The sea otter and stages in its investigation

by Professor I. I. Barabash-Nikiforov[*]

The sea otter or *kalan* (*Enhydra lutris* L.) is a carnivorous mammal belonging to the otter subfamily (Lutrinae) of the weasel family (Mustelidae). From this it is clear that the name "sea beaver" [*morskoi bobr*], which is very frequently applied to this animal, is completely unsuitable (the beaver is a rodent).

The general external appearance of the sea otter and a number of details of its morphology—its elongated cylindrical form, the hind legs transformed into flippers, the closeable ear apertures and nostrils, and the peculiarities of the skeletal structure—very obviously indicate that the animal is adapted to living in the water.

A specific characteristic of the sea otter is its habit of swimming (when it is undisturbed) on the water with its belly up. The sea otter eats in this position using its fore-paws as hands; and in this position the mothers carry the young, holding them to their breast.

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[*] Original citation: Barabash-Nikforov, I. I. 1938. Morskaya vydra I etapy ee izucheniya. *Priroda* 1938(2):51-61. Translated by W. E. Ricker, Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., 1965. Fisheries Research Board of Canada Translation Series, no. 551. This is a preliminary translation prepared for the use of the Fisheries Research Board of Canada. It is not a definitive English version of the article, and it has not been checked or approved by the author. Transferred to electronic copy and edited by Mark Uhen and Michell Kwon, Smithsonian Institution, 2007.

Spending the greater part of the day on the water, sea otters come to coastal skerries or on shore to rest, or at night. On land the animal moves comparatively little and is clumsy, whereas in the water it exhibits great dexterity and liveliness, being a splendid swimmer and diver.

The average normal size of an adult sea otter is as follows: length of the trunk about 1m, and of the tail about 30 cm; the weight is about 30 kg. Old individuals reach a body length up to almost 1.5 m and a weight of 40 kg.

The skin is loosely attached to the animal's muscles, hanging below the belly when it is walking; this gives the impression that the body of the sea otter is encased in a sack. Hence the skin, when removed, considerably exceeds the length of the body, reaching on the average up to 2 m.

The fur of the sea otter is extremely soft and silky. Its color varies considerably, from almost rusty to a rich black. Most prevalent however is a dark brown color with a light luster, and with a moderate quantity of grey hairs. In pre-war days the price of sea otter pelts on the world market varied form 2 to 2.5 thousand rubles, occasionally reaching 3 or 4 thousand rubles. During the period of civil war [in the USSR] the Japanese paid from 4 to 4.5 thousand yen for sea otter skins. At the present time, occasional sea otter skins that accidentally come into the hands of the Soviet Fur Trust are valued at about 4 thousand rubles.

For a long time the excellent quality of the skin and its high price was the cause of an unrestricted and intensive industry for sea otters. This led to a marked contraction of the original range of this unusual animal, which has now been reduced to small numbers on Kamchatka, the Kuril and Aleutian Islands, and the Pacific coast of North America.

In the USSR the main mass of sea otters (about a thousand individuals) lives on the Commander Islands, and only an insignificant number (a few tens) remain near the southern tip of the Kamchatka Peninsula near Cape Lopatka. In spite of the prohibition on killing sea otters which was imposed after the October Socialist Revolution, their stock has increased very little; in which we many undoubtedly recognize the result of the excessive depletion of the main mass of the animal by an unregulated industry in the past. A stock whose exploitation has exceeded a certain limit is either doomed to extinction or, if it re-establishes itself, it does so extremely slowly. This general biological law is fully applicable to the sea otter.

Strange as it may seem, the biology of this valuable animal remained almost wholly unstudied up to recent times, although it is extremely interesting because of a number of unique characteristics. To some extent this may be explained by the inaccessibility of the places where some sea otters live.

The first careful description of sea otters was made by Georg Steller, one of the talented naturalists of his day, who observed sea otters during the time of the enforced wintering of Bering's second expedition on the Commander Islands (1741-1742).

Steller described very carefully the habits of the animals, which at that time were of a very confiding nature. The sea otters not only did not show any great fear of man, but even came right up to them. This trustfulness also made it easy for hunters to bring the stock of sea otters to almost complete extermination on the Commanders.

Steller made no attempt to domesticate even one sea otter, the better to study the habits of this animal. Undoubtedly he would have succeeded quite easily if he had made the attempt.

After Steller, not a single naturalist made any observations on sea otters for almost two centuries. It is true that information about them is to be found in the works of I. Veniaminov (1840), Snow (1902), and a few other authors, while S. Lekh (1907) even devoted a special article to the Commander sea otters, but all these descriptions were based on unverified information obtained from the local population of hunters, and not on original observation.

Lekh, whose article has the greatest interest for us, at the beginning of the present century had the position of a trade inspector on the Commanders. Being occupied with administrative matters [page 53] and commercial affairs, he saw sea otters only at the time of their breeding migration. Nor were any observations on sea otters made by the naturalists who at various times worked on the Commander Islands—Grebnitsky, Chersky, and Suvorov. In the papers of these and later authors, and also in a number of

unpublished accounts about the Commander industry, either the information of Steller and Lekh is repeated, or else they deal exclusively with the question of [the size of the] stock of sea otters, and their behavior at the time of their encounters with man.

Beginning with Lekh, the theme of the extraordinary wildness of the sea otter runs like a red thread through all the stories dealing with this animal. It is not hard to recognize the source of this opinion. Among the hunters for a long time there has existed a number of beliefs [*poveriya*] concerning the incompatibility [*neterpimost'*] that sea otters exhibit toward man. There is no question that these beliefs had some basis in fact, because they refer to the period of intensive pursuit of sea otters, when the animals had developed great wariness. However, this view was carried over mechanically and quite uncritically to sea otters which were already receiving protection (after the collapse of the industry), concerning which I will speak further in a future article.

Thus up to very recent times all our information about sea otters has been limited to old and very incomplete published data, and to the unsupported anecdotes of hunters. A number of factors in the biology of the animal have remained completely unknown to us.

The study of the biology of sea otters passed its nadir only in 1930, when under the sponsorship of the Kamchatka Development Company and the Pacific Research Institute the writer of these lines undertook systematic observations on sea otters on the Commander Islands.

Following the plan adopted by the organizations mentioned, the research work was divided into the following 3 consecutive stages: (1) studying the biology of the animals in nature; (2) performing experiments on domestication, holding and rearing them in captivity; and (3) performing experiments in acclimatizing them in other regions.

Being occupied for 2 years on the Commander Islands on the basic biology of the sea otter in nature, I have only partially undertaken the second stage of the work (in particular, experiments at domesticating the animal) considering it desirable to turn the completion of this stage over to animal husbandry experts and zoo technicians.

I conducted this work on Copper Island, which at the present time is the principal place of habitation of the sea otter. I conducted the field observations on this animal by means of a 40-power telescope or binoculars, and made hydrological and hydrobiological observations using a deep water thermometer, dredge, and other appropriate apparatus. Regular series of observations were made on the particular places where sea otters were concentrated—Bobrovaia Bay and the northwest tip of the island.

Because of the natural conditions existing on Copper Island, field observations on sea otters are always attended by great difficulties. Conditions for winter work are particularly rugged, for most parts of the island are poorly adapted to movement on land, and getting about in a boat is even worse. In some cases (during unfavorable, extremely

changeable weather) there was considerable risk in getting out to the northwest tip of the Island.

Let us consider briefly some of the basic factors in the biology of the sea otter that were learned during the 1930-32 studies.

Place of habitation. Selection of bodies of water in other places, where sea otters might be acclimatized can be done correctly only after considering the conditions under which it lives in its native home. Therefore a hydrological and hydrobiological study of the local habitat of the sea otter was given very serious attention. Data were obtained on the temperature of the sea and its relation to fluctuations in air temperature, on the rise and fall of the tide, on the structure and composition of the substrate of the coasts and the sea bottom, on their bicoenoses, and so on. Special attention was given to [page 54] the species composition and distribution of animals which were of any significance in the food habits of the sea otters (mollusks, sea urchins, fishes, and crabs). In many places vertical transects of the coastal zone were made, which gave a direct picture of the distribution of animal and plant associations.

The coast in places where sea otters live consists of a band of reefs, that descend to a depth of 5-10 meters and have at their base larger or smaller accumulations of boulders. The latter may vary down to a scattering of stones of various sizes, or even fine gravel. The upper parts of the reefs, where they stand out of the water, consist of stony plateau covered with indentations, crevices, and slopes of projections, all covered with

fragments of the alga *Fucus*. The fauna here is of typical groups of littoral type (barnacles, *Littorina purpurnitsi*, mussels, and so on). In the holes that remained full of water at low tide, or in cracks that are joined to the sea, we find sea urchins, sea anemones, small hermit crabs, and starfish. The lower limit of the littoral marks the upper boundary of the growth of the ribbon-like algae (*Laminaria* and *Alaria*). Commonly one or other these occupies the upper part of the sublittoral, growing there in a clearly defined band, not very wide, below which the slopes are occupied by a tangle of large palmate laminariae.

Among the rhizoids of the algae that cover the slopes of the reefs a rich fauna finds shelter, consisting of sea urchins, mussels, ascidians, and various crustaceans, sponges, bryozoans, and others.

Of much the same character is the distribution of flora and fauna on the underwater slopes of the coastal skerries used by the sea otters for rest or for hauling out at night. The stony bottoms (rubble and gravel) at the base of these reefs provide shelter for octopuses, crabs, and a number of other invertebrates; while sandy bottoms, which replace the stony bottoms at greater depths, are occupied locally by considerable quantities of certain species of sand clams (*Mya, Spisula*).

Such is the general character of the distribution of plant and animal communities in places where sea otters live. Naturally [page 55] this picture can vary in one direction or another with the time of year, the position of the particular sector, the details of its

relief, the amount of wave action, and other conditions. I am not able to go into greater detail within the limits of this article.

A special study was made of one of the species of *Alaria*, *A. fistulosa*, which forms a continuous chain about the whole island.[1] Sea otters very often frequent these algae and remain among them for long periods of time, which is the reason that a number of authors have regarded them as a necessary feature of the habitat of these animals, and even as a component of their food (they postulate that the sea otters feed not only on the animals that live among the algae but also on the algae themselves).

Found commonly at depths of 5-10 m, the dark-brown thalli of *A. fistulosa*, reaching 6-8 m in length, have the appearance of a true underwater forest. At low tide (and in shallow places at other times also) the terminal branches of the thalli are bent downward and become much interlaced, forming a continuous network.

Our studies showed that *Alaria*, in contrast to other algae, is very poor in animals. Since our observations did not confirm that the otters fed on vegetation, the importance of the *Alaria* beds as a source of food disappears. It is most likely that the otters are attracted to this algae by the comparatively quiet condition of the sea in such regions (the waves naturally do not run so high there). The beds of *Alaria* that are situated at a distance from the islands (the so-called "outer cabbage patches"), attached to the reefs that are scattered about in the vicinity of the island, apparently serve migrating otters as

[1] Algae of the genus *Alaria* are known collectively by the name of sea cabbage.

stopping places, or refuges where they can rest or take shelter from marauding killer whales.

The presence of such "stations" (be they patches of algae, small islands or isolated rocks) can in fact be regarded as a necessary feature of a sea otter habitat.

Diurnal and seasonal movements. Our observations showed that the intensity of activity of sea otters is determined by the following basic causes: the degree of repletion of the animals, the food supply of the region, hydrometeorological factors, and their reproductive instinct.

Diurnal movements are limited to a shift from where they spend the night to the place where they feed, and back again. Strong winds and stormy seas restrict the region of activity of sea otters, forcing them to remain close to shore. In still weather the animals go farther out to sea, searching for banks that are rich in food.

The above relationship is clearly indicated by the following table:

Effect of the strength of the wind on the abundance of sea otters in Bobrovaia Bay (wind strength is on the Beaufort scale)

Date	Wind direction	Wind strength	Number of sea otters
July 13/31	SW	6	52
July 14/31	S	7	70
Nov 10/31	NNW	6	48

Dec 10/31	WSW	5	47
Jan 25/32	SW	6	38
June 1/31	–	0	4
June 4/31	NE	1	5
July 21/31	–	0	4
Sep 5/31	SW	1	2
Jan 15/31	ENE	1	3

The table shows that the effect of the wind on the animals is determined mainly by its strength. The direction of the wind is of importance only in stormy weather, which influences the sea otters' selection of a particular side of the island's coast, in accordance [page 56] with their tendency to take shelter in a protected place. Naturally this pattern was not always clearly evident.

Since still weather is mainly characteristic of the summer period, while stormy weather occurs in winter, it is easy also to picture the seasonal movements of the animal. Continued storms, and the absence of the alga *Alaria* which they root up, means that the otters in winter remain in the immediate neighborhood of shore. In summer, on the contrary, the otters spend a large part of the day in distant parts of the sea, coming to shore again only for the night.

As for wandering away to considerable distances, only single animals were observed to do this, and in general was seen very rarely. Apparently they are stimulated by the reproductive instinct. Group migrations of sea otters, such as took place during comparatively recent times, were mostly associated with frightening of the animals, or in

some cases, with the disturbance of the balance of food supplies. At the present time such migrations are not observed.

Food. Clarification of the question of the sea otter's food is of very great importance in formulating rations for sea otters held in captivity, and for determining the necessary immediate conditions for their transplantation to new localities. To a considerable extent this problem has never been settled.

Because of the absence of a sea otter industry at the present time and the resulting impossibility of examining stomach contents, there remains only direct observation on the feeding grounds and the analysis of regularly-collected feces and methods of studying the foods of these animals. By these methods I have obtained a rather clear picture of the qualitative composition of the sea otter's food, and its seasonal changes. Figures 3 and 4, which are based on a study of about 500 scats, show the general percentage representation of the kinds of foods and changes in food composition with time of year.

Sea urchins comprise the principal food of the otters, followed by molluscs, crustaceans and fishes. Marine vegetation in reality does not constitute food of the otters. The inconsiderable fragments of thalli which are rarely encountered in the scats are completely unchewed and wholly undigested. Apparently algae are either accidentally swallowed by the otters, or else are rarely consumed by them in inconsiderable quantities not as a food product but as some kind of organic requirement. In winter the food of sea

otters consists almost entirely of sea urchins and molluscs; in summer it is supplemented by the crustaceans and fishes which approach shore at that time.

The analysis of the scats, supplemented by direct observations on the feeding animals in nature and in captivity, has resulted in a very full list of food objects used by the sea otter. To present it here, however, is not possible because of lack of space.

Reproduction. Observations made by others and by myself show that sea otters do not have a definite time for mating, which makes it impossible to determine the duration of [page 57] pregnancy. Breeding behavior ending with copulation was observed both in summer and winter. Accordingly it is difficult also to determine the length of the immature period among the sea otters.

Judging from the fact that sea otter pups are born fully developed, and with fully formed teeth, we may imagine that the length of pregnancy estimated by the hunters—8-9 months—is close to the truth.

The female bears one pup, which remains with her for a long time. I have frequently seen a very large pup with its mother, in some cases a little bit bigger than she is. Swimming and feeding independently, it nevertheless remained continuously close to

its mother. From time to time the mother seized it from behind with her paws [*podmyshki*] and the two of them swam thus, in a vertical position.[2]

The photograph presented show one such occasion, and also the position of a mother lying with her new-born pup on the rocks (Fig. 5).

A number of direct observations have not confirmed that extreme inseparability of the mated pairs of which Steller spoke, and other authors after him. These observations were the basis for the suggestion of polygamy among sea otters.

Careful study of materials in archives concerning sea-otter industry leads us to the conclusion that there is an uneven distribution of sex ratio among sea otters, with a predominance of males. This fact alone is enough to show that it is not possible to re-establish the stock rapidly. There are, it is true, a number of other causes which limit their rate of increase. It is more correct to speak of a whole complex of factors associated with the basic cause—which is the former over-exploitation by an uncontrolled industry, of which we have spoken earlier.

On the basis of my own observations and study of materials in the archives, I have determined the annual increase of the stock to be 7%, instead of the 10-12% which has been accepted previously. Data for recent years have not only confirmed the correctness of this deduction, but indicate that we must now further reduce the index of increase

[2] Newborn pups, as already mentioned, are held on the mother's breast while she swims on her back, i.e. in a horizontal position.

(approximately to 4-5%). Nevertheless the common opinion that sea otters are "dying-out" [*vymiraniya*], in the sense of degenerating [*vyrozhdenie*], I have conclusively refuted by a study of the external appearance of the animals and of their fur, and also by histological studies of their testes. These investigations showed a completely normal picture of active spermatogenesis, and failed to indicate any trace of degenerative processes.

[page 58] Molt. As a criterion for estimating the course of molting among sea otters I have used the number of hairs swallowed by the animal in licking their fur {which appear later in the feces), and also the hairs which have adhered to snow or rocks in the places where they lie. It is obvious that during the period of most intensive molting a considerably larger quantity of hair must be shed into the feces and onto the lying grounds than at other times.

These observations have confirmed previous information to the effect that the change of coat in sea otters is very gradual, and that there is no definite time of molting. To this may be added that the molting is somewhat accelerated during the spring and summer.

Competitors and enemies. In Steller and to some extent in Lekh, we find it emphasized that sea otters greatly fear pinnipeds (hair seals and fur seals) and cannot endure their presence. My observations do not confirm this. I have frequently observed sea otters swimming peacefully side by side with hair seals and even with large sea lions.

Sea otters may continually be observed in the immediate neighborhood of fur seals (near the southeaster tip of the Island).

The pinnipeds just mentioned, and also certain sea birds, are competitors of sea otters in that they use as food a large quantity of fish and various invertebrates. However this competition is only partial, inasmuch as it does not involve the basic food object of the sea otters –sea urchins.

As enemies of the sea otters, if we disregard poachers, we can only point to killer whales, which sea otters greatly dread, as our observations have shown.

Parasitic infection is comparatively light. A complete helminthological dissection of two sea otters, and analysis of a great quantity of feces (during the food studies), has indicated the presence of a small number of nematodes of the species *Porrocoecum decipiens* (which is commonly found also in a number of pinnipeds), and occasional specimens of cestodes which could not be accurately identified.

Among ectoparasites, only two specimens of the louse *Echinophthirius fluctus* were found on one of the sea otters, this species being also found on certain pinnipeds.

Relations to man; an experiment in domestication. Earlier I mentioned the opinion which has been prevalent up to quite recent times, which ascribes to sea otters extreme wariness and timidity. Because the existence or absence of this factor will to a

considerable degree determine the chances of success in holding the animal in captivity, and because ascribing an almost superstitious timidity to the sea otter has hampered further progress toward domestication (and also, we hope toward commercial utilization), there was an urgent need to make an objective trial of this matter. This quickly led to the conclusion that these aspects of the character of the sea otter had been greatly exaggerated.

On theoretical grounds alone we might have postulated that even if sea otters were very timid during the period when they were energetically pursued, nevertheless with the cessation of the industry they must have relapsed, in greater or lesser degree, to that native state of trustfulness for which Steller is our witness. Observations have fully confirmed this hypothesis. The sea otter proves to be less timid than many other animals.

In order to bury this harmful prejudice once for all, I made a first attempt at domesticating sea otters. The experiment, which did not have any support from administrative quarters on the Island, had to be undertaken under very primitive conditions in an abandoned hut converted into a cage[3] as well as possible. This narrow, badly lighted and badly ventilated compartment, equipped with only a small basin in which the water became stagnant, naturally did not foster great hopes for good results

[3] The fur hunters, and the Island officials who were influenced by them, would not admit the possibility of domesticating sea otters, or even keeping a captured sea otter alive long enough to get it to the place where the experiment was undertaken. Attempts to hold animals isolated from contact with man, and as nearly as possible in the wild condition, were a general characteristic of traditional systems of raising fur animals, which have been discounted by the present experiment. On the Commander Islands, in addition to sea otters, the same tendency was evident in my time in relation to the fur seal and, to some extent the Arctic fox.

from this experiment. Actually [page 59] the two sea otters which were held there survived only a short time (10 and 13 days). But the complete effect of domestication which it was possible to elicit in this short time surpassed all expectations and completely justified the undertaking. Within the first few days of confinement both otters took food from the hand, came when called, and permitted us to stroke them.

This experiment led to an acute crisis of opinion about sea otters and gave a remarkable impetus to the development of further measures directed towards artificial utilization of animals with valuable furs.[4]

In addition to demonstrating the extreme ease with which sea otters may be domesticated, the experiment has confirmed some evidence obtained from observations in nature, especially with respect to their food. In particular it has confirmed the great lack of discrimination of the animal in respect of food. The sea otters readily ate meat and cereal products which were offered to them in experimental portions (in addition to foods that are normal for them). At the same time, the experiment corroborated the fact that sea otters do not eat algae.

Under conditions of little mobility in narrow enclosure, the average daily ration of the sea otters was determined to be 2.5 kg (by giving them excess rations, then gradually

[4] It is curious that after observing the behavior of the first tame sea otter, yet still believing such a thing to be impossible, the local population and the administration endeavoured to explain it on the basis that this sea otter had gone crazy from fright, or else that it was an individual which had escaped from a circus in America. This impelled me to repeat the experiment with a second otter, whose behavior finally laid incredulity to rest.

decreasing them). During this time the sea otter's ration sometimes remained uneaten (while it was in a generally healthy condition), which circumstance indicates the ration's adequacy under the given conditions. If they were held in a more roomy cage their ration would naturally be greater (approximately twice as large, in my opinion; further experiments have confirmed this).[5]

Pathological and anatomical autopsies of the deceased animals showed without question that the cause of the sickness and death of the first domesticated sea otters was the unsuitability of their quarters. Now that this experiment has been performed, there can be no doubt that maintaining sea otters in captivity under suitable conditions is just as feasible as holding a variety of other animals.

[page 60] In 1932 a year-round cycle of observations on the sea otter in nature was concluded. Let us review the results of the work performed in 1930-32. During this period the first detailed study was made of the environment in which the animals live, the behavior of the animals was studied in relation to hydrological and other conditions, and the quantitative and qualitative composition of their food was determined. Certain questions concerning their reproduction were clarified (in particular, information was obtained on possible polygamy among sea otters, on the absence of any foundation for the idea that the animals had degenerated, and so on). Accurate information was obtained concerning the molt. Enemies and competitors of sea otters were investigated, and causes

[5] Malkovich in his article "The sea otter in captivity" (*Priroda*, No. 3, 1937) without taking into consideration the conditions of confinement, suggests that the norm which I determined would be insufficient.

of their mortality; and corrections were introduced into the determination of the rate of increase of the stock. Finally, the prevailing belief in the natural wildness of the sea otters was overthrown, and rapid and complete domestication of this animals was shown to be possible.

Thus we approach the next stages in the study and utilization of the sea otter with a considerable degree of prerequisite knowledge of its biology.

In 1932 research on the Commander Islands was transferred to the control of Soiuzpushnina [Association for the Export and Import of Fur Goods]. As mentioned earlier, the next stages of the work on sea otters, according to the plan which I had set up, were to involve conducting experiments in holding (and breeding) in captivity, and then their acclimatization in other waters. In actuality, the fur breeder Malkovich was sent to the Commanders in 1934 from the now-reorganized Research Institute for the Fur Industry, with a special assignment to conduct experiments in holding sea otters in captivity. The experiments continued until 1936, and completely confirmed the predictions I had made. Being able to construct special cages, Malkovich readily held sea otters in them for several months (in all 11 sea otters were under his observation; the daily ration each animal under conditions of confinement in a roomy enclosure was about 5-6 kg). Unfortunately these experiments did not take full advantage of the rich possibilities available to the investigator, and the rationale in setting up certain experiments seems to have been poorly considered (for example, holding a sea otter until it died from starvation, separation of a new-born pup from its mother, and so on).

The experiments confirmed once again how easy it is to domesticate sea otters, their catholicity as regards food, and the absence of any definite time for molting. Feeding on preserved foods, and holding the animals in a freshwater basin, were not continued for a long enough time, and thus these particular experiments remain inconclusive.

During this period a "first" was the breeding of one pair of otters in captivity. It was not determined, however, whether fertilization took place, for the female in question, which in external appearance seemed barren, succeeded in escaping from the enclosure. It must be noticed, however, that after mating with this female the same male attempted to fertilize other females. This fact indicates the likelihood of the hypothesis of polygamy among sea otters which I had put forward as a result of observations in nature. Of course it is still impossible to ascribe decisive significance to this single case, or to apply it to the behavior of the animals in nature.

From 1936 onward the responsibility for scientific work on the Commander Islands was taken over by the Federal Arctic Research Institute [Vsesoiuznyi N.-I. Arkticheskii Institut]. The first steps taken by the Institute in this sector—organization of a Biological Research Station on the Commander Islands and manning it with a staff of qualified workers (biologists and fur breeders)—suggests that the study of the Commander fur animals, including the sea otter, is now in good hands.

In conclusion I would like to express a few hopes and indicate some considerations that bear on the further course of work in studying the sea otter.

While retaining my original opinion about the sequence of investigations, I would regard it as necessary at the present time to give more attention to the second of the three stages of work indicated above, that is, study of conditions of confinement (and rearing) [page 61] of the animals in captivity. The principal thing that must be accomplished at this stage is to confirm the possibility of maintaining sea otters on preserved foods. The almost complete omnivory of the sea otter is a favorable factor, suggesting the possibility of developing artificial foods for them (having the form of hardtack, for example). This would have great practical importance, because in holding sea otters in captivity in winter, and also in transporting them for acclimatization in other places, supplies of fresh foods will always be obtainable only with great difficulty. We can scarcely go wrong in affirming that only when the food problem is fully solved will it be possible to obtain practical results from holding sea otters in enclosures (rearing them). At the same time, we must be on guard against an over-multiplication of a broad array of experiments using a lot of sea otters. The latter can lead only to a fragmentation of experiments and insufficient depth in any of them, as in the experiments of 1934-36. During the first stages it would be best to limit ourselves to 4 or 5 specimens; but once having worked out satisfactory means for holding them (construction of pens, a satisfactory feeding regime, and so on) it will be possible to conduct carefully planned and scientifically based experiments. Along with experiments on animals held in enclosures, we must also

continue observations in nature. Here also much remains to be done, for example in the way of developing methods of observation, taking censuses of the animals, and so on.

A few words concerning the prospects for the third stage of investigation – the acclimatization of sea otters in other waters. Many different places have been suggested for such experiments. In my opinion greatest attention should be given to the site suggested by Prof. P. A. Manteifel, who has recommended that we fix attention on some point along the Murman coast.[6] Personal familiarity from working both in the Murman region and on the Commanders, and acquaintance with the hydrometeorological and hydrological characteristics of the two regions, permits me to regard the Murman coast as a most suitable one for this purpose (and especially the region of the former site of the Murman Biological Station). Here the sea does not freeze up in winter, while sea urchins are abundant, and so are other animals that sea otters eat. At first the acclimatization experiment must be conducted in an enclosed area, the animals being supplied with food and held continuously under observation. There would be no great difficulty in finding a bay suitable for this purpose in the place mentioned. The experiment must be performed with a small number of sea otters, and not before there is available a very detailed analysis of the natural conditions and food resources of the place selected, as compared with the corresponding information from the Commander Islands.

In case of a successful result, it will be appropriate to extend experiments to other regions. There is little doubt that Copper Island will in future become a reserve for this

[6] P. A. Manteifel. [Reconstruction of the trapping and hunting industries based on the USSR fauna.] *Zhurnal "Sots. Rekonstruktsiya",* 1935.

most valuable of fur animals, a supplier of precious breeding material for a number of other regions, just as it is at the present time in respect to the blue fox.

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