Seasonal movements and high-use areas of spotted seals (*Phoca largha*) in the Pacific Arctic

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Background

Spotted seals (*Phoca largha*) are pelagic foragers that use Bering Sea pack ice for pupping, nursing, and resting when ice is present and rest on shore during the open-water season. Warming of Pacific Arctic waters associated with climate change may affect fish and invertebrate prey of spotted seals, and therefore affect their foraging behavior. Decreases in the extent of sea ice and lengthening of the open-water season have eased access to the Arctic for development and shipping, prioritizing the need to identify areas important to seals. Our understanding of movements, high-use areas, and foraging habitats of spotted seals is limited. Therefore, we worked with Alaska Native hunter-taggers along the Beaufort and Bering sea coasts to deploy satellite-linked transmitters on spotted seals from July through October 2016–2018 to describe movements and identify high-use areas.

Methods

- We worked with seal hunters to capture spotted seals in entanglement nets and instrument them with satellite-linked transmitters.
  - **SPLASH** (Wildlife Computers, USA) or **CTD tags** (Sea Mammal Research Unit, Scotland) were glued to the hair on their mid-dorsum.
  - **SPOT tags** (Wildlife Computers, USA) were attached to a rear flipper.
- **Movements:**
  - We used location data collected by all SPLASH, CTD, and SPOT tags.
  - We estimated daily locations for all tagged seals using a continuous-time Correlated Random Walk (CRW) model (package *crawl* in R).
  - We **evaluated movements** of seals based on:
    - **Season**: Open-water (May–November) and Ice (December–April).
    - **Tagging area**: Beaufort and Bering seas.
- **High-Use Areas:**
  - We identified high-use (core) areas based on the density of daily estimated locations within 50×50 km square cells across our study area. The volume rasters calculated are utilization distributions (UD).
  - **UDs were calculated** for:
    - **Season**,
    - **Tagging area**, and
    - **Distance from shore**:
      - Offshore (>5 km): associated with foraging
      - Nearshore (<5 km): associated with resting and foraging
        - Haul-out data collected by tags informed identification of resting areas.
  - We considered **core areas** to be cells with UDs of <50% volume.

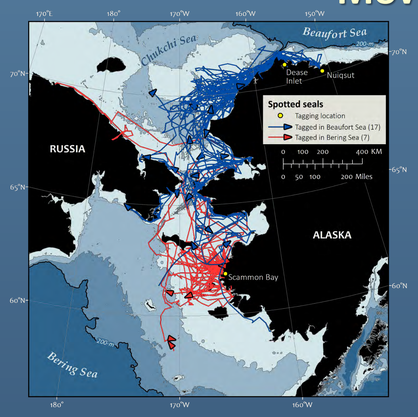
Spotted seal instrumented with a CTD tag, 2016.

Results

- We deployed satellite-linked transmitters on **24 spotted seals** from 2016–2018 (4 SPLASH, 20 CTD, and 24 SPOT tags).
- Seals were **tracked 137–443 days**.

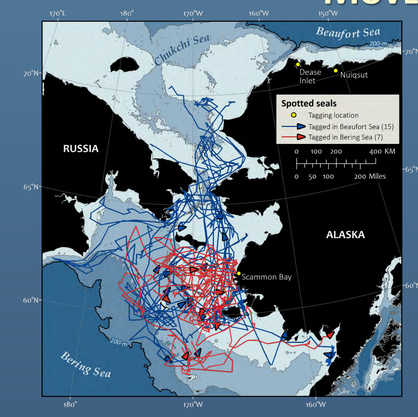
Learn more about ADF&G's ice seal tagging studies here

Open-Water Season Movements



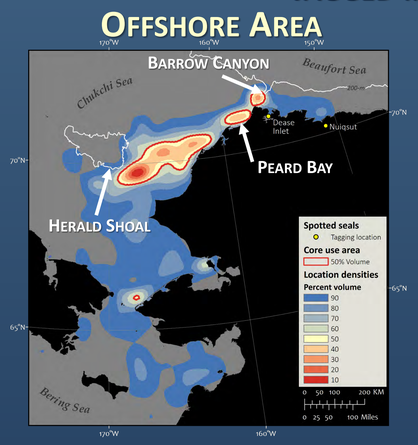
- All seals made **frequent east-west movements** between foraging areas and the Alaskan coast, including returning to tagging locations.
- Seals **tagged in the Beaufort Sea** moved between foraging areas in the Chukchi Sea and the Alaskan coast.
- Seals **tagged in the Bering Sea** moved between foraging areas in the central Bering Sea and the Alaskan coast.
- **Seals rarely moved between the Bering and Chukchi seas.**

Ice Season Movements



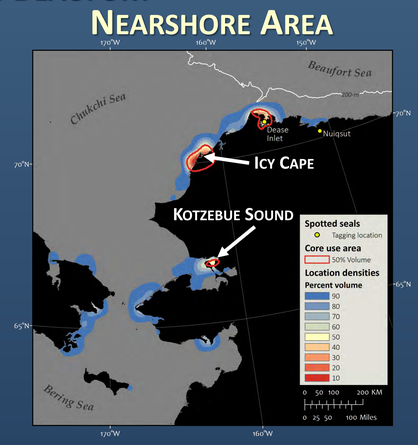
- In December, seals **tagged in the Beaufort Sea** moved south, ahead of the advancing pack ice.
- By mid-January, **all seals** regardless of tagging location occupied pack ice and foraged in the central Bering Sea.

High-Use Areas
Tagged in Beaufort
Offshore Area



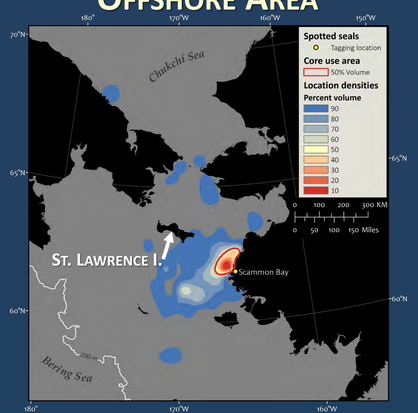
The primary foraging area was between Herald Shoal and nearshore waters of the northeast Chukchi Sea (<50 m deep).

Nearshore Area



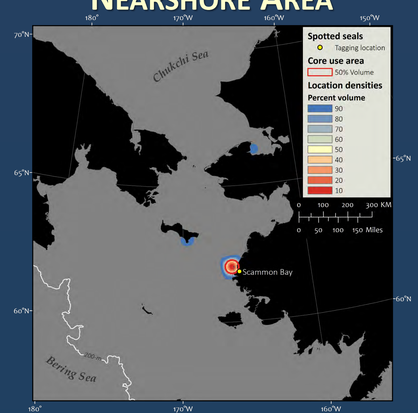
Resting areas primarily included islands near Icy Cape, Dease Inlet and Kotzebue Sound.

Tagged in Bering
Offshore Area



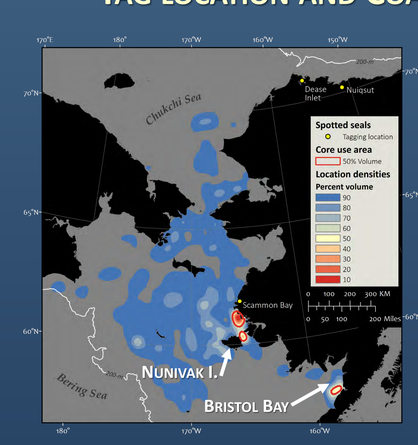
The primary foraging area was between the central Bering Sea and Alaska coast, including tagging location.

Nearshore Area



Resting areas primarily included islands near Scammon Bay, where they were tagged.

High-Use Areas
Tag location and Coastal proximity Pooled



- When sea ice was present, seal high-use areas overlapped regardless of tag location and distance from shore.
- Seals foraged and rested primarily near Nunivak Island and the Alaska coast.
- Low sea ice in the Bering Sea in recent years may be limiting spotted seals from using the central Bering Sea.

Summary

- Spotted seals in the Chukchi and Bering seas made frequent east-west foraging movements, rested on shore, and rarely moved between seas during the open-water season.
- Movement patterns we identified highlight the importance of tagging seals in multiple regions annually to understand movements and habitat use throughout their range.
- Continued studies of seal movements will be necessary to monitor for changes in behavior with changes in climate and development activities.

Future Work

- Examine how seal high-use areas are influenced by oceanographic characteristics and sea ice.

Acknowledgements

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