We Are Watching!
The Long-term Monitoring Program of the Exxon Valdez Oil Spill Trustee Council

Mandy Lindeberg – NMFS AFSC Auke Bay Laboratories
EVOSTC: A Legacy of Significant Science and Ecosystem Approach

History of Funded Science:

- Injury assessment studies
- Recovery studies
- Ecosystem programs (SEA, APEX, NVP)
- Herring Research & Monitoring
- GOA Long-term Monitoring

Gulf Watch Alaska

March 1989: tanker & Orcas

Low level toxicity to fish
Gulf Watch Alaska Program

**Overall Goal:** Provide sound scientific data and products that inform management agencies and the public about the EVOS-affected regions of the GOA

**Objectives:**
- Sustain and build upon existing time series data in EVOS-affected region
- Monitor key ecosystem components and their potential impacts to injured resources
- Make current and historical ecosystem data readily available to a wide variety of users
- Develop science synthesis products to support decision making by management agencies and the public
- Communicate with regional partners, tribal villages, and management agencies
GWA Program Organization

An Integrated Ecosystem Approach

Program Management Team

Outreach Steering Committee  Science Review Panel

Science Coordinating Committee

Environmental Drivers  Pelagic  Nearshore
GWA Components and Scientists

Gulf Watch Alaska Ecosystem Components

- Environmental Drivers
  - GAK-1 – Danielson, Weingartner
  - Seward Line – Hopcroft, Coyle
  - Prince William Sound - Campbell
  - Kachemak Bay – Holderied, Shepherd
  - Cont. Plankton Recorder - Batten

- Pelagic Ecosystem
  - Killer Whales – Matkin
  - Summer Marine Birds – Kuletz, Kaler
  - Forage Fish – Arimitsu, Piatt
  - Humpback Whales – Moran, Straley
  - Winter/Fall Seabirds - Bishop

- Nearshore Ecosystem
  - PWS, Kenai Penin., Kachemak Bay, Katmai
  - Status of >200 species – e.g. sea otters, nearshore birds, oyster catchers, intertidal organisms
  - Coletti, Esler, Kloecker, Monson, Weitzman, Konar, Iken.
GWA Monitoring Locations

Environmental Drivers Component
- Oceanographic sampling
- Continuous Plankton Recorder
- Oceanographic; seabird & marine mammal obs
- Continuous Oceanographic sites

Pelagic Component
- Forage fish, Seabirds
- Humpback whales
- Seabirds as forage fish samplers
- Seabirds
- Killer Whales

Nearshore Component
- Sampling station

Seabird foraging trips
Killer Whale study area
Continuous Plankton Recorder
Seward Line
Exxon Valdez Spill Area Boundary
Environmental Drivers:
GAK 1 – S. Danielson, T. Weingartner

SHELF:

Water Column Temperature Anomaly 1970-2016

Marine Heat Wave or “The Blob”
INSIDE WATERS: Temperature Anomalies

Environmental Drivers: PWS oceanography – R. Campbell

CTD time series anomalies: Bars = quarterly average; Points = data; Green line = trend

Surface: 2 m
Deep: 200 m

4°C above average HOT!

Autonomous profiler: Negative anomalies = very shallow, strong thermocline
Environmental Drivers:
Lower Cook Inlet & Kachemak Bay - Doroff, Holderied

INSIDE WATERS:
2012-2016 Kachemak Bay Water Temperature Profiles

- Hot summers!
- Cold Winter
- Warm winters!
INSIDE WATERS: Change in Plankton Assemblages (2009-15)

Environmental Drivers:
PWS oceanography – C. McKinstry, Campbell

Note: a few examples, but many changes in many species
Numbers of whales in AB pod and AT1 population 1984-2015
Recent Observations

Feeding conditions:

- 2015 Coho up – whales with “doughnut” heads (fat), socializing

- 2016 Coho down – whales not so fat, no fall social groups, likely feeding out of PWS/KF, over at Copper River
Pelagic Ecosystem: PWS Humpback whales – Moran & Straley

Abundance, Distribution, and Diet

- Preliminary population estimate of 465 (95% CI; 405-552)
- Movements follow herring, primary prey
- Herring failing, whale diet changing
- May be reaching carrying capacity

Shifts in seabird distribution under different temperature regimes

All species

- **Warm** = Higher densities; fall

- ‘**Inshore**’ seabirds most influenced by GOA conditions

- ‘**Offshore**’ species always in Outer/Off-shelf (fulmars, storm-petrels, albatrosses)

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*T. Zeller, USFWS*
Pelagic Ecosystem: PWS Marine Birds – Kaler, Kuletz, Cushing, Labunski

INSIDE WATERS: Summer Marine Bird Surveys

Pelagic foragers declining

Recent Observations:

- 2014, 2016 marine bird survey data followed trends, pelagic species numbers remained low since at least 2005

- Largest murre wreck ever reported in AK, 2015-2016

- Complete reproductive failure of PWS Black-legged Kittiwake in 2016, not seen in 32 yrs (D. Irons, unpubl data)

15 July surveys (1989-2016)
4,300 transects, 26,000 km, >350,000 birds
Patterns in the Nearshore

General findings: Patterns of variability differed across metrics, with some fluctuating synchronously at broad spatial scales and others showing site-specific variation.
Nearshore Ecosystem:

- **KATMAI** densities have increased with declining energy recovery rates, suggesting a food-limited state.
- **KENAI** densities and energy recovery rates have been stable, indicating population at carrying capacity.
- **PWS** pre-spill; may be reaching carrying capacity

**e.g. Patterns of a Major Predator:**

Sea Otters (2006-2015)
Nearshore Ecosystem:

- Mussels
  - factors operating across the northern GOA and local drivers were affecting mussel survival and subsequently abundance

- Clams
  - In general densities are declining in all regions but they are known to be highly variable, influenced by both top-down and bottom-up drivers
Nearshore Ecosystem:

e.g. Patterns of a Benthic Apex Predator - Sea Stars

- **KATMAI** dominated by *Evasterias* in all years except for the last sampling year (2016).

- *KACHEMAK BAY* had overall low densities in the early years but later, *Evasterias* became the dominant genus.

- **KENAI** had the highest diversity of sea stars of all the regions, dominated by *Pisaster* in most years but all were declining over time.

- *Western PWS* had the lowest diversity of sea stars.

*Sea Star Wasting Disease*
Recap of Findings

2014-2016: Marine Heat Wave

- **ENVIRONMENTAL DRIVERS:**
  - Temperature – warm water anomaly present throughout all GWA regions, to depth
  - Primary productivity – decline of cold water species, warm water species persist

- **PELAGIC ECOSYSTEM:**
  - Declining populations – seabirds, forage fish
  - Change in behavior, distribution, diets
  - Die offs and Unusual Mortality Events

- **NEARSHORE ECOSYSTEM:**
  - Highly variable patterns among key trophic species driven by local and Gulf-wide influences
  - Disease – sea stars coincides with heat wave

Scientists affectionately call the marine heat wave the “Warm Blob”
Alaska Regional Stranding Network

"Gulf Watch Alaska has provided invaluable assistance to the NOAA Fisheries Alaska Region Stranding Network. In the summer of 2017, separate crews collected photos, measurements and samples from two stranded humpback whales in geographically challenging locations in Prince William Sound.

In view of the 2015 Large Whale Unusual Mortality Event as well as ongoing shifts in the marine environment, tracking and collecting data from stranded large whales has become of even greater importance, and the efficient and thorough data collection of the Gulf Watch crews was deeply appreciated."

Mandy Migura and Dr. Kate Savage
NOAA NMFS Alaska Region Stranding Coordinators
New Sighting!

"Thanks to NOAA Alaska Fisheries Science Center, the EVOSTC, and the Prince William Sound Science Center for providing fast-track funding and logistics that made it possible to have a seabird observer onboard the NOAA R/V Oscar Dyson Juvenile Walleye Pollock and Forage Fish Survey."

An unusual observation resulted from the survey, the first record of a Nasca booby in Alaskan waters, typically only seen in the southeastern Pacific Ocean."

Dr. Kathy Kuletz

USFWS Migratory Bird Management
Supervisory Wildlife Biologist / Seabird Coordinator

A Nasca Booby (Sula granti) first sighting approximately 20 km east of the Barren Islands, Alaska. August 2017.
GWA Data and Publications

Special Issue Forthcoming:
Spatial and Temporal Ecological Variability in the Northern Gulf of Alaska: What Have We Learned Since the Exxon Valdez Oil Spill?

- 19 Peer Reviewed papers
- GWA and HRM contributions

Published Datasets:
- 45 datasets publicly available through DataONE online
GWA and Future Monitoring

Legacy Datasets in the Northern GOA

- GAK 1
- Sea otters
- Middleton Is. seabirds
- Killer whales
- Marine birds
- Herring
- Seward line
- CPR


Uniquely situated to capture change at multiple ecosystem levels

“We are now monitoring the unusual”
GWA Crew          Thank You!