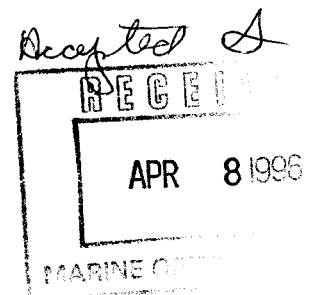


**STUDENT INTERNSHIP  
UNIVERSITY OF HAWAII MARINE OPTION PROGRAM**

**WAIKIKI AQUARIUM  
ADVISORS: DR. KEN YATES, CURATOR  
AND J. THEODOROU, AQUARIUM BIOLOGIST  
FALL 1995**

**Melinda Williams  
February 6, 1996**



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## Fall 1995 Internship Waikiki Aquarium

The Hawaiian monk seal (*Monachus schauinslandi*) is an endangered species endemic to the Hawaiian Islands. They mainly inhabit an area extending 1,800 km of the Northwestern Hawaiian Islands (NWHI) from Kaua'i to Kure Atoll. Due to their limited population, estimated between 1,300 and 1,400 individuals, and a declining population rate of approximately 6% per year, efforts have been made to study the behavior and biology of the seals in an attempt to conserve the species. In 1972, the Marine Mammal Protection Act gave the National Marine Fisheries Service jurisdiction over the seals. In 1976, the Hawaiian monk seal was listed as an endangered species under the Endangered Species Act at which time the NMFS began a recovery plan and has implemented such studies with wild populations of the NWHI and with individuals in captivity. Captive research facilities on O'ahu are located at Sea Life Park, Kewalo Basin, and the Waikiki Aquarium. This internship project was conducted at the Waikiki Aquarium with three adult male seals. The semester-long study focused on monk seal biology and behavior, husbandry techniques and non-invasive research. Knowledge gained from these studies may be instrumental in future conservation efforts for this endangered species.

### Introduction

The Hawaiian monk seal (belonging to the pinnipedia family Phocidae, genus *Monachus*, and species *schauinslandi*) is thought to be a primitive true seal due to many of its anatomical features (Ray,

1976). Perhaps a result of this primitiveness in comparison with other phocids, the monk seal appears to be very sensitive to human intrusion (Gilmartin, 1983).

Originally there were two other species of monk seals that inhabited the Earth. The Caribbean monk seal, *M. tropicalis*, has not been seen since the 1950's and is presumed to be extinct. The Mediterranean monk seal, *M. monachus*, currently has a total population of approximately 500 (Van Riper, 1982). All three species are unique among modern pinnipeds in that they inhabit subtropical areas. With the spread of human activity throughout the areas of their habitation, populations of all three species have experienced a major decline (Gilmartin, 1983).

The main area of habitation for the Hawaiian monk seal extends 1,800 km of the Northwestern Hawaiian Islands (NWHI) from Kaua'i to Kure Atoll with the primary breeding populations occurring at Laysan Island, French Frigate Shoals, Lisianski Island, Pearl and Hermes Reef, and Kure Atoll (figure 1) (Ragen, 1993).

The first significant decline occurred in the mid-1800's when the seals were hunted for their oil and pelts and as a food source (Ragen, 1993). Records from voyages of the *Gambia*, 1859, reported 1,500 pelts brought into Honolulu from this one voyage alone (Kenyon and Rice, 1959). Hunting activity decimated the population and by the late 1800's sightings of monk seals was rare (Ragen, 1993).

The population showed a slight comeback in the early 1900's when wide range surveys were taken. Although these surveys were extremely inconsistent and unreliable, monk seals were apparently observed in small numbers (Kenyon and Rice, 1959).

The next big decline in the monk seal population occurred from the 1950's to 1970's when increased military activity brought more human intrusion to the NWHI area. Due to this high level of human activity, females abandoned preferred pupping areas; thus pupping rates declined (Kenyon, 1972).

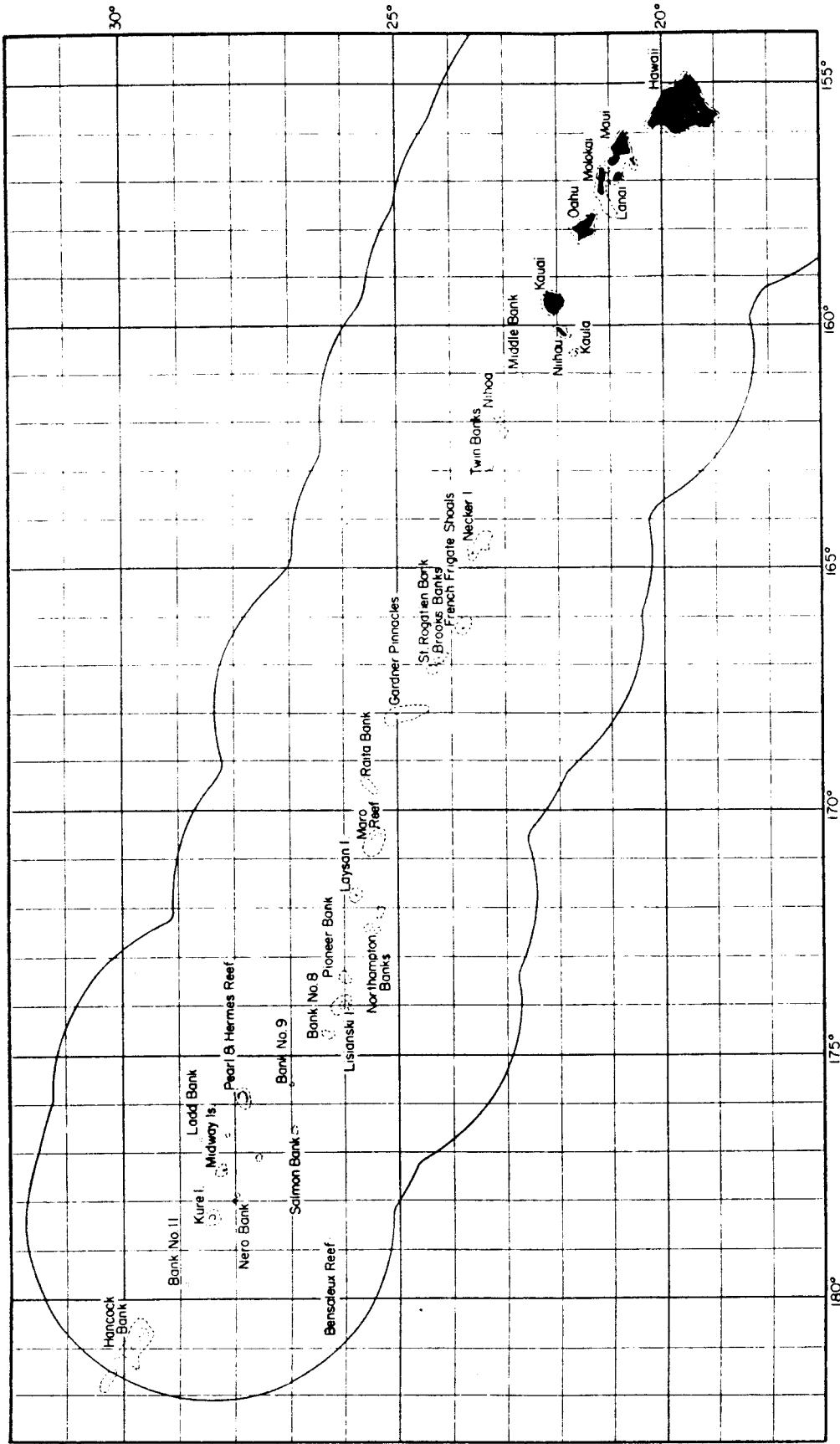


Figure 1. The U.S. Fishery Conservation Zone around the Hawaiian Archipelago

The Hawaiian monk seal was placed on the endangered species list by the International Union for the Conservation of Nature and Natural Resources (IUCN) in this organizations *Red Data Book* of endangered mammals, in 1976, after there was noted a 50% reduction in beach counts in a 20 year period (Gilmartin, 1988). Today the Hawaiian monk seal is the most endangered pinniped in U.S. waters (Ragen, 1993).

In response to the mandates of the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) was given jurisdiction over the welfare of the Hawaiian monk seal population in 1972. Programs, implemented by NMFS, have been conducted on seals in the NWHI and on seals in captivity.

The NMFS 1991-1993 Work Plan (Gilmartin, 1993) for the monk seals in the NWHI included four main goals, most of which were successfully achieved:

- 1) recovery of the western populations (Kure, Midway, and Pearl and Hermes Reef)
- 2) mobbing research\*
- 3) monitoring of five major breeding sites
- 4) data analysis for status report

Captive population studies have proven invaluable for understanding facets of monk seal biology and behavior, as well. In captivity, studies have included blood sampling techniques, correlations between testosterone levels and aggression (Theodorou, 1996), assimilation studies and observations of social and hierarchical systems.

On O'ahu, captive individuals have been studied in three

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\* Mobbing is a deleterious behavior common in some NWHI populations when a group of males attack a female for copulation. During this type of attack, females are often seriously and sometimes fatally injured as males, trying to copulate, bite the dorsal area of the female's neck (Atkinson et al, 1994). Mobbing is thought to have evolved due to a skewed sex ratio occurring in seals of the NWHI, where there appears to be a higher mortality rate in females. Males, eager to spread their genes with limited numbers of females, mob the females that are available (Atkinson et al, 1994).

locations: Sea Life Park, Kewalo Basin, and the Waikiki Aquarium. This internship focused on the three male Hawaiian monk seals living at the Waikiki Aquarium. The NMFS obtained the three seals from the NWHI, whereupon, each was brought to the Aquarium. Each of the three seals was taken due to unique circumstances and may not have survived if they had been left in the wild.

Nuk'au, whose name means sleek swimmer in Hawaiian, is approximately 15 years old and arrived in 1983 from Laysan Island when he was two years of age. He was found with a large scar on his abdomen, perhaps, decreasing his fitness for survival in the wild. Although the cause of this scar is unknown the Aquarium has theorized three possible causes. First, Nuka may have cut himself on sharp coral while swimming. Second, he may have survived an attack by a tiger shark, as tiger sharks are the main predators of monk seals in the NWHI. Thirdly, Nuka may have been entangled in fishing net or monofilament fishing line. Entanglement by abandoned fishing material is a major problem for many marine organisms.

Maka Onaona, Hawaiian for soft or gentle eyes, is the youngest seal at the Aquarium, estimated to be 11 years old. He was found in 1984 in the French Frigate Shoals when he was three weeks old, abandoned from his mother. As monk seal pups generally are not weaned until they are 5-6 weeks, Maka most likely would not have survived if left on his own.

Au'kai, whose name in Hawaiian means sea traveler, was taken from Laysan Island in 1987. He is the oldest seal at the Aquarium, thought to be approximately 18 years of age. Au'kai was considered a CRAM individual. CRAM is an acronym for convicted rapist and mobber. Au'kai was removed from the wild population to help prevent such attacks.

The Waikiki Aquarium's non-invasive research, as approved by the NMFS, is designed to better understand monk seal biology and



behavior. The Aquarium emphasizes human contact with the seals on a daily basis. Through human handling and training exercises, the seals remain accustomed to human contact and can, therefore, be studied with greater safety and comfort to themselves and to the Aquarium staff and volunteers. Greater understanding of the biology and behavior of this endangered species will enable a more successful program for the for the final goal, a balanced wild population.

The proposed internship was designed to study the captive behavior of the three Hawaiian monk seals at the Waikiki Aquarium. The project's focus was directed as an observational study of behavior, with a primary interest in vocalization and aggression characteristics. In addition to behavioral observations, the researcher was trained in many aspects of husbandry regarding the monk seals including: feeding, training, obtaining saliva and blood samples and inspecting the animals overall health.

Unexpected events at the Aquarium forced changes to the planned observational study. The 70,000 gallon seal pool was resurfaced during the semester. The construction took a month to complete, during which time the seals were moved. This posed obvious problems for a study of behavior. Au'kai, the newest seal to the Aquarium, was moved to a holding facility at Kewalo Basin where he inhabited a pool with another male seal, Shige. Nuka and Maka, the two remaining seals, were moved to a holding pool at the Aquarium.

In response to these activities, the researcher would expect to see noticeable changes in the seals' observed behaviors which may mask or magnify their normal behavioral patterns. Working on the assumption that behavior in the wild or in captivity may be altered due to stress, changes in the normal, captive behavior of the seals may be caused by the stress induced by the following three factors. First, the seals were no longer living together in a common

community. Second, both holding areas were much different than the Aquarium's monk seal habitat to which the seals were accustomed; the pools and haul out areas were smaller and the fiberglass construction was very different from the natural rock design at the Aquarium. Finally, the seals were forced to live in closer proximity to each other. At the Aquarium's seal habitat, similar to conditions in the wild, they are able to keep distance from one another. Although the aquarium staff provided the most stress-free system possible, Au'kai may have endured additional stress due to his being transported to and from the Kewalo Basin facility. Fortunately, he was housed with a seal he had lived with years earlier at Sea Life Park, possibly reducing a difficult introduction process.

The researcher was unable to continue observations due to access restrictions as well. Access to Au'kai was limited to Tuesday feeding sessions, and structural limitations to the pool holding Nuka and Maka, prohibited continued observation.

It is most important to state that the semester internship was by no means a waste. The researcher was able to collect some raw data of daily behavior, but of even greater importance was the valuable experience and knowledge obtained by working with the Aquarium staff. Various aspects of work at the Aquarium, including husbandry techniques implemented in the care of the seals, became the emphasis of the internship and were instrumental in making this a successful learning project.

## **Experience and Training**

### **Feeding Sessions**

The feeding sessions at the Aquarium are open to the public and along with a presentation on seal biology and behavior incorporate an education program for the visitors to the exhibit. Volunteers interested in becoming monk seal trainers for the feeding sessions must complete a training program.

The first aspect of seal husbandry learned in the training program was diet and meal preparation. Working with other volunteers, the researcher inspected and cleaned approximately 2500 grams of herring and 500 grams of capelin for each seal per day, totaling an average of three kilograms of fish per seal per day. To supplement this diet, the seals are given vitamins (B, E, and a multiple) each day. The volunteers insert the vitamins, in tablet or capsule form, through the gills of a herring.

In addition to learning husbandry, part of the monk seal training program requires that each volunteer learns the hand signals for communication with the seals (Appendix I). The volunteer must also memorize and present a speech to the public about monk seal biology, behavior and the importance of the Aquarium's on-going research for the conservation of the Hawaiian monk seals. Once the volunteers have completed the training program successfully, they are allowed to work with the seals during the daily feeding/training sessions.

The importance of working with the seals on a daily basis is to keep them accustomed to human handling for non-invasive research. The research is important to better understand Monk Seal behavior and biology so that methods for conservation of these highly endangered species may be implemented. In addition, it is believed

that if the seals are accustomed to human interaction every day, experiences, such as being moved or having blood samples taken for research purposes, will not be as traumatic as it would be otherwise. For these reasons, there are many facets to the feeding sessions.

## Objects and Equipment

Each trainer begins the feeding and training session with: a bucket of fish (attached by a belt around the trainer's waist), a target (a three foot piece of white plastic tubing, knobbed on the end), a whistle, a large plastic ball, a tape measure, a saliva sampler ( a clean piece of sponge held in forceps), and a few objects for retrieval (usually two square plastic objects, one that sinks and one that floats).

The purpose of the target is to station the seal in a location so that examinations are possible. The seals have been trained to "target" on the tube by touching their nose to the end of it (Figure 2).



Figure 2: The seals are trained to hold their nose to the white pole, called a target, to control the animals and keep them stationary for examinations.

The trainers check each day for cuts and abrasions over the trunk and flippers of each seal(Figure 3 & 4). Their eyes, nose and mouth are also checked to make sure they are clear, look healthy and that any mucus that may be present appears normal. Trainers often practice blood sampling techniques with the seals by pressing down hard with their fingers on the seals' trunk just above their hind flippers. This is to simulate an actual blood sampling location to familiarize the seals with the procedure.



Figure 3 & 4: Part of husbandry practices at the Aquarium includes examining the seals for cuts and abrasions over their trunk and flippers.



The whistle is used for positive reinforcement. The seals have been taught that when they respond correctly to a hand command from the trainer, they will hear a whistle. After a series of requested behaviors have been successfully completed, each followed by a whistle, the seals are given a fish reward.

During each training session a girth measurement is taken. The measurement is taken using a measuring tape placed around the seals girth just behind the front flippers (Figure 5). The purpose of the measurement is to monitor the seals weight, as measuring their girth is much easier than weighing them. The seals at the aquarium weigh between 340 and 490 pounds.



Figure 5: Changes in the weight of the seals is estimated by a girth measurement that is taken using a measuring tape placed behind the front flippers of the seal.

A saliva sample is also taken from each seal on a daily basis (Figure 6). Currently, the samples are taken only to keep the seals accustomed to such a procedure. However, the Aquarium's on-going research often implements the use of saliva samples when testing testosterone levels of the three male seals.



Figure 6: Saliva samples, analyzed in annual physical exams and used in research, are taken from the seals on a daily basis to keep them accustomed to such a procedure.

The retrieval command was implemented as a safety measure for the seals, in addition to being an activity for their amusement (Figure 7). As a safety concern, it is important that if a foreign object falls into the pool the seals are able to retrieve it for the trainer. This will hopefully prevent ingestion of a foreign object by a seal that might be harmful to him.

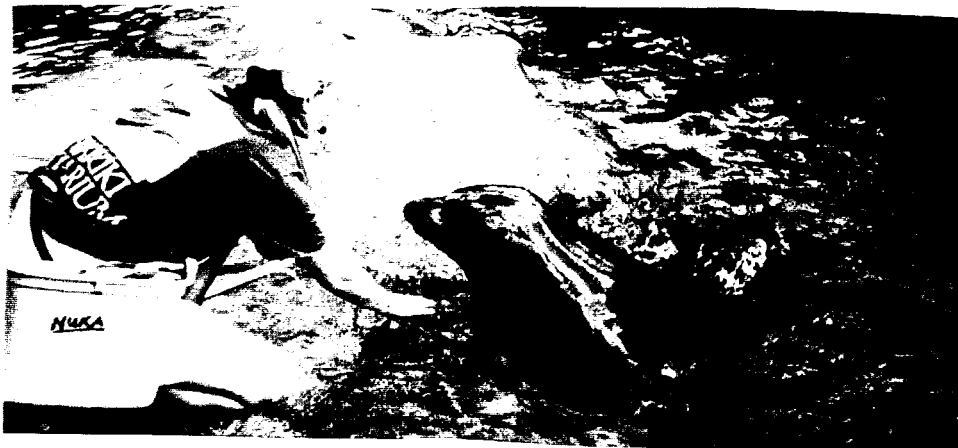


Figure 7: The retrieval command is an important behavior for the safety of the seals so they do not ingest any foreign objects that may enter the habitat.

## **Communication**

An important responsibility of the trainers is to communicate with each other. The feeding sessions must end for all seals simultaneously to avoid the possibility of the seals attacking one another. Trainers continue to verbally communicate the remaining number of fish they have to feed and finish feeding at the same time in an attempt to minimize such a confrontation. It is also important that the trainers communicate in a situation where a trainer has 'lost control' of a seal. This is often called the seal 'breaking' from the training session. The trainer can communicate a warning to the others of a seal approaching from behind, which could be a potentially dangerous situation for the trainer as well as for another seal.

## **Safety Rules for Monk Seal Trainers**

A few safety rules are abided by during the training sessions to prevent incidents and for the safety of the trainers. Although trainers interact with the seals every day, the seals are wild animals and have on rare occasions, been known to bite, even when unprovoked. Examples of these rules include: never reach or step over the seals at any time; never turn your back on a seal or come up behind an animal without signaling to him that you are there; never walk inbetween two seals in close proximity; keep your hands out of the fish bucket unless you intend to feed a fish; and communicate with other trainers in the event of a problem. Failure to abide by the rules could result in a dangerous situation for all the trainers within the enclosed habitat.



## **Interim Training**

During the interim, when the seals were in their temporary facilities, the training sessions continued in a limited capacity. Maka and Nuka were fed each day when their pool was drained of water, limiting the variety of behavioral commands. In addition, this researcher was also able to feed and train Au'kai at the Kewalo Basin facility on Tuesdays, where he was in a full pool with a haul out area. Au'kai molted while at Kewalo Basin and during his molting period refused to haul out of the water for examinations and measurements. His molting is now complete and he is again hauling out of the water for his feeding session back at the Aquarium.

## **Monthly Meetings**

The trainers attend monthly meetings when feeding and training procedures and recent behaviors of the seals are discussed. It was at one of these meetings that a suggestion was made to work on a new behavioral command for the amusement of the seals and to test their ability to distinguish colors. Since it is unknown if monk seals have color vision, the intention of the new project was to acclimate the seals with a black and white test and then move on to a color recognition test. The new command involves showing a seal (Nuka) a black dumbbell-shaped object and then asking the seal to retrieve an identical object from a group of objects of varying color and shape. Nuka has demonstrated quick mastery of this behavior in its initial phase using only the black dumbbell. A white dumbbell-shaped object will soon be added to the design and eventually other colors

will be implemented. Nuka will have to retrieve the proper colored object, without the aid of a shape discriminant.

## **Behavioral Observations**

Observational data of the seals' behavior was collected on focal sampling checksheets (Figure 8). With this system, each seal was monitored for a set ten minute period and all behaviors observed during this period were recorded. This is by no means to be judged as a comprehensive behavioral study. Due to unforeseen alterations to this project, the researcher has attempted to only identify common characteristics, contributed to the seals, that were suggested by the data.

Data suggest that all three seals spent the majority of their days in a restful state, either on the bottom of the pool, surfacing to breathe, or on the rocks of the haul out area.

When the behavioral study was initiated, Maka was often observed challenging Nuka, the alpha(dominant) male. The researcher was interested in the progression of this challenge. Observational data suggested that Nuka was still the alpha male due to his continued dominance of Maka, illustrated by various aggressive acts. These two seals were often seen interacting in this way. Aggressive acts included: approaching, jousting (lunging with mouth open), and vocalizing (separated into two types: I-short guttural noises, II-elongated barking roars). Body positioning was used by the seals to strategically place themselves in visual contact. The seals would most often position themselves (regardless of distance) in a head to head relationship, rarely remaining with their backs turned to one another for very long. On rare occasions, Maka would rest in the haul out area with Nuka resting behind him, in a



tail to head situation. This may be indicative of a hierarchical social system evolved in captivity. Future behavioral research would be necessary to ascertain such claims and to study indications of Maka's submissiveness to Nuka's dominance. Eventually, Maka's 'breaking' behavior and advances toward Nuka diminished and have recently ceased to exist. This researcher has no explanation for the cause of the behavioral change but believes it to be a good area for further study.

Observations of the seals' behavior also suggested that the vocalizations of one seal would often elicit vocalizations from another seal. These vocalizations (Types I and II) were produced in many situations. They were observed in and out of the water, during rest periods and during social interaction. Au'kai was never observed vocalizing; all recorded vocalizations were between Nuka and Maka.

It is also interesting to note that the positioning of the seals in the water was almost always consistent. Maka almost always dictated the center position, with Au'kai at the makai end of the pool. Nuka was most often seen at the mauka end of the pool or roaming within the pool area. Interestingly, Au'kai was always observed to move to the mauka end of the pool on Thursday afternoons, when the pool is drained. There he would spend hours, until the pool was emptied, swimming in circles counter-clockwise. This behavior was never observed at any other time.

Maka, the youngest seal, tended to be the most active, spending more time swimming about and moving in and out of the water. When resting, he was most often observed on the bottom of the pool inside the cave, near the center of the habitat. Neither of the other seals were observed to occupy this space in the cave.

Au'kai was almost always solitary: swimming in circles, floating and resting on the bottom of the pool. He was often observed performing repetitive behaviors. For example, he often would swim along the bottom of the seal pool, touching his nose to the wall.

When he would reach the end of "his area" he would turn around, take a breath and begin the behavior again. He rarely interacted with the other two seals, but was observed defending his space if confronted. Confrontations were usually instigated by Nuka.

The other two seals, Nuka and Maka would often spend a great deal of time in the same general location, either in the pool or in the haul-out areas.

It is important to note that the researcher's learning experience was greatly increased during this internship in regards to behavioral recording techniques. Much of the primary observations were unrecorded, due to the need to spend time identifying behaviors that would be commonly seen. It was also important to be able to recognize the seals individually and to have a system for recording behaviors quickly and efficiently. As the study progressed, the behaviors of the focal individuals were observed and recorded more effectively by the researcher.

## Conclusion

Since, the time of the observational study, the researcher has been employed by the Aquarium as a student aquarist, requiring many new responsibilities and participation in on-going projects. Primary responsibilities continue to include husbandry and care of the Hawaiian monk seals and organization and assistance for the volunteers for the abovementioned feeding sessions.

Additional responsibilities include: cleaning the seal pool habitat including draining the pool and removing the weekly growth of algae with high pressure sprayer; learning how to operate the pump and filter system; maintenance and cleaning of large tropical reef systems

including siphoning and acid-cleaning system gravel; and the cleaning of glass, acrylic and backdrops to display standards.

The position also entails feeding of tropical fish, including eels and invertebrates such as the Hawaiian spiny and slipper lobsters. This researcher has also learned to identify each lobster individually and record dietary behaviors for determination of isolation during molting processes. It is also the responsibility of the student aquarists to feed the juvenile green sea turtle in such a fashion as to insure the turtle will be a successful forager when released into the sea.

Currently, the researcher is working with the Aquarium implementing an assimilation study of the seals. The purpose of the study is to determine what food resources (ie. fish, lobster, squid) the monk seals are able to digest most efficiently and therefore extract the most nutrients from. Malnutrition has been shown to be a problem in certain populations in the wild (Ching, 1994). In the Aquarium's on-going research, chromium oxide capsules are placed in the seal's diet, as a tracer or marker for assimilation. The seals will then be given a diet of each food source and assimilation rates will be determined by fecal collection.

Recently, the researcher participated in the annual physical examinations of the seals by the veterinarian and team from the NMFS. This entailed taking blood samples, X-rays and saliva and fecal samples. Practice efforts (as noted above) for taking blood samples paid off as two of the three seals voluntarily held for blood sampling, a practice that had never before been possible.

In conclusion, it is this researcher's opinion that the knowledge and experience gained by interning at the Aquarium not only led to a student aquarist position but also continues to be a gratifying and rewarding experience beyond the scope of this original project.

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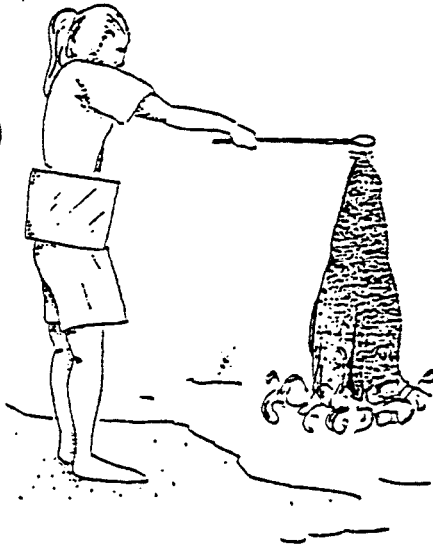
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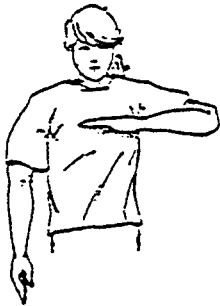
1) TARGET

Place target so that the animal can get to it. If the animal removes his nose from the target, using your right hand point to the target. Upon releasing from target make sure you remove the target from the vision of the animal before you reward.



2) SWIM ON BACK

Left hand with palm down and fingers together against chest. Show the animal this cue until you want them to stop swimming.



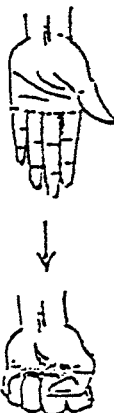
3) COME ON BOARD

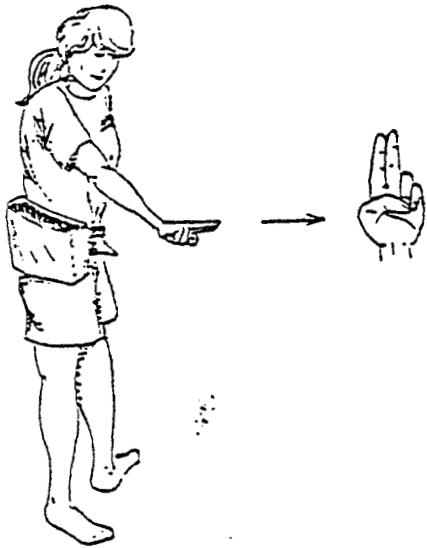
Using right hand sweep across your body from left to right. Make sure that the target is out of sight of the animal so as not to cause confusion.



4) ROLL ONTO SIDE

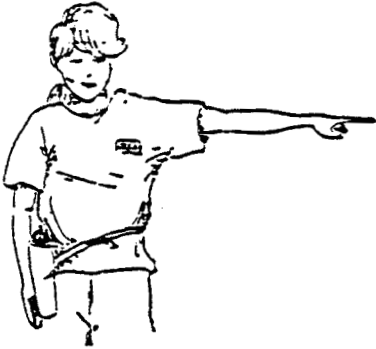
Put left hand at side with palm out. Roll up fingers to make a fist. When releasing the animal make sure the animal rolls back and touches target before being rewarded.





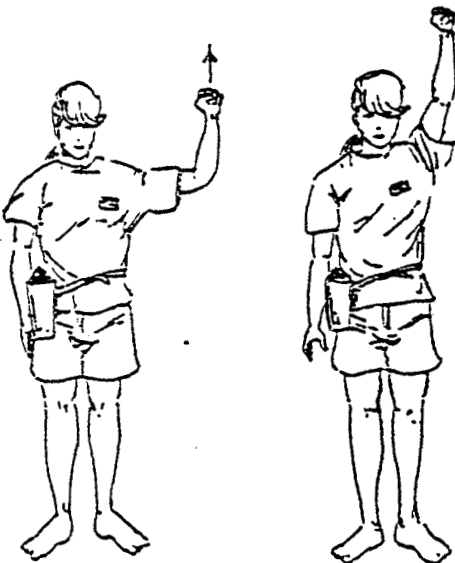
9) STATIONING IN FRONT OF TRAINER

Right hand with index and middle finger extended out. The animal should get off the island and station in front of the trainer and remain until hand is put down.



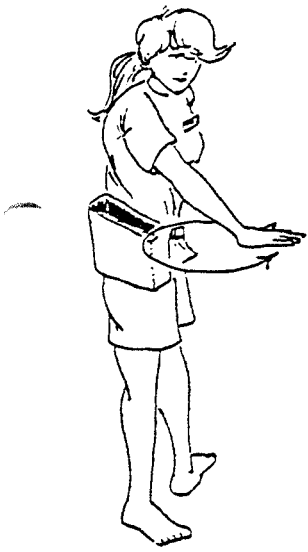
10) RETRIEVAL

Using left hand point to object to be retrieved.



11) HAUL OUT ROUTINE

Station animal in nock (as described earlier) then raise fist above head for the animal to come out of the pool through the gate.



**Rotating:**

Right hand out with palm facing the ground rotate in clockwise or counter clockwise direction. Animal should keep rotating until command is completed and then the animal should stop in front of the trainer.



**Retrieve green colored ball:**

In front of chest form a circle with fingers on top and thumbs on the bottom.



**Retrieve red colored ball:**

In front of chest form a cross (Or X) with arms right arm over left arm. Keep fingers closed into fists.

5) Blow Bubbles (Nose ONLY)

Left hand up to left cheek. Remove left hand when you want animal to stop.



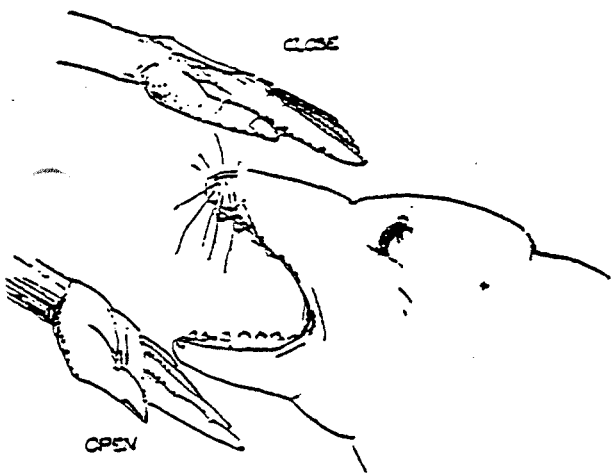
6) VOCALIZE

Left hand at waist level move hand palm out to palm down. Stop when you want the animal to stop vocalizing.



7) OPENING & CLOSING MOUTH

Target animal in front of you. Hold right hand out with palm up underneath animals chin. The animal should hold the mouth open until the trainer releases by putting left hand gently on top of animals nose.



8) STATIONING IN NOCK

Left hand clinched held up in a right turn signal fashion. The animal should stay in nock until arm is lowered.





**Rolling over:**

Right hand with index and middle finger extended out, rotate in a circular move. Rotate the direction you want the animal to roll, either to the right or left.



**Flipper to nose:**

Right hand made into a fist. Bring fist up to nose. The animal should place one flipper to its nose. Stand to the animals left side if you want left flipper to nose, stand to the animals right side if you want right flipper to nose. If you want both flippers to be placed on animals nose, bring both hands made into fists up to nose.