ecosystem indicators to detect anomalous conditions in the Gulf of Alaska during 2011

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Introduction

NOAA compiles and synthesizes information about the Alaska marine ecosystem annually into an ecosystem considerations report primarily for the North Pacific Fisheries Management Council, but also the scientific community and the public. The goal of this report is to provide stronger links between ecosystem research and fishery management and to spur new understanding of the connections between ecosystem components by bringing together many diverse research efforts into one document. There are more than one hundred time series of physical and biological indicators that are tracked and updated, many annually. The status and trends of these indicators are monitored for early signals of ecosystem change that may have management implications. Here we present the status of ecosystem indicators in 2011 that cumulatively suggest anomalous conditions occurred that year.

Widespread Reproductive Failure

Mushy Flesh Prevalent

Seabirds

Halibut

- Both attributed to poor foraging conditions

Forage Fish

- **Below average forage fish CPUE** in small mesh surveys around Kodiak, Shelikof Strait and Pavlof Bay (Urban et al., 2012.) (Figs. 1 and 2)
- Consistent with GOAIERP survey results (Moss et al. 2012)
- Winter Shelikof Strait age-1 (2011 year class) pollock surveys estimate low
- Percent juvenile pink salmon CPUE in SE Alaska 2nd lowest in 15 years. (Orsi et al., 2012)

Seabird Reproduction Assessment

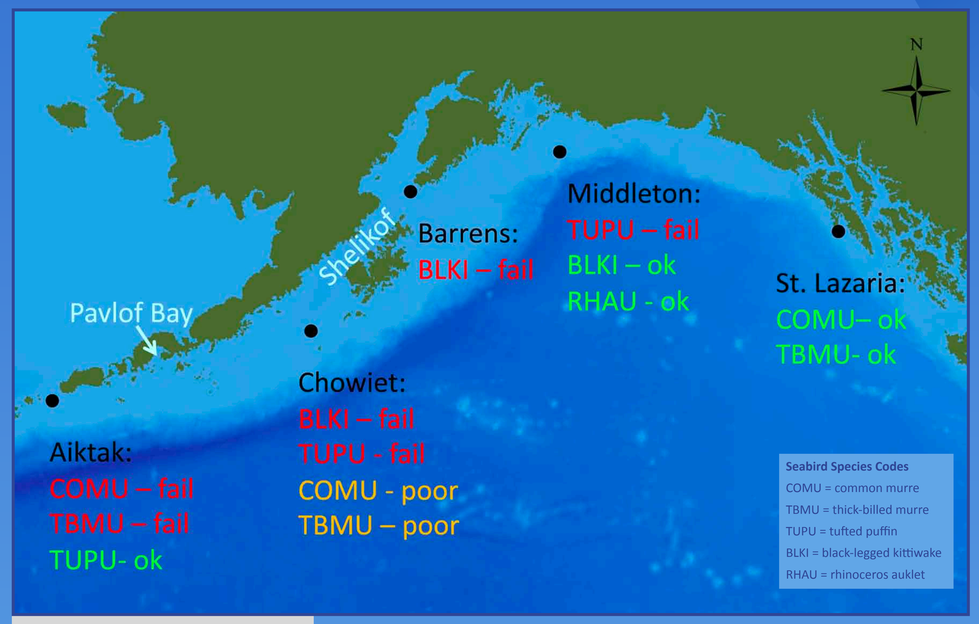

Figure 1. Locations of seabird colonies (identified by island name) and reproductive success of seabirds observed during 2011.

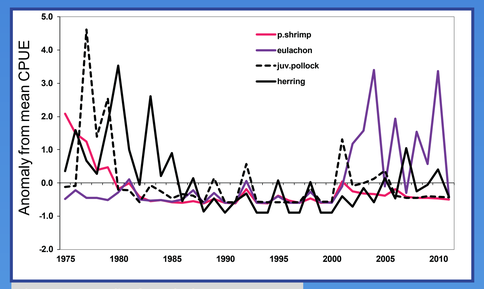

Figure 2. Anomalies from the long-term mean of forage species CPUE (kg km^{-1}) in small mesh surveys in the Gulf of Alaska, 1972-2011.

Zooplankton

- **Very low zooplankton biomass** in the Gulf of Alaska shelf region as sampled with Continuous Plankton Recorders (CPR) (Fig. 3) (Batten 2012).

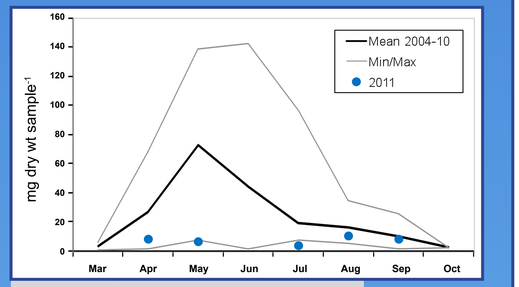

Figure 3. Mean (black lines), minimum and maximum (grey lines) monthly mesozooplankton biomass for the NE Pacific CPR sampling of the region shown above, together with monthly data for 2011 overlaid as points.

Climate

- Decline in poleward branch of the Alaska Current (Bond 2012)
- PAPA Trajectory Index unusually east and southernmost since 1993 (Stockhausen and Ingraham, 2012) (Fig. 4).
- Back to back La Niñas (Bond 2012).

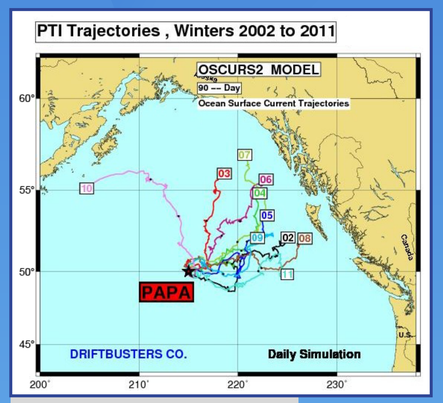

Figure 4. Simulated surface drifter trajectories for winters 2002-2011. Endpoints of 90 day trajectory for winter 2010/2011 is labeled 11.

Conclusions

- Synthesis of indicators' status across multiple trophic levels can reveal broad-scale changes in the environment that may have important biological and management implications.
- Upper trophic organisms (e.g., seabirds and halibut) in particular serve as integrative (reproductive success, body condition) indicators that can provide near-real time cues of environmental state.
- Changes in bottom-up forcing factors may have negatively influenced productivity at lower trophic levels that in turn negatively influenced upper trophic organisms during 2011.
- Thus, 2011 may be a poor year class for forage fish and forage-fish eating predators such as groundfish.
- Future work should include an evaluation of new or different indicators to follow to best monitor ecosystem state in the Gulf of Alaska.

Acknowledgements

All citations and figures 2, 3, 4 and 5 are reprinted from Zador, S. (ed.), 2012. Ecosystem Considerations 2012, Stock Assessment and Fishery Evaluation Report, North Pacific Fisheries Management Council, 605 W 4th Ave, Suite 306, Anchorage, AK 99501. We thank the many people who contribute their research to this report. Scott Hatch kindly provided the seabird data from Middleton Island. Alaska Maritime National Wildlife Refuge staff collected and reported all other seabird data. The Ecosystem Considerations Report can be downloaded from http://access.afsc.noaa.gov/reem/ecoweb/index.cfm. The recommendations and general content presented in this poster do not necessarily represent the views or official position of the Department of Commerce, the National Oceanic and Atmospheric Administration, or the National Marine Fisheries Service.

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