Introduction to Harbor Seals

- *Phoca vitulina richardii*

**Length:** 1.8 m (6 ft)
**Weight:** 110 kg (245 lb)

**Abundance:** 200,000 Alaska
**Trend:** varies by stock

**Habitat and life history:** Coastal distribution and in estuaries; pupping in June, molting in August; modest movements in response to prey availability outside breeding/molting periods

**Legal status, threats, mandates:** ESA Candidate (Iliamna Lake only); MMPA not Depleted; unknown threats have caused regional declines
Overview of AFSC Research on Harbor Seals

• Abundance and trends: Aerial surveys of the species’ range in Alaska
• Movements and habitat: Satellite telemetry of location, diving behavior, and haul-out time; glacial fjords habitat
• Health, condition, and stock structure: Studies based on samples from live-captured harbor seals
Abundance and Trends - Partners

Alaska Native Harbor Seal Commission

National Park Service

Newhalen Tribal Council
Tribal Government for Newhalen, Alaska

Alaska Maritime National Wildlife Refuge
Abundance and Trends – Methods
Abundance and Trends – Methods

• Fixed-wing aerial surveys
• Entire harbor seal range divided into fixed survey units
• Handheld cameras (terrestrial sites); fixed vertical cameras (glacial fjords)
• GPS track recorded and linked to photos (effort)
Abundance and Trends – Methods

• Novel methods required for glacial fjords

Figure 2: Example data set of aerial surveys for harbor seals conducted on 11 August 2008 in Icy Bay, Alaska. The outlines of aerial photographs are shown within the study area. Open plots have 0 seals, and darker shaded plots have more seals.
Abundance and Trends – Methods

• Haul-out times from both terrestrial and glacial sites

Estimated Harbor Seal Locations Falling Within Alaska Coastal Survey Units
(Blue Locations During July, August and September)
Abundance and Trends – Methods

- Account for covariates of counts and haul-out time: time of day, day of year, tidal state

Figure 7: Fitted time-of-day models for all stocks from terrestrial survey data.
Abundance and Trends – Data Quality

- Statewide sampling survey design
- Annual effort allocated by seal density, conservation concerns (i.e., local declines), and funding
- Enterprise database of long-term survey data
- Time series formulation produces estimates for every year
- Bayesian hierarchical model accounts properly for variance of counts and haul-out proportion
Abundance and Trends – Data Quality

- Total statewide abundance is reasonably precise and indicates a large population of about 200,000

Figure 8: Posterior densities of estimates of yearly totals. For the posterior distributions, the blue dots are the modes, the green dots are the medians, and the red dots are the means.
Abundance and Trends – Data Quality

- Posterior distributions for annual abundance and trends
- Statistics from posteriors feed directly into PBR framework for stock assessment
- Good precision leads to high $N_{\text{min}}$, reduces need for MMPA actions
Abundance and Trends – Strengths

• Statewide sampling survey design is efficient and accommodates fluctuations in funding support
• Annual effort allocated by seal density, conservation concerns (i.e., local declines), and funding
• Annual estimates available statewide whenever new surveys are conducted
• Stock assessments are complete and up-to-date for 11 of 12 stocks (except Pribilof Islands)
Abundance and Trends – Weaknesses

• Recent decline in funding support may lead to very poor precision in some areas
• Aleutian Islands remain very difficult to survey, poorly sampled for haul-out, and an area of greatest conservation concern
• Our methods remain costly, labor intensive, and potentially risky for field personnel
Movements and Habitat – Partners

Alaska Native Harbor Seal Commission

BOEM
Bureau of Ocean Energy Management

National Park Service

Alaska Maritime National Wildlife Refuge
Movements and Habitat – Methods

Estimated Movement Paths for 14 Harbor Seals Captured and Released in Clam Lagoon, Adak, Alaska
Movements and Habitat – Methods

Average Haul-out Behavior (Hourly Percent Dry) for Adult Females
Movements and Habitat – Methods

Dive Behavior for Sub-adult Males

-300  -200  -100   0

dive depth (m)

Sep  Oct  Nov  Dec  Jan  Feb

date

PV2014-2007

PV2014-2016

PV2014-2019
Movements and Habitat – Methods

- Aerial survey data combined with data on response to vessel approach, to estimate total disturbance by a cruise ship in a glacial fjord
Movements and Habitat – Data Quality

• Satellite telemetry provides crucial information about haul-out time for estimation of abundance
• Movements (i.e., seasonal migration) are crucial for survey design and interpretation
• Development of novel transmitters allowed estimation of haul-out during peak molt
• Enterprise database for telemetry, with extensive data-quality checks for Argos data
• NMML expertise in movement modeling provides a framework for statistical treatment of telemetry data
Movements and Habitat – Data Quality

- Movement models used to properly account for irregular timing of Argos locations
Movements and Habitat – Strengths

• Synergy between abundance, trends, movements, habitat objectives:
  • Satellite telemetry provides crucial haul-out information for estimation of abundance
  • Studies of vessel impacts have resulted in specialized modes of abundance/trend monitoring of glacial fjords, and ecological insights
  • Long tenure with Argos system supports deep understanding of the data process
Movements and Habitat – Weaknesses

- Telemetry studies limited to a few parts of harbor seal range in the state
- Linking movement or spatial use data with environmental data to identify ‘habitat’ has lagged behind telemetry data collection
- Long-standing need for a data manager has compromised our rate of timely publication of telemetry studies
Health, Condition, Stocks & Diet – Partners

- NMFS Southwest Fisheries Science Center
- NMFS Marine Mammal Health and Stranding Response Program
Health, Condition, & Stocks – Methods

- Morphometrics
- Blubber thickness via ultrasound
- Blood, other tissues, and pathology samples collected during live-captures for telemetry studies
- Pathology, contaminants, and genetics lab analyses outsourced to diagnostic laboratories
- Collaborative interpretation and reporting with partners
Health, Condition, & Stocks – Data Quality

• Routinely collaborating with a veterinarian on all live-capture studies
• Highly-developed protocols for animal handling and sampling
• Refining methods for seal capture in the Aleutians
Health, Condition, & Stocks – Strengths

• Health and condition data provide context & covariates for analysis of movements and behavior
• Harbor seals in Alaska provide one of the best examples of extensive genetic basis for stock determination followed by comprehensive population assessment for each stock
Health, Condition, & Stocks – Weaknesses

• Sample sizes are small and represent only limited regions within the statewide range
• Harvest bio-monitoring for harbor seals is less comprehensive than for ice seals; poor basis for complementary sampling from live captures
• No diet studies currently being conducted
Communication

• Results of AFSC monitoring and research on harbor seals are applied in assessments of population status under the MMPA and ESA

• AFSC monitoring and research results are communicated through peer-reviewed publications and publicly available reports (69 total publications by PEP authors in past 10 years, 14 related to harbor seals)

• AFSC monitoring and research results are communicated to the public at large via presentations to Alaska communities, Alaska Native organizations, and professional conferences
Access

• AFSC data on harbor seals are routinely provided in response to requests from AKRO, ADF&G, USCG, and other agencies and organizations

• A long-standing need for a program data manager has compromised our ability to make some data available in a timely manner, but existing databases provide a solid foundation for meeting requirements for metadata and data access
Recommendations

• Funding instability leads to inefficiencies in planning and implementing annual aerial survey effort: stabilize funding

• A long-standing need for a program data manager has compromised our ability to make some data available and to publish results in a timely manner: recruit Polar Ecosystems Program data manager