

NOTES ON CAPTIVE SEA OTTERS*

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THE former range of the sea otter (*Enhydra lutris*) extended along the Pacific coast from lower California northward to the Aleutian Islands, and westward to the Komandorskiye Ostrova (Commander Islands), the Kamchatka coast, and the Kuril'skiye Ostrova (Kuril Islands). The species was nearly exterminated in North American waters around 1900 by fur-hunters. In 1911 total protection was given, at least on paper, to the depleted North American population and the establishment of the Aleutian Islands National Wildlife Refuge in 1913 added reality to the legal protection. With improved control through the administration of the refuge and the presence of armed forces in the islands, which has acted as a deterrent to international poachers, the otter population has made a marked recovery in certain areas, such as Amchitka Island. However, natural redistribution occurs slowly and there is inconclusive evidence of inter-island movement among the otters. Because of this inertia an early step in the management of sea otters will be the restocking of suitable parts of the former range with captured wild animals. The relative ease with which otters may be approached and taken in a large landing net on beaches and, at times, in the water suggested that this operation would be feasible.

Employees of the U.S. Fish and Wildlife Service, working with a considerable knowledge of the wild sea otter (Fisher, 1939; Murie, 1940; Jones, 1951a), therefore made repeated attempts, beginning in 1951, to maintain captured sea otters for the purpose of relocating them. Unfortunately, all otters taken during several winter seasons died within a few hours or days. Observations made on the dead and dying otters (Jones, 1949-53) suggested that mortality was due to a stress or shock reaction incident to capture, handling, and confinement. Accordingly, the U.S. Fish and Wildlife Service and the Purdue University Agricultural Experiment Station collaborated on a preliminary physiological investigation to determine the cause of mortality among captive sea otter on Amchitka Island in February and March 1954. These months were chosen because in late winter the otters are concentrated inshore and are easier to catch. During the investigation the research team made physiological

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Fig. 1. Adult male seal otter, weight 70 pounds, in holding tank. Note bristly appearance of lighter head fur, vibrissae, and short claws on upper side of fore paws.

observations on twenty-two otters, three of which survived and were placed temporarily in the Seattle Woodland Park Zoo before being transferred to the National Zoological Park, Washington, D.C., on 14 June 1954. This paper is based on the reactions of these three to captivity and handling up to the time they left Seattle, and of others held for shorter periods. Results of the physiological investigations will be reported elsewhere (Stullken and Kirkpatrick, 1955).

The research team met with disappointments and failures in trying to develop satisfactory methods for handling and feeding. The survival of three otters showed some degree of success, but their welfare was not jeopardized by experiments to determine the limits of their tolerance to various aspects of handling. Had we known about the success of the Russian work in the Komandorskiye Ostrova (Mal'kovich, 1937; 1938), we might have benefited from their experience in keeping confined otters in good health, particularly as regards the amount of food needed daily. Their Ostrov Mednyy (Copper Island) sea otter station established in the early 1930's is described by May (1943) and illustrated by Hrdlicka (1945, p. 396), both of whom visited the island in 1938. Results of the Russian work did not reach us until our expedition ended, but interesting similarities in observations, methods, and results are apparent.

The sea otter is at home in water, but on land its body is pendulous and poorly supported by the relatively short, muscular limbs. The total length of an adult is about four feet, and the females are generally smaller than the males. Among the animals we handled, four adult females ranged from 38½ to 50 pounds, and males, apparently older than yearlings, ranged from 30 to

82 pounds. Scheffer (1951) records a female of 43¼ pounds and a male of 76 pounds. Mal'kovich (1937) gives the weight of a captive male at 37.3 kg. (82 pounds).

The musteline head is flat and blunt, the eye small and dark, and the small external ear, fleshy, vascular, and naked, is twisted upon itself. A blunt, black nose pad separates stiff decurved vibrissae (Fig. 1). The fore paws are pad-like with no separation of the digits, although the terminal phalanges are movable and give great flexibility to the tips of the paws. The short and slightly curved claws are normally retracted on to the back of the paw but may be rotated forward to extend beyond the tip of the paw. The hind foot is a broad, flipper-like structure, fully webbed, each digit having a nail-like claw above and terminal callouses below. Unlike the fore paw, the hind foot is furred on both sides and all phalanges are mobile. In the following discussion the fore feet and hind feet will be referred to as paws and flippers respectively.

The body fur is dark, soft, and luxurious, with fine dense guard hairs and under fur, but the head fur has a bristled appearance. In some individuals the head and neck are a contrasting buff colour, and grizzling of guard-hair tips is common in older otters. The fur of the chest is usually worn shorter than that of the rest of the body. The skin is remarkably loose on the body, even about the head, and is not underlain with blubber as in other marine mammals. There is a capacious fold of skin on the chest extending from one arm-pit to the other, which the otter can manipulate to form a pouch for holding food; however it is not an enclosed structure like a marsupium (Fig. 2).

Captive otters and their environment

In previous years the sea otters captured at Amchitka were held in fresh-water ponds or in a tank about ten feet in diameter, containing sea water two feet deep and a small platform of rocks (Figs. 1 and 3). The longest time any otter survived in the tank was eleven days, most deaths occurring much sooner, usually preceded by the otter shrieking. Since the temperature of the water in the tank fell below that of the sea, it appeared that otters kept in the tank suffered from cold. This was supported by the observation that young otters



Fig. 2. Skins at centre and right show the outline of the loose skin and short fur of the chest pouch.

transferred from dry quarters to the tank for a cleansing bath began screaming almost at once.

In 1954, as it seemed that exposure to cold was one cause of mortality, we held some animals in a dry environment. Three of these otters survived two and a half months without water for swimming until they were temporarily transferred to the Seattle Woodland Park Zoo. When released there, in an enclosure with a freshwater pool four feet deep, the otters promptly entered the water and swam. However, during their first swim they began to shiver without coming out, so the pool was drained to help them regain the shore and dry themselves. The next day they swam, and again showed signs of cold but soon climbed out to dry. After about three days they used the water normally without getting cold. Presumably the water-repelling properties of their fur had recovered after being temporarily destroyed by keeping them dry and permitting their fur to become dirty. Our observations, as well as the Russian reports, show that water for swimming is desirable, if not necessary, for the welfare of captive sea otters. The temperature of the water is important, but the exact water temperatures that captive sea otters can tolerate are not known. The annual fluctuation of the sea temperature at Amchitka Island is from 38°F to 47°F. Water in the Seattle Zoo pool was about 50°F, and daytime air temperatures of 60° to 65°F caused no signs of distress.

The subjects for most of our observations were three young, probably yearling, otters: one female (Hortense) weighed 19¾ pounds when captured, one female (Aggie) weighed 24 pounds, and a male (Peter) weighed 25 pounds.

For eleven days after capture Hortense was kept as a pet in the heated house serving as laboratory and living quarters for five men; she had the run of the dry, bare floor during the day. At night she was confined in a cage containing grass. The cage consisted of a wooden frame 1½ x 2 x 4 feet covered with 1 x 1-inch welded wire fabric. Aggie and Peter were confined in similar cages during the early days of their captivity. They were never taken into a heated building, but were let loose in the "otter house" six days and one day after capture respectively. The "otter house" was a small, wooden warehouse, well ventilated and fairly well lighted by windows facing north and east. Neither walls nor windows completely prevented the penetration of the wind-driven rain, so that walls and floor were usually damp. Fresh, dried grass spread upon a layer of sawdust kept the otters from contact with the plank floor. The "otter house" provided an open space of about 15 x 20 feet and room for the cages which were supplied with grass bedding and raised several inches above the floor. At night the otters used the cages freely, irrespective of ownership.

The otters successfully maintained in captivity were fed four times daily at 0700-0730, 1100-1200, 1600-1700, and 2100-2300 hours. After the food requirement was determined, each otter consumed a total of six to seven pounds of fish per day, about one or one and a half fish per meal.

Little handling of the otters was necessary. Weights were taken by dropping a large sack over an animal, scooping it up, and then weighing the sack with the animal in it.

Sleeping: The normal sleeping position was on one side or supine, rarely prone. The head and neck were usually turned to one side, with the hind quarters curved or straight. The paws were held either rigid or relaxed, usually with the palms together beneath the chin or pressed tightly over the ears. In the latter position the muzzle was thrust into the pouch region. At other times the head rested upon the palm of one paw, and the other paw relaxed under the chin or extended outward or upward. The flippers usually were spread, sole down, with the tail straight back, but commonly one or both of them was turned nearly at right angles to the long axis of the body. Occasionally, when an otter lay prone, its flippers were flexed forward under the abdomen. When the otter was supine, an intermittent reflex raising and outward rotation of its flippers suggested sculling, like that which takes place when the otter floats asleep or awake in the water. (This reflex also occurred when the otters fed on their backs). Breathing movements occurring at a rate of about 12 per minute were accompanied by slight nostril dilation and twitching of the vibrissae. Otters sound asleep on a wooden floor were not awakened by gentle walking or normal conversation a few feet from them.

Preening: The otters preened regardless of the condition of their fur, but rubbing was intensified when the fur was wet. Fluffing the fur occurs both in and out of the water, and might be considered a nervous reaction because it appears to be an automatic function in both wild and captive otters (Fisher, 1939, p. 24; Jones, 1951b, p. 354).

Preening was carried out in any position. A supine animal might raise its head, thrust its nose into the fur of the chest or abdomen, and rub it rapidly from side to side, snorting and blowing. Simultaneously the paws rubbed sides, haunches, face, ears, or neck with rapid rotary, and to and fro motions. Folds of the loose body skin were repeatedly gathered and scrubbed vigorously between the paws. Paw movements were not always synchronized. Hortense was adept at rubbing her right elbow with her left paw while rubbing her face with the back of her right paw. With arms folded before the chest, the otter rubbed opposite forelegs or shoulders with both paws simultaneously or the backs of the opposite paws alternately. In this action the digits were frequently extended outward away from the palm. There seemed to be no part of the body the fore paws could not reach and rub. There was much snake-like wriggling on the straw accompanied by pushing of the flippers against the floor and ear rubbing while the otters were on their backs, sides, or bellies. In the cage the wire was used as a rubbing surface for head, neck, and sides. When the fur was wet, the head and neck were shaken vigorously, in many positions, occasionally accompanied by a flipper scratching the shoulder region. Vigorous shaking in a half-reclining position swung the paws away from the body centrifugally, and even rotated the whole body to some extent.

When permitted freedom of the "otter house", the otters sought the drier areas of straw for preening and sleeping, although warmer spots in direct sunlight were usually avoided. When reclining, the otters occasionally drew bunches of loose grass over themselves, rubbing the grass between the paws

and against the body; however, this was not kept up for long at a time. On days when the soiled, damp, and matted grass was replaced with clean, dry grass, the otters' interest in grass increased and they frequently climbed into the box containing fresh bedding. They apparently enjoyed handfuls of grass dropped directly upon them.

While in any position the otters moved their skin to and fro, mainly in the abdominal and lower back region and less about the shoulders. This action, also noted in wild sea otters (Fisher, 1939, p. 24), is apparently done by contraction of dermal muscles; it is not a rapid twitching like the flicking of a horse's skin, but a slower peristaltic-like wave easily followed by the eye. Its purpose may be to separate water-matted fur by raising the guard hairs, although the movement also occurred when the fur was dry or nearly so.

For a few hours after capture, especially when wet and nervous, the chest and, less commonly, the sides and haunches were vigorously slapped with the paws. This resulted in water spattering from the fur and paws, but it may have been a nervous reaction only since it was particularly marked immediately after capture. Depending upon conditions and size of the otter, the slapping sounds may be audible from some distance.

Licking the fur was not common, although the chest and belly may have been licked when the muzzle was held against these parts. The tongue was rarely visible as the muzzle moved about in the fur, and there was no sustained licking of one area as seen in dogs and cats. The tongue was not used to clean the face, lips, or paws, even though an artificial feed, "Teralac",¹ stuck to the paws. Occasionally when preening, the otters appeared to chew or nibble at the fur of the chest and the forearms.

Reaction to handling: From the first moment of capture, the otters showed definite individuality of response to handling. The urge to escape dominated, and new captives were not ordinarily aggressive unless forcibly restrained or provoked. Generally the newly caught otter fought the net by twisting and rolling, and biting at it or any other object within range. Small animals of 18 to 25 pounds in weight required little restraint and usually lay sullenly on their backs with heads erect when cornered. This was not cowering but an alert defensive position from which the otter could rear or lunge to snap, often using its paws with surprising speed in an attempt to grasp an irritating object. A hand touching the neck or back of the head was easily grabbed, and if not quickly withdrawn, was scratched or bitten. Such attempts to bite were accompanied by hissing and rattling snarls but no prolonged growls.

Since the skin is extremely loose over the entire body, the otter can bite a hand holding it by the scruff. Small otters up to 25 pounds in weight were momentarily restrained by grasping the neck from behind with both hands although the snapping jaws came close to the fingers. When held in this manner, the paws and less commonly the flippers were used with considerable force against the hands.

¹"Teralac", a dried milk-like substance, was supplied for this work by Chas. Pfizer and Company, Brooklyn, New York.

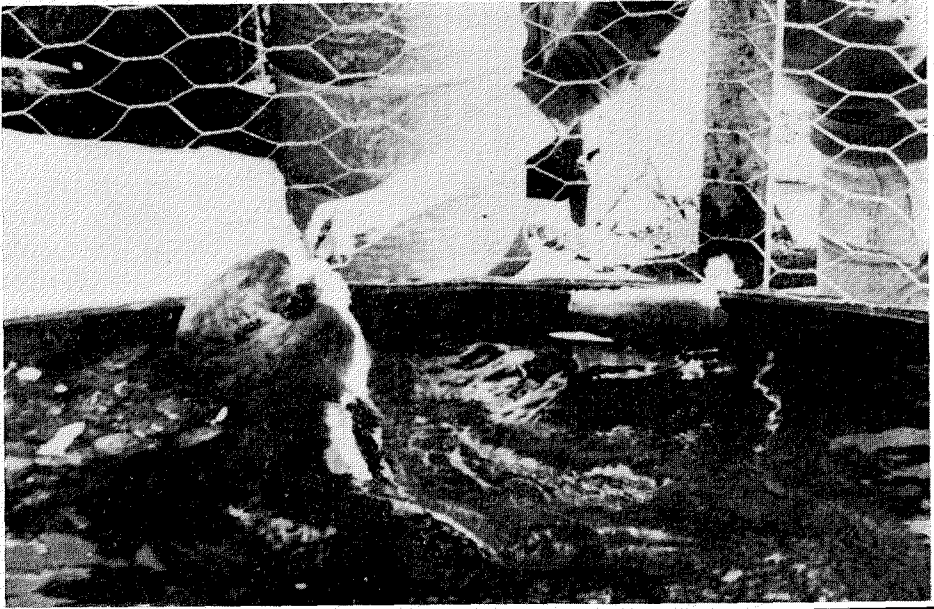


Fig. 3. Large male sea otter accepting food shortly after capture.

Men handling otters were occasionally bitten because of carelessness or inadequate protection of hands or arms. Resulting injuries were usually in the form of pinches which sometimes did not break the skin. Hortense was the most easily handled, probably because she received most attention, but even after three weeks of captivity she objected to being touched. Before being picked up, she was induced to bite and hold a mitten loosely covering the hand. While thus preoccupied she was lifted and gently cradled in the arms. As soon as her body was securely supported, she lost interest in biting and could be carried short distances or held for several minutes. Peter was less docile and Aggie resisted all handling violently.

After a few days in captivity, when not handled, the otters usually ignored people, movements, and sounds. Flash bulbs, lantern light at night, and unusual sounds (gunshot, carpentry, shouting, and whistling) elicited only passive interest. No signs of affection for man were noted, but the close presence of people was tolerated even to the extent of lying on their feet or resting against their legs while feeding. Hortense, the most active and curious, climbed upon persons while exploring, but any other human contact not self-initiated, such as petting or examination, was swiftly rejected.

Food and feeding behaviour: The remarkable fact that some wild sea otters accept food from human hands shortly after capture has been noted previously (Barabash-Nikiforov, 1938; Jones, 1951b). In 1954 the Amchitka otters kept at first in dry cages, did not immediately come forward for food, remaining on the defensive in a far corner. They would eat, however, if food was thrown to them or offered on a stick. One newly caught otter swimming

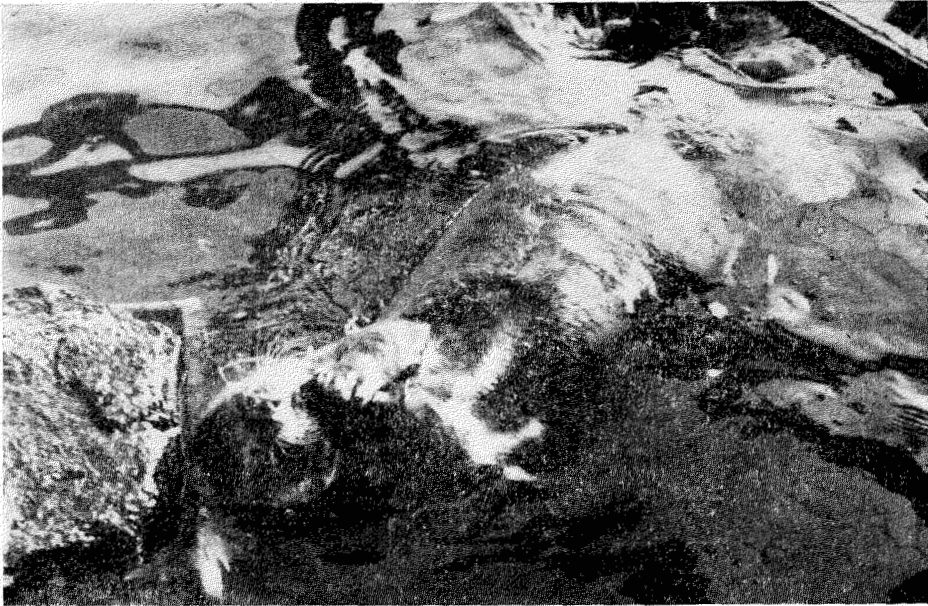


Fig. 4. Large male sea otter reclining to eat when hauled out in holding tank.

in the holding tank, approached an outstretched hand, took food in its paws or mouth (Fig. 3), and turned upon its back to eat in the usual manner (Fig. 4). Sea urchins and limpets tossed into the tank were retrieved by this otter with alertness and rapidity in quick dives, and held with one arm and the loose skin pouch while the items were eaten one by one. Another otter, on its first day in captivity, readily accepted pieces of goose and seal meat while resting on the rocks in the holding tank; clutching pieces of food beneath one arm, it tried to secure additional morsels offered to two other otters in the tank. This habit was also noted by Jones (1951b, p. 353).

Although the otters usually lay upon their backs to eat, apparently any position was satisfactory. Occasionally an animal lay on its belly with the head and upper body twisted to one side. In this position in the "otter house" straw frequently got into the mouth with the food and, although some might be withdrawn by the paws, it was commonly ingested and found in the feces.

During the early part of each otter's confinement, food intake was determined both by the supply available and its acceptability. Efforts were made to give the otters a variety of foods in order to find which were palatable or seemed to stimulate their appetites; not all foods were equally acceptable to the different animals and collecting sufficient quantities of palatable foods was a problem during stormy periods. Limpets, blue mussels, sea urchins, periwinkles, hermit crabs, and starfish were gathered in small quantities from rocks at low tide. An occasional octopus was taken clinging to a fish trap. However, fringed greenling (*Lebius superciliosus*), laboriously taken in live traps and long lines set in Constantine Harbor, made up the bulk of the diet for the



Fig. 5. Immature sea otters, after a few days in captivity, begging to be fed.

first few weeks, and this fish was consistently palatable. Small amounts of "Teralac" were added to the diet periodically.

The greenling, usually held in a live tank, were cut into small chunks and the bones of the heads and vertebrae were chopped fine. The spiny-rayed fins of large fish were discarded, and the viscera were divided among the otters to give a balanced diet. The otters soon learned the meaning of the fish bucket and the hand-axe used for chopping fish. Various begging attitudes were assumed, but for the first pieces the three animals would be directly underfoot or trying to climb up the leg of the person feeding them (Fig. 5). Chunks were grasped in the teeth, or in the paws if the otter was on its back. Larger fillets were held edgewise in the paws and strips of flesh pulled off with the incisors. The molars were used to crush bones and mash muscles. Small pieces of skin were thoroughly chewed and swallowed, but larger pieces were often cleaned of flesh and then discarded. In general the otters masticated their food much more thoroughly than most other carnivores; there was no gulping or "wolfing" of chunks.

Molluscs were eaten with relish. Small limpets, blue mussels, and snails were chewed up entire with loud crunching noises, and then swallowed. Larger limpets were usually extracted from the shells by holding the molluscs' flesh against the lower canines and pulling downward on the shell with the paws. If this was not successful, the shell was held with the paws at the side of the mouth and cracked by the molars; the pieces were then cleaned in the

same manner as the whole mollusc. Otters habitually cleaning shells this way would wear the anterior surfaces of the lower canines and incisors, as noted by Hildebrand (1954).

Octopus was a favourite food. When the tentacles were chopped into small pieces, the still-functioning suckers sometimes clung to the otters' faces or more often to their palates or pharynxes. This difficulty was met by attempts to scratch in the open mouth (similar to a dog's behaviour with a caramel in its mouth) or to pull out the tentacle with the paws; a morsel lodged farther down caused much gagging and hawking until it was dislodged, retrieved, and chewed again. The persistent efforts to chew and swallow octopus tentacles indicated their enjoyment of this mollusc.

The basis for differences in food acceptance was not clear, but individual condition and temperament were perhaps important factors. As already noted some very hungry, newly caught otters took goose and seal flesh and viscera from the hand, items usually rejected by otters in better condition; less trusting individuals refused any food in human presence. Although accustomed to captivity, one otter steadfastly refused starfish which were eagerly snapped up by the others, and Dolly Varden trout from a freshwater lake were refused by all. Hortense ate greenling skin and fins discarded by the others, posing the question whether she was more hungry or was simply less discriminating.

Captive sea otters were thought to be omnivorous by Barabash-Nikiforov (1938) who states that they will eat starchy products and pelleted foods as well as meat. Mal'kovich (1937) reported that cooked food was acceptable but the kind of food and method of cooking are not given.

Most of our observations on feeding behaviour were made on three otters during the first three weeks of captivity or on animals not surviving that long; tests with otters after longer periods of acclimatization might prove them less particular than short-term experience suggests. Sea otters certainly do learn to eat strange foods. When frozen flounder fillets (thawed) were offered to our animals, for the first week only one otter ate them, but within three weeks all were eating them and apparently preferring them to fresh whole greenling. Jones (1951b, p. 353) observed a preference for frozen halibut over native rockfish.

As a group the three Amchitka captives were fond of invertebrates but the few pounds we could occasionally gather with considerable effort merely diversified the main diet of greenling and frozen flounder. Later, when a fourth animal was added and the group was taken to Adak for several weeks, large quantities of live shrimp were included in the diet as well as chitons, urchins, and crabs, which were all more numerous than at Amchitka. At the Seattle Woodland Park Zoo, the three surviving otters accepted cod, ling cod, rockfish, smelt, and littleneck clams; squids were also eaten but octopus was less attractive than on Amchitka.

Well-conditioned otters consumed such quantities of fish and other marine life that it was often difficult to secure adequate supplies. When the passage of food through the alimentary tract was timed, by feeding a meal of molluscs to animals on a pure fish diet, it was found that it took an average of

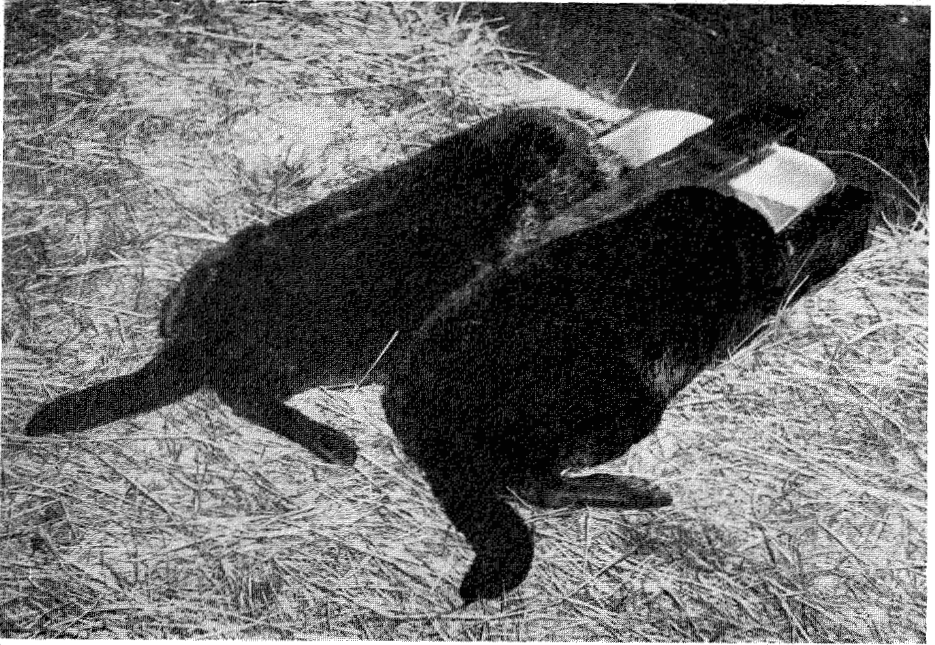


Fig. 6. Two sea otters drinking from a tip-proof pan.

three hours for the shells to appear in the feces. This indicated a need for frequent feeding, and prompted the schedule given on p. 49. When fed approximately $2\frac{1}{4}$ pounds of fish and meat per animal per day (12 to 15 per cent of body weight), the otters occasionally passed the tarry feces indicative of enteritis. Later the rations were increased to about 7 pounds of fish per animal per day (25 to 35 per cent of body weight) and improvements in condition were noted at once—signs of enteritis disappeared, weights increased, and the otters became stronger (Stullken and Kirkpatrick, 1955).

On Adak the amount of food eaten by the four otters rose to 35 pounds per day, with fish comprising about $\frac{4}{7}$ of the total. As the weight of all the otters was 98 pounds the daily food consumption was about 35 per cent of the body weight. Otters kept by Mal'kovich (1937) consumed from $7\frac{3}{4}$ to $18\frac{3}{4}$ pounds daily according to their size, or an average of 22.7 per cent of body weight; but young individuals, comparable to ours in weight, took 29 to 35 per cent of their weight daily while large adults took less—17 to 23 per cent.

Drinking: When water was first offered to otters kept in a dry environment, the animals attempted to get into the water and swim. The water in a bowl, pan, or bucket was usually tipped or pawed out, and wallowed in, making the provision of small quantities of water for drinking impractical; however, snowballs were acceptable substitutes. The otters held the snowballs in their paws and bit off, chewed, and swallowed small pieces; two snowballs the size of baseballs were often consumed without stopping. Later a large

tip-proof pan was provided with wooden guards to prevent the animals from crawling into the water (Fig. 6). Water one-half inch deep was lapped up while the lower jaw rested on the bottom of the pan; there was no head motion, and although the nostrils were not submerged, there was considerable bubbling and slobbering. When the water was deeper it was difficult to tell whether it was lapped or sucked up because the head was dipped in and swished about while one paw was swirled around in the pan. It is not known whether wild otters require drinking water, but the three captives held in a dry environment consumed about a gallon of fresh water daily. No conclusive observations were made to determine whether sea water would satisfy their water requirement. They did not appear to need salt and did not develop the cloudy eyes which occur in otarids held in fresh water. Of the Ostrov Mednyy captives seen by Hrdlicka (1945, p. 397), one had lived for three months in fresh water.

Locomotion: The peculiar hobbling gait of a sea otter is not unlike that of a land otter, though more clumsy. The head and hips are held higher than the shoulders, with the lumbar region arched even higher than the hips; the tail may drag or be held at an upward angle. Ordinarily, when not moving, the otters do not stand but drop to their bellies, sides, or backs.

At their usual slow gait, an otter's paws and flippers on opposite sides move alternately as in other fur-bearing animals. A laborious gallop is possible for short distances with both paws hitting together alternating with both flippers hitting together. When hurrying there is sometimes no coordination as the short fore legs are moved rapidly, together or alternately, and the hind legs are moved more slowly. At a slow walk, the flippers may be placed outward about 30 degrees from the line of forward motion and at other times the toes may be directed straight forward.

One otter was adept at climbing anything offering a purchase. It was never seen to leap straight upward, although it did attempt jumping from a cot to a higher table about two feet away, and frequently made downward jumps of about two feet.

Sociability: For the most part, the otters ignored each other when thrown together in the "otter house", but they evidently received moral support from the presence of other animals and conversely were depressed by isolation. At the beginning of her captivity, Hortense definitely disliked the small cage that did not permit her to wander at will or associate with people or other otters. On the shipboard trip from Amchitka to Adak, the four otters occupied separate but adjoining cages where they could see or smell one another but could not get together. They were restless and screamed. Later, when the three survivors were moved to Seattle, a large cage held them all, which was more satisfactory judging from their calm behaviour. It is possible that captive otters stimulate one another. One of our animals held in a tank enclosure alone refused food for twenty-four hours. As soon as two other otters were turned in with him he began feeding, though he remained quite shy. Mal'kovich (1937) notes that a single otter held in captivity for two months was lonely, but changed when a second otter was introduced. A sign

of mutual interest was that the second otter, being afraid of man and apparently concerned for the first otter, tried to protect him by dragging him into the water at the sight of man.

During the first few days of captivity, after learning to take food from human hands, the otters bickered for the same piece of food; no fighting or mauling of a serious nature, however, occurred in the common confines of the "otter house". In some instances the larger animal stole from the smaller but rarely bullied. On one occasion Aggie crawled upon Peter's belly and lunged for a fish in his paws which he quickly pulled back with a vocal *ha-ab-ab-ab*. Another time Aggie successfully grabbed a morsel from Peter who objected with a low, explosive *oof* as the fish was jerked away. His vocal objections to attempted thievery were usually a series of low, staccato grunts, *ugh-ugh-ugh*. Hortense, the smallest, was generally fed away from the others to prevent her being molested, and as long as there was more food at hand, the others seldom pursued and robbed her. Once Hortense herself stole food from a weak captive she had seen but a few minutes before.

The competition for food may have been the result of extreme hunger. Later, when the captives had gained weight and seemed in better physical condition, bickering at feeding time was rare and little competition marred their docile behaviour. When all the otters had food, they lay side by side or even leaned against one another while eating and tidbits could be fed to one otter within inches of another's nose without interference. They did not appear to seek direct contact with their pen-mates, and it seemed accidental that they sometimes rested against one another. No playing or any outward signs of interest between otters was observed.

Voice: The loudest vocal effort was a multi-syllabled shriek, variable among individuals, phonetically rendered as *eeee-eeee-eh*, or *eeee-eh*, or *eeee-er*. The first syllables were always high in pitch, given either with a quaver or as a clear, shrill shriek. The last syllable was short and grunt-like, in a much lower tone, and was inaudible at a distance of a few feet.

Captive otters in great distress, particularly moribund animals, uttered combinations of these sounds in high-pitched, ear-piercing screams. One young pup of 4¼ pounds cried continuously, giving utterance about every two seconds with a two-syllabled *eee-ee*, which at a distance resembled the mewing of a kitten. The otters might squeal at any time except when sleeping. Restlessness while calling usually seemed to indicate that they were hungry, thirsty, or lonely.

A series of low, soft grunts, *uh-uh-uh-uh*, were uttered by otters feeding together. Grunts of objection have been described as well as vigorous hawking in attempts to clear the throat. Other sounds made, in addition to the slapping already noted, included rumbling belches following eating and drinking, and audible flatus. Hiccupping commonly occurred but this was not accompanied by audible sound.

Elimination and sanitation: The otters showed no signs of establishing a midden or of fastidiousness in their excretory habits. Fluid or semi-fluid feces were dropped spontaneously. Defecation usually occurred in a standing

position, tail raised, rectum partially prolapsed, and was often accompanied with urination. The animals ignored the scats, treading on or avoiding them purely by accident.

Aggie, Hortense, and Peter, the subjects of most of the observations recorded here, were transferred from Adak to Seattle by motorship as deck cargo and were lodged temporarily in the Seattle Woodland Park Zoo on 1 June 1954. According to the report of Ford Wilke, a member of the research team, the otters "appeared in excellent condition" and spent a comfortable two weeks in a bear grotto with a pool 4 x 8 feet in size, constantly supplied with fresh water at about 50°F. They were then flown from Seattle to Washington, D.C. in a first class passenger aircraft pressurized to 5,000 feet, and delivered to the National Zoological Park on June 14. All three succumbed within ten days. The causes of their deaths are uncertain as none of the biologists responsible for their care up to June 14 were present, but the extremely high air temperatures at the time of their arrival in Washington, D.C. were presumably harmful.

In all phases of the 1954 investigation of sea otters on Amchitka, including our daily work with captive animals, we were dependent upon the invaluable support of William Golley, David C. Hooper, Calvin J. Lensink, and Ford Wilke of the U.S. Fish and Wildlife Service. Some of the notes for this paper were also contributed by Mr. Wilke, and these are gratefully acknowledged.

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