Environmental and Anthropogenic Drivers of Haul-Out Dynamics and Health Risks in California Sea Lions (*Zalophus californianus*) at Yaquina Bay

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Background

California Sea Lions (*Zalophus californianus*) occupy a central position in marine food webs, making them a crucial piece for ecosystem stability (Bartling, 2023). One vital social behavior for sea lions is the development of rookeries, aggregated haul-out locations for colonies to rest, reproduce, and interact with others. One rookery in Newport, OR, is a popular tourist attraction where visitors can get within 3 meters of California sea lions.

In related pinniped species, such as the Hawaiian monk seal, human disturbance has been observed to cause shifts in rookery locations, which can lead to reduced reproduction and overall population decline (Gerodette, 1990). The top causes of sea lion rookery disturbances are:

- ✓ **Illness**
- ✓ **Biotoxin exposure (e.g., domoic acid toxicosis),**
- ✓ **Pathogens (e.g., H5N1).**
- ✓ **Anthropogenic disturbances**

Overall, these disturbances can lead to increased stress of sea lions, resulting in worsening body conditions and decreased reproduction rates and population. Signs of a DA toxicosis outbreak threaten the neurological health of the sea lion rookery (Krasner, Martinez, Field, et al., 2025; Collier, Mann, Ali, et al., 2022; Gamarra-Toledo, Plaza, Gutiérrez, et al., 2023).

Predictions

1. Entanglement prevalence is expected to be highest during the post-peak phase of the Dungeness crab fishery (March–July), when derelict gear is most likely to persist in the water, and lower during the early peak (December–February) and low-activity periods (October–November).
2. Sea lion haul-out abundance is expected to vary systematically with tidal activity.
3. Haul-out abundance is predicted to be lower during periods of increased anthropogenic disturbance (e.g., vessel traffic, human presence, and noise).

Method

Study Species

We observed California sea lion aggregations in Yaquina Bay, Oregon (≈ 200 - 400 animals). These highly social pinnipeds form year-round haul-outs, except during the breeding migration (June to July). Males develop a pronounced sagittal crest around 5 years of age and typically weigh 200 - 390 kg and reach lengths of 2.0-2.5 m, while females are smaller (50 - 110 kg; 1.5 - 2.0 m). Females are rarely observed in Oregon; observations primarily included adult and juvenile males.

Study Sites

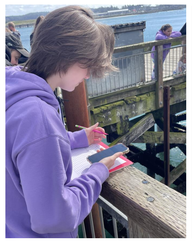
Observations were conducted at two haul-out locations in Yaquina Bay, OR: Port Dock One and North Jetty rock haul-out. Observations were conducted at Port Dock One in person and via a live webcam through the Clearwater Restaurant.

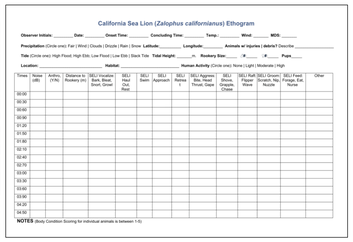
Materials

Data were collected using a printed ethogram including behavioral categories such as haul-out, swimming, approach, retreat, aggression, rafting, grooming, and feeding.

Supporting tools included:

- *Decibel X* mobile app
- Nikon 8×42 binoculars
- Timer
- Manual counter





Sampling Protocol

- We used a mixed behavioral sampling design including scan and continuous sampling methods.
- Anthropogenic disturbances (e.g., vessels, human presence) were recorded when observed. Distance to the rookery was estimated, and corresponding behavioral responses (e.g., alert, movement, flushing) were documented.

Results

H1: Entanglement & Dungeness crab fishery Seasonality. Not Supported
Although marine debris was observed, insufficient temporal data (early peak and low-activity periods) limited our ability to detect seasonal patterns in entanglement prevalence.

H2: Tidal Activity & Haul-Out Abundance. Not Supported
No significant relationship was observed between tidal activity and sea lion haul-out abundance.

H3: Anthropogenic Disturbance & Haul-Out Abundance. Not Supported
Haul-out abundance did not vary significantly with increased anthropogenic disturbance.

Unanticipated Finding Domoic Acid Toxicosis Symptomology

One (potentially 2) sea lion exhibited symptoms consistent with DA toxicosis (e.g., vomiting, head swaying).

Figure 1. *Observed Habitat*

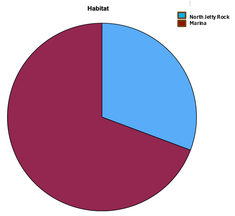


Figure 2. *Observed Injury Type*

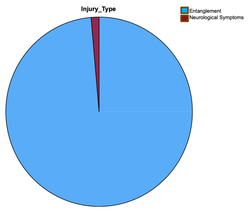


Figure 3. *Weather at Observations*

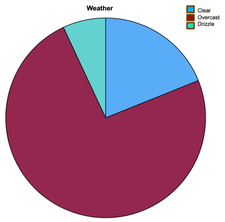


Figure 4. *Tide at Observations*

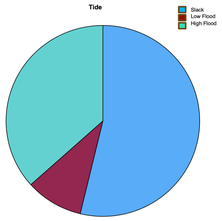
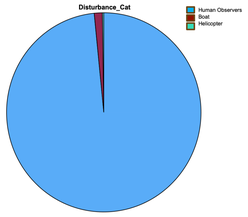
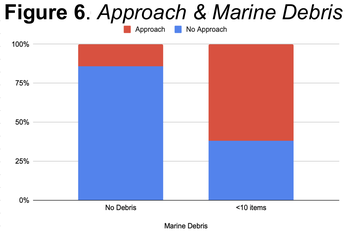


Figure 5. *Observed Disturbances*



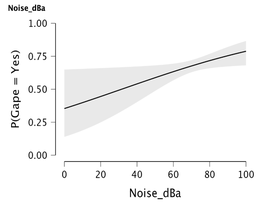
In addition to the predicted outcomes, several notable trends were observed.

Figure 6. *Approach & Marine Debris*



Approach behaviour were observed during days with marine debris, $\chi^2 = 166.22$, p=0.001, $\Phi = 0.495$ (also toward the debris)

Figure 7. *Noise & Gape*



Noise significantly increased the odds of gaping, $B=0.023$, SE = 0.10, Wald $\chi^2 = 4.63$, p= 0.03

Discussion

Confirmed observations of symptoms of DA toxicosis provide evidence that **there is a potential risk of more sea lions with this neurotoxin in the rookery.**

This is important to monitor, collaborate with the Oregon Department of Environmental Protection to treat those affected, and hopefully decrease the spread within the rookery and the marina.

The increased aggression (gaping) associated with anthropogenic noise indicates that **human disturbance affects rookery dynamics.**

Increases in aggressive behavior result in rookery instability, thereby making the haul-out location less desirable; thus, vigilance regarding predictors of instability, such as anthropogenic noise and debris, is important for rookery health.

If marine debris initiates curious exploration (i.e., approach behavior). This could increase exposure to harmful pollutants (e.g., oil, surfactants, etc.), ghost nets, garbage (choking hazards) and potentially further contribute poor body condition and compromised long-term Health. Collectively, they could also result in rookery instability, aggression, and pathogen contagion.

Example of DA toxicosis; Photo credit: Marlin Harms

Example of netting entanglement on a sea lion at Port Dock One, Photo Credit: Makenzie Flanagan, ©2026

Future Directions

- ➢ Over the course of the year, how prevalent is marine debris at Yaquina Bay?
- ➢ Do DA toxicosis symptoms follow offshore variability in upwellings and warm-water anomalies in the nearshore rookery?

Broader Implications

Yaquina Bay experiences high levels of tourism and fishing, which may increase pollutant exposure in sea lion rookeries. Continued monitoring could support policies that reduce environmental disturbance, such as stricter pollution controls or modified marina practices. Understanding the impact of human activity on sea lion behavior is key to determining whether management actions are needed to protect rookery stability.

Seasonally, the risk of domoic acid exposure is highest from late spring through summer into early fall, when upwelling fuels harmful algal blooms, though earlier events can occur under favorable conditions. Accordingly, the observation of two symptomatic males within a Newport rookery in March falls slightly ahead of the typical seasonal peak but is consistent with low-level or emerging bloom conditions rather than a full outbreak. Since the early 2000s, recurring bloom events have produced periodic large-scale strandings and mortality episodes. Better identification of DA symptoms and the timing of the year could inform local management and conservation policies, as well as best practices for visitors along the pier. We will continue this research through 2027 for annual data.

Scan QR Code for References