

**NEXT STEPS TOWARD OPTIMAL WELFARE FOR CALIFORNIA SEA LIONS  
(*ZALOPHUS CALIFORNIANUS*) IN ACCREDITED ZOOS AND AQUARIUMS**

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## **Abstract**

The welfare of zoo-housed California sea lions (*Zalophus californianus*) has not been comprehensively analyzed in the literature. This study begins to address this gap by gathering information on current care and management practices affecting welfare via a survey of accredited facilities housing California sea lions in the United States. The survey focused on areas of care and management indicated by accreditation standards and available literature to have an outsized impact on the presence of positive welfare states. The primary areas of focus were training, enrichment, social behavior, and human-animal interactions. The survey findings were compared to available peer-reviewed literature to identify the care practices that promote positive welfare states, validate current care and management practices, and make recommendations to optimize current care and management practices. Many of the practices described in the survey results seem to contribute to positive welfare states. Beyond using training to physically and mentally stimulate the animals, facilities are encouraged to optimize session frequency and quality to maximize learning efficiency and to broaden the use of behavioral modification techniques outside of typical training sessions to reinforce other desirable behaviors. In terms of enrichment, facilities are encouraged to develop clearer goals and evaluation processes, as well as to implement new enrichment more frequently. California sea lion social groups should be large in size or dynamic in management to encourage species-typical social behavior. Finally, we found that interactions between staff and sea lions, as well as between guests and sea lions, have the potential to positively affect welfare if the sea lions have agency over their participation. This survey offered some useful information into understanding the welfare of California sea lions living in accredited zoological facilities in the United States and offers additional avenues of inquiry for future welfare research.

## Introduction

### *Welfare Science in Zoological Facilities*

Achieving high levels of welfare for resident animals is a key priority for accredited zoological institutions. Beyond an ethical obligation, optimal animal welfare supports better breeding, research, and education programs, all contributing to zoological facilities' ultimate mission of conserving wildlife.

Animal welfare refers to an animal's collective physical, mental, and emotional states over a period of time (*Animal Welfare Committee*, n.d.). Historically, zoological welfare research has focused on mitigating risk factors associated with poor welfare. These early welfare measurements included a focus on indicators of poor health, such as reduced life expectancy (e.g., Mason & Veasey, 2010), reduced reproductive viability (e.g., Hartley, 2016), or the prevalence of disease (e.g., Kuhar et al., 2012). As welfare science has developed, zoological welfare frameworks now promote positive experiences in addition to minimizing negative experiences (Whitham & Wielebnowski, 2013).

As suggested by Boissey et al. (2007), positive welfare states are the product of the "presence of positive experiences, such as pleasure." Positive experiences that contribute to a positive welfare state may also include having control over environmental outcomes (Pines et al., 2007; Sambrook & Buchanan-Smith, 1997;), making choices (Leotti et al., 2010; Verspeek & Stevens, 2020), or having opportunities for problem-solving (Clark, 2011; Harley et al., 2010; Krebs & Watters, 2017). While some welfare components can be addressed at the population level, individual preferences and perspectives inform what makes an experience positive and may vary significantly from one individual to another.

While participation in welfare research by zoological collections has expanded, the welfare of marine mammals in zoological facilities is comparatively understudied (Clegg & Delfour, 2018). A few species of cetaceans (primarily *Orcinus orca* and *Tursiops truncatus*) are the subjects of most marine mammal welfare research. These findings have primarily investigated health and physiology and have revealed little about other welfare domains (Clegg & Delfour, 2018).

### *Current State of California Sea Lion Welfare in Zoological Facilities*

California sea lions (*Zalophus californianus*) in zoological facilities often capture the attention of the visiting public with their dynamic behavior and charismatic personalities; however, as a species, they have not received the same welfare research attention as other high-profile species (Rose et al., 2019). The reason for the lack of research exclusively centered on California sea lions may be attributed, in part, to the absence of clear negative welfare indicators among this species, which initially motivated welfare research in other animals. According to the Association of Zoos and Aquariums, the median life expectancy of California sea lions in AZA-accredited facilities is 23.3 years. This is compared to a median life expectancy of 7.7 years for males in the wild and 11.1 years for females in the wild (Hernández-Camacho et al., 2008). California sea lions reproduce readily in zoological facilities. Naturally found along rugged, rocky coastlines in various climatic conditions, California sea lions are physiologically primed to cope with diverse physical environments (Aurioles-Gamboa, 1988). These adaptations may make California sea lions more successful at adapting to various environments in zoological facilities.

The lack of welfare research on these animals suggests they require species-specific investigation to be able to assess and ensure optimal welfare. Further investigation into California sea lion welfare may improve current practices and serve as a case study for optimal care and management practices for other species. If California sea lions are flourishing in zoological facilities, their care and management practices may serve as a valuable model for other zoo-housed species. Indeed, an early appeal for evidence-based management in zoos by V.A. Melfi suggested a protocol for promoting positive welfare in the interim as species-specific evidence develops: “Identify animals that are thriving in zoos and replicate the conditions they are kept under to manage their conspecifics in zoos.”

As a result of their historic role as performers for the visiting public, marine mammals like California sea lions have traditionally been managed with significantly more training and behavioral management than most other species housed in zoological collections. California sea lions' unique care and management practices are worth investigating in terms of their positive and negative impacts on animal welfare.

In the United States, regulatory frameworks for animals in zoological institutions are designed to meet basic welfare needs. All exhibitors displaying California sea lions must be

licensed by the United States Department of Agriculture (hereafter USDA) and follow the standards of care that are outlined in the Animal Welfare Act (hereafter AWA). The purpose of these standards is to prevent harm to the animals and were designed to ensure “humane care and treatment” for animals in public exhibitions (7 U.S.C. § 2131(1), 1976). The regulations set forth by the AWA include guidelines for food, veterinary care, and housing that is safe and comfortable. These minimum standards provide a rudimentary framework to ensure zoo-housed animals are not exposed to conditions that would cause negative welfare states.

“Accredited” facilities follow additional standards designed to further elevate animal welfare. The Association of Zoos and Aquariums (hereafter AZA), the Zoological Association of America (hereafter ZAA), and The Alliance of Marine Mammal Parks and Aquariums (hereafter AMMPA) are three key zoological accrediting organizations with members in the United States who house California sea lions. To become accredited by these organizations, facilities must meet their respective standards for various operational practices, including animal care and management. In addition to offering more stringent guidelines on topics covered by the AWA, these accrediting bodies lay out additional requirements in more advanced components of animal care like training and enrichment.

### *Factors Affecting Positive Welfare States in Zoo Animals*

Previous welfare research indicates several recurring components of care and management that may have an outsized impact on creating positive welfare states: training, enrichment, social management, and human-animal interactions (Brando, 2018). These four components of care and management impact behavioral welfare and affective state, which correspond with positive welfare states.

Training in a zoological setting typically refers to the conditioning of specific behaviors primarily through operant conditioning, usually with an emphasis on positive reinforcement. Through this process, desirable behaviors are conditioned to occur in response to a particular stimulus. Training has been a central component of the care and management of marine mammals (including California sea lions) since the conception of marine parks (Gillaspy et al., 2014).

The Association of Zoos and Aquariums broadly define enrichment as “a process to ensure that the behavioral and physical needs of an animal are being met by providing

opportunities for species-appropriate behaviors and choices” (*AZA Enrichment Guiding Principles*, n.d.). Historically, the provisioning of enrichment included the addition of novel stimuli to an animal’s environment (Young et al., 2019). However, in recent years, enrichment has become more intersectional and incorporates a variety of social, cognitive, behavioral, and sensory opportunities and should be “goal-based” i.e. designed to target behaviours in the animals’ repertoire which may improve welfare (Monreal-Pawlowsky et al., 2021).

Social management refers to the husbandry practices that impact the composition of conspecifics with whom an animal spends time, as well as the relationships and behavior between animals. The dynamics within social groups of animals may affect the frequency and intensity of affiliative and agonistic behaviors (Rose & Croft, 2015; Williams et al., 2019). These interactions between animals not only affect behavioral welfare but may also impact affective state or physical health, depending on their nature.

Human-animal interactions are often emphasized in farm animal welfare frameworks because of their potential to create significant fear, stress, and negative experiences for the animals (Zulkifli, 2013). In zoological facilities, animals are also exposed to many forms of interaction with humans, from the visiting public observing their habitats to keepers directly engaging with them as part of their husbandry. These various interactions significantly influence the ultimate welfare of animals living in zoos (Cole & Fraser, 2018).

To evaluate how these components of care are impacting the welfare of California sea lions in zoological facilities, we created a survey for accredited facilities in the United States housing California sea lions. The goal of the survey was to better understand the current care and management practices across the range of accredited facilities housing California sea lions. It was designed to be easy to complete, encourage participation as much as possible, and be a starting point for further California sea lion welfare research. The primary goals of this study are to (1) identify the care practices that seem to promote positive welfare states in California sea lions, (2) validate current care and management practices based on published studies with other species, (3) and make recommendations to optimize current care and management practices.



## Methods

### *Study Design*

This study uses a survey designed to fill gaps in the existing literature by gathering information about current care and management practices for California sea lions in accredited zoological facilities in the United States. The survey was created and distributed via Qualtrics. It consisted of 67 questions, including multiple-choice, free-response, and rank-choice. The questions were broken down into seven categories. Five of the categories were the five areas of care and management determined to have an outsized impact on welfare states: training, enrichment, social management, and human-animal interactions. An additional section asked questions about general sea lion welfare and the importance of various welfare domains. The survey also included a basic information section that collected information regarding the participating facility, the individual completing the survey, and basic demographic information about the sea lions living in the facility and the staff that care for them.

This study specifically focused on examining accredited facilities, as opposed to all facilities licensed by the United States Department of Agriculture (USDA), with the intention of selecting those facilities that are already surpassing the minimum welfare standards and actively striving to establish and maintain positive animal welfare conditions. The three accrediting bodies for this study are The Association of Zoos and Aquariums (AZA), The Zoological Association of America (ZAA), and The Alliance of Marine Mammal Parks and Aquariums (AMMPA). The requirement for a facility to be located in the United States was implemented to streamline the institutional review board (IRB) process.

### *Population and Sample*

The studied population is accredited zoological facilities housing California sea lions in the United States. For the purposes of this study, a zoological facility includes any zoo, aquarium, marine park, oceanarium, or related facility open to the general public and licensed as an exhibitor by the USDA/APHIS. The population, which totaled 56 facilities, was determined from lists of accredited facilities published by each accrediting body, cross-referenced against USDA/APHIS inspection reports to confirm that the facility houses California sea lions. Each facility was invited to participate and designate a representative directly involved in the care and management of the collection of sea lions to complete the survey on behalf of the facility. Of the

56 facilities, 35 responded to the survey invitation. Of those 35, 23 indicated they were willing to participate, and 21 facilities completed the survey. The 21 facilities that participated in the survey represent approximately 38% of the total population of accredited facilities in the United States housing California sea lions.

There were three requirements for the individual completing the survey, which they confirmed as part of the informed consent section of the survey: (1) they are at least 18 years of age; (2) they are currently employed in a full-time capacity at an Association of Zoos and Aquariums (AZA), Zoological Association of America (ZAA), or Alliance of Marine Mammal Parks and Aquariums (AMMPA) accredited facility located in the United States of America housing California sea lions; (3) they have a reliable knowledge of the individual sea lions and the care and management practices of their facility.

#### *Data Collection Methods*

All facilities were invited to participate via email. AZA facilities were contacted via their respective institutional representative for sea lions. ZAA and AMMPA facilities were contacted via email addresses available on their websites or available via the International Marine Animal Trainers (IMATA) membership directory. The survey was distributed via an anonymous Qualtrics link, and participants were given approximately four weeks to complete the survey. Survey results were received from participants from January 24th, 2023, to March 31st, 2023. The only question participants were required to complete was an informed consent acknowledgment. All 21 respondents answered each of the 67 questions.

## **Training**

### *1.1 The Effect of Training on Positive Welfare*

Training in a zoological setting involves the conditioning of desired behaviors to occur under the presence of specific stimuli. The training process contributes to positive welfare by offering animals opportunities for choice and control, promoting species-typical behavior, offering physical and cognitive challenges for animals, and building a trusting relationship between animals and their care staff. The questions about training in the survey were designed to better understand the procedures and frequency of training at responding institutions, as well as

to understand the goals of training, what husbandry behaviors are trained, and how animals are given agency in the training process.

### 1.2 Training Priorities

Although the training methods for conditioning sea lion behavior bear resemblance to those employed when marine mammal training began in the 1940s, there has been a shift in the goals of today's training. Most facilities indicated that husbandry training was their top priority. Husbandry training is defined as training animals to participate in their own health care (Ramirez, 2012). As such, responses that include the “husbandry” or “medical” can be considered a response for husbandry training.

*Table 2. Training Priorities and Public Viewing of Training Sessions*

Facility:	What are the training priorities at your facility?	Does your facility offer training sessions for public viewing?
Facility 1	husbandry and guest connection	Yes
Facility 2	Medical behaviors are first priority. Then fun/exercise behaviors.	Yes
Facility 3	Husbandry, mental and physical stimulation and activity	Yes
Facility 4	medical behaviors that the animals can voluntarily participate in: ultrasound, xray, blood draws, eye drops, teeth brushing	Yes
Facility 5	Mainly treating/looking at wounds and body presentation behaviors, and other medical behaviors like voluntary injections or crate, exercise/enrichment behaviors also occur such as porpoises or barks	Yes
Facility 6	Husbandry behaviors (ideally blood draw, X-ray, toothbrushing, etc.) are the main goal - working towards these currently by training more "foundation" behaviors (laying down, duration, desensitization to novel people or objects). We mix these husbandry goals with small, "fun" behaviors to interrupt the harder husbandry behaviors.	Yes
Facility 7	husbandry, interactions programs, show, cognitive	Yes
Facility 8	Husbandry, gating, encounters with guests	Yes
Facility 9	Husbandry behaviors and show behaviors	Yes
Facility 10	Husbandry	No
Facility 11	Voluntary medical behaviors, behaviors that indirectly improve their health (endurance, flexibility, agility, etc.), natural behaviors, mental stimulation/complex behaviors and behaviors that seem positive to that individual. that	Yes
Facility 12	husbandry, public presentation, relationship, medical	Yes
Facility 13	Husbandry care, shifting on and off habitat, new training for mental stimulation	Yes
Facility 14	Husbandry, training new behaviors	Yes
Facility 15	Safety behaviors - shifting, staying, backing up, going to the water, allowing a gate to be closed keeping them in a certain area - Husbandry - getting on a scale, blood draws, voluntary injections, eye drops, mouth checks/tooth brushing, tactile	Yes
Facility 16	husbandry (blood draws, ultrasounds, x-rays), high energy behaviors (porpoises, fast swims)	Yes
Facility 17	Husbandry behaviors, Mental stimulation, Physical Exercise	Yes
Facility 18	Medical & husbandry behaviors	Yes
Facility 19	Reinforce anything but aggression, training as enrichment, shows & programs	No
Facility 20	Husbandry behaviors	Yes
Facility 21	Husbandry 1st, then mental stimulation and physical challenging	No

Many zoological facilities housing sea lions continue to offer training sessions specifically for public viewing. 90% of facilities that responded to the survey (19 out of 21) said they offered training sessions specifically designed for public viewing (Table 2). Formalized training sessions designed for public viewings, such as narrated keeper talks and scripted presentations, are important for conservation education. Zoological park visitors have shown a marked increase in animal knowledge and commitment to conservation actions after attending live animal presentations in zoological facilities (Heinrich & Birney, 1992, Miller et al., 2012, Spooner et al., 2021).

The survey results indicated that husbandry activities were the primary training focus for most facilities. Nineteen of 21 facilities that responded to the survey listed husbandry/medical training as their first training priority (Table 2).

Participation in husbandry training can improve physical health outcomes. When animals are trained to participate in husbandry behaviors, zoological care and health teams can provide better preventative and reactive healthcare. Conditioning for voluntary participation in husbandry procedures can also improve welfare by decreasing animals' stress responses. Stress indicators are lower when animals are trained to participate voluntarily in medical procedures (Desportes et al., 2007). The training of California sea lions to perform husbandry behaviors serves to mitigate negative welfare states by improving physical health outcomes. Furthermore, the implementation of husbandry training practices fosters positive experiences for the animals by transforming potentially stressful medical interventions into voluntary, reinforcement-based opportunities. The widespread use of husbandry training at responding facilities shows how facilities are already working to improve affective state by reducing the stress of medical interventions and reframing an animal's voluntary participation in their healthcare as an opportunity for positive reinforcement.

### *1.3 Husbandry behaviors*

Husbandry training refers to conditioned behaviors related to an animal's physical health. Examples of this training include conditioning the animal to allow examination of different body parts and more intensive diagnostics such as positioning for radiographs and ultrasounds. Additionally, many marine mammals are trained to participate in more intensive medical interventions like receiving intramuscular injections, ophthalmic medications like eye drops, or gastric sampling.

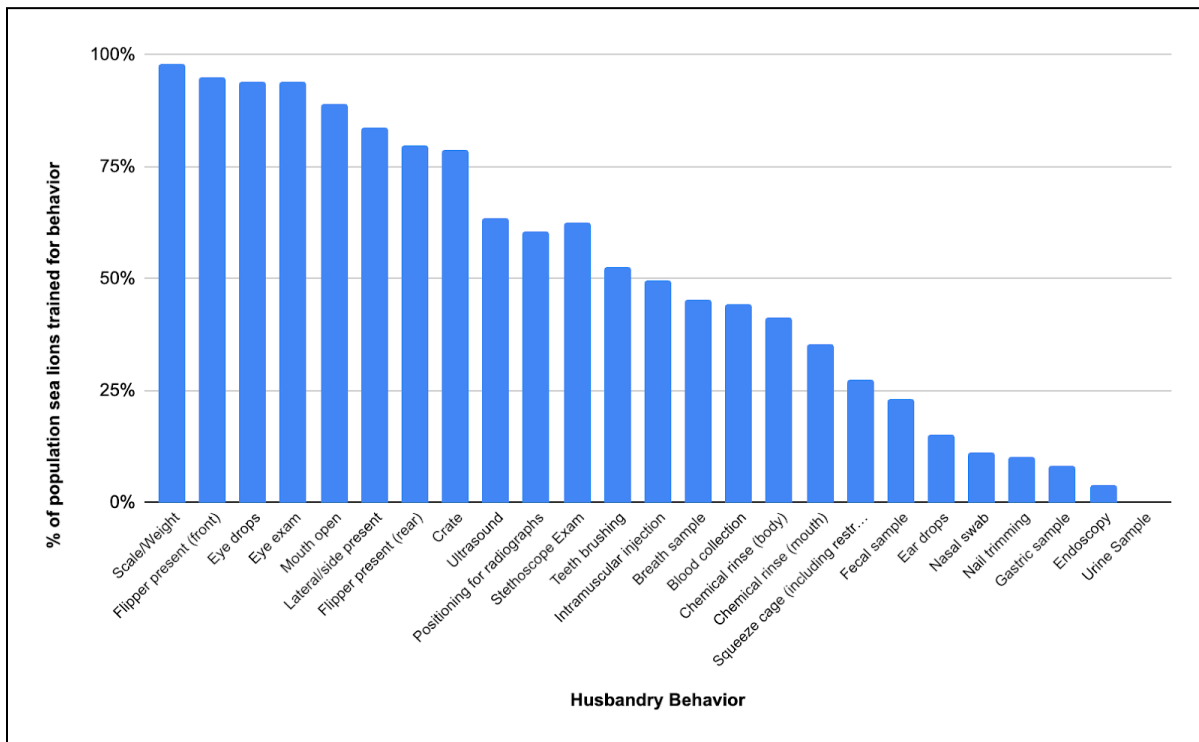
To better understand how comprehensive husbandry training programs are, we asked responding facilities to indicate how many sea lions at their facility were trained for various husbandry behaviors. Table 3 and Figure 2 detail how many California sea lions were trained for each husbandry behavior from the total sample population. Individuals from every responding facility were trained for multiple husbandry behaviors.

*Table 3. The number of California sea lions trained for husbandry behaviors*

Behavior:	Total number of sea lions trained for behavior (n=99)	Number of sea lions trained for behavior at facilities with four or more training sessions/day (n=45)	Number of sea lions trained for behavior at facilities with three or fewer training sessions/day (n=21)
Scale/Weight	97	45	19
Flipper present (front)	94	44	17
Eye drops	93	42	18
Eye exam	93	44	16
Mouth open	88	38	17
Lateral/side present	83	40	10
Flipper present (rear)	79	36	11
Crate	78	42	6
Ultrasound	63	30	10
Positioning for radiographs	60	28	10
Stethoscope Exam	62	32	7
Teeth brushing	52	21	9
Intramuscular injection	49	23	11
Breath sample	45	27	8
Blood collection	44	27	6
Chemical rinse (body)	41	32	5
Chemical rinse (mouth)	35	22	4
Squeeze cage	27	11	7
Fecal sample	23	16	1
Ear drops	15	12	2
Nasal swab	11	11	0
Nail trimming	10	4	5
Gastric sample	8	5	2
Endoscopy	4	2	1
Urine Sample	0	0	0

Table 3, above, indicates the number of sea lions from the total sample population trained for specific husbandry behaviors. Across all 21 responding facilities, there were 99 total California sea lions (n=99). Table 3 also stratifies the data based on the number of training sessions at responding facilities based on the responses in Table 1. Facilities were separated into two groups: those with four or more training sessions per day (n=45 sea lions) and those with three or fewer training sessions per day (n=21 sea lions). Figure 2 visualizes the data from Table 3 as percentages of the sample population.

*Figure 2. Percentage of sample population individuals trained for various husbandry behaviors*

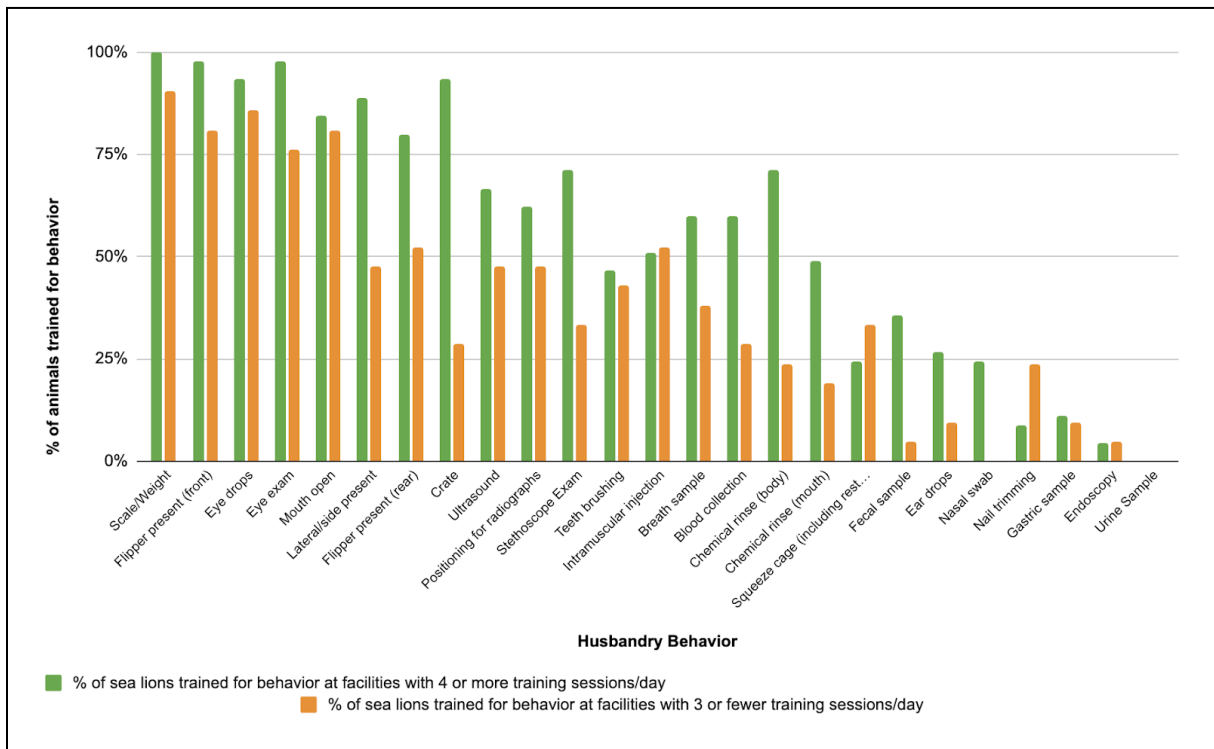


The most commonly trained husbandry behaviors were positioning on a scale to measure an individual's weight, presenting their flippers for examination, eye examination/receiving eye drops, and open mouth. These behaviors may be more commonly trained because they are less invasive than more complex husbandry behaviors like blood collection or ultrasound.

Animal participation in husbandry training is not only a product of the operant process but also largely dependent on the trusting relationship that develops between zoological care staff and the animals (Brando, 2010). Training sea lions for less invasive husbandry interventions creates a foundation of trust to allow for more complex and intensive interventions. Additionally, four of the five most commonly trained husbandry behaviors are utilized for preventative care. A robust preventative health care program allows zoological staff to identify potential health issues promptly to avoid more intensive intervention.

If husbandry training contributes to optimal welfare, optimizing the training program to produce productive results is essential. When comparing responding facilities with four or more training sessions a day to facilities with three or fewer training sessions a day, facilities with four or more training sessions had a higher percentage of California sea lions trained for 21 out of 24 husbandry behaviors (Figure 3).

*Figure 3. Percentage of individuals trained for various husbandry behaviors at facilities with four or more training sessions per day vs. facilities with three or fewer training sessions per day.*





We cannot draw firm conclusions from the comparison of facilities with three or fewer sessions per day versus those with four or more sessions per day because of the difference between the sample sizes of each group (4 or more sessions, n=45; 3 or fewer sessions, n=21). Additionally, only 13 of the 21 responding facilities were included in this comparison due to varying numbers of daily training sessions. Training sessions vary in length, and there could be many other factors that influence this discrepancy. However, facilities are encouraged to assess how the number of training sessions could be optimized to maximize their animals' learning output.

#### *1.4 Temporal Predictability of Training Session Times*

Previous research indicates that the temporal arrangement and predictability of training sessions can have an effect on animal behavior outside of training sessions. In order to evaluate the possible implications of these findings for California sea lions, we asked facilities about the timing, frequency, predictability, and duration of their training programs.

Several studies of zoo-housed species suggest that temporally unpredictable feeding events promote adaptive behavior to overcome the uncertainty of food provisioning (Greco et al., 2016 [elephants], Reneerkens et al., 2002 [shorebirds], Shepherdson et al., 1993 [small felids]). These findings highlight the prevailing practices in most zoological facilities to create as much variability as possible. The implementation of temporal variability in routine care regimes is based on the concept that, under predictable schedules, exploratory motivation may lose its functional purpose within the confines of a zoological setting and instead result in the development of stereotypic or repetitive behavior (Bassett & Buchanan-Smith, 2007).

In contrast to these findings, a 2021 study of cetaceans in zoological facilities found that dolphins subject to training sessions that occurred at predictable times each day exhibited higher behavioral diversity and higher distance traveled per hour than dolphins whose training sessions occurred on a more variable schedule (Miller et al., 2021a, Miller et al., 2021b).

The authors of the Cetacean Welfare Study referenced above suggested that temporal predictability of feeding events may instead increase an animal's awareness of when training sessions occur so they can spend more time outside of sessions engaged in a more diverse array of behaviors and spend more energy in normal physical activity (Miller et al., 2021b). The Cetacean Welfare Study offers relevant insight into the management of California sea lions, not

only because of the physiological similarities between the species of marine mammal but because of the important distinction in the type of feeding opportunity.

Previous research concluding that unpredictable feeding events improve welfare primarily referenced feeding opportunities that included limited mental and physical engagement. The elephants were mainly offered piles of hay, the cats were offered ground feline diet behind exhibit furniture, and the shorebirds were given food set on trays. In contrast, the dolphins' feeding opportunities came in the form of a training session which required the animals to engage more of their physical and mental faculties.

Figure 4. Visualization of session times

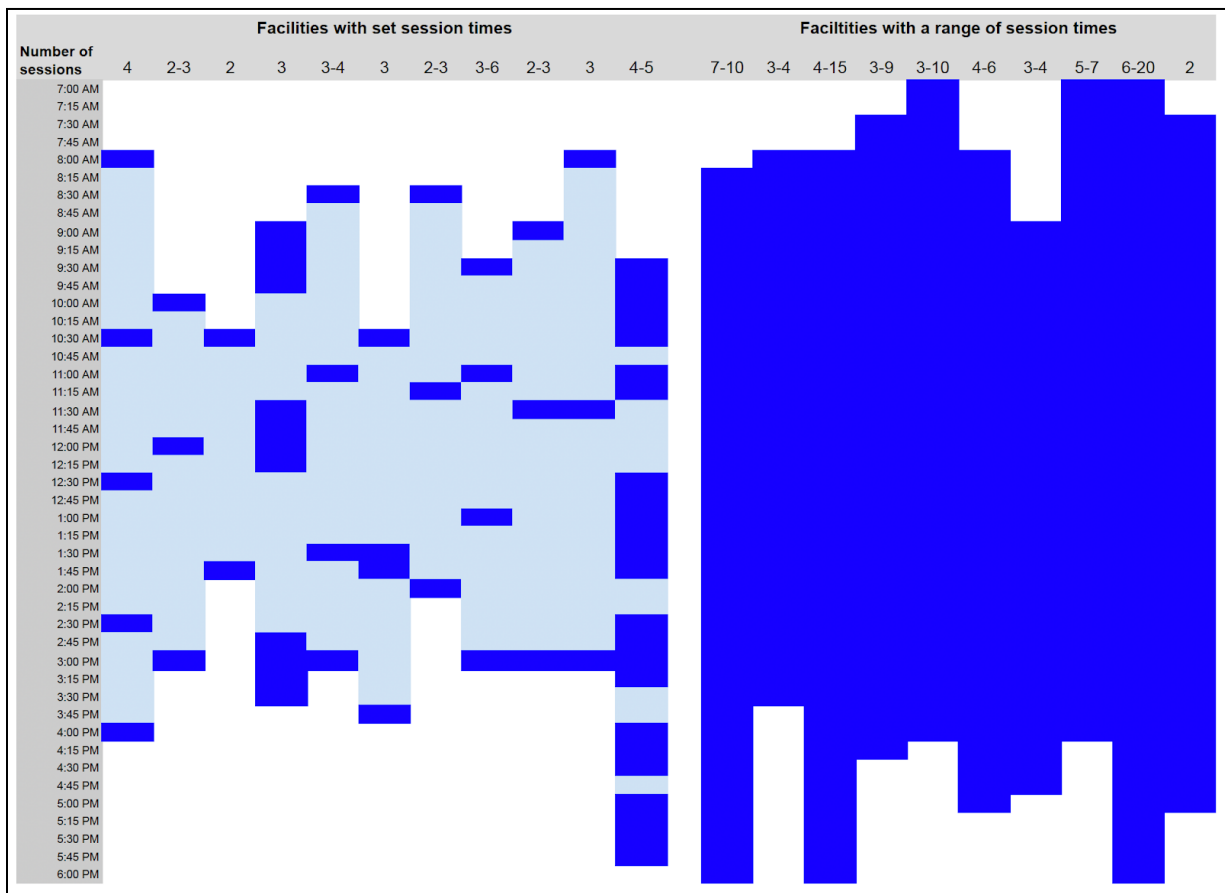


Figure 4 displays when training sessions occurred at each facility. The number of training sessions each facility conducts is listed in the first row above the respective column. For the facilities with set session times, the dark blue bars indicate each session; the light blue indicates the time between sessions. For the facilities with a range of session times, the dark

blue bars indicate the periods during which sessions may occur. Excluded from this visualization were late-night sessions that facilities indicated only occurred seasonally or on an occasional basis.

As depicted in Figure 4, eleven facilities reported that sessions occur at the same time every day, while ten reported sessions do not occur at the same time. This even divide regarding session timing is not uncommon. The 2015 review of elephant management practices found that 45.7% of facilities fed their elephants on a predictable schedule (Greco et al., 2016). The 2021 Cetacean Welfare Study reported that 34% of facilities to conduct training sessions on a predictable schedule (Miller et al., 2021b). These diverging practices may result from practical limitations like staff scheduling or a lack of understanding of the impact of temporal predictability of feeding opportunities on animal behavior and welfare.

All 21 facilities reported that sessions typically occur between 7:00 AM and 6:00 PM (Figure 4). Several facilities reported seasonal variations in programming that resulted in occasional sessions later in the evening, such as “night shows.”

The foraging behavior of California sea lions in range populations varies considerably depending on several factors such as location, sex, time of year, and the behavior of available prey species (Costa et al., 2007, Feldkamp, 1987). Foraging bouts tend to occur in multiple clusters between sunrise and sunset (Feldkamp et al., 1989), which indicates that California sea lions in zoological settings could easily adapt to consuming their daily food intake during a restricted period. However, there is currently no empirical evidence to suggest that the 7:00 AM to 6:00 PM window for training sessions and food intake is optimal. Despite this, the high degree of variation in foraging strategies among wild California sea lion populations suggests that this restriction might not necessarily result in unnatural behavior among California sea lions in zoological settings.

For the 11 facilities that reported sessions occurring at the same time every day, there was an average of 6.14 hours between the first and last sessions. For facilities that reported sessions during a range of times throughout the day, there was an average of 9.14 hours between the first and last possible session times.

There is insufficient data from this study and other literature to suggest whether maximizing the time between sessions is optimal. It is clear that repeatable and often predictable

patterns of behavior emerge from the temporal patterns of an environment (Bell et al., 2009). As such, the timing structure of training sessions may impact the behavior of the sea lions before and after the session. A study of bottlenose dolphins in three European marine parks found a direct connection between human-controlled periods (such as enrichment and training sessions) and the dolphins' social behavior before and after those sessions (Clegg et al., 2017). We encourage zoological facilities housing California sea lions to evaluate how the timing of training sessions impacts the behavior of the individuals in their collection and make adjustments to meet the needs of those individuals.

#### *1.5 Discontinuation of the training and maintenance of certain behaviors*

As training priorities evolve, so do the specific behaviors being trained and maintained. As a result, some behaviors that were once trained may no longer be maintained. In addition to a shift in programmatic goals, some of these behaviors that are no longer maintained may be part of an attempt to improve welfare. Certain behaviors that were once commonplace in theatrical-style sea lion shows may have unintended physical health consequences. We incorporated questions about behaviors that are no longer trained/maintained into our survey to better understand the varying perspectives on the topic.

*Table 4. Behaviors no longer maintained*

Behavior:	Rationale:
“Jump” on the ground	Discontinued due to vet concerns about the impact of these behaviors on the animals’ joints (x2 response)
Front flipper “dance”	
Conga	
Balance on rear flippers	
Flip	
“Ball balance” on nose	Discontinued due to public perception (x4 response). Some facilities mentioned that though these behaviors are no longer in public presentations, they are permitted to be asked when not in view of the public for additional physical/mental engagement.
Jumping through a hoop	
Catching rings in mouth	
“Kiss”	Discontinued due to concerns about safety (x2 response)
“Hugging”	

Facilities reported several specific behaviors that they were no longer training/maintaining (Table 4). The rationale for the discontinuation of particular behaviors is also summarized in Table 4. 13 facilities (59%) reported that certain behaviors were no longer trained or maintained. When asked for further details about which behaviors are no longer trained and why, five recurring reasons were given:

1. Physical effect on animal
2. Animal's perceived interest/enjoyment  
Some facilities reported individual animals repeatedly refusing to perform particular behaviors for multiple trainers. They interpreted this as the animal not feeling comfortable with those behaviors and no longer asked them.
3. Staff turnover  
Several facilities reported behaviors lost during periods of staff transition. These may have been behaviors that were not fluent or novel behaviors that never had formal training plans and S<sub>D</sub>S (cue for behavior).
4. Not needed for current program goals  
(ex: not in the current show, prioritizing husbandry behaviors)
5. Medical behaviors needed for the specific procedure that is now complete  
(ex: echocardiogram, tooth dremel)

Though training elevates the animals in human care, specific behaviors that are injurious should be discontinued.

### *1.6 Acquisition and learning of behavior versus maintaining conditioned behaviors*

One of the stated aims of training is to provide mental stimulation. Six responding facilities specifically listed “mental stimulation” when asked about their training priorities. However, the definition of “mental stimulation” in this context is unclear. Enrichment, which also aims to be “mentally stimulating,” works toward this goal by encouraging species-specific behaviors and offering opportunities for choice within the environment (Shepherdson, 2003). Training is undoubtedly useful and important in modern animal care and management, but there is a lack of systematic evidence to evaluate the impact of training outside of training sessions (Melfi, 2013). As such, it may be erroneous to rely on “training sessions” as an unknown mix of learning and maintaining behaviors as the most frequent way to mentally stimulate California sea lions in zoological facilities.

The acquisition of behavior through the training process involves a range of cognitive engagement and that process of learning and behavior acquisition can certainly be classified as “mentally stimulating” (Kirsch et al., 2004, Manteuffel et al., 2009). However, training sessions

comprise more than the acquisition of behavior. They also include the maintenance of previously conditioned behaviors. After all, this is the goal of training a behavior: to request an animal perform that behavior when presented with a specific cue.

The balance between learning and maintenance may offer important insight into the cognitive value of “training sessions.” To better understand how this dynamic plays out, we asked facilities how often animals learn new behaviors in sessions versus maintaining already conditioned behaviors. In Table 4, 15 out of 21 facilities reported that their animals work on learning a new behavior in at least one session each day.

There were three common reasons for new learning not occurring daily. The first reason reported was staff turnover and skill level. Training new behaviors is a more advanced skill than maintaining conditioned behaviors, and some facilities said they did not always have the staff for that to be possible. One facility reported pausing learning new behaviors while they reinforce fundamentals for their naive animals. Finally, the demands of public programming limited some facilities' ability to train new behaviors consistently.

If new learning is not regularly occurring, zoological facilities should supplement mental stimulation through other husbandry and care practices, like enrichment, to ensure animals are consistently cognitively challenged.

## **Enrichment**

### *2.1 Enrichment in zoological facilities*

Enrichment is a common component of care for animals in zoological facilities. Yet, the application of enrichment varies widely. The first quantitative enrichment study was published in 1978 (Yanofsky & Markowitz, 1978). Since then, the practice of enrichment (also referred to as environmental enrichment) in zoological facilities has grown to include a range of strategies, including feeding enrichment, tactile enrichment, structural enrichment, auditory enrichment, olfactory enrichment, visual enrichment, social enrichment, and human-animal interactions (Hoy et al., 2009). This review will analyze social enrichment and human-animal interactions in separate sections, so this section will primarily focus on the first six categories of enrichment. The aim of various enrichment interventions in modern zoos is to offer animals more control over their environments and promote species-typical behaviors (Westlund, 2014).

## 2.2 Enrichment goals

Because of the wide-reaching definitions of enrichment and its application in zoological settings, we asked responding facilities to describe the goals of their enrichment program. Figure 5 shows the results of this question presented as a word cloud. The word cloud did not yield particularly insightful results because responses varied widely, and the visualization did not clearly highlight common goals.

Figure 5. Word cloud of enrichment goals



We utilized Qualtrics' word cloud generator to attempt to highlight frequent responses. This generator counts the occurrences of repeated words and displays them to convey the frequency of particular words and phrases visually. The larger and darker word, the more frequently it was mentioned. The number of words included in the graphic was limited to 50.

When reading the responses and grouping common words and phrases, "mental stimulation" recurs as a common theme. Nine facilities specifically mentioned mental



stimulation in their response. Other than this common phrase, the responses were very general and did not list the specific aims of the facilities' enrichment programs. The question (see Table 5) may have been confusing and limited the survey's usefulness in understanding the enrichment goals, but the varying and vague responses could also point to a lack of clear and specific goals for California sea lion enrichment in the accredited zoos we surveyed. In their 2001 paper, Mellen and MacPhee identify goal-setting as the first step in implementing an animal enrichment protocol (Mellen & Sevenich MacPhee, 2001). This goal-setting is necessary to determine what species-specific behaviors the enrichment is designed to encourage (Monreal-Pawlowsky et al., 2021). Without clear goals, enrichment efforts may be a wasted resource.

Table 5. Complete Survey Responses: Enrichment goals implementation and relationship to training

Facility:	What is the goal of enrichment for the sea lions at your facility?	How would you describe the relationship between enrichment and training?	Are consumable items incorporated into enrichment?	Does your facility require all enrichment to look "natural"?
Facility 1	there are a lot of goals and we have a really strong enrichment program. The main goal is probably the mental stimulation.	Training is one of the most successful enrichment in my facility	Yes	No
Facility 2	Exhibit natural behaviors. Mental stimulation.	Training new behaviors is very enriching. Training behaviors that incorporate play are very enriching.	Yes	No
Facility 3	From our Enrichment Plan: The Long Island Aquarium is committed to enhancing the psychological and physical wellbeing of the animals in our care. The welfare of all of our animals depends on their environment, habitat and daily husbandry. An essential aspect of their daily husbandry includes the enrichment that we provide for them. Animals in our facility are provided with the richest possible environments and activities for their mental and physical health. The results of our enrichment and training programs present our animal ambassadors in the best possible light and strive to inspire people to care about wildlife conservation. Aquarium guests are offered an enriched experience, providing them the opportunity to better appreciate the natural behaviors and abilities of our animals. It is our goal to have healthy, thriving animals that help to inspire and educate our guests and the need to be more environmentally conscious and aware	They go hand in hand; a good enrichment program includes training and training is enrichment.	Yes	No
Facility 4	Our goals change quarterly: they are currently cognitive engagement, tactile stimulation, jumping, and play.	They do not overlap here.	Yes	No
Facility 5	To occupy them from focusing on each other in negative ways, to keep them busy when solitary for periods of time, to mentally stimulate them, and to try to facilitate a little more natural feeding strategies (having to "hunt" for food, or figure out how to get it out of a puzzle instead of being handed it).	Training is enrichment, and just like other forms of enrichment it can either be received well, or poorly, by the animal depending on how it's done. Training is an important category of enrichment as it is mentally and physically stimulating.	Yes	No
Facility 6	To provide choice and opportunity for the sea lions daily. Adding novelty.	We consider training sessions to be a form of enrichment but have a separate enrichment procedure for all of our animals outside of training (we have a database that auto-populates enrichments for animals by type (sensory, environmental, food, toy, etc.). We do incorporate enrichment devices into training sessions to change things up, such as ending a session with a puzzle feeder or seeing how they might interact with a novel object. Some sea lions need to be trained to interact with novel toys and objects during a session so that they know how to use them as an enrichment out of session (such as teaching them to pull on a rope to drop down fish/ice, which might be something ignored if they did not learn how to use it).  Overall, we find enrichment and training to be separate but that they can be combined in ways that further enrich and enhance the training sessions and free time throughout the day.	Yes	No
Facility 7	Variability and Choice of enrichment, also keeping things novel and exciting	The relationship needs to be engaging and variable. Choice is a huge factor of our enrichment program and how we train the animals to enjoy different types of novel enrichment ideas. We pair enrichment use with variable primary and also use as secondary reinforcement daily	Yes	No
Facility 8	To encourage natural behaviors and provide variability and discourage stereotypic behaviors	Training is often essential to encourage interaction with enrichment. An animal will get more benefit from an EED if it has been properly trained.	Yes	No

Table 5. (continued)

Facility:	What is the goal of enrichment for the sea lions at your facility?	How would you describe the relationship between enrichment and training?	Are consumable items incorporated into enrichment?	Does your facility require all enrichment to look "natural"?
Facility 9	To provide opportunities for exploration and exhibiting natural behaviors. We have categories/goals to reach with the sea lions from the enrichment items provided. We as trainers can then choose from approved items as to what we think will meet those goals for the day.	They go hand in hand. Both very important for the animals overall wellbeing, providing mental stimulation and variety in their lives.	Yes	No
Facility 10	Provide mental stimulation, attempt to provide novel interactions,	They are both necessary they complement and enhance each other.	Yes	No
Facility 11	For our facility enrichment is their permanent environment, temporary objects we can incorporate into their environment (toys, etc.) and their training program. It is anything that can improve their welfare; whether that is mental, physical or social.	Training is the most complex form of enrichment.	Yes	No
Facility 12	The sea lions are provided a variety of enrichment types: manipulation, sensory, social, environmental to encourage natural behaviors	Training is a type of enrichment. Enrichment devices can also be included in training sessions to encourage interaction as well as be trained to be secondary reinforcers	Yes	No
Facility 13	Our sea lions live in a natural environment so while enrichment is important, it isn't as much of a focus for us from a training standpoint because our sea lions have a great deal of natural enrichment in their habitat. We do use it for variability and to show them new things or to help get them more comfortable in a new area. But fortunately for us, their natural environment and social group is very enriching on its own.	Since our environment is naturally enriching, we do usually have to train our sea lions to interact with toys. Usually once we introduce an object and they are comfortable with it, they will sometimes play with it on their own. Other enrichment that is food based or involves jello or ice, usually doesn't require any training.	Yes	No
Facility 14	Our sea lions historically have not been engaged in enrichment that is not food-based. Currently, our goal is to find ways to encourage our sea lions choose to interact with more types of enrichment.	Our sea lions know several behaviors that include enrichment items. We also have the ability to feed gelatin in training sessions, which has been used for enrichment.	Yes	No
Facility 15	Enrichment which gives the sea lions mental stimulation and allows and encourages them to exhibit natural behaviors.	I believe that training is a form of enrichment. It allows animals the choice to engage or not, you can train animals to interact with EEDs, training engages the animals mentally and physically.	Yes	No
Facility 16	To promote choice in animals' lives by encouraging animals to utilize and explore their environments in new ways through various enrichment devices and techniques. It encourages species appropriate behavior, enhances mental stimulation through the option of choice, promotes an increased level of involvement in animal care, and impacts guest understanding of animals' mental and physical capabilities	Training is a form of enrichment for our animals, as it does stimulate our animals both mentally and physically. We are also able to use enrichment as reinforcement for our sea lion collection.	Yes	No
Facility 17	Provide mental stimulation and elicit species specific behaviors.	Training is a form of enrichment by providing mental stimulation and physical exercise. Promotes natural behaviors.	Yes	No
Facility 18	Demonstrate natural behaviors	Training can be enriching, both are important.	Yes	No
Facility 19	The goal is to stimulate their minds, initiate play, and as a secondary reinforcer.	Training is a form of enrichment!	Yes	No
Facility 20	The goal of enrichment is to change their environment in a stimulating manner	Enrichment can be woven into training. All training is a form of enrichment. However, enrichment can occur outside of training sessions as well.	Yes	No
Facility 21	to mentally stimulate them,	currently separate but we are starting to incorporate enrichment into the sessions hoping it will have a residual affect	Yes	No

### 2.3 Enrichment Frequency

The frequency of enrichment application as well as the frequency with which new enrichment strategies are implemented contribute to the overall effectiveness of an enrichment program. Table 6 describes the frequency of enrichment provision for the responding facilities. Two facilities were not included in this figure because they included training sessions in their count of enrichment opportunities. As previously discussed, while training may be enriching, it may also not always be so, and this figure was designed to specifically convey the frequency of provisioning of other enrichment strategies outside of training sessions.

*Table 6. Frequency of enrichment provisioning*

		Number of facilities that reported particular frequency	
		Minimum frequency that enrichment is offered	Typical frequency that enrichment is offered
Frequency of enrichment delivery	More than 1x/day	2 (11%)	12 (63%)
	1x/day	13 (68%)	5 (26%)
	Less than 1x/day	4 (21%)	2 (11%)

Table 6 examines the frequency of enrichment provisioning. Based on the responses, facilities were sorted into one of three groups: facilities that provide enrichment more than once a day, facilities that provide enrichment once a day, and facilities that provide enrichment less than once a day. Facilities shared the typical frequency of enrichment provisioning, as well as the minimum frequency of enrichment provisioning. Two facilities were excluded from this data because they included training sessions in the number of enrichment opportunities offered and did not share the number of opportunities for environmental enrichment.

The majority of facilities provide multiple opportunities for enrichment throughout the day. A 2010 survey of enrichment practices at zoos reported that 38.8 % of respondents delivered tactile enrichment (novel objects) once a day and 21.9% delivered tactile enrichment multiple

times a day (Hoy et al., 2009). This indicates that the responding facilities in this study may be delivering enrichment to their California sea lions at a higher rate than a larger sample of other captive mammals.

Another important component of enrichment frequency is incorporating novel strategies into the enrichment program. According to research conducted on animals in laboratory settings, the more frequently a stimulus occurs, the faster habituation, or decreasing response to that stimulus, occurs (Murphy et al., 2003). Consequently, incorporating new enrichment strategies is crucial to maintaining the behavioral outcomes they produce (Renner et al., 2000).

The 2021 Cetacean Welfare Study found the schedule of new enrichment implementation to have a significant relationship with a number of behavioral outcomes. They found that total energy expenditure for the sample dolphins was higher for individuals receiving new enrichment on a monthly/weekly schedule than those who received new enrichment on a year/year+ schedule (Lauderdale et al., 2021). They also found a relationship between the schedule of new enrichment and social behaviors like group active behavior and interaction with conspecifics. These studies offer interesting insight into the potential importance of scheduling new enrichment for sea lions in zoos and aquariums.

This may be an area where zoological facilities housing California sea lions should devote additional consideration. When asked how often new enrichment items/strategies are incorporated, all 21 facilities responded that they do not have a specific schedule for implementing new enrichment. Many facilities reported adding new items as their budgets and approval processes allow. One facility also mentioned that if an enrichment strategy scores poorly on its internal evaluation of its use two times in a row, it is removed from the rotation of enrichment for modification.

#### *2.4 Enrichment Design and Implementation*

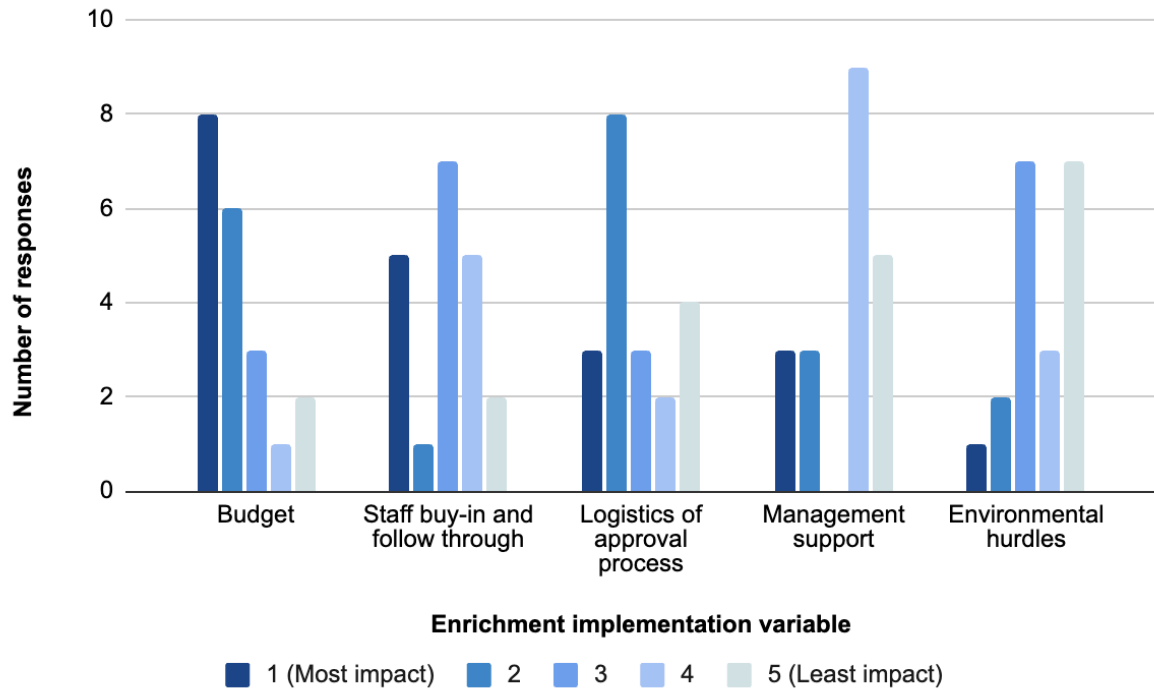
Because enrichment can be an effective technique for encouraging species-appropriate behavior and ultimately improving welfare, we wanted to better understand barriers to implementing new enrichment. Facilities were asked to rank the impact of five variables on implementing new enrichment. 40% of facilities responded that budget was the biggest limitation to implementing new enrichment (Figure 6). Commercially available items that can withstand

the play and foraging behaviors of large carnivores such as California sea lions can be expensive to acquire. The scarcity of ideas for enriching marine mammals, combined with a consumerist culture, has led to floating plastic toys dominating the majority of strategies used for marine mammal enrichment. A study examining the impacts of cognitive foraging enrichment versus floating plastic items on dolphins found that the cognitive foraging items where the dolphins had to problem solve to achieve the food improved long-term welfare indicators, while the non-cognitive items where food was placed on or near the floating plastic items did not (Clegg et al., 2023). Most of the cognitive foraging items in the study were built by the facility staff members from low-cost, upcycled items (I. Clegg, pers. comm). Zoological facilities could consider implementing more cognitively challenging enrichment items instead of more expensive-less effective floating plastic toys.

Twenty-five percent of facilities in our survey responded that “staff buy-in and follow through” was the second biggest obstacle to implementing new enrichment. These findings align with another survey of zoological staff found that the time taken to complete other tasks impacted the schedule with which enrichment was provided for almost 97% of staff (Hoy et al., 2009).

Finally, because enrichment can be an effective technique for encouraging species-appropriate behavior and ultimately improving behavioral welfare, we wanted to better understand barriers to implementing new enrichment.

Figure 6. Ranking factors on their impact on new enrichment implementation



The final result from the enrichment section of the survey conveys how different variables affect the implementation of new enrichment. Facilities were asked to rank five variables on a scale from 1 to 5, with 1 having the most impact on implementation and 5 having the least impact.

A debate exists among zoological facilities where some facilities express concern that unnatural-looking enrichment items may detract from the educational messaging of the exhibits. A study examining this premise found that enrichment type did not alter the perception of visitors (Kutska, 2009). The requirement to make enrichment items appear natural further complicates an already potentially cumbersome process of building robust enrichment items for marine mammals in an underwater environment, and limits the enrichment opportunities available. Fortunately, no responding facility reported that they are subject to this requirement (Table 5).

### 2.5 Enrichment Success

When asked to define the success of a particular enrichment strategy, only four facilities described a systematic process to holistically evaluate the performance of a particular enrichment

item/strategy. Several facilities reported “animal interaction with item” as a component of how they evaluate success. However, an item should not be considered enrichment unless there is evidence that it was used in the manner it was intended to reach the desired goal (Kemp, 2023).

The AZA explicitly requires written goal setting, documentation/record-keeping, and evaluation of enrichment programs for accredited members (*The Accreditation Standards & Related Policies 2020 Second Edition*, 2023). ZAA requires a documented enrichment program for marine mammals (which includes California sea lions) (*ZAA Accreditation Standards 2021 Edition*, 2021). The presence of these accreditation standards paired with the lack of answers from the facilities to this question indicates that many respondents are likely documenting the animals’ responses to enrichment in their daily practices but may not have thought to include it in their definition of enrichment success.

## *2.6 The Relationship between Enrichment and Training*

Enrichment and training both hold important functions in achieving optimal animal welfare in human care, and facilities housing California sea lions need to incorporate both into their care and management practices. Enrichment and training tend to be implemented separately and manifest differently in application, but both share the goal in modern facilities of physically and mentally stimulating animals to improve and optimize their welfare. As discussed in the training section, some training activities might be considered as enrichment. Additionally, some enrichment activities might require formal training for the animals to optimise the level of choice and control they have over the item.

To better understand this connection, we asked facilities to describe the relationship between enrichment and training. Twelve facilities explicitly stated that training is enrichment. As discussed in the training section, learning and acquiring new behaviors in training sessions may be enriching; however, the maintenance of existing behaviors may not have the same level of mental stimulation.

Five facilities responded that training could be utilized to encourage interaction with enrichment devices. Evidence suggests that formally training animals to utilize certain enrichment devices may increase the effectiveness of the enrichment (Fernandez et al., 2019). Additionally, some enrichment strategies can build comfort around novel stimuli, decreasing stress responses and building resiliency (Lehmann & Herkenham, 2011). Training to use



enrichment devices and reducing overall stress are both ways that training can be used to enhance the effectiveness of various enrichment strategies.

### *2.7 Next steps for enrichment programs*

The responding facilities appear to be providing enrichment to their California sea lions at a higher rate than a larger sample of other captive mammals, with the majority of facilities offering multiple opportunities for enrichment throughout the day. This suggests that these facilities are doing well in terms of the frequency of enrichment provisioning. Incorporating novel enrichment strategies was identified as an important factor in maintaining the effectiveness of an enrichment program, but most facilities reported not having a specific schedule for implementing new enrichment. Budget was identified as the biggest limitation to implementing new enrichment. Therefore, facilities may need to devote additional consideration to scheduling enrichment activities each day, providing staff with the knowledge and resources to build their own enrichment, whilst also encouraging staff to seek cost-effective and upcycled enrichment options.

## **Social Management**

### *3.1 Social Group Composition*

Appropriately composed social groupings are one of the most influential ways for zoological facilities to encourage species-typical behavior for social species in their collections. In many cases, the size of social groupings in wild populations significantly affects food intake, reproductive success, and ultimately survivorship (Price & Stoinski, 2007). Though animals living in zoological facilities do not face the same stressors for survival, the ability to engage in social and reproductive behaviors with conspecifics has a great impact on their welfare (Maple & Perdue, 2013, pp. 85–86, Meehan et al., 2016, Price & Stoinski, 2007).

California sea lions are a gregarious species with complex social interactions. In their native habitat along the Pacific coast, California sea lions gather in large breeding rookeries in groups numbering hundreds of individuals (Bonnell & Ford, 1987). California sea lions utilize vocalizations within these social groups to communicate with each other. Females call their young, juveniles play, and adult males jockey for dominance. These vocalizations between individuals are critical in organizing and maintaining their social groups (Peterson &

Bartholomew, 1969). California sea lions are also highly thigmotactic. Social groups have often been observed in tight piles (Peterson & Bartholomew, 1967). Observations of California sea lions have also shown strong mother-pup bonds and affiliative behavior between related individuals (Hanggi & Schusterman, 1990). Breeding rookeries are maintained year-round and home to breeding males, females, and juvenile sea lions. The majority of male sea lions are unsuccessful in their attempts to establish breeding territory and retreat to “bachelor” beaches (Heath & Perrin, 2009). To create optimal welfare for California sea lions in managed care, zoological facilities must house groups of sea lions so that they can express these innate social behaviors.

Zoological facilities must balance replicating wild social groupings to encourage natural behavior with the environmental limitations of a zoological setting. Additionally, zoological facilities must protect their collections from excessive aggression and stress from conspecifics, even if those factors are “natural” for their wild counterparts. A number of studies on zoo-housed primates and ungulates have demonstrated that excessive social density contributes to higher rates of aggressive and stress-related behaviors, as well as an increase in potential negative welfare indicators like stereotypies, decreased reproductive success, and decreased longevity (Almazan et al., 2005, Barnes et al., 2002, Bashaw et al., 2001, Mallapur & Choudhury, 2003). These negative welfare impacts can be exacerbated by competition over resources and unstable dominance hierarchies (Waples & Gales, 2002).

California sea lions are social animals, and it is important for them to be able to express species-typical social behavior to achieve optimal welfare. However, trying to mimic the exact size of wild sea lion groups may not be practical or necessary because factors beyond social and reproductive behavior affect the size of sea lion groups in the wild. Significant marine resources are required to sustain a population of California sea lions. Only a limited number of areas along the Pacific coast have the stocking densities capable of offering nutritional sustenance to these large carnivores. A 1987 study examining California sea lion distribution showed that California sea lion populations fluctuate in location based on the behavior of prey species (Bonnell & Ford, 1987). This may suggest that the large breeding groups of California sea lions discussed in the literature may not reflect the preferred social group size for California sea lions but rather the group size necessary to maintain life and reproductive fitness in that particular area.

While the optimal social grouping of California sea lions in a zoological environment may not align with the number of individuals found in the wild, it is crucial to ensure that the group is of an adequate size to allow the animals to engage in their species-specific behaviors. The AZA Marine Mammal Taxon Advisory Group (MMTAG) and California sea lion Species Survival Plan (SSP) recommend that a minimum of three California sea lions of any sex be housed together (Martinez et al., 2021).

Figure 7. Social group composition of responding facilities

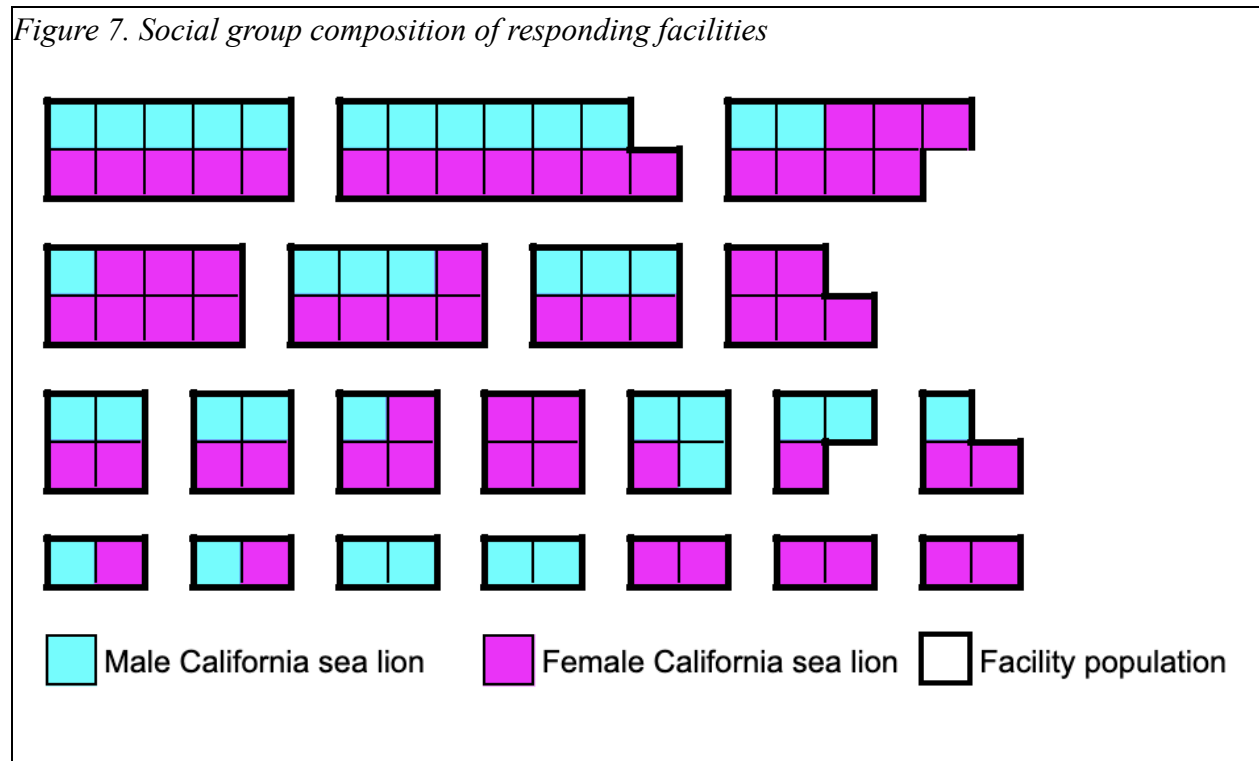


Table 7. How many California Sea lions Live at your facility:

	How many MALE CSL at your facility?	How many FEMALE CSL live at your facility?	TOTAL sea lions at facility
Facility 1	5	5	10
Facility 2	1	3	4
Facility 3	1	3	4
Facility 4	2	1	3
Facility 5	2	0	2
Facility 6	2	2	4
Facility 7	6	7	13
Facility 8	3	1	4
Facility 9	1	7	8
Facility 10	1	1	2
Facility 11	2	7	9
Facility 12	2	0	2
Facility 13	1	2	3
Facility 14	1	1	2
Facility 15	0	4	4
Facility 16	0	5	5
Facility 17	0	2	2
Facility 18	0	2	2
Facility 19	3	5	8
Facility 20	3	3	6
Facility 21	0	2	2

The size and composition of social groups for California sea lions in responding facilities varied significantly. Figure 7 visualizes the social groups of California sea lions at responding facilities. The size of the populations at the responding facilities ranged from 2 to 13 California sea lions. Six facilities housed two California sea lions. Four of those six facilities that only have two animals house their California sea lions with harbor seals (*Phoca vitulina*). Harbor seal social behavior differs greatly from that of California sea lions (da Silva & Terhune, 1988, Lander et al., 2002, Sullivan, 1982). While a mixed-species habitat may more effectively demonstrate the complexity of the Pacific ecosystem where these animals are found, cohabitation

is not a comparable substitute for appropriate social groupings with members of their respective species, and facilities should strive to maintain social groups of sea lions that are sufficient in size promote optimal welfare.

### 3.2 Social Group Management

Social management of species in zoological facilities can be particularly challenging for animals with temporal and seasonal variations in their social preferences. California sea lions express many components of fission-fusion social groupings in the wild, which involves “temporal variation in the spatial cohesion between group members, who form subgroups that can also vary in size and composition over time” (Ramos-Fernandez & Aureli, 2018). Range populations of California sea lions have not been described with the term “fission-fusion” in existing literature, partly because there is much to learn about the relationship between the spatial association of large breeding groups of California sea lions compared with true social bonds. However, “fission-fusion” has been used to describe the social behavior of the closely related Galapagos sea lion (*Zalophus wollebaeki*, Wolf et al., 2007).

The social management of other zoo-housed species that live in fission-fusion groups involves the variable separation and reunification of a group of animals with the goal of enhancing their overall social experience. These dynamic social groups have been shown to increase affiliative behaviors, decrease aggressive behaviors, and increase behavioral diversity in a number of zoo-housed species (Hartley et al., 2019, Miller et al., 2021, Stoinski et al., 2004, Williams et al., 2020). These studies, which demonstrate the potential benefits of dynamic social groupings for fission-fusion species, advocate for using evidence-based management to determine how social management impacts each individual’s overall social experience.

Responding facilities were divided on their social management systems of California sea lions. Figure 8 shows the divide between the two social management structures: rigid social groups and dynamic social groups. Ten facilities utilized a rigid social structure for their California sea lions, where the animals spent all their time with the same group. Eleven facilities utilized a dynamic social management system where animals spent time with different individuals.

The management structure differed based on the composition of the sea lion population. All of the facilities housing multiple males and at least one female utilized dynamic

management. The use of dynamic social groups in these facilities limits the potential for aggressive behavior between males while preserving their opportunity to engage in social behavior with other sea lions. Three of the four facilities with one male and multiple females utilized rigid social groups. Based on the current literature and the survey responses from this study, there is not one social management practice that is recommended for all facilities. Facilities housing California sea lions should empirically assess how different social groupings affect the frequency of affiliative behavior and adjust social management strategies to optimize welfare.

## **Human-Animal Interactions**

### *4.1 Human-animal Interactions in zoological facilities*

Human-animal interactions have a major effect on the welfare of zoo-housed animals, including California sea lions. Some evidence suggests that the overall quality of human-animal relationships in a zoological setting may account for the discrepancy in welfare outcomes from facilities with similar physical environments and care standards (Cole & Fraser, 2018). Farm welfare research has shown that negative human-animal interactions can have a negative effect on overall welfare (Hemsworth et al., 1981; Hemsworth et al., 2000; Hemsworth et al., 1994). Conversely, it has also been demonstrated that positive human-animal interactions have the ability to elevate welfare. When animals are exposed to high quantities of positive interactions, fear may be reduced, and bonds between animals and their care staff may form (Cole & Fraser, 2018). Due to their intensive management and participation in public programs (such as shows and encounters), California sea lions in zoological facilities will likely have more human-animal interactions than many other zoo species. If these interactions are not just neutral but demonstrably positive, they can create or maintain positive welfare states that contribute to optimal welfare.

### *4.2 Types of human-animal Interactions*

California sea lions' interactions with humans in zoological facilities can be largely divided into interactions with zoological professionals and interactions with the visiting public. Interactions with zoological professionals include daily interactions with the husbandry care staff

(keepers, trainers, etc.) and non-routine visits from other zoological professionals such as veterinary technicians, veterinarians, water quality staff, or curators. Interactions with the visiting public include both the visitors' presence while observing sea lions in their habitat or during a presentation and their interactions with sea lions during structured encounters that allow direct interaction between sea lions and guests. All of these interactions with various humans have the potential to create experiences that are perceived positively or negatively by the animals involved (Claxton, 2011). As such, it is important to explore how each of them contributes to the welfare of California sea lions in zoological settings.

#### *4.3 Interactions with zoological professionals*

Strong, positive relationships between zoological care staff (keepers) and the animals under their stewardship have the potential to positively impact animal welfare. Positive relationships decrease indicators of stress and fear in various species (Baker, 2004, Bassett et al., 2003, Wielebnowski et al., 2002). Operationalizing the components of a “strong bond” or “positive relationship” can be challenging, but care staff perceptions of their relationships with animals have been shown to correspond with biological indicators. As part of a multi-institution, multi-variable study on the welfare of elephants in zoos, a survey comparing keepers' perceptions of their bond with elephants was compared to various biomarkers. Positive keeper attitudes predicted lower mean serum cortisol responses in elephants (Carlstead et al., 2019). These studies suggest that interactions that care staff perceive to be positive, correspond with positive welfare indicators and may contribute to overall positive welfare.

The bond between animals and their care staff develops through shared involvement in positive experiences. Positive reinforcement training sessions are one type of shared positive experience that can enhance the relationship between care staff and animals (Ward & Melfi, 2013). Training sessions are effective for building this relationship because the care staff's presence is paired with the delivery of the reinforcer used to condition behavior. This link also extends to trainer praise, attention, and tactile reinforcement serving as an effective conditioned reinforcer in some situations (Kelleher & Gollub, 1962, Zimmerman, 1957). Training also limits the need for negative human-animal interactions, such as physical restraints, through voluntary participation in husbandry behaviors (Brando, 2010).

All 21 facilities reported that their California sea lions have a choice to participate in training sessions, which may increase the likelihood that these interactions contribute to positive welfare. Responding facilities indicated that their sea lions demonstrate that choice by stationing with their trainer and responding to cues (discriminative stimuli) to complete requested behaviors. The capacity to engage in alternative behaviors grants participating animals the autonomy to partake in interactions solely when they are inclined to do so. However, given that marine mammals typically obtain all of their food through training sessions, some argue that their decision to participate may be contingent upon their hunger levels.

#### *4.4 Use of barriers in staff interactions*

The term “protected contact” was first described in the early 1990s as an alternative to traditional elephant handling (Wilson et al., 2015). Traditional, free-contact management involved elephants and care staff sharing space and care staff using a combination of positive reinforcement training in combination with aversive negative reinforcement and positive punishment training in the form of a sharp hook. Protected contact management places a physical barrier between elephants and care staff. This barrier was implemented to establish enhanced safety for the care staff working with the elephants, as well as add a degree of control for the elephants, who could simply move away from the training wall if they did not wish to participate.

California sea lions are typically managed using free contact (shared space between trainers and animals). Free-contact management with sea lions differs from traditional elephant management because positive reinforcement strategies are always exhausted before utilizing other, more coercive types of operant conditioning.



*Table 8. Free contact versus protected contact interactions*

Do staff members interact free-contact (without a barrier) with ALL sea lions in your collection at least SOME times?		
Yes, all staff interact with all sea lions free contact, at least some of the time.	19	90%
No, there is always a barrier between staff and some sea lions.	2	10%

Table 8. describes the nature of staff interactions with sea lions in responding facilities. The proximity and access staff have to an animal are likely to influence the nature of their interaction, and as such, we wanted to understand how care staff interacts with sea lions at responding facilities.

Nineteen out of 21 responding facilities reported care staff sharing space with all of their sea lions at least some of the time (Table 8). Two facilities reported that certain animals were always protected from staff with a barrier. A facility might have several reasons to utilize protective contact management strategies for specific individuals or in particular training contexts. Some individuals may have a learning history that does not equip them to interact with people in a safe and comfortable manner (Meck et al., 2000). Some husbandry behaviors may place animals in particularly sensitive positions. A barrier between staff and sea lions not only offers an additional safety measure for the care staff who are in close proximity to the animal, but the animal may feel more at ease knowing that the humans will not cross the barrier (V. A. Melfi et al., 2019, p. 137). However, California sea lions have other opportunities to demonstrate their willingness to participate in training sessions interacting with staff, so a physical barrier is not usually necessary to offer the animals agency over participation.

#### *4.5 Interactions with the visiting public*

Research into the effects of visitor presence on animal welfare suggests that the net effect may be negative (undesirable) or positive (enriching) depending on the species and the variables of a particular circumstance (Davey, 2007). One study examining visitor effects on a population of California sea lions at a zoological facility found no significant changes in behavior when visitors were present (de Vere, 2018). During the observation period for this study, two of the sea

lions gave birth. Post-parturition, they showed greater preference for land areas both adjacent to and out of sight of visitors when nursing compared to while pregnant (de Vere, 2018).

Recent studies examining how opportunities to avoid guest view (via off-exhibit areas) in several bear species offer compelling insight into the effect of additional opportunities for choice and control on animal welfare. Three separate studies examined how off-exhibit access impacted the behavior of a pair of polar bears (*Ursus maritimus*), a pair of American black bears (*Ursus americanus*), and a pair of giant pandas (*Ailuropoda melanoleuca*). All three studies found that off-exhibit access improved behavior outcomes with a significant decrease in pacing and an increase in foraging and social play (Bruno et al., 2023; Owen et al., 2005; Ross, 2006).

*Table 9. Opportunities to Avoid Public View*

Are off-exhibit areas (out of public view) always available to animals when they are on display?		
Yes	9	43%
No	12	57%

Nine responding facilities indicated that areas out of public view are always available to their California sea lions; twelve facilities reported that areas out of public view are not always available (Table 9). Further study of the effect of off-exhibit access on California sea lions is necessary to determine their impact on welfare. We recommend that all facilities with the capability of offering off-exhibit access do so until such data is available to offer more conclusive results.

*Table 10. Visitor-animal Interactions*

Does your facility offer public programs that allow the public close proximity without a barrier?		
Yes	13	62%
No	8	38%

In addition to passive interaction from guests viewing sea lions in their habitat, some California sea lions are also involved in structured encounters where they share space with guests. Thirteen responding facilities reported offering public programs that allow close

proximity without a barrier (Table 10). Up-close encounters with marine mammals in zoological facilities have been demonstrated to increase visitor knowledge and conservation actions (Blandford et al., 2023; Miller et al., 2012). As such, these types of interactions serve an important function for zoological facilities forwarding their missions. Positive interactions during encounters with guests may not only enhance zoological facilities' missions but also elevate animal welfare. One study that examined the behavior in the presence of familiar care staff and “keeper for a day guests” did not find any detrimental effects from the presence of the “keeper for a day” (Martin & Melfi, 2016). These interactions could be leveraged to improve overall welfare by increasing the total number of positive human-animal interactions.

For guest encounters to have a positive impact on California sea lion welfare, the sea lions must remain comfortable during the interaction. Responding facilities in the current study that conduct guest encounters with sea lions were asked to list behaviors that they consider to be indicators of sea lion comfort and discomfort (Table 11). These behaviors can be utilized by facilities to assess animal comfort and potentially stress levels in guest interactions. The frequency and duration of comfort behaviors and discomfort behaviors could be compared in future studies to empirically assess an animal’s overall ease during guest interactions.

*Table 11. Behaviors Indicating Comfort and Discomfort During Guest Interactions*

Behaviors indicating comfort:	Behaviors indicating discomfort:
<ul style="list-style-type: none"> <li>● Relaxed body</li> <li>● Calm eyes and body posture</li> <li>● Completing behaviors to criteria</li> <li>● Focus and attention on trainer</li> <li>● Willingness to perform behaviors</li> <li>● Staying engaged in sessions</li> <li>● Consuming diet as normal</li> <li>● Eye contact with trainer</li> <li>● Soliciting tactile</li> <li>● Not breaking into the water routinely</li> </ul>	<ul style="list-style-type: none"> <li>● Focus on guests instead of the trainer</li> <li>● Tense body posture, stacked neck, wide eyes</li> <li>● Leaving or retreating to the pool or water</li> <li>● Avoiding being touched and not offering vulnerable behaviors</li> <li>● Hesitation to come over to the interaction area or to stay on deck</li> <li>● Refusing behaviors or not completing them to criteria</li> <li>● Heavy breathing or vocalizing</li> <li>● Poor stationing position</li> <li>● Open mouth, and flared vibrissae</li> <li>● Uninterested in training or diet</li> </ul>

These behaviors may offer facilities benchmarks to assess their animals' behavior as more comprehensive measures of California sea lion welfare in guest interactions are developed.

In addition to the keen observation of behavioral cues, respondents also listed several other keys to California sea lion comfort in guest interaction. (1) Participating animals should always have the ability to leave the area where the guests are to enter a pool or off-exhibit area. Retreat spaces, where animals can successfully avoid human interaction, have been an effective tool in offering animals control over interaction with visitors (Anderson et al., 2002). (2) Separate exit routes for sea lions and guests are always maintained. Guests never block sea lions' paths to the water. California sea lions have been observed entering the water to avoid aversive stimuli (Schusterman, 1977), and maintaining that specific path may offer the animal an increased sense of security to remain on land. Conversely, sea lions are never reinforced in a position that would block the guests exit from the area. Reinforcement for positioning in a path that blocks human exit may increase the future likelihood of that behavior occurring. (3)

Multiple sea lions are trained to participate in encounters so that trainers can utilize the perceived strengths and preferences of each individual while still accomplishing programmatic goals.

These recommendations shared by responding facilities should be implemented to maximize animal comfort and guest safety. Animals in zoological facilities have unique preferences and abilities based on their individual learning histories and genetic composition (Tetley & O'Hara, 2012). Zoological care staff have also been shown to have a reliable understanding of these individual differences (Williams et al., 2019). Incorporating this knowledge into guest encounters helps ensure successful interactions that fulfill the zoological facilities' mission and create positive experiences for the participating animals that contribute to optimal welfare.

### **Conclusion**

Comparing the results of the survey to published literature, we found that many of the care and management practices that are typical in the care and management of California sea lions at responding facilities are likely to contribute to positive welfare states. However, these care methods must be continually adjusted and empirically evaluated to ensure maximum efficacy and to avoid unintended consequences that would negatively affect welfare. Further studies should work to develop sea lion specific welfare indicators to confirm whether management practices do indeed correlate with positive welfare.

Training is an essential component of the care and management of California sea lions, especially given that the current intensive management style of these animals involves daily guest interactions and presentations. The number of training sessions and temporal predictability of sessions may affect both the effectiveness of training and animals' behavior outside of sessions. As such, facilities are encouraged to optimize session frequency and timing based on their individual animals. Additional opportunities for choice and control through training are another strategy to elevate positive welfare states.

While California sea lions in the surveyed facilities seem to have been offered enrichment more frequently than mammals in other studies, the goal-setting and evaluation stages of enrichment could be improved. Facilities are encouraged to design enrichment strategies with specific behavioral goals and have a clear method for evaluating their

effectiveness. Facilities are also encouraged to regularly implement new enrichment strategies to maintain the novelty and behavioral effectiveness of the enrichment.

Appropriately sized social groups are essential to elicit species-typical behaviors that promote optimal behavioral welfare. There was a high degree of variation in the composition of social groups from the responding facilities. Further studies should assess how differently sized groups of sea lions impact the frequency and intensity of affiliative and agonistic behaviors. California sea lions should be housed in large or dynamic social groups as a means of meeting their social needs.

Agency is key to ensuring animal comfort during guest and staff interactions. Whenever possible, animals should be given the choice to participate in an interaction to ensure the experience is positive. Persistent use of training to build relationships between staff and sea lions is an excellent way to create positive human-animal interactions and to avoid situations where negative human-animal interactions, like restraints, are necessary. A clear understanding of the behavioral responses of comfort and discomfort should be shared among all staff working with the animals. Observing behavioral cues during human-animal interactions will allow care staff to accurately assess animal comfort.

Not only did this study help identify common and unique practices that may enhance sea lion welfare in zoological settings, but it also served as a pilot investigation to determine if surveys might be a useful and accessible tool for identifying and sharing approaches that enhance the welfare of all animals in zoological facilities. I found it easier to analyze the quantitative data collected in the survey than the qualitative data, but nevertheless the anecdotal impressions from facilities were also valuable in contextualizing management practices. Although the data collected through surveys is limited in nature, surveys about welfare may serve as an important way to share best practices while other direct investigations into species-specific approaches to improve welfare develop.

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