



## Human-assisted Fostering of Hawaiian Monk Seal Pups

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An unusual feature of Hawaiian monk seal (*Monachus schauinslandi*) reproductive behavior is that lactating females often nurse pups other than their own (Johnson and Johnson 1984, Alcorn and Henderson 1984, Boness 1990). A female apparently becomes confused over the identity of her pup and allows another pup to suckle. However, because females do not have sufficient nutritional reserves to raise more than one pup, the female will usually allow only one pup to suckle at a time. In order to survive, the displaced pup must find another lactating female, and this is frequently the one from which the first pup just came. The net result is an exchange of pups. Such "pup switching" or fostering behavior is more common where the density of mother-pup pairs is high (D.J. Boness, pers. comm.).

Why such a "loose" system of pup recognition should have evolved is an interesting question. Perhaps there has been little selection for accurate pup recognition because there was little need for it. True to their name, monk seals are solitary animals, and do not form the dense colonies that characterize other pinniped species. Widely scattered mothers are less likely to encounter other pups and to have to distinguish them from their own. On the other hand, fostering behavior may have evolved because it has positive benefits. There are several hypotheses to account for the evolution of fostering behavior: increased maternal experience, continuation of normal reproductive cycle, and increased inclusive fitness (kin selection). Riedman and Le Boeuf (1982) have suggested that some combination of these factors may explain fostering behavior in northern elephant seals (*Mirounga angustirostris*).

Whatever the reason for its evolution, we may be able to use the apparent lack of



Fig. 1: Female Hawaiian monk seal with two pups. One of the pups is not hers but has been temporarily adopted. This represents an unstable situation, because the female will not continue to nurse both pups. The rejected pup will have to be adopted and nursed by another lactating female if it is to survive. The feeding and care of another animal's offspring is called fostering. Photo by M. Craig

own-pup recognition in Hawaiian monk seals to aid in the recovery of this endangered species. A separated, abandoned, or prematurely weaned pup with little chance of survival can, with human assistance, be reunited with a lactating female, who will then nurse it through weaning. Here we describe several such successful rescue efforts and discuss their implications for future conservation work.

### Human-assisted Fostering

The breeding range of the Hawaiian monk seal (Fig. 1), one of Hawaii's two native mammals, is from Nihoa Island to Kure Atoll in the Northwestern Hawaiian Islands. Occasional births occur in the main Hawaiian Islands. Last year they included a birth on Kaua'i and the first recorded birth on O'ahu in modern times. Individual adult females can often be recognized by distinctive scars and natural marks in the pelage, and nicks and cuts on the flippers. Pups are more difficult to distinguish individually because they lack scars. However, pups pass through definite stages (termed P1 through P5 in our field notes) during the nursing period, and, combined

with the fact that the mother-pup pairs usually remain on the same section of beach, it is often possible to follow a pup during its nursing period with reasonable certainty. Weaning occurs after an average nursing period of 39 days (T.C. Johanos, manuscript in prep.) at stage P4 or P5. Similar estimates, based on smaller samples of females, have also been reported (35 days: Kenyon and Rice 1959; 37 days: Johnson and Johnson 1984; 41 days: Boness 1990).

The four cases of successful human-assisted fostering described below took place at French Frigate Shoals, Northwestern Hawaiian Islands. French Frigate Shoals is an atoll composed of about 10 more or less permanent sand islands and one volcanic pinnacle (Amerson 1971). From beach counts of 250-300 seals made during recent years, it is estimated that about half of the current monk seal population lives at this atoll (Gerrodette 1985). East and Whale-Skate Islands are the two most important breeding islands at French Frigate Shoals (Westlake and Gilmartin 1990). Tern Island is an important hauling site, but births rarely occur there. The number of seals using Tern Island has increased greatly over the

last 15 years since the U.S. Coast Guard abandoned a loran station on the island (Schulmeister 1981, Gerrodette and Gilmartin 1990).

#### Case #1: East Island, 1986

Female B had two P1 pups with her at 1300 hours on 20 April. One pup looked approximately a day older than the other, which still had its umbilical cord attached. Both pups suckled briefly, but were interrupted by the female. She alternately attacked and fled short distances whenever the pups approached. From the water's edge, the female hauled up to the beach crest, traveled in circles, and eventually headed back down to the water. Both pups attempted to follow her, but they moved slowly and appeared to become tired and weak. The smaller pup became stranded at the beach crest. We decided to intervene because of the risk of the pup developing heat stress. At 1504 hours we picked up the extremely hot pup, cooled it in the ocean, and carried it to an adult female that lay nearby. This female vocalized and chased the pup away. Female F was sighted in the water, investigating the shoreline. As soon as she saw the pup, she began giving characteristic "moaning" vocalizations often emitted by mothers to attract pups (Eliason et al. 1990). We placed the pup on the berm, and female F and pup immediately moved toward each other. She nuzzled the pup all over and rested her chin on it. The pup had not suckled, but the pair was asleep, hauled up for the night, when observations ended at 1557 hours. It is unknown whether this pair remained together or if further pup exchanges took place. However, the pup survived to weaning, even though its exact identity was unknown, because all pups on the island at the time weaned.

#### Case #2: East Island, 1986

On the same day as the previous incident, female H was swimming with one P1 pup when she was approached by another swimming P1 pup about 1600 hours. The female vocalized repeatedly but did not attack either pup. When the trio hauled out, we could see that one pup was slightly larger, and the larger pup blocked the smaller from nursing. Female H was still accompanied by both pups the following day. She appeared agitated whenever the pups attempted to suckle and

neither pup was nursed for a sustained period. Only one pup (usually the larger) was able to get into suckling position at a time. At 1450 hours female M was seen swimming nearby, making the same "moaning" vocalizations described above, and investigating each mother-pup pair along the beach. We decided to intervene because it was unlikely that female H could successfully wean both pups. At 1500 hours we picked up the pup farthest from the sleeping female H (the larger one). The female did not awake. We placed the pup at midbeach in front of searching female M. She immediately hauled out, approached the pup, nosed it, and presented her ventrum. The pup began to suckle three minutes after being placed on the beach, and continued for 15 minutes. The pup soon fell asleep, and the pair was still asleep together when observations ended at 1753 hours. As with Case #1, it is unknown if the pair remained together, but all pups on the island at the time survived to weaning.

#### Case #3: Whale-Skate Island, 1988

Female W10 was accompanied by both P1 and P2 pups on 24 May. The female alternately repulsed one pup or the other, and neither pup was able to suckle in an hour of observation. The next day a P2 pup (presumably the same one as the previous day) was with female W10; a P1 pup was alone nearby and its movements appeared weak. We knew that female W6 had been nursing a young pup two days previously, but that she had been without a pup since then, so it was likely that she was still lactating. At 1530 hours we picked up the lone pup, carried it 50 m down the beach, and placed it near female W6, who was sleeping at the water's edge. Female W6 did not see us approach but turned and saw us as we were moving away. The adult female and pup both vocalized, moved together, and sniffed each other. About two minutes after the pup was placed near her, the female rolled on her side, presenting her ventrum to the pup. The pup immediately began to suckle. For the next two days, female W6 was seen, apparently with the same young pup, but on 28 May, female W7 appeared to be nursing the pup we had picked up (based on the size of the pup), and female W6 had a larger pup. After that, female W7 continued to be seen every few days with what was probably the same pup

until weaning occurred about 25 June.

#### Case #4: Tern and Whale-Skate Islands, 1988

An abandoned P1 pup was found on Tern Island on 16 June. From observations the previous day, we knew that female W28 on Whale-Skate Island, 5.5 km away, had become separated from her four day old pup. We did not know if the Tern Island pup belonged to female W28, but we considered it likely. Finding any young pup on Tern Island was a rare event, so finding a separated pup of just the proper size right after female W28 had lost her pup was a highly unlikely coincidence. Moreover, on other occasions we have seen young pups, who are weak swimmers, swept away by currents. Since prevailing winds blow from Whale-Skate toward Tern, W28's pup could have been carried in that direction. We picked up the pup, took it by boat to Whale-Skate Island, and placed it with female W28. She seemed to reject the pup at first, but the next day the pair was nursing normally. The pair continued to be seen together over the next month until the pup weaned about 15 July.

#### Discussion

Alloparental care (care of young by helpers other than the biological parents) occurs in a wide variety of mammals and birds (Riedman 1982). Such behavior seems to be reproductively costly and unlikely to evolve under classical natural selection. However, there are several possible ways that altruistic behavior such as alloparenting may evolve (Krebs and Davies 1987). By helping raise another's young, a helper may increase its own survival rate, obtain a breeding territory, and gain valuable parenting experience, all of which may contribute to greater production of its own offspring later in life. This appears to be the case among some birds (Emlen 1978) and primates (Lancaster 1971, Hrdy 1976). Riedman and Le Boeuf (1982) suggest that fostering behavior may be beneficial in northern elephant seals by continuing a regular reproductive cycle after losing a pup. This is based on the assumption that lactation and continued nursing help induce ovulation and copulation, and therefore increase the chance of giving birth the next year.

Fostering behavior may also have evolved through kin selection, in which the helpers are related to the young they care for. The theory of kin selection (Hamilton 1964, Michod 1982) postulates that the costs of helping are balanced by the benefits of genetic relatedness. By increasing the probability of survival of relatives, the helpers increase the probability of passing on some of their own genes. However, Boness (1990) did not find any reproductive costs associated with pup exchange behavior in the Hawaiian monk seal. Also, we do not know if Hawaiian monk seal pups involved in pup exchanges are related, or if females tend to foster pups related to them. Genetic studies in progress may allow us to answer some of these questions.

Among pinnipeds, fostering is more common in phocids (true seals) than in otariids (sea lions and fur seals), but most instances have occurred after human disturbance at the pupping colonies (Stirling 1975). In Hawaiian monk seals, an early instance of nursing an alien pup after human disturbance was described by Kenyon and Rice (1959). However, exchange of pups can also occur repeatedly under natural conditions (Boness 1990). Mother-pup recognition seems to involve visual, olfactory, and auditory cues (Eliason et al. 1990), but "mistakes" occur frequently, at least at some locations.

For several years the National Marine Fisheries Service has conducted a successful rehabilitation program for prematurely weaned female monk seal pups at French Frigate Shoals (Gerrodette and Gilmartin 1990). In this rehabilitation program, weaned female pups less than 90 cm in girth are transported to Honolulu for intensive care and feeding, then released as yearlings back into the wild the following spring. However, the weaned pups taken for rehabilitation are much larger than the young pups in the human-assisted fostering cases described above. Rehabilitation of very young pups has not yet been attempted with the Hawaiian monk seal. The remote location makes it difficult and expensive to transport seals, and the chances of successful rehabilitation from such a young age are unknown. Two young Mediterranean monk seal pups (*M. monachus*) were successfully reared in 1988 at the Seal Rehabilitation and Research Centre, Pieterburen, Netherlands, and released into the wild in 1989 (t Hart

and Vedder 1990).

The cases of human-assisted fostering described above offer an alternative to captive rehabilitation that is preferable from several points of view. It is less expensive and involves less handling of the pup. The pup does not risk exposure to exotic diseases which might be carried back into the wild population. Possible long-term effects of hand-rearing in captivity are unknown, but it seems unlikely that removal of an otherwise healthy pup from natural conditions will be better than foster maternal care in the wild, especially when fostering is known to occur naturally.

However, there are stringent requirements that will limit the application of such a procedure. First, abandoned pups must be discovered promptly. Field observations suggest that newborn pups will become too weak to suckle if abandoned for more than a few days. Older pups can survive somewhat longer periods of fasting. Because of intensive field work, we were able to act promptly when the situation arose in these four cases.

Second, successful fostering of an abandoned pup requires the availability and identification of a lactating female without a pup. Unless parturient females have been individually identified and closely followed during the pupping season, it usually will not be known which females are lactating when an abandoned pup is found. In each of the cases above, we either knew that a particular female had recently lost a pup, or saw a female exhibiting a characteristic pup-searching behavior.

Third, there may be other factors affecting successful fostering that we do not understand. An attempted fostering at Laysan Island in 1988 was not successful (Johanos et al. 1990). An attempted reunion of an abandoned pup with a lactating female at East Island in 1983 was not successful (W. G. Gilmartin, pers. comm.). The lack of success in the latter case may have been due to the older stage of the pup (P3), but older pups have also been known to be adopted by lactating females, either with or without their own pup (Alcorn and Henderson 1984, Boness 1990).

Finally, because the Hawaiian monk seal is an endangered species, human intervention during the nursing period is not to be taken lightly. Some of the recent declines in monk seal population size are related to past disturbance at the pupping sites (Gerrodette and Gilmartin 1990).

Moreover, disruption of normal maternal care has been a factor in the decline of many threatened and endangered mammals (Oldfield 1988). In the cases described above, we intervened only when the situation seemed serious, and we attempted to minimize our presence. In all four cases, the adopting female was aware of humans, probably through both sight and smell, but that did not preclude successful fosterings.

Under the right circumstances, therefore, human assisted fostering of abandoned monk seal pups appears to be an effective means of "rescue." To date, alloparental care has been exploited as a conservation strategy mainly in birds, most notably in the case of Sandhill Cranes (*Grus canadensis*) incubating and raising young Whooping Cranes (*G. americana*) (Doughty 1989). The success of the attempts described above suggests that natural fostering behavior could also be exploited as a limited conservation strategy in the Hawaiian monk seal.

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