

Indices of Health, Condition, and Mortality for *Enhydra lutris kenyoni* in Alaska: an unusual mortality event



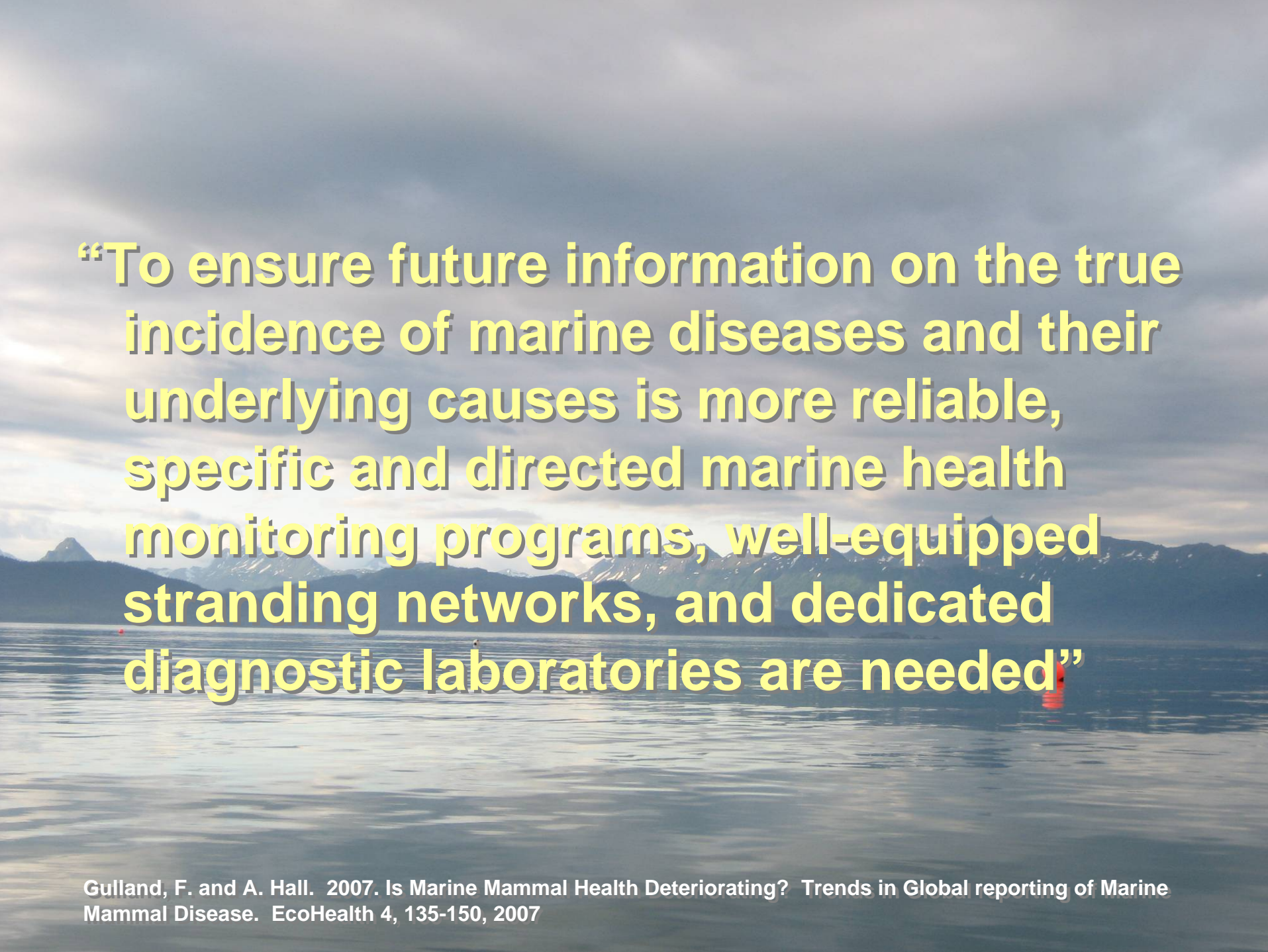
Angela Doroff
Marine Mammals Management
U. S. Fish and Wildlife Service

“ A recent rise in the reporting of diseases in marine organisms has raised concerns that ocean health is deteriorating... The annual number of mass mortality events in the U.S. doubled between 1980 and 1990 but since 2000 has been between 7-8 events per year...Causes of mass mortality events have included biotoxins, viruses, bacteria, parasites, human interactions, oil spills, and changes in oceanographic conditions...”

Gulland, F. and A. Hall. 2007. Is Marine Mammal Health Deteriorating? Trends in Global reporting of Marine Mammal Disease. *EcoHealth* 4, 135-150, 2007

Trends in Disease Reports Over the Past 40 Years

- 1960s-1970s primarily helminth and bacterial disease events were reported
- 1970s-1980s an increase in the number of mortality investigations that investigated viruses
- 1990s began to see protozoal diseases and harmful algal toxins reported...an increase of mortality events related to biotoxins was observed



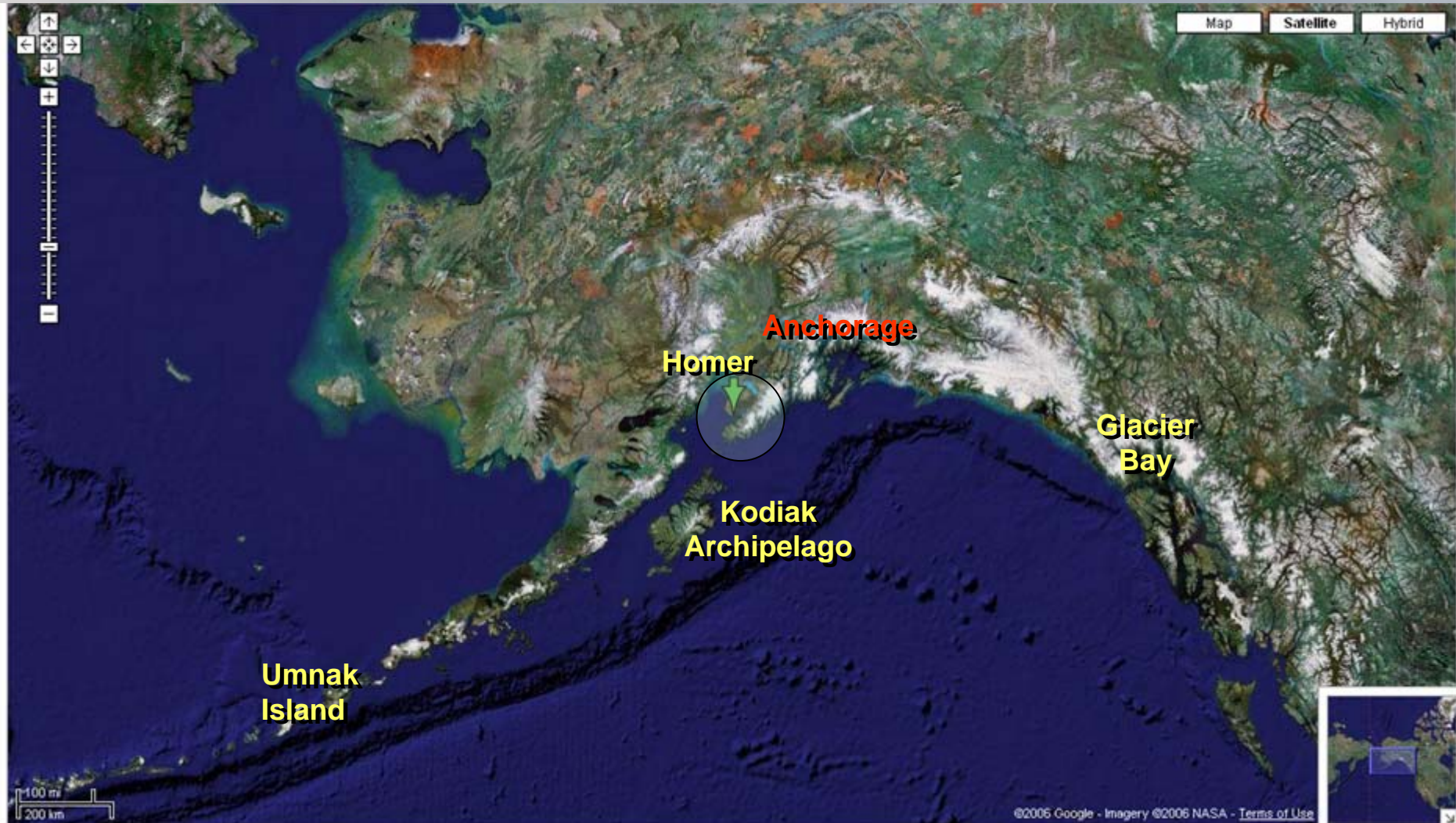
“To ensure future information on the true incidence of marine diseases and their underlying causes is more reliable, specific and directed marine health monitoring programs, well-equipped stranding networks, and dedicated diagnostic laboratories are needed”

Sea Otter Mortality Event

- Background – Geography and brief history
- Data summaries – stranding numbers
- VE/Sepsis pathology – typical case
- Ongoing and Planned Research
- Discussion



Sea Otter Carcass Recovery in Alaska



All Sea Otter Strandings 1998-July 2007



Southwest Alaska

33

20 AK Penin./Aleutians

13 Kodiak Island

(3 with location unknown)

Southcentral Alaska

291

23 Prince William Sound

21 Resurrection Bay

247 Kachemak Bay

Southeast Alaska

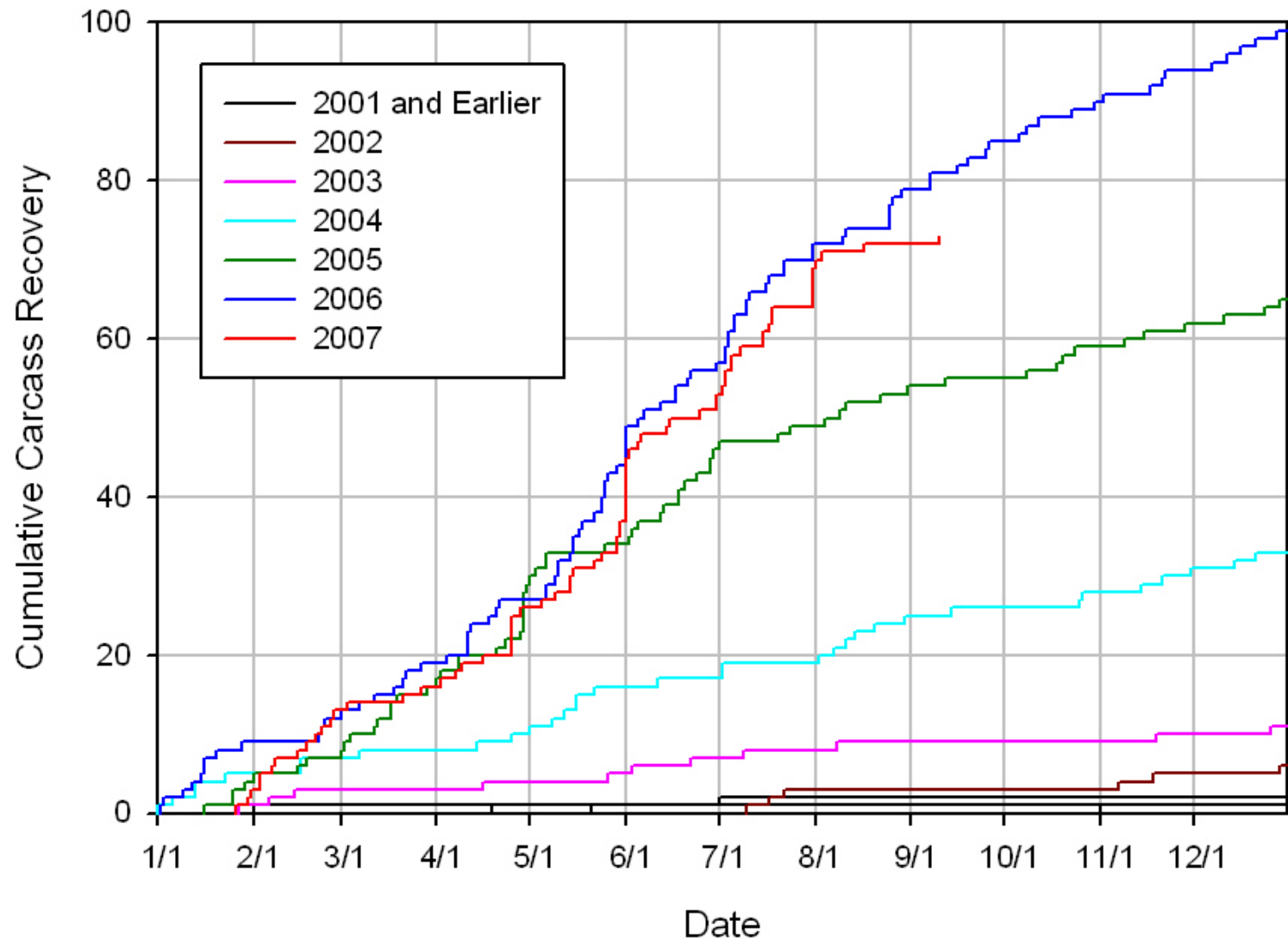
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4 Glacier Bay

4 Juneau/Sitka

1 Yakutat

Cumulative Sea Otter Carcass



Current Diagnostics

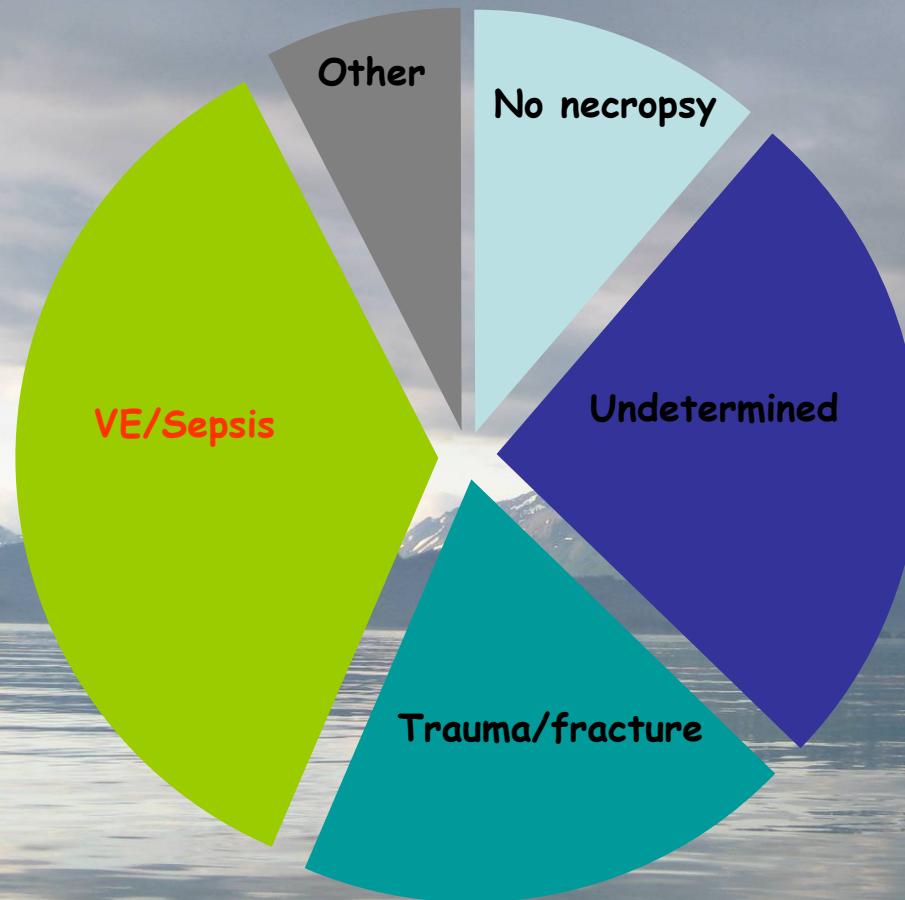
TOOLS

- Histopathology
- Serology
- PCR
- Microbiology culture

DISEASES

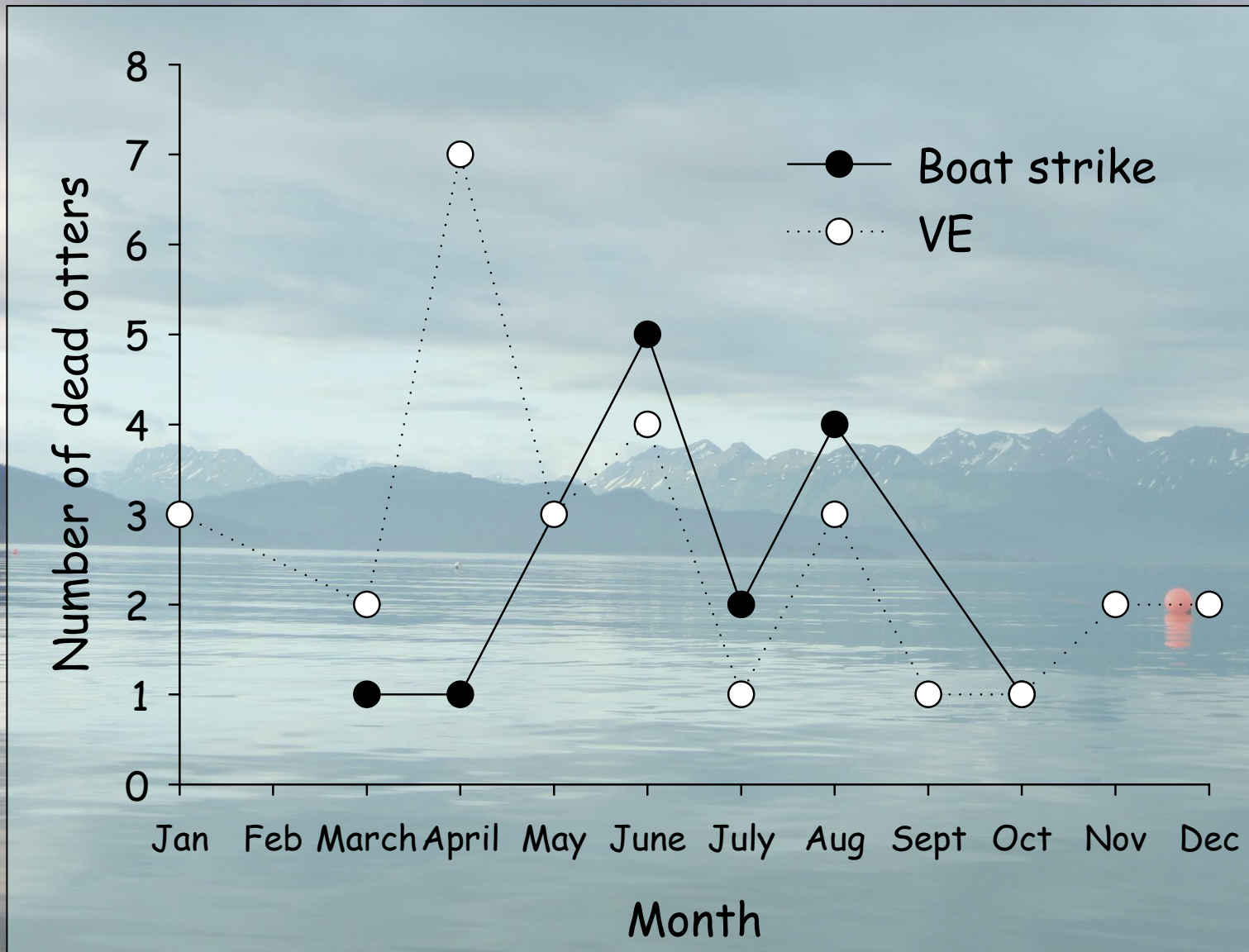
- Viruses (CDV, PDV)
- Bacteria (strep, brucella, bartonella)
- Protozoal (toxoplasmosis gondii)
- Fungal (histoplasmosis)
- Neuro toxins (Domoic acid)

All Mortalities – Cause of Death



VE = inflammation in innermost layer of tissue that lines heart valve
Sepsis = the presence of bacteria in the blood along with tissue damage -

Temporal Patterns of Mortality



Sources of Mortality in California Vs Alaska

Southern sea otters 1998-2001*

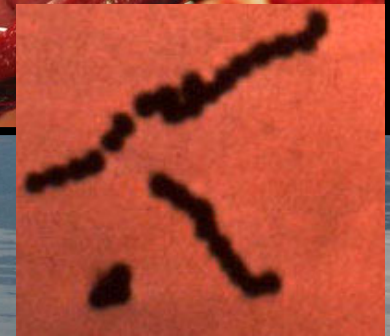
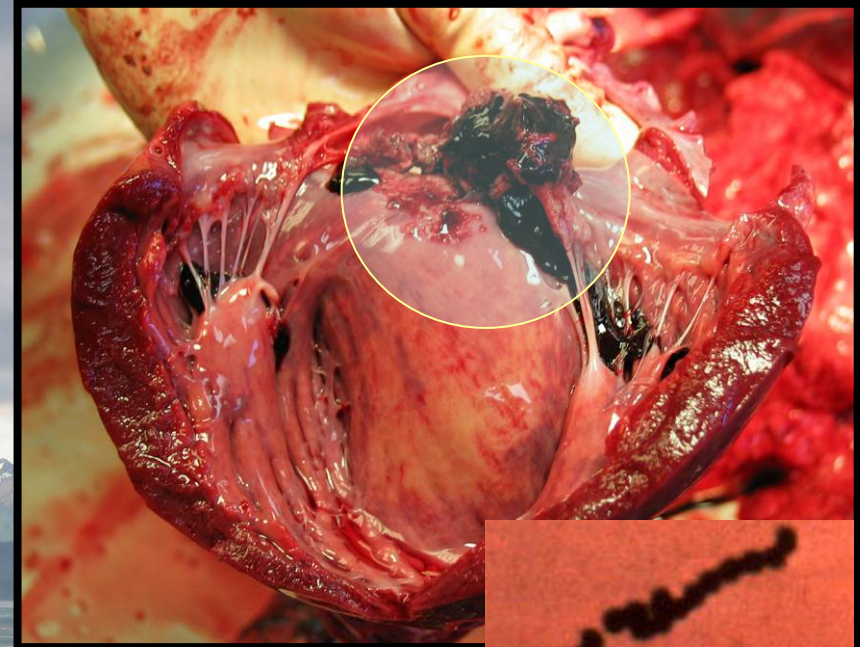
1. *Toxoplasma gondii* encephalitis
2. Acanthocephalan infection
3. Cardiac disease (myocarditis)
4. Great white shark predation
5. Lacerations or trauma (unknown cause)

Northern sea otters 2002-2005

1. Cardiac disease (VE)
2. Trauma (lacerations or blunt trauma)
3. Unknown cause
4. Reproductive/fetus trauma
5. GI impaction

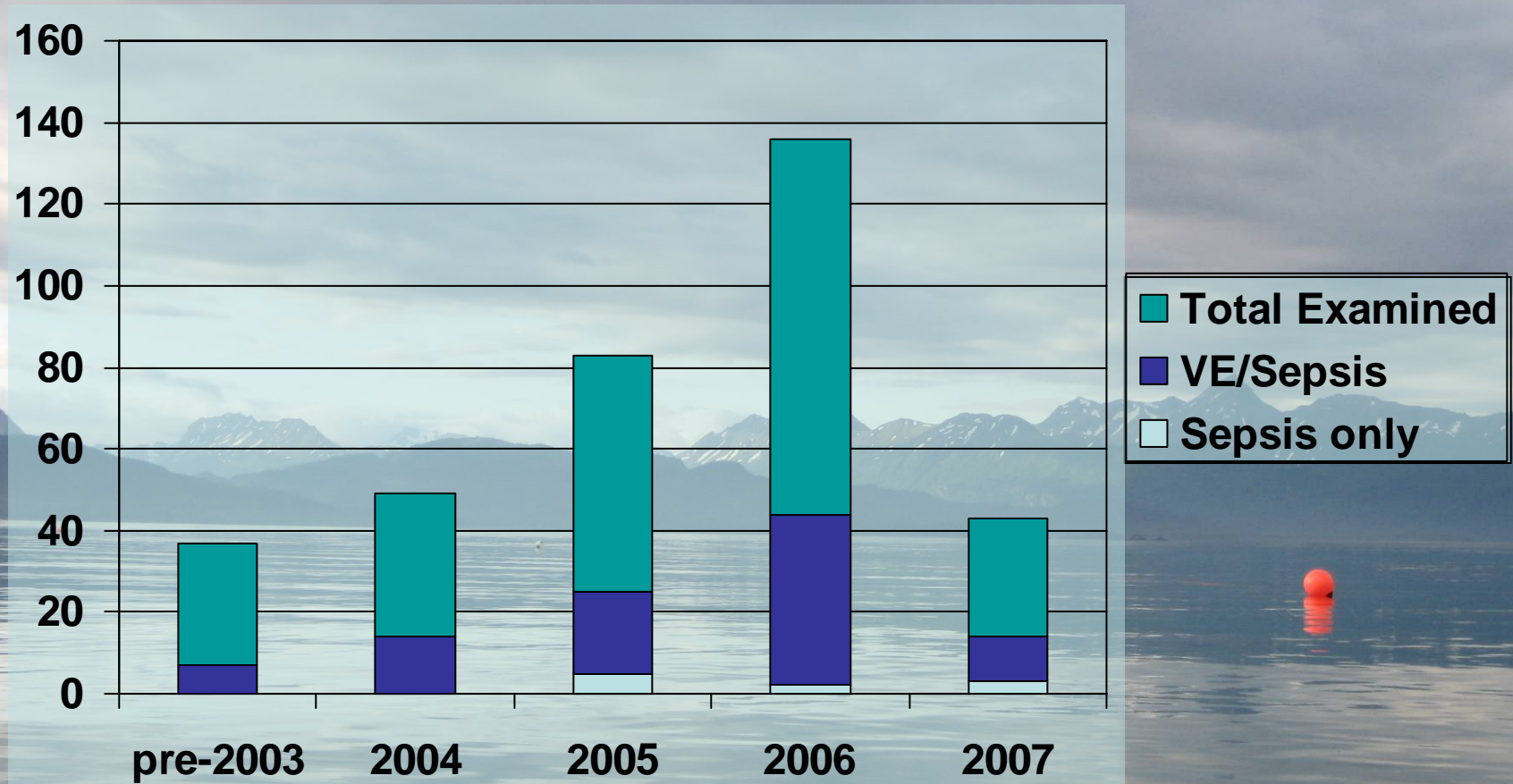
* Kreuder et al. 2003

Typical VE/Sepsis Case



–Valvular endocarditis (VE): Inflammation of tissue lining the heart valve caused by the bacteria, *Streptococcus infantarius* ss *coli* (bovis/equinus complex)

VE/Sepsis Cases by Year



Ongoing and Planned Research



Randy Wilder

- Potential or contributing causes of the mortality include:
 - 1) immunosuppression due to a viral infection, contaminants, or genetic predisposition/reduced variability
 - 2) viral or other pathogen infection which causes damage to tissue cells
 - 3) pre-existing valvular abnormality due to congenital defect (i.e., genetic) or other factors
 - 4) something in the diet that causes damage to the digestive tract and release of the bacteria into the bloodstream.

Some Current Hypotheses

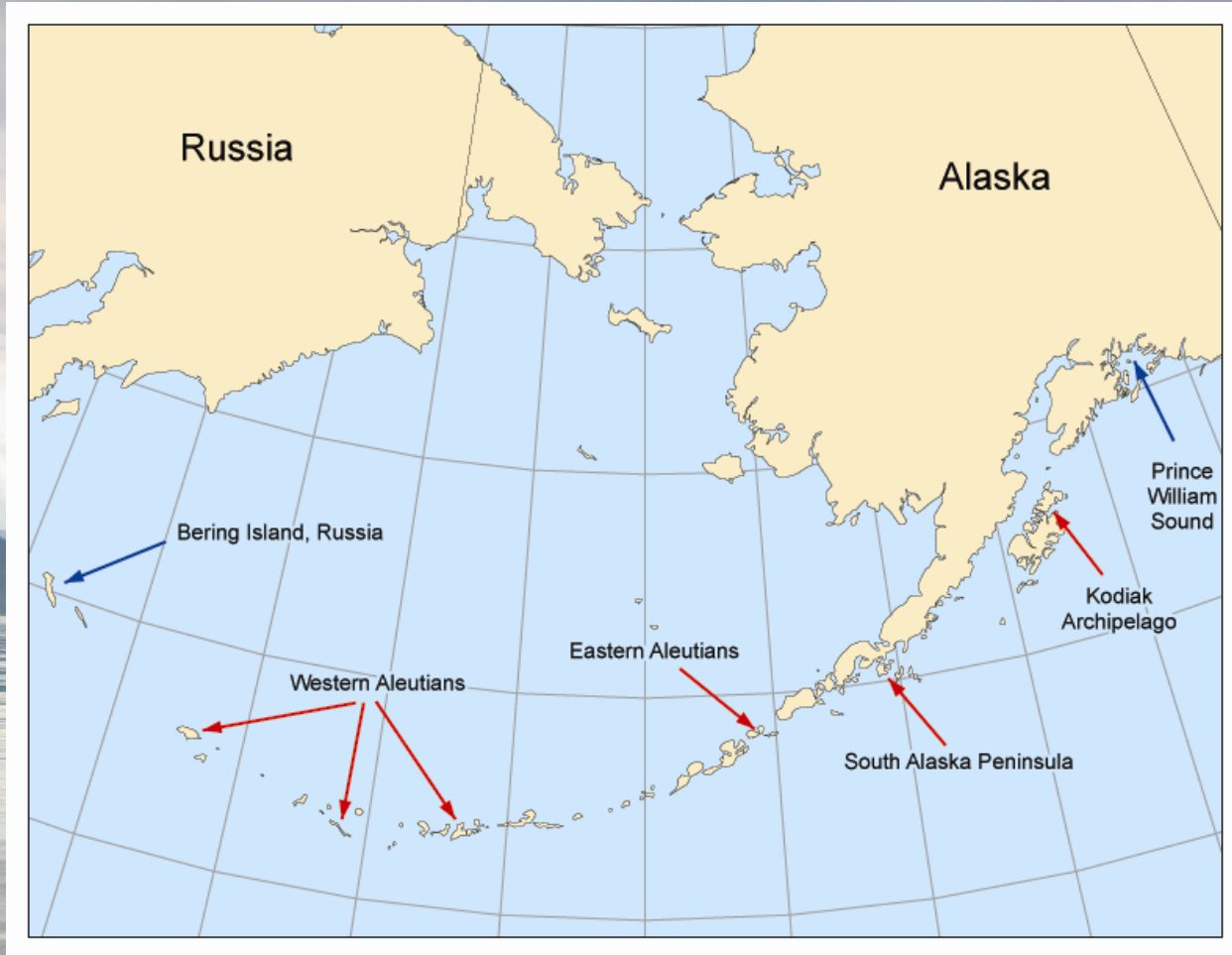
- ▶ **Increased exposure to bacteria**
- ▶ **Increased virulence of bacteria**
- ▶ **Predisposing factors allowing bacteria to infect:**
 1. **immunosuppression due to virus, contaminants, genetics**
 2. **pathogen causes damage to tissue cells**
 3. **pre-existing valvular abnormality (congenital defect)**
 4. **diet causes damage to digestive tract and releases bacteria**

Monitoring Population Health

- Live Captures
 - Age/Sex
 - Body Condition
 - Blood Chemistry
 - Immune Function
 - Parasites
 - Disease Screening

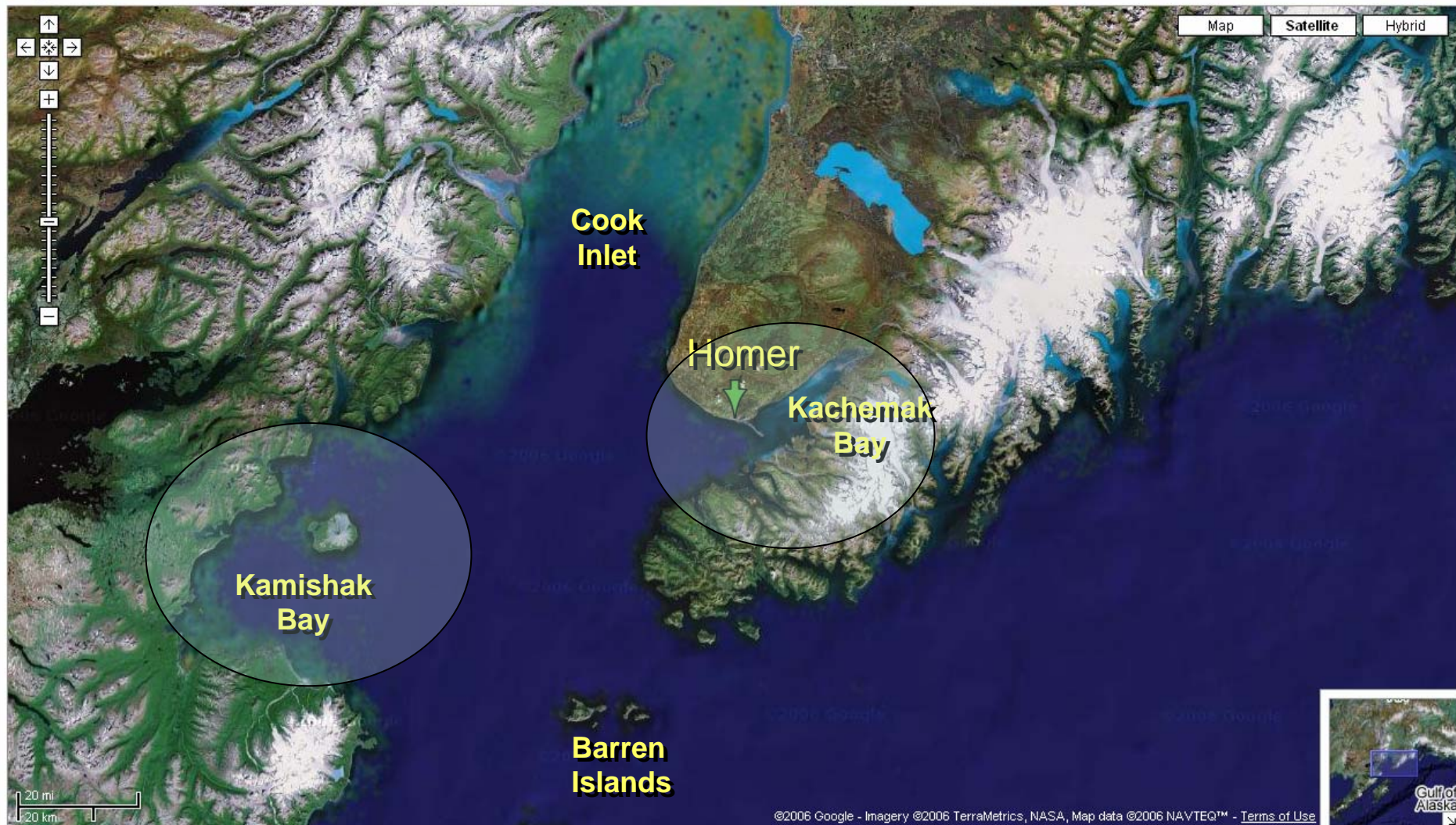


Standardization of Morphology and Clinical Data: sea otter capture locations in previous studies on health and disease in free-ranging animals



Goldstein, T. A.M. Doroff, T.Tuomi, D. Monson, V. Gill, A. Burdin, P. Conrad, J. Dunn, C. Field, C. Kreuder, D. Jessup J. Bodkin, and J. Estes. Comparison of health and disease exposure between two sea otter populations: the declining Southwest population and the stable Commander Islands population in Russia. In prep.

2007 Lower Cook Inlet Capture Study Area



Study Objectives

- **To estimate annual rates of survival of sea otters in Lower Cook Inlet and contrast results to similar measures recorded for sea otter populations at/below equilibrium density.**
- **Determine body condition (mass/length) and infer population status in comparison with other known-status populations.**
- **Assess individual otter health through disease screening and immune function tests (LPA). Correlate these measures to probability of survivorship using multivariate risk-factor analysis.**
- **Use oral and fecal cultures to establish the prevalence of SBE/S complex in free-ranging sea otters; use ultrasound imaging of heart valves to compare with those in fresh-recovered carcasses. Test for differences in survivor probabilities between SBE/S - exposed/non-exposed animals.**
- **Evaluate diet as a risk factor for SBE/S exposure: stable isotope composition of whiskers from animals dying of SBE/S, other causes, and live-otters in Kamishak and Kachemak Bays; direct observations of foraging behavior in radio-tagged study animals to quantify diets; and screen known sea otter prey for SBE bacteria.**
- **Recover any study animals that die during study and determine cause of death through necropsy.**

Capture Results

- 11 Female Otters
- 33 Male Otters



Health and Condition Data

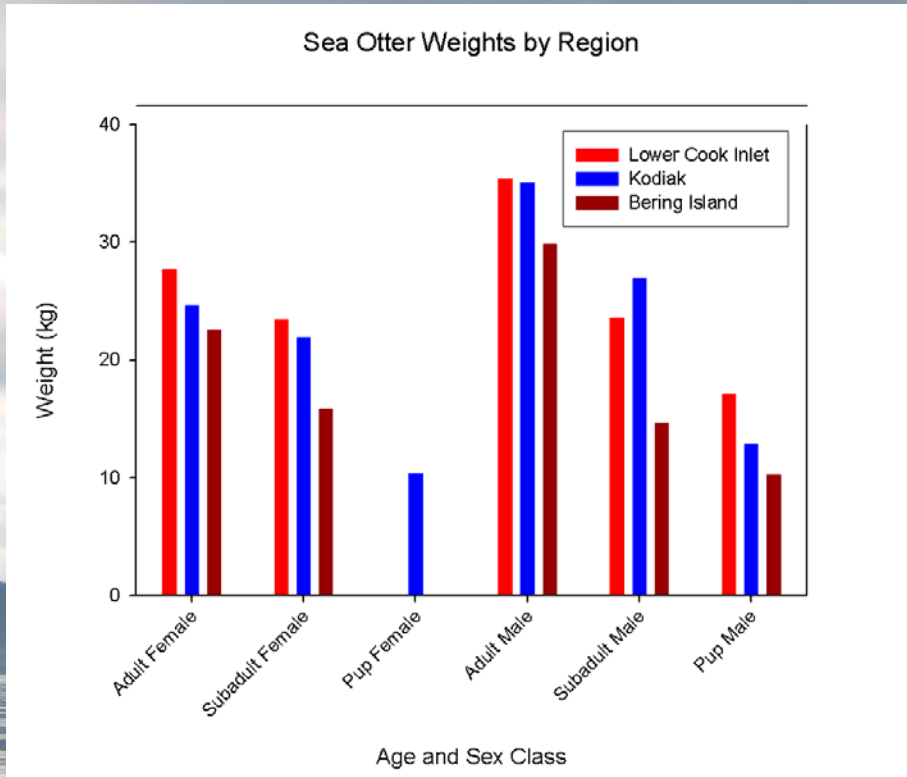
- 44 VHF Radio Transmitters
- Biological Samples
- Heart Ultrasounds



Capture Study – Diagnostic Samples

Tissue Type	Purpose (Lab)
Serum	Serum Chemistry (Quest Diagnostics) Serology – Morbilli Panel (OADDL); Brucella (Mystic); Bartonella (archive;UCD); Lepto (archive; UCD); Herpes PhHV-1 (archive; OADDL); Calicivirus (archive; NVSL); Protozoal (Toxo/Sarco; UCD).
Whole Blood	CBC/Diff (Quest Diagnostics)
Blood	Lymphocyte Proliferation Assay (archive; Mystic Aquar.)
Urine	Collected as available (archive)
SubQ Fat	Collect as available (contaminant studies)
Flipper plugs	USGS/FWS (archive)
Whiskers	Isotope levels for diet (FWS)
Swabs	Microbiology cultures (UCD)
Feces	Microbiology cultures (UCD); Virology screen (USF)

Body Condition



- All study animals had some subcutaneous fat
- Some had intraspecific bite wounds (flipper/lip area)
- Teeth were in excellent condition
- Weight by sex/age class similar to Kodiak which has ample uninhabited habitat



Monitoring Free-Ranging Sea Otters

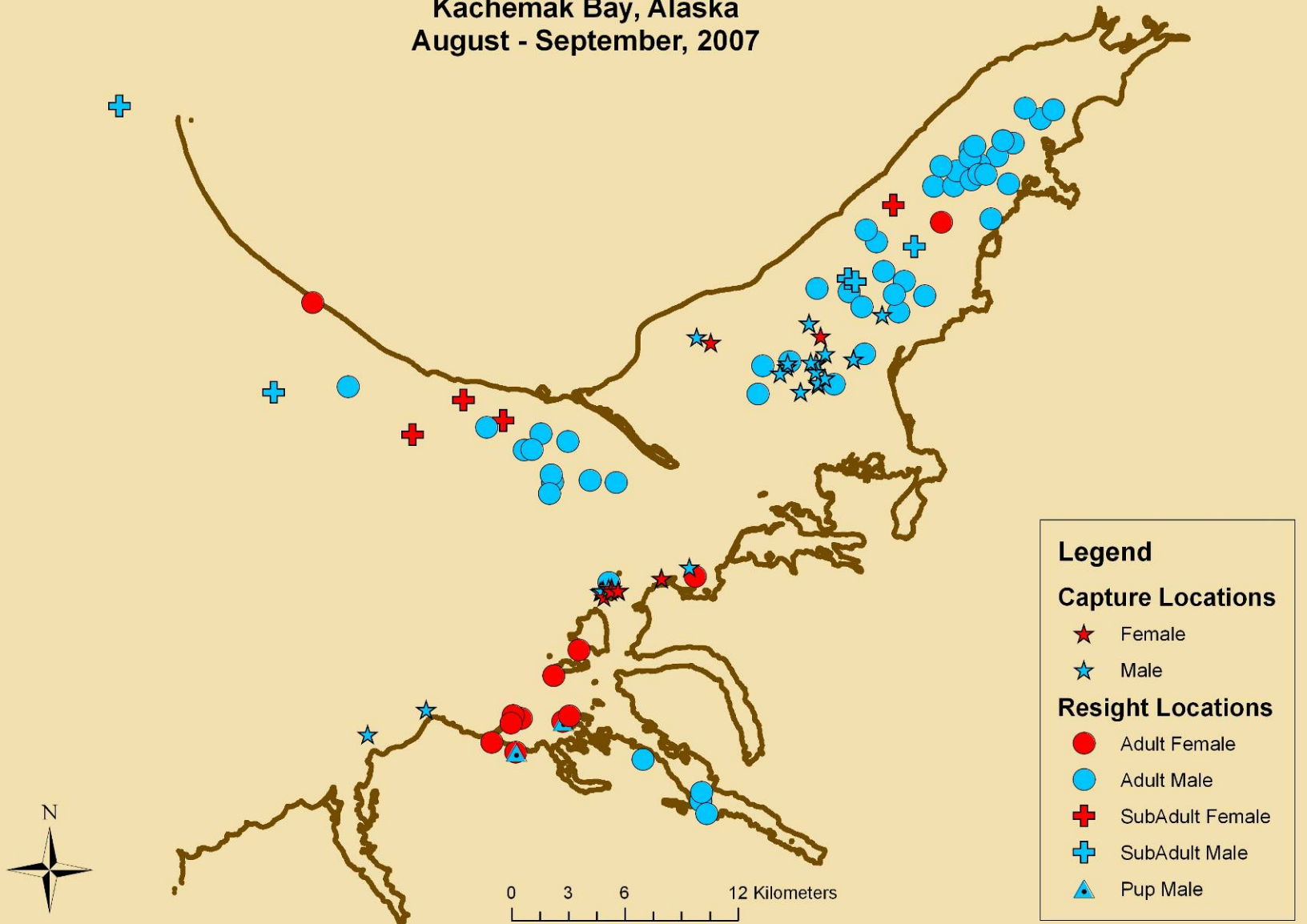


- Marking:
 - Unique VHF radio frequency
 - Combination of colored and position
- Monitoring:
 - Located weekly visually or radio signal
 - Mortality signal in each VHF transmission



Sea Otter Movements

Kachemak Bay, Alaska
August - September, 2007



Current Projects with Collaborators

- ▶ **Monitoring free-ranging sea otters.**
- ▶ **Pathogenesis of *Streptococcus Infantarius sp. coli* valvular endocarditis in sea otters.**
- ▶ **Molecular identification of a Phocine Distemper-like virus.**
- ▶ **Chlorinated fatty acids.**
- ▶ **Investigation of immune dysfunction as a predisposing factor of septicemia.**
- ▶ **Sea otter forage taxa through isotope markers in vibrissae from beach-cast carcasses.**
- ▶ **Comparison of contaminant levels in sea otters that died of infectious disease (VE/S) with non-diseased animals.**
- ▶ **Levels of *S. infantarius sp coli* in heart valves from subsistence-hunted sea otters.**

Partners/Team

- **On Site Coordinators:** Linda Comerchi NOAA and Angela Doroff USFWS
- **Response/Stranding:** Verena Gill/Dana Jenski, USFWS; Tim Lebling and staff, ASLC; Debbie Tobin, Karen Korbel, and Cy St. Amand and the volunteers of the AMMSN, Homer; USFWS Refuge staff.
- **Clinical:** Pam Tuomi, DVM/C. Goertz, DVM and staff; ASLC.
- **Necropsy:** Kathy Burek, DVM, AVPS; Pam Tuomi, DVM/C. Goertz, DVM,ASLC; C. Cross, DVM; M. Miller, DVM., and many volunteers.
- **Database:** Southern Sea Otter Program (M. Miller, et. al.); CDFG-Santa Cruz; Dana Jenski/Doug Burn; USFWS.
- **Consultation:** Terri Rowles, NOAA; Frances Gulland, DVM, TMMC; Jonna Mazet; UCD.

Questions??



Randall Davis, TAMU

