An Investigation of Southern Sea Otter (Enhydra lutris nereis) Play Among Three AZA Populations: How Play Can Support Otter Conservation, Education, and Welfare

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BACKGROUND

Historically, behavioral ecologists learn about the health and welfare of an animal population by observing them in their natural habitat. These observations may be noninvasive through field surveys, activity budgets, trail cameras, or physical specimens (e.g., scat, hair/fur, and salvage). However, as habitat becomes constrained, climate changes, and populations shift, human-care facilities, preserves, and rehabilitation centers support orphaned, injured, or "nuisance" animals. In their support, they reduce the animals' risk of predation, pathogens, parasites, food scarcity, and other environmental stressors (Miller, Mellen, & Kuczaj, 2013). Animal-care or "captive" contexts, though, introduce new stressors, like boredom, loneliness, constrained space, limited opportunities for biologically relevant behavior (e.g., mating, parenting, foraging/hunting, and territorial management), and obesity (Mason, 2006).

As zoos, aquariums, preserves, rehabilitation, and rescue centers assume the mantle of conservation, rescue, and rehabilitation, it is essential to understand how enrichment, habitat, sexual composition in conspecific populations, age, and reproductive status might affect health and wellness – physically, psychologically, and socially. Play is one of the best behavioral contributors to animal welfare (Brooks & Burghardt, 2023), partly because it disappears when animals are under a fitness challenge. Play varies across genera, and although there are critical similarities across species, some behaviors that look like play may reflect aggression, submission, territoriality, and defense. Therefore, assessing what behaviors covary in bouts of observed play is helpful. Play is often limited to juvenile animals in natural habitats because the essential life-sustaining behavior occupies all their observed play (Held & Spinka, 2011). In human care, animals have a wealth of time unrelated to foraging, hunting, territoriality, etc. In human care, play is observed across generations and sexes in various contexts (Brooks & Burghardt, 2023). To understand what constitutes play and how it might affect frequencies of stereotypy, we conducted a comparative study of three southern sea otter communities, one using in-person observational data (Oregon Zoo) and two using recordings from remote cameras (Oregon Coast Aquarium and Monterey Bay Aquarium). Data collection across the facilities spanned September 2014 through January 2024. We observed approximately 348.72 hours of in-person or Zoom-recorded web camera footage with an average interrater reliability of 91% across observer teams.

Empirical Questions and Predictions

1. What discrete behaviors constitute sea otter play in human care?
2. Does sex composition best predict play?
   HR₁: We predict that bachelor groups, regardless of age, will reflect young sea otter behavior in natural habitats (i.e., ↑ play)
3. What better predicts less stereotypy, quantitative (enrichment number) or qualitative (type) enrichment?
   HR₂: We predict qualitative enrichment (e.g., novelty, cognitive toys rather than food) would negatively correlate with ARBs

METHOD

Southern Sea Otter (*Enhydra lutra nereis*) **Subjects**

These observations include all rescued and rehabilitated captive southern sea otters. From the Oregon Zoo, the population involved five mixed-sex otters [*n=5, Eddie (M), Thelma (F), Juno (F), Lincoln (M), Uni Sushi (F)*], some of whom were not concurrent and have since passed; the Monterey Bay Aquarium with five female otters [*n=5, Rosa, Selka, Kit, Ivy, Abby*], and the Oregon Coast Aquarium's three male otters [*n=3 Oswald, Schuster, Earle*]. OCA is the only facility in this study that has the same composition of sea otter residents. These facilities were selected based on proximity, web camera reliability, and habitat – 80% of all habitats are visible.
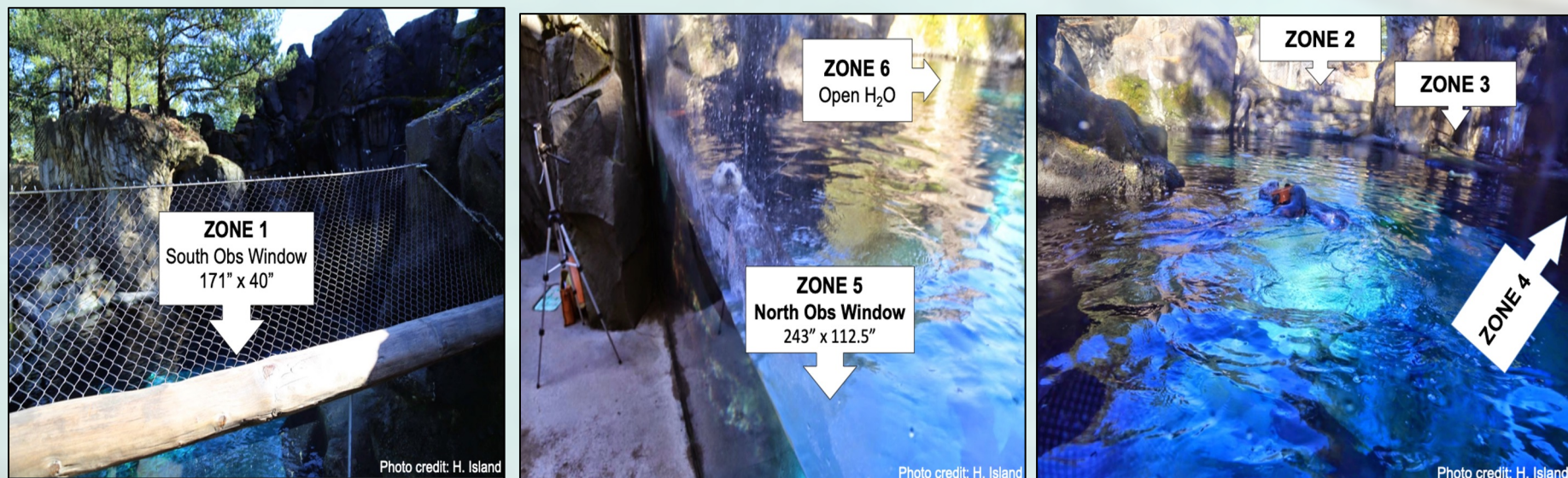
Materials

We assessed our data using a standard behavioral ethogram analogous to the one used in Island, Wengeler, and Claussenius-Kalman (2017), Zoom software, and IBM Statistical Software in the Social Sciences (SPSS).
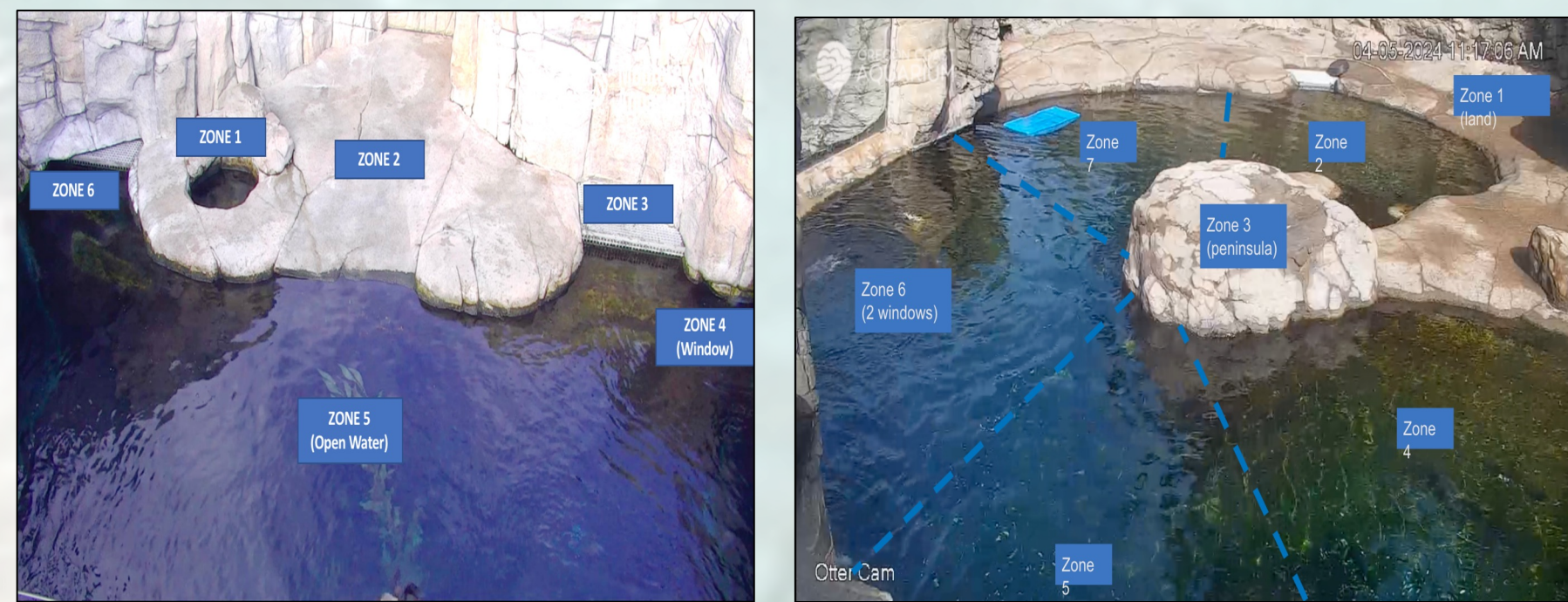
Design and Procedure

This naturalistic study spans 10 years, from 2014-2024, wherein different pairs of observers carried out 0-1 focal scan sampling in 10-minute intervals with 348.72 hours of observation across three exhibits (Oregon Zoo, Monterey Bay Aquarium, and Oregon Coast Aquarium). Observations were recorded using a 41-item ethogram across exhibit zones, noting where the behavior occurred in the exhibit for each facility by otter.

RESULTS

Empirical Questions and Hypotheses

1. What discrete behaviors constitute sea otter play in human care?

One of the objectives of this study was to ascertain differences in play behavior across three populations of human-care Southern Sea Otters (*Enhydra lutris nereis*) based on sex composition, enrichment, and enrichment quality. To assess the constituent behaviors of play, we calculated Phi coefficients for all dichotomous (absent = 0; present = 1) ethogram behaviors, yielding significant coefficients between:
Play bouts and **Enrichment**, $\Phi=0.016$, $p=0.02$; **Chase/Follow**, $\Phi=0.151$, $p<0.001$; **Porpoise**, $\Phi=0.42$, $p<0.001$; **Bite/Nip**, $\Phi=0.03$, $p<0.001$; **Grapple**, $\Phi=0.02$, $p=0.009$; **Forward roll**, $\Phi=0.04$, $p<0.001$; **Backward roll**, $\Phi=0.02$, $p<0.004$; **Paws-to-glass**, $\Phi=0.30$, $p<0.001$; **Backward Dive**, $\Phi=0.03$, $p<0.001$.

2. Does sex composition predict play?

✓ Yes! *HR₁: We predict that bachelor groups, regardless of age, will reflect young sea otter behavior in natural habitats (i.e., ↑ play)*
The comparative data from the three southern sea otter populations show a significant difference in the prevalence of ARBs between mixed sex (OZ, $M=0.03$ $SD=0.18$), female (MBA, $M=0.07$ $SD=0.17$), and male (OCA, $M=0.18$ $SD=0.38$) groups, $F(2)=490.30$, $p<0.001$, $\delta^2=0.05$.

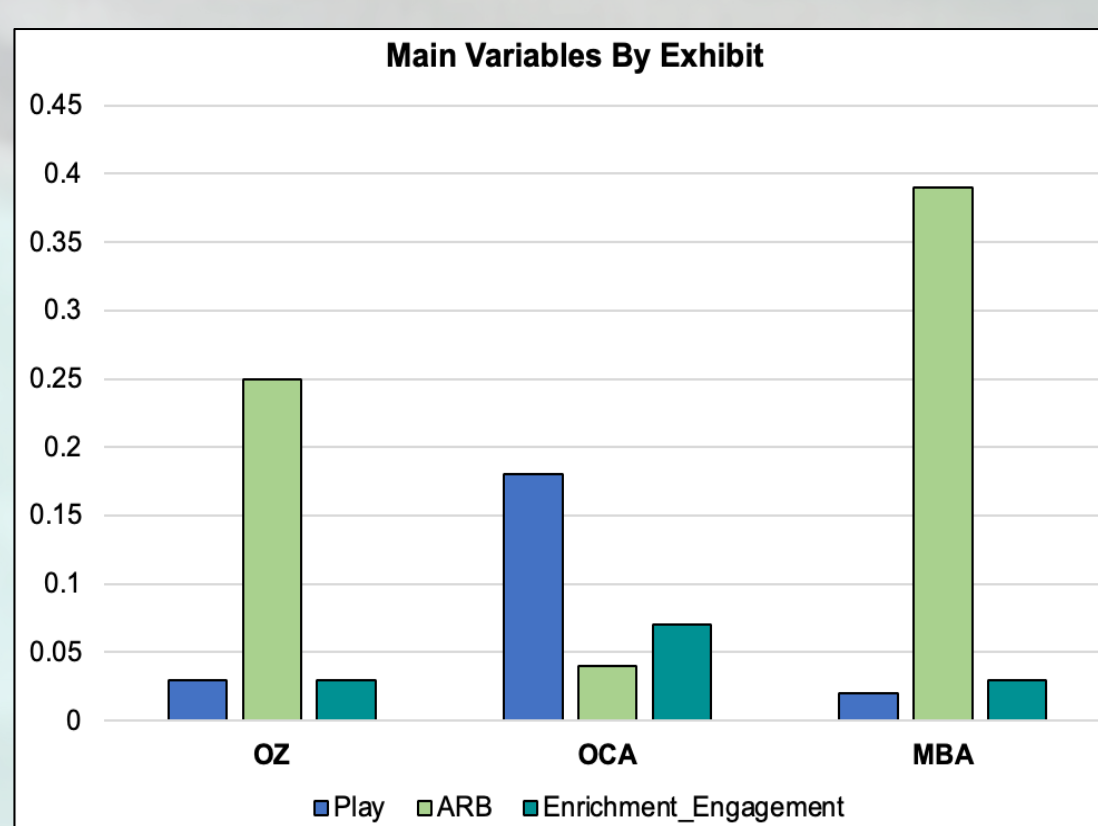**3. Is more better? Does the number of enrichment items (i.e., quantitative) reduce ARBs?**

✗ No. *HR₂: We predicted the number of enrichment items would offer more engagement and fewer ARBs. This was unsupported.*

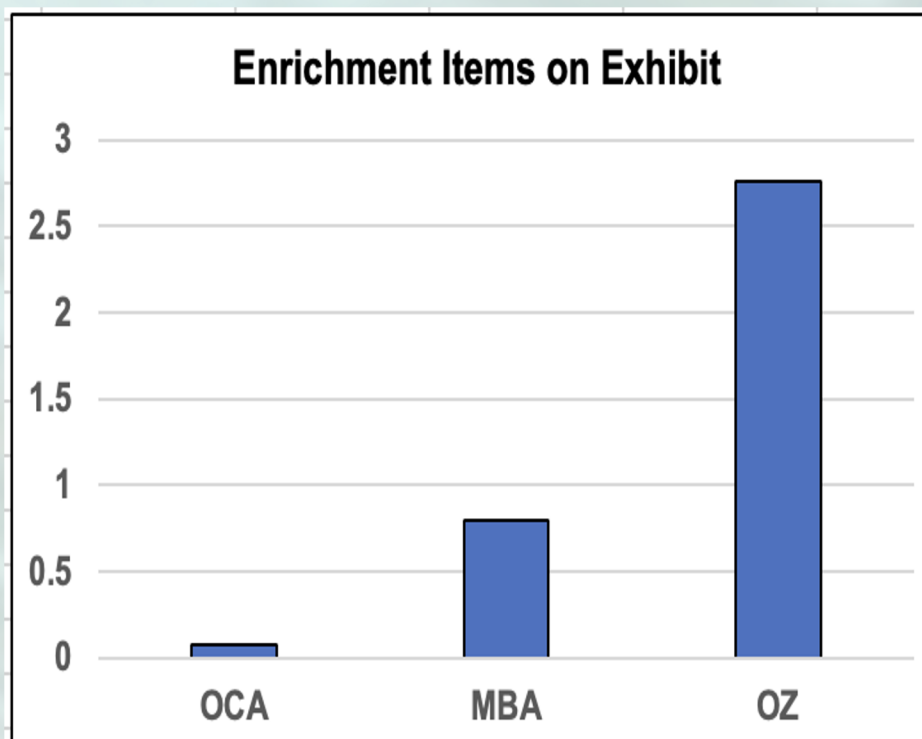**Does the type of enrichment (i.e., qualitative) reduce ARBs?**

✓ Yes! *HR₃: We predicted qualitative enrichment would negatively correlate with ARBs.*

Most ARBs were observed at MBA ($M=0.39$, $SD=0.49$), followed by OZ ($M=0.25$, $SD=0.44$), with the OCA all male otters engaged in very few ARBs ($M=0.04$, $p<0.001$, $\delta^2=0.03$

Oregon Zoo by Established Zones

Monterey Bay Aquarium (L) and Oregon Coast Aquarium (R) by Established Zones

Main Variables By Exhibit

Enrichment Items on Exhibit

Diversity of Enrichment Categories

Selka and Ivy, Monterey Bay Aquarium, 2024
Earle, Oregon Coast Aquarium, 2024

Enrichment Diversity by Engagement Categories

Frozen Food	Physical Engagement	Habitat Engagement	Problem-Solving
Iced Fish	Tower of Babel	Mat	Puzzle ball with treat
Air Fish	Balls	Kelp	Ice rings with treats
Ice	Kong toys	Rope	Shell game w/ buckets
Pumpkin	Unsinkable duck	Turtle Pool	Feeder Log
Clams	Rope Swing	Rope Swing	Frozen water bottle
	Slide	Felt ribbons	Slide
	Jug		Wrapped treats
	Buoy		
	Frisbee Chase		
	Barrell		
	Hoops		

CONCLUSIONS

Play in a captive context is a protective behavior and a marker of wellness. A playful animal reflects a cognitively, socially, and physically healthy animal (Reed-Smith, 2008). The purpose of this study was to identify discrete behaviors that comprise play behavior across three different populations of southern sea otters. To further assess if there were differences based on sex, the facilities were selected in part based on their otters' sexual composition. Additionally, since some of the data collected overlapped with the Shelter-In-Place of 2020 and consequent closures extended into 2021, we also selected facilities based on remote observation ability and the ability to see at least 80% of the exhibit. Finally, we piloted an otter webcam site (n = 10) for the remote observations to account for functionality, reliability, and angle into the exhibit space (Lucey et al., 2020).

We found that the Oregon Zoo had the most enrichment items on exhibit at any one time but the least enrichment engagement. Further, the OZ and MBA otters engaged in more observable stereotypies than the OCA otters, who also had the least number of enrichment items at any time. The OCA otters were provided with more enrichment variety, preventing boredom (a potential source of ARBs) and reducing habituation. This suggests that including habitat enrichment at all times may contribute to familiarity and disinterest. It is also possible that the MBA otters observed during the COVID pandemic were demonstrating reactive ARBs in response to fewer visitors, a potential source of social engagement, one of the five domains of animal welfare (Williams et al., 2021).

PLAY – How it Helps

Play among the three otter populations was associated with the following behaviors: **Grapple** (playful wrestling, decidedly different from agonistic fighting), **Nip/Bite** (non-injurious), **Porpoise**, **Backward dive**, **Paws-to-glass** (used as a platform to push from), **Enrichment Engagement**, **Chase/Follow**, and **Rolls** (e.g., forward and backward). Understanding what constitutes "play" as a welfare variable in human care facilities has far-reaching potential since play occurs only when fitness challenges are absent. This is one reason why it is more frequent in juvenile animals in their natural habitat, liberated from hunting, foraging, finding safety, and breeding, they can engage in play. It is thought that play reinforces maternal and sibling bonds and offers trial runs at predation, mating, and conflict avoidance (Beckel, 1991).

Animal Welfare
✓ Encouraging enrichment opportunities for otter play supports healthy endocrine levels, reduces the load on adrenal function, and further reinforces social attachments among conspecifics.

Visitor Enjoyment
✓ Naturally, playful otters bring greater visitor enjoyment, reinforce the enrichment and health protocols of the zoo or aquarium, and legitimize tax expenditures for facilities that rely on tax money for support (e.g., Oregon Zoo).

Conservation
✓ Recognizing the discrete behaviors that comprise play across diverse contexts helps wildlife and conservation scientists evaluate the health and welfare of individual animals in their natural habitat.

Economic
✓ Healthy animals require less veterinary intervention, may support more time on exhibit, and greater visitor engagement, satisfaction, and return visits (Greggor et al., 2019).

FUTURE DIRECTIONS

This study was limited to zoos and aquariums and, in two cases, remote observations. Although we were careful to use at least two concurrent coders for all observations, the limited sample size and the constraints of observing (remote, glare, limited communication with some of the facilities, etc.) may have introduced third variable problems. To further support the discrete behaviors observed in play, behavioral observation in the field with native otters in their natural habitat is warranted. Further, this research did not include physiological markers (e.g., glucocorticoids, health records, etc.) and endocrine covariates, which would further support this welfare variable. Finally, a more comprehensive comparison of play across the subfamily of Lutrinae, especially using matched samples for sociality (e.g., Giant Otters to Asian Small-Clawed Otters, Eurasian Otters with NARO, etc.), would further support play as a welfare variable in captive and native contexts.

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