CFAES

Department of Animal Sciences – Center for Human-Animal Interactions Research and Education

Establishment of Baseline Levels for California Sea Lion (*Zalophus californianus*) Welfare

Winans, M., Cole, K., Flint, M., and George, K.A.

INTRODUCTION

Although historically zoological institutions acquired animals primarily via collection from the wild, now most accredited zoos in the U.S. translocate animals between institutions[1]. Additionally, removing marine mammals from U.S. water is prohibited, although there are some exceptions for "public display"[2]. As relocation of animals has become more common, stressors associated with relocation are a potential welfare concern[3,4]. In measuring welfare, there has been a recognized need for the use of multiple parameters, particularly in marine mammals[5,6]. Recently, mammalian hair has been evaluated as a biomarker to measure cortisol concentrations as an indicator of potential chronic stress, so this biomarker and behavior will both be utilized in this study[7].

Figure 1. California sea lion from sample population

AIM

As relocation is associated with potential welfare concerns, the objective of this project is to measure the welfare of the Columbus Zoo and Aquarium's California sea lions in response to relocation from Myakka City, FL to Columbus, OH. The phase of the project presented here aimed to establish baseline welfare measures to be used for comparison in future phases of this study. Data was collected while the animals were housed at temporary facilities in Myakka City, FL, and both the physiological parameter of hair cortisol concentrations (HCC) and behavior were measured as indicators of welfare.

HYPOTHESES

1) Sex will have no effect on both behavior and HCC
2) Age will be negatively correlated with HCC, and younger individuals will be less likely to perform inactive behavior than active behavior
3) Change in staff will be negatively correlated with HCC and the likelihood of performing active behavior.
4) Inactive behavior will be more likely than active behavior following a following a staff change and in later periods.

MATERIALS & METHODS

Behavior

- Data collected for 17 months in five periods, using scan sampling method
- Behavior was coded utilizing an ethogram[8,9,10]
- Data analyzed using SAS version 9.4, PROC MIXED model, and LSMeans were assessed with the Tukey adjustment applied.

Hair Cortisol

- Hair sample obtained using electric trimmers to shave approximately two square inches of hair from the dorsal side of the rear, immediately cranial to the hind flippers.
- Samples analyzed via ELISA[11], and data were analyzed using SAS version 9.4, PROC MIXED model, and LSMeans were assessed with the Tukey adjustment applied.

RESULTS

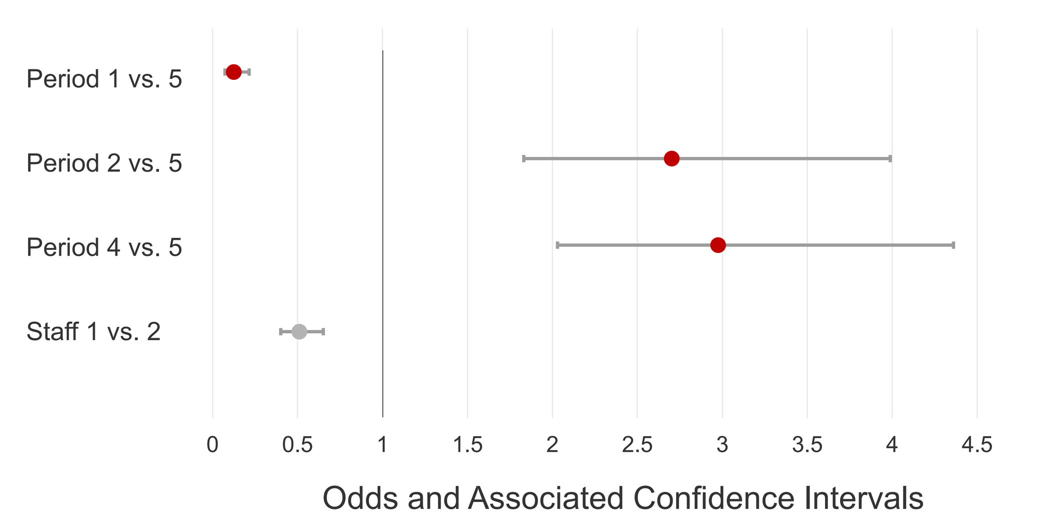
Behavior

Table 1. Odds Ratios Estimates for Group

Comparison	Odds Ratio	95% Confidence Interval
Period 1 vs. 5	0.125*	(0.073, 0.215)*
Period 2 vs. 5	2.702*	(1.831, 3.988)*
Period 3 vs. 5	1.348	(0.928, 1.957)
Period 4 vs. 5	3.006*	(2.050, 4.408)*
Staff 1 vs. 2	0.509*	(0.399, 0.649)*
Female vs. Male	1.899	(0.732, 4.924)
Age 1 vs. 23	1.801	(0.238, 13.643)
Age 13 vs. 23	1.010	(0.212, 4.819)

Significant comparisons are denoted by an '' following the odds ratio and confidence interval.*

Figure 2. Odds Ratio Comparisons of Group Behavior



RESULTS

Behavior, cont.

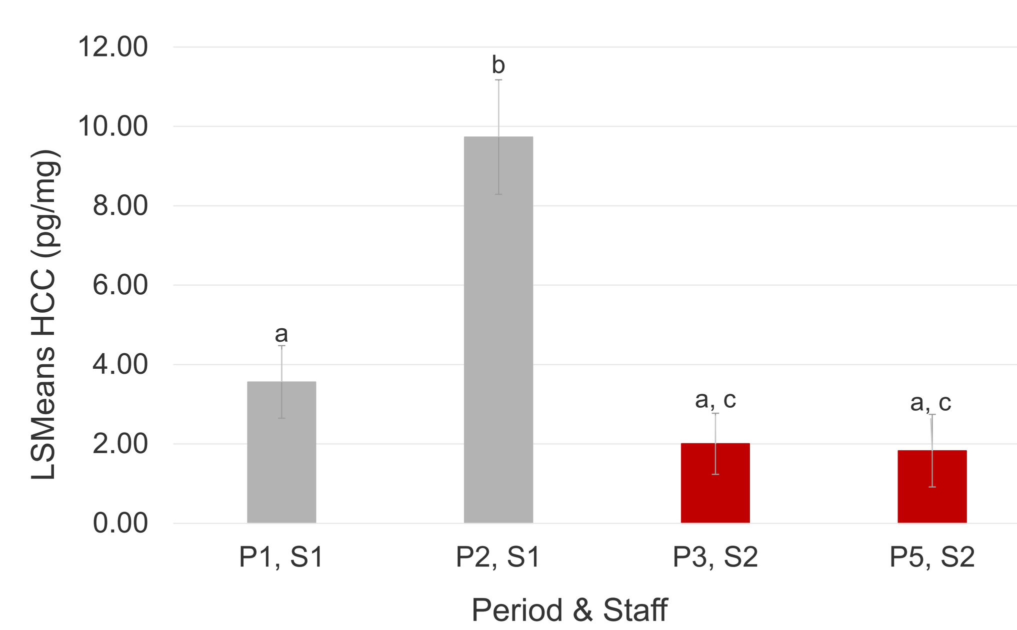
- Factors that significantly impacted the odds of performing inactive behavior over active behavior were period ($p < 0.0001$) and change in training staff ($p < 0.0001$), while sex had no effect ($p = 0.39$).
- Due to large variation in age of individuals, age was not able to be included in this analysis
- All odds ratio comparisons are detailed in Table 1
- See Figure 2 for odds ratios and associated CI's of significant factors

RESULTS

Hair Cortisol

- Age was significantly correlated with HCC between juvenile and adults (age 1 and 13, $p = 0.01$, age 1 and 23, $p = 0.02$), but not within adults (age 13 and 23, $p = 0.7553$)
- No effect of sex on HCC ($p = 0.85$)
- Change in training staff also significantly positively correlated with HCC ($p = 0.03$)
- Period was significantly correlated with HCC ($p = 0.01$), see Figure 3 below for depiction of HCC across periods and change in training staff

Figure 3. Hair Cortisol Concentrations across Periods



DISCUSSION & CONCLUSION, cont.

- Sex had no effect on both HCC and likelihood of active behavior, although this may be due to the 2:5 female to male ratio in our sample.
- Contrary to our hypothesis, we found no effect of age on likelihood of active versus inactive behavior, but did find that adults had significantly higher HCC than the juvenile.

DISCUSSION & CONCLUSION, cont.

- Results supported the hypothesis that change in staff, from variable to consistent staff members, was negatively correlated with HCC.
- Results also supported the hypothesis that period and change in training staff were significantly associated with the likelihood of performing inactive versus active behaviors.
- Results indicate period and training staff to be predictors of both HCC and behavior in zoo-housed California sea lions, which is consistent with previous literature on animals in human-care[4].
- The effects of age and sex on HCC are uncertain[7], but this study suggests there is no effect of sex, and an effect of age only between juveniles and adults.
- This study contributes to the gap in marine mammal welfare literature[6] by establishing a species-specific range of HCC values and assessing these values in response to potential welfare concerns.
- These findings will serve as the baseline measures for the sample population and will be assessed against post-relocation measures to determine the impact of transport and relocation on the animals' welfare.

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