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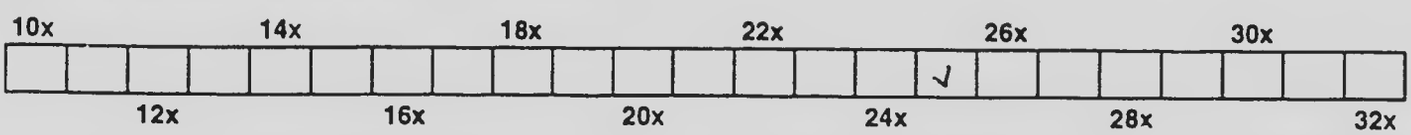

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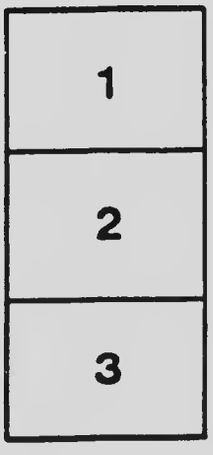

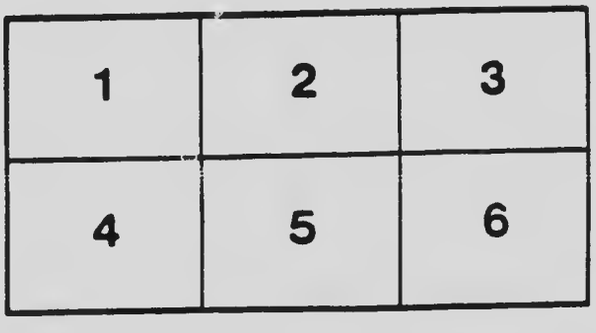

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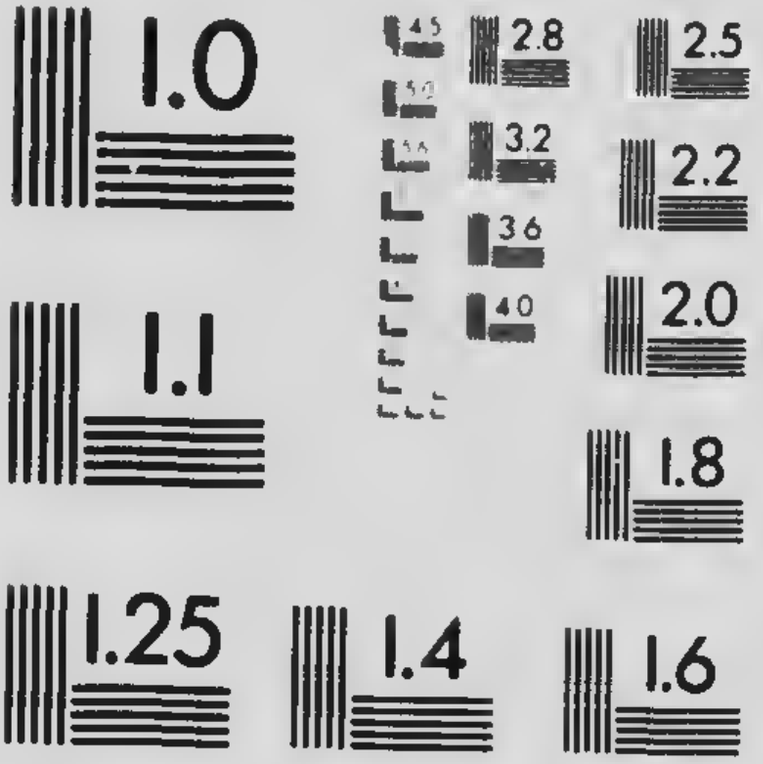

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THE SEA-LION QUESTION IN BRITISH COLUMBIA

CONTRIBUTIONS TO CANADIAN BIOLOGY

THE SEA-LION QUESTION IN BRITISH COLUMBIA

REPORT BY

DR. CHARLES F. NEWCOMBE, Victoria, B.C., Chairman,
WM. HAMAR GREENWOOD, Vancouver, B.C., Secretary, and
DR. C. McLEAN FRASER, Curator of the Government Biological Station, Nanaimo, B.C.

PART I.

Preliminary Report of the Commission, 1915, (with 2 Maps and Appendices).

PART II

Report and Conclusions of the Sea-Lion Investigations, 1916, (with 36 Half-tone views).

OTTAWA
J. DE LABROQUERIE TACHÉ
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Part I.

PRELIMINARY REPORT OF THE COMMISSION ON THE SEA LION QUESTION, 1915.

INTRODUCTION.

In May, 1915, the Biological Board of Canada appointed an honorary commission to make an inquiry as to the effect of the bounty of two dollars per head which had been offered by the Dominion Government to aid in the reduction of the number of sea-lions in the province of British Columbia, and which applied during the year 1915 only.

The commission, after some changes, finally consisted of Dr. C. F. Newcombe, of Victoria, chairman; W. Hamar Greenwood, B.A., of Vancouver, secretary; and Dr. C. McLean Fraser, of the Biological Station, Nanaimo.

Early in August, Prof. A. B. Macallum, of the University of Toronto, Secretary of the Biological Board of Canada, visited the west coast and met two of the commissioners at Vancouver. Authority was then given for an early commencement of the investigation, but it was left to the commissioners themselves to draw up a plan of operation which would best fulfil the purposes of the proposed inquiry. The commissioners at once decided that there should be a division of the work of the commission, Mr. Greenwood undertaking to collect all information possible by correspondence and personal interviews, the other two members more especially devoting their time to field and laboratory work, with the view of gaining more knowledge as to the life-history of the sea-lion.

In order to facilitate the statistical section, a schedule of questions was drawn up and forwarded to officials of all the fishing plants of the province, and, for the field party, application was made through the Biological Board for the use of one of the vessels belonging to the Department of Naval Service. These matters are referred to later in the report.

2. ACTION ELSEWHERE ON THE SEA-LION QUESTION.

The sea-lion question is by no means a new one. As long ago as 1898 it was very much to the fore in California. In 1899 the State Commission authorized the killing of numbers of the animals, giving the reason for so doing in the sixteenth biennial report of the State Board of Fish Commissioners of the state of California for the years 1899-1900, pp. 28-40. In this report is included, as well, much correspondence on the subject.

At the outset, in April, 1899, the commissioners called a meeting of all persons interested to consider the evidence that might be offered regarding the damage done by sea-lions. The reason given in the report for calling this meeting is as follows: "For many years the fishery interests have strenuously complained of the damage done by sea-lions in the bays and rivers of the state. This commission has had the subject under consideration for many years. During the fall of 1898 and the spring of 1899 the salmon fishermen made repeated calls upon us for relief in this behalf, claiming that the sea-lions were appearing in the bays and lower rivers in increasing numbers, and that they follow the salmon from the ocean for more than 100 miles

inland. The managers of the canneries and the buyers for the San Francisco markets joined in these requests. Our patrol force corroborated the statements and alleged that the territory covered by them swarmed with these animals. Formerly the sea-lions were hunted for commercial purposes, but their hides and oil no longer find a profitable market, and the industry has failed, in consequence of which they have greatly increased in number."

Fishermen, market men, and cannery men were unanimous in asking for a reduction in number on account of the destruction by them of salmon and other food fishes. So voluminous was the evidence that such scientists as Jordan, Gilbert, and Harkness were convinced of the justice of the plea.

As a number of the larger rookeries were situated on federal lighthouse reservations, the commission wrote to the Hon. Lyman Gage, then Secretary of the Treasury, to ask permission to kill sea-lions on these reservations, giving quite fully the reasons advanced for making such a request. The request was granted on April 27, but on May 31, before any lions were killed, the permit was suspended. On June 9 a letter from the Treasury Department gave the information that the suspension was due to protests from the United States Fish Commission, the secretary of the United States Department of Agriculture, the New York Zoological Society, and various others.

The commission in reply stated its case at greater length, and called the attention of the Treasury Department to the fact that while their evidence was backed up and accepted by scientists who had studied the question at first hand, all of the opposition came from men who had no personal knowledge of the various aspects of the question. This reply was sufficient to convince the United States Commissioner of Fisheries, who therefore withdrew his opposition. However, it failed elsewhere, and consequently the Lighthouse Board refused to cancel the suspension until further evidence was adduced.

The case of the commission, of which A. T. Vogelsang was chairman, may be stated briefly as follows:

Previous to 1884 sea-lions were killed for commercial purposes. Cheaper substitutes have been obtained for the hides, oil, and trimmings, and commercial killing is no longer profitable. Since that time the animals have greatly increased in number, and hence the amount of destruction has greatly increased. They chase the salmon for a long distance up the bays and rivers. "They are voracious and destructive to the last degree. It is estimated by the fishermen upon the rivers, and the salmon canners, that from 20 to 40 per cent of the fish entering the bays are destroyed by this means. They enter the nets of the fishermen and take the fish already gilled. They tear and destroy the nets and cause irreparable damage to the hardy and industrious fishermen. They are seen every day during the salmon run with fish in their jaws and almost no net is hauled that does not show a large percentage of fish destroyed by these animals. It is so now that the fishermen, when laying out their nets, must patrol them from end to end as they drift with the current or tide, armed with Winchester rifles, to protect the nets from the depredation of these beasts." There is little use in providing hatcheries to increase the supply of salmon if the sea lions are allowed to kill so many of them in the sea. Captain Butwell, chief lightkeeper at Año Nuevo island, in the summer of 1899 made an examination of the stomach of a large grey sea-lion (*Eumetopias stelleri*) and found over sixty pounds of fish bones. In the following summer a deputy killed a sea-lion with a salmon in its jaws, the head of which sea-lion is now preserved at Stanford University.

The case of the opposition is presented most fully by W. T. Hornaday, as representing the New York Zoological Society. He says:

> "Judging from all the facts which have been brought forward up to this date, and from correspondence with naturalists from the Pacific coast, we

feel constrained to say that, in our judgment, the evidence against the destructiveness of the fur seal is very far from being sufficient to warrant the California Fish Commission in asking the United States Government to permit the destruction on its reservations." He blames the California Commission for condemning the sea-lion on what he considers unsatisfactory evidence. His reasons are summarized as follows:-

"*First.* We have good reason to believe that the estimated number of sea-lions on the Pacific coast (40,000) is very greatly in excess of the actual number.

Second. The estimate of the amount of fish consumed daily by the sea-lion herds (500,000 pounds) we consider to be preposterous and absurd. This presupposes that each sea-lion consumes 50 pounds of fish per day, whereas, the full ration of an adult male sea-lion in captivity amounts to only 12 pounds or less per day.

"*Third.* - In the absence of statistics based on detailed scientific observation of known reliability, the assumption that the sea-lions are responsible for a marked decrease in the fish supply of the Pacific coast is unwarranted.

"*Fourth.* The people of the whole United States have proprietary rights in all the living creatures which inhabit the waters of the coast of California, as well as all other states, and particularly the sea-lion herds which breed on the public domain; and the people of California have no right, either in law or equity, to wantonly destroy the sea-lion herds until the justification of such a course has been clearly and satisfactorily proven.

"*Fifth.* The sea-lion has been condemned by the California Fish Commission without having had the benefit of counsel or witness for the defence, a proceeding so thoroughly un-American that the findings based thereon are unworthy of serious consideration."

In view of these reasons he asked for the preservation of "the very interesting and valuable sea-lion herds of the Pacific coast."

Mr. Vogelsang, in direct reply to Mr. Hornaday, says that the fifth reason is entirely untrue, as he has shown in his correspondence that all evidence available was considered, some of this evidence from scientists of repute. He objects to the statement that sea-lions are valuable, and as far as the interest goes, they cannot be considered more interesting than other harmful animals, the coyote for instance. He indicates the weight of such remonstrance by saying: "It seems to me remarkable that your society is not aware of the fact that the fur seal does not frequent the rookeries of the California coast, and the varieties against which our activities have been chiefly directed are the barking sea-lion (*Zalophus*) and, incidentally, the grey sea-lion (*Eumetopias*)."

The commission was so confident of the correctness of their stand that they published all this correspondence in the matter and left the public to judge.

Before going further it should be stated that throughout this California report reference is made to two species of sea-lion, the barking sea-lion (*Zalophus californianus*) and the grey, or Steller's sea-lion (*Eumetopias stelleri*), but the general statements apply to both of these. There is evidence that both are found in British Columbia waters, but although *Zalophus* has been reported, it may be only an occasional visitor (see further evidence in this report). The grey sea-lion is the common one on the British Columbia coast and northward.

While the controversy was going on between the California State Commission and the Treasury Department, in the summer of 1899, Prof. L. L. Dyche, of the University of Kansas, made examination of the stomachs of several sea-lions killed

in the vicinity of Monterey, finding in the cases where the contents were suitable for identification, these consisted largely of squid. No traces of salmon were found.

A reference to this work of Dyche's, which was made in an article by C. H. Merriam appearing in *Science*, May 17, 1901, has been very extensively quoted in support of the contention that sea-lions are of little detriment to the fishing industry. Without in any way questioning the results of the investigation, it may be pointed out that these results do not necessarily have much bearing on the sea-lion question in British Columbia. We have no evidence that the grey sea-lion is ever found as far south as Monterey, although it is quite possible that some individuals from the rookery at Año Nuevo or even from that at the Farallones may pay visits to that region. On the other hand, at that time the California sea-lion was found in large numbers around Santa Cruz island, a short distance north of Monterey, and at many points to the south of this. There is every likelihood, therefore, that the majority, if not all, of the animals examined by Dyche were of the California species. Colour is given to this conclusion further by the statement of the United States Commissioners, later referred to, "that the Steller sea-lion is largely a fish consumer and the California sea-lion is largely a squid eater," this statement, of course, being based on the evidence they were able to obtain at that time. It is the Steller sea-lion, almost entirely, with which we are concerned.

On account of further refusals of the Lighthouse Board in 1900 to cancel the suspension of the permit to kill sea-lions on the federal reservations, in 1901 the California commission asked for the appointment of a special commission to look into the matter thoroughly. The request was granted. Cloudsley Rutter was appointed chairman of the commission, R. E. Snodgrass was named by the California commission, and E. C. Starks by the California Academy of Science. This commission visited points along the coast from Monterey to Puget sound, making personal observations and obtaining information from those having personal knowledge of the subject. The report of the commission was submitted to the United States Fish Commission, and appeared in the report of the commissioner for 1902, pp. 116-119.

The following remarks bear on *Eumetopias*. Eighteen stomachs were examined, of which thirteen contained food. All of these had eaten fish, and five of them had also eaten squid, but the fish was relatively large in amount, up to 35 pounds, while the squid was small, six being the greatest number in any stomach. "This study indicates that the Steller sea-lion is largely a fish consumer and the California sea-lion is largely a squid eater. It seems apparent, however, that either species feeds on whatever is most convenient."

"At the mouth of the Columbia river, sea-lions were seen fishing in considerable numbers near the jetty at the mouth of the river, but none was seen to catch a fish of any kind. Gulls were frequently observed hovering about a group of sea-lions and acting as if picking up food. One such flock of gulls was seen coming gradually nearer the jetty from a group of sea-lions about a mile away; after a time it was shown that they were following a large piece of salmon flesh, which the tide brought within 20 feet of the observer. Salmon were seen and photographed that had been mutilated (presumably by sea-lions and seals) after being caught in gill nets. Such mutilated specimens were common. The fishermen stated that the seals simply pull off the gills but the sea-lions always take a bite out of the belly of the netted salmon. A number of pound nets were visited, but no sea-lions were seen in them.

"The fishermen were unanimous in their denunciation of the sea-lions. A fishing company at Chinook, Washington, states that it was damaged $1,500 in 1901 by sea-lions letting fish out of the nets, the damage to the nets not being included. The sea-lions enter the traps in the same way that the fish do, and, after eating what they wish, break their way out through the side

"The shallow water and the large number of salmon at the mouth of the Columbia river make that point a favourite breeding ground, and there is no doubt that the sea-lions are doing much damage there."

Although permission to kill sea-lions on federal reservations was refused, the commission, by means of arming their patrols, killed a great number of sea-lions at other points along the coast. The report states: "It may be added that our activities have been exerted, nevertheless, to the destruction of a large number of these animals upon such rookeries and other places along the coast as are not subject to the control of the Treasury Department of the United States. The effect on the salmon industry is already apparent, as, since the summer of 1899, the number of sea-lions present in the bays and rivers has been much less than formerly." Apparently the number killed by the patrol was greatly augmented by the number killed by the fishermen themselves.

The destruction at that time seems to have had the desired effect, as since then no serious complaint has been made to the commission. We have this on the authority of Mr. N. B. Scofield, who was in 1898, and is now in 1916, in the employ of the California Fish commission. Sea-lions have been so reduced in numbers that in 1909 a law was passed, forbidding the killing, maiming or capturing sea-lions, in the waters of Santa Barbara channel and on the land adjacent thereto, in order to prevent the extermination of the black or California sea-lion.

As evidence that California was not alone in the demand for reduction in the number of sea-lions, it may be stated that the Oregon Legislature passed a Bill, offering a bounty of $2.50 for each sea-lion killed in the waters of the state or within one marine league of the shore. On account of faulty wording of the Bill, the money was not available, but the Fishermen's Protective Union raised a fund by private subscription to hire men to shoot the lions on their breeding grounds. In Washington, too, there has been some complaint at times but nothing definite seems to have been done.

3. PREVIOUS WORK ON THE SEA-LION QUESTION IN BRITISH COLUMBIA.

So far as is known to the present commission, the only investigations hitherto made in British Columbia are those which were conducted by the chairman and his son, in the year 1913. In the spring of that year, the chairman was requested by the British Columbia authorities in Victoria, B.C., to conduct an investigation to disclose the numbers of sea-lions that frequent and breed upon our coast, and the number and locations of the islands where they breed. This was in consequence of the many complaints made that sea-lions were seriously damaging the fisheries.

No information whatever was furnished to those in charge of this inquiry of 1913 relating to previous controversies regarding the food habits of sea-lions in California or other states, but before starting for the north, such literature as was accessible was consulted, and an examination was made of the report of the United States Commissioner of Fisheries for 1902, to which reference was made by Hornaday and others when describing the California and Steller's sea-lion. This report at once revealed the widely divergent opinions entertained by competent naturalists as to the food habits of the sea-lions, and special pains were taken in the field to procure from all sources information as to their food, and the evidence of the older Indians, who in their younger days had depended largely on sea-lions for food, and had utilized their skins and other parts in various ways, was noted.

The result of the inquiry made by these investigators is mentioned in the annual provincial report for the year 1913, published in 1914. The ground covered by it included the coast line from Boundary bay, North Latitude 49°, to the Nass river in 54° 40', at various points in which the officials of more than thirty salmon canneries and herring plants were personally interviewed, and further information was obtained from their employees, both white and Indian. Amongst these points were the lower Fraser river, Knights inlet, Alert bay, Quathiaski cove, Rivers inlet, Bella Coola, Kimsquit, Namu, Bella

Bella, Skeena river, Nass river, Masset, Skidegate, Quatsino, Clyoquet, and the important cannery known as Kildonan, at Clyoquesit, Barkley sound. As the result of inquiries at these stations it was learned that serious complaints of depredations by sea-lions were made at only two localities, viz., Rivers inlet and Barkley sound. In each of these places damage had been so great that active steps had been taken to diminish their numbers by the fishing companies affected. Indians questioned at more than forty villages were unanimous in stating that the principal food of sea-lions was fish, and that these fish consisted in the greater part of fish eaten by man, especially salmon, herring, and halibut. In not a single instance was any wish expressed that sea-lions should be protected, as no dependence is now placed on them for food, clothing, or any of the native arts or industries.

Over 1,800 miles of coast line were examined, mostly in a small gasolene sloop. Three groups of islands, forming breeding places, were noted, and a fourth indicated, and the number of individuals seen was estimated at upwards of 11,000. In addition to the rookeries, a large number of isolated rocks, used as resting places, were visited and recorded. The rookeries and hauling-out places were shown on a map accompanying the report.

Later in the season a second visit to the rookeries in Queen Charlotte sound and off cape Scott was made. A number of successful photographs were taken, islands not before visited were explored, and an estimate made of the numbers frequenting these. The joint report shows that the injury to the fisheries complained of is of two kinds. At Rivers inlet the complaint was that nets were damaged and destroyed and vast numbers of salmon were devoured or mutilated, while at two localities in Barkley sound it was stated that the principal loss was in the herring fishery, which suffered largely through the presence of great bands of sea-lions surrounding the schools of fish and driving them out from the heads of bays and inlets where the most successful fishing had always been carried on. Complaint was also made that they devoured enormous numbers of herring and halibut.

As regards the food question, little information was obtained by personal observation. Three adults were examined, two of which contained no food whatever in their stomachs, while the third was full of fish, including salmon, cod, and bass.

A second kind of sea-lion was reported by Indians of Barkley sound as occurring there, and from their description it was concluded that this was the California species, *Zalophus californianus*. It is surmised that this species and perhaps the majority of the individuals belonging to Steller's species came from the American side, as the rookeries in the state of Washington are far nearer to Barkley sound than those on the Canadian side.

4. THE CALIFORNIA SEA-LION IN BRITISH COLUMBIA WATERS.

The following notes tend to confirm the statements made by Indians of Clyoquet in 1913, that a second kind of sea-lion visits Barkley sound at times, though never in large numbers.

Dr. C. H. Townshend, Director of the New York Aquarium, permits the quotation from a letter written on November 9, 1915, of a passage relating to a period when he was the naturalist on the United States Bureau of Fisheries steamer *Albatross*:

> "I visited Barkley sound in 1889 with the *Albatross*. The sea-lions I saw and heard barking at the time were on some rocks, I think not far from the lighthouse. They were unquestionably the California species, which is the only barking sea-lions in that region. Sea-lions do a good deal of moving about up and down the coast. They do not confine themselves to any one neighbourhood."

Dr. Townshend also sent, at the same time, a copy of the Bulletin No. 29, of the Zoological Society of New York, for April, 1908. This contains an interesting article by Dr. Townshend entitled "An Inquisitive Sea-lion," describing the behaviour of a young specimen of *Zalophus californianus*, which was attracted to the *Albatross* while at anchor one evening at Port Townshend, by the barking of a setter dog. It spent the night in the ship's dinghy, and Dr. Townshend was able to make a very successful photograph of it before it grew dark. The photograph is reproduced on page 412.

Further information of similar bearing was obtained from Prof. Trevor Kincaid, of the University of Washington. At the Alaska-Yukon-Pacific Exposition, held in Seattle in 1909, two animals were included in one of the exhibits, as fur seals. Prof. Kincaid was asked to examine them, as there was much doubt as to the correctness of this designation. Both of them were found to belong to the California species of sea-lion, and those in charge of them stated that they had been taken in the salmon traps at New Dungeness, not far from the entrance to Puget sound. After the close of the exposition the two animals were moved to the zoological collection at Woodland park, Seattle, still labelled as Alaska fur seals. A visit was made by a member of this commission to the Zoological Garden mentioned, and the caretaker was interviewed with little result. The animals in question had died soon after their arrival at Woodland park.

In December, 1915, Indians employed in hunting for the commission, stated that the second kind of sea-lions was well known in Barkley sound as the black or barking kind, but these only pass in as far as Alberni canal very seldom. The last one that was recalled had been killed off Nahmint about five years ago.

5. THE SEA-LION QUESTION AS IT AFFECTS BRITISH COLUMBIA.

At the preliminary meeting of the commission in August a decision was reached as to two main methods of seeking information on the sea-lion question. The one was to make a trip along the coast to get personal information if possible, although little was expected on account of the lateness of the season, and failing this, or supplementing this, to get information from those who claimed to have firsthand knowledge concerning the habits and food of the sea-lions as well as the nature and extent of their depredations. The other was to obtain information by correspondence with cannery managers, fishery officers and others interested or likely to be able to furnish such.

In connection with the former of these, the Department of the Naval Service kindly put at the disposal of the commission, for three weeks, the steamer *Malaspina*, Captain Holmes Newcomb commanding. The commission is under no little obligation to Captain Newcomb, his officers and crew for the courtesy shown during the trip.

On August 30 the *Malaspina*, with Drs. Newcombe and Fraser on board, started northward. The attempt to visit all of the rookeries along the coast had to be given up through lack of time, partly due to delay by smoke and fog, and by waiting for a chance to coal at Prince Rupert. The Cape St. James rookery was not visited, nor was that on the Cape Scott group of islands; three attempts to get out to the Hayeocks and Triangle islands all failed on account of foggy and heavy weather. The rookery on the Sea Otter group was visited, where there were sea-lions visible, but on account of the dangerous reefs in the vicinity, it was not possible to get close enough with so large a boat to make an estimate of the number and the swell was too heavy to attempt it with a small boat. A small rookery at the west end of Hope island was visited, and here the only attempts made to capture sea-lions proved abortive. On two mornings in succession Indian hunters, hired for the purpose, tried to shoot and spear one or more of the herd of forty or fifty that were visible in the surf, but without

success. Finally the rookery at Solander island, off cape Cook, was visited. The weather was very foggy, but after waiting for an hour and a half in the vicinity, the captain was able to bring his ship near enough the rocks to make the sea-lions plainly visible. The number was estimated to be at least 1,000, although it may have been somewhat in excess of that number. Dr. Newcombe, in his report in 1913, did not consider Solander island to be a rookery but as shown elsewhere in this report, he is now convinced that it is one.

6. INFORMATION FROM EYE-WITNESSES.

As the personal information on this trip, consequently, was somewhat limited, as much as possible was made of the evidence of eye-witnesses. These may be divided into three classes: (1) Those who were not sufficiently familiar with sea-lions to be able to distinguish them from hair seals, (2) those who claimed to have personally seen sea-lions chasing and eating some species of fish, (3) those who claimed to have seen sea-lions eating fish and had also examined the stomachs of one or more of these animals.

Of group (3) the majority were Indians, some of them old men, who, in earlier days, had made use of many portions of the sea-lions for various purposes. Besides these there were two white men, viz., Mr. F. Inrig, manager of the British Columbia Packers' cannery at Wadhams on Rivers inlet, and Mr. J. Boyd, Fisheries Overseer at Bella Bella. Group (2) included cannery men, cold storage men, active fishermen, sea captains, fishery officers, as well as others, in no way directly connected with the fishing business. The evidence of those in group (1) has not been considered.

Representatives from numerous localities from Alert bay to Prince Rupert, and all along the west coast of Vancouver island from cape Scott to Barkley sound supplied information for this area and even beyond it to the mouth of the Nass river and Hecate strait. Twenty-six in all made statements sufficiently definite to be worthy of consideration. The commission does not vouch for any of the evidence submitted, but sees no reason to doubt its accuracy. The points at least on which there was general agreement must be accepted until such times as they can either be corroborated or disproved. Already a portion of the evidence has been confirmed as shown in a later portion of the report.

7. MATERIALS USED BY SEA-LIONS AS FOOD.

There was not a dissenting voice to the assertion that sea-lions eat food fishes. Of the food fishes eaten, salmon and halibut have been most frequently noticed, and of the species of salmon, spring, sockeye and coho. Humpback and dog salmon were not reported. Besides the salmon and halibut, other food fishes, viz., herring, oolachan, red cod, ling cod, and rock cod were mentioned. Devil fish (which probably included squid also) were frequently mentioned, dogfish and birds in a single instance. It may be well to note here that lack of positive evidence is not negative evidence. These men, almost without exception, stated that they saw no signs of sea-lions chasing other than food fishes or of the remains of other than food fishes in their stomachs. Naturally so, because in the first place they would never take the trouble to learn the haunts of fish not suitable for food, and in the second place, the sea-lions would be killed almost entirely in the neighbourhood of fishing grounds of some sort, and would more likely than otherwise have eaten those very food fishes. This does not prove that the sea-lion does not eat anything else in the sea when the food fishes are not readily available. This matter is taken up again later.

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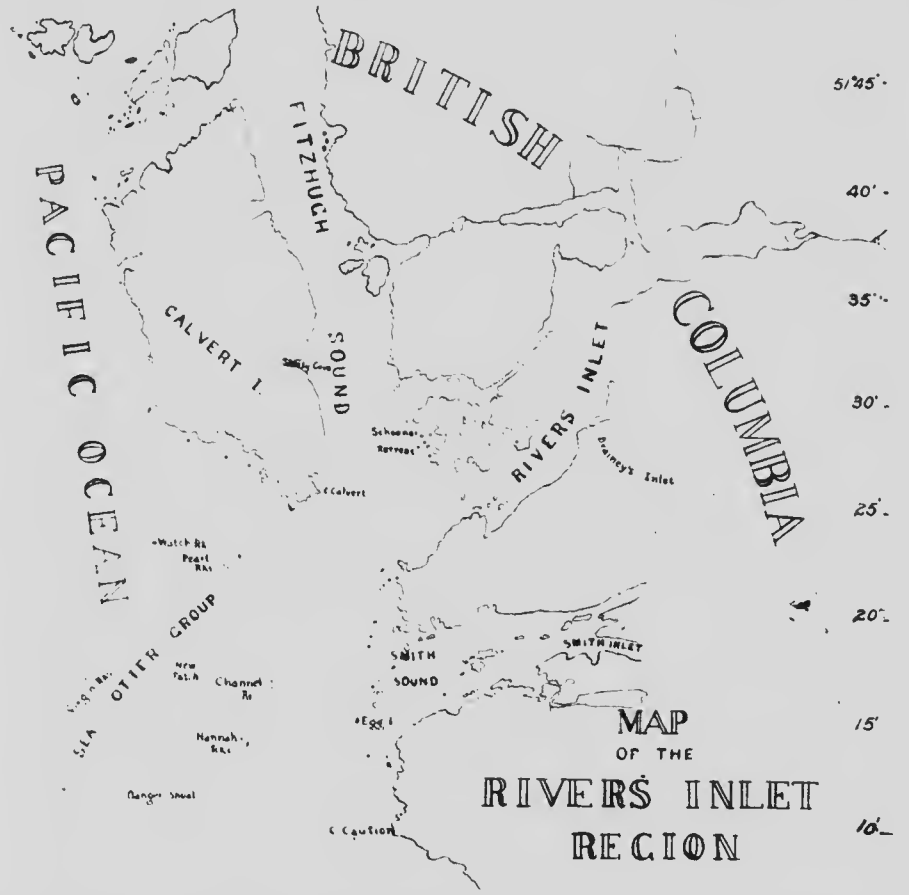
S. INJURY TO THE FISHING INDUSTRY.

With regard to the injury done to the fisheries of the province, only the salmon, halibut, and herring industries need be considered. Taking first the salmon fishery, the complaints of injury were almost wholly confined to the Rivers Inlet region. Here the sockeye season is at its height just after the pupping season, during which period it has been stated by many authorities, no food is taken by the adults. When the pups are two or three weeks old, according to the Indians, they are able to swim at the surface of the water and are then taken by the adults into the neighbouring waters



while the latter satisfy their appetites, now especially voracious after the long fast. It is quite probable that the amount of the stomach content at that time (Mr. Imrie reported having seen thirty-six sockeye salmon in one lion's stomach) cannot be taken as typical for the whole year.

The sea-lion is such a powerful swimmer that it can readily overtake a salmon, which it catches and shakes until the piece comes out and the bite is swallowed. If the fish are plentiful, the bitten fish is not touched further but another is attacked in a similar manner. If the fish are scarce the part of the fish left after the first bite

may be seized again by the same individual or by other individuals, as they commonly go hunting in small herds. At times they find it more convenient to take the salmon out of the gill-nets, especially when they are being hauled, as then the fish are near the surface of the water. One case was reported where sixteen salmon in succession were taken, as fast as the net was hauled to the surface, the one animal making the entire capture. It is at such times that harm is done to the gear. The lions are so powerful that if the net is taut they pass through it with ease. If it is looser they may get tangled up in the net and do much more damage to it.

The rookery in the Sea Otter group of islands is opposite the mouth of Rivers inlet, (see map, page 130), so that all schools of fish entering the inlet must pass near by. The sockeye run comes just at the time when the lions need the greatest supply of food, hence what could be more opportune for them.

Apparently in the early days of the industry the sea-lions were not so numerous. It was not until about 1911 that they appeared in large enough numbers to be especially troublesome. In 1912 and in 1913 so many fish were taken from the nets set in the inlet for some distance from the mouth that the fishermen found it useless to continue fishing in that locality. Many of the sea-lions were killed in 1914 and 1915, and the season of 1915 was a particularly good one in the inlet.

The injury done to the halibut fisheries has not been so serious, partly because the habits of the halibut require a different method of fishing. The attack made on an individual of this species can only be observed when a halibut is taken from the hook when that part of the line is near the surface, at which time the halibut is attacked in the same way the salmon is. Damage was reported from Hecate strait and from the area to the north and northwest of Vancouver island. In fishing for this species there is little chance for any damage to gear.

Damage to the herring industry was reported only from Barkley sound. Here the complaint was not so much that the numbers of the herring were being diminished as that the schools are broken up, scattered and driven seaward. As many as 300 sea-lions have been reported from the sound where they use the Bird rocks for a hauling-out place. Two plants have been in operation, one at Pachelet, near the entrance, and the other at Pachenkesit, far up the sound. Barkley sound is a long distance from any known rookery, but as the lions do not appear here until late in the fall, the pups no longer need care, and as the adults are such powerful swimmers such distances would not mean much to them. In other localities, notably Clayoquot, Quatsino sound, and in the Nass river, herring runs are followed by sea-lions, but as yet not enough fishing has been done for any special observation to be made.

9. THE FLATTERY ROOKERY.

This Malaspina trip covered the "spheres of influence" of all of the British Columbia rookeries, but it was possible that it did more than that. Barkley sound is a long way from Solander island, where, so far as is known, the nearest British Columbia rookery exists. It is much nearer to what is generally spoken of as the Flattery rookery, off the west coast of the state of Washington. It is probable that occasional sea-lions seen in the strait of Georgia, as far north as the mouth of the Fraser river and at Entrance island, near Nanaimo, as well as others in the strait of Fuca, are from the Flattery rookery. On that account it seemed desirable to obtain more definite information concerning this rookery.

Mr. John N. Cobb, editor of the *Pacific Fisherman*, who has shown much interest in the work of the commission, obtained the assistance of the United States Revenue Service, who kindly placed the *Snohomish*, Lieut. H. W. Pope commanding, at the service of its members, for the purpose of visiting the rookery. As the State Department was also interested in the information, Mr. Cobb went along to represent that department.

On October 25, Mr. Cobb and Drs. Newcombe and Fraser met the *Snohomish* at Port Angeles and proceeded to Neah bay, where the night was spent in order to make an early start in the morning to visit the rookery. In the morning, however, such a storm was raging outside the cape, that visiting the rookery was out of the question. The next day was no better, and hence the visit had to be abandoned. The trip was not utirely in vain notwithstanding, as from the Indians at Neah bay it was learned that the rookery in question is located on the Jagged islets, about nine miles south of the Umatilla reef, or twenty-one miles south of cape Flattery. Judging from some photographic prints of the rookery that were shown, it must be quite a large one. The Indians, too, gave the impression that it was of large size although no definite estimate could be obtained from them. From this rookery the sea-lions come out into the strait of Fuca, haul out on rocks not far from Neah bay, and even come into the bay itself after fish. The Indians here had the same story to tell concerning the eating of halibut, salmon, and herring.

10. BARKLEY SOUND INVESTIGATION.

In order to obtain more definite information as to the damage done by Steller's sea-lion than that afforded by the statements of white and Indian fishermen, certain arrangements were made with Mr. Martin, manager of the Wallace Fisheries Company at Kildonan, Barkley sound. Mr. Martin courteously afforded every facility at his disposal at the cannery, and the commissioners had such an excellent base of supply provided for them that it was unnecessary to take any camp outfit.

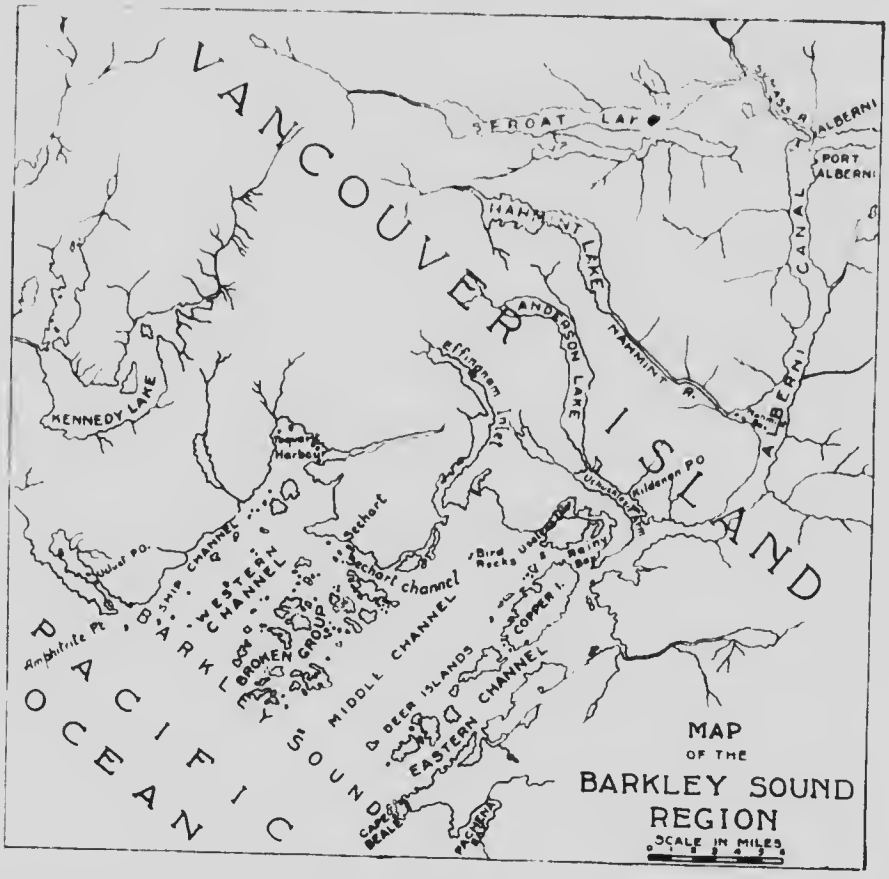
Two points of special interest were to be taken up. The first was with regard to the interference by sea-lions with the herring fishery in the way of keeping these fish off-shore, or by breaking up the schools; the second was with respect to the statement that they annually devour large quantities of herring.

In 1915, the sea-lions made their first appearance for the season in Barkley sound on November 1. On the morning of November 3, Dr. Fraser, being provided with a motor-boat and two men from the cannery, was able to visit their hauling-out place on Bird rocks. Small groups were seen from the entrance of Uchucklesit harbour to Bird rocks, and on the rocks there were about sixty, but these fell off into the water before it was possible to get a shot. It was an easy matter to chase small herds, up to ten or twelve, for a long distance, as they kept together well, coming to the surface often. Some shots were fired, but as no means of retrieving them were available at the time, no specimen was obtained. Some photographs, indicating their presence, were obtained, but otherwise these do not give much information. Apparently all of these lions were of the Steller species, and there were no small ones in the lot.

On the following morning, on the way from Kildonan to Port Alberni, small groups of lions were seen at intervals from the mouth of the harbour almost as far as the Canadian Northern construction headquarters. In every locality in which they were seen there was every evidence of herring schools there also.

From reports received by the chairman early in December, it was learned that sea-lions were in great abundance in nearly all of the numerous inlets branching from the larger waters, known as Barkley sound, and that they were as usual pursuing the herrings, which were then being taken for curing and for bait. As stormy weather then prevailed, causing wrecks and loss of life just outside of the sound, it was thought that a more successful hunt could be made in the more inside waters of Uchucklesit inlet. As Dr. Fraser was out of the province at the time, and Mr. Greenwood's engagements prevented him from taking part in the investigation, the consideration of the food question as far as these Barkley sound sea-lions were concerned was undertaken by Dr. Newcombe alone.

It was a matter of congratulation, however, that Mr. Clyde L. Patch, Dominion taxidermist, was able to take an active part in the investigation. Hearing from the chairman that an attempt was to be made to secure a large number of sea-lions (including, it was hoped, the California species), Mr. Taverner, zoologist of the Royal Victoria Museum, Ottawa, supported by the Director of the Geological Survey, Dr. R. G. McConnell, offered to send a skilled taxidermist, with a view to saving all skeletons and skins for permanent preservation as a mounted group. Mr. Patch co-operated heartily in the work of collecting specimens, and, in spite of very adverse weather conditions, secured the desired parts of fourteen individuals, together with data as to sex and size. He also made plaster casts of various parts, to be utilized when mounting these specimens.



On arriving at Kildonan, a short distance inside of Uchucklesit inlet, on December 16, it was found that the herring and their pursuers were no longer there; they had been for some weeks, but had passed out into the sound. Native hunters were secured, and a small gasolene fish-boat was hired, in preference to the large craft, the loan of which was offered by Mr. Martin. The two Indians were armed with rifles and with the ordinary fur-seal spears of the west coast, in order to retrieve the bodies of any wounded individuals. Independent Indian hunters were also promised a certain sum for every sea-lion they could secure.

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The first goal was the Bird rocks, the principal resort and retiring place of sea-lions in Barkley sound, where, it was stated, a day or two earlier, some hundreds had been seen from passing vessels. On the way out two independent hunters in a small canoe furnished with gasolene were overtaken. They had just wounded a female sea-lion, and speared it while under observation.

At Bird rocks there was a large number of sea-lions, some hauled up, and a large number swimming about close to the shore. All were somewhat wild, but two were killed and hauled on board to be examined at leisure at Kildonan. The weather was dull and rainy, and hence it was impossible to secure successful photographs. After this the hunting was left to the Indians to carry on, resulting in eleven more specimens being brought in, two of which were paid for by Mr. Patch on behalf of the Geological Survey, as the chairman considered that a run of eleven or twelve specimens, all telling the same story, was sufficient for the purpose of the commi-

On opening the stomachs of the twelve specimens containing fish, it was found that all of them had herring in an unmutilated condition. Evidently they had swallowed them without any mastication. The quantities amounted to from one-half to two gallons, including the pulpy mass of more or less digested food. Two contained one or two rounded stones.

The following table shows the sex, length, etc., of those examined, as noted by Mr. Patch:—

No.	Where Killed.	Sex	Length.	Stomach Contents.
1	Bird rocks.	Male.	8 ft. 4½ in.	Small crabs, decayed fish.
2	"	"	9 " 5 "	Stone, clam shell
3	Off Cetuckleset	Female	" 3 "	Herring.
4	"	Male.	" "	"
5	"	"	" "	"
6	"	"	" "	"
7	"	"	8 " "	"
8	"	Female	8 " 7½ "	"
9	"	Male.	8 " 3½ "	"
10	"	"	8 " 2 "	"
11	"	"	7 " 3½ "	"
12	"	"	8 " 8 "	"
13	"	Female	7 " 11 "	"
14	"	Male..	8 " 3½ "	"
			10 " 4½ "	

In addition to these fourteen, a male brought to Kildonan a few days previous to the arrival of Dr. Newcombe and Mr. Patch, was opened and examined by Mr. W. A. Newcombe, who reported that it had been killed amongst the herring, and that it contained a large number of these fish and their skeletons, in addition to a pulpy mass of indistinguishable material.

From the results above detailed it seemed clear that at this time of the year, at least, the main food of Stellar's sea-lion, while in Barkley sound, is one of the most important food fishes of the province, and that the contention of the white and native fishermen relating thereto was amply supported by incontestable evidence.

Some of the stomach contents were bottled up and sent to Dr. Fraser for examination, on which he reports as follows: The main portion of the material from sea-lion stomachs sent from Barkley sound consisted of herring in a more or less digested state, but the other contents are worth considering. These were (1) the dorsal fin and some vertebræ of dogfish- enough to make diagnosis definite; (2) a portion of a vertebral column of a flatfish not enough to make identification of species possible; (3) a clavicle from some bony fish, possibly from the same flatfish; (4) a number of cephalopod beaks; (5) a clam shell that had been bored by *Thais*; (6) small stones; (7) numerous nematode parasites of the Ascaris type.

The finding of the dogfish remains is especially interesting. Only one of all the eyewitnesses examined mentioned dogfish as an article of sea-lion diet. In recent years the dogfish have been so numerous in Barkley sound during the early part of the herring season that the fishermen find it unprofitable to put out their nets since the dogfish do so much damage to them. It may be only a coincidence, but when the sea-lions come in about the first of November, the dogfish no longer interfere with the nets. The fact that sea lions do eat dogfish indicates that it might be more than a coincidence. Without question the dogfish is a greater pest than the sea lion at the present time. It might be a still greater pest if the sea-lion were exterminated.

The flatfish remains, as well as those of the squid and devilfish, indicate that at times the sea-lion is a bottom feeder, possibly only in shallow water. The dead clam shell and the stones were likely scooped up when the bottom feeding was being carried on.

From the variety obtained in two of the stomachs it seems as though the sea-lion is not restricted in its diet but that anything will serve, the most abundant material receiving the greatest attention.

II. INFORMATION BY CORRESPONDENCE.

While the investigation in the sea-lion haunts was being carried on, the secretary was getting information by correspondence. To facilitate and notify this, a set of questions, accompanied by a circular letter (see appendix), was sent to each British Columbia cannery manager, etc., who was likely to have knowledge of any phase of the question. To these questions a large number of replies were obtained, and these, in general, definitely confirmed the evidence already quoted, and brought out some points not previously considered.

Comparatively few endeavoured to estimate damage to gear, but the total estimates given amounted to over $1,000 for the year 1915. It was scarcely expected that any very definite figures would be given for the value of the fish lost by mutilation or for the diverted run of fish but a number of replies indicated that in the case of the salmon, the value of the fish lost by mutilation, and in the case of the herring, the value of the loss by diverted run, would be considerable. The only place where any definite change in the number of sea lions was noted was at Rivers inlet, where there was a definite increase during 1911-12-13, and since then a noticeable decrease.

None of those directly interested in the fish business could give any definite information as to the value of sea-lions. Such information from other sources will be treated separately.

The correspondents were almost unanimously in favour of complete extermination, to ensure which they wished a Government bounty, none of them feeling able to cope with the situation themselves. That extermination might be as rapid as possible, shooting the adults and clubbing the pups on the rocks soon after they were born in June, should afford the most definite results, although poisoning and other extreme methods were also suggested. These methods would not do very well in Barkley sound where the sea-lions come in late in the fall. As a bounty mark, the muzzle seemed to satisfy the majority, although it was also suggested that the mark should be changed from year to year.

12. KILLING SEA-LIONS.

Nothing was done systematically towards the killing of sea-lions, except in Barkley sound, where it has been going on with more or less vigour for several years, until the year 1914. So much damage was done to the fisheries of Rivers inlet in 1913 (Manager Ingrig estimated the loss of gear at Wadham's cannery alone at

$3,021) that the following year several cannerymen decided to cooperate in decreasing the number. A levy of $1.50 was made for each boat fishing, and as there were 700 boats fishing, this provided a fund of $1,050. Two dollars a tail were offered for sea-lions, and in thirty-six hours enough tails were obtained to take up all the bounty, that is to say 525 were procured.

During this year again, on Barkley sound, men were supplied with guns and ammunition and sent to drive the sea-lions away from the schools of herring. They can be chased thus like herds of cattle. No effort was made to retrieve any of those shot, but a large number must have been killed.

In 1915, Wadham's cannery supplied two gasoline fish carriers, and giving twenty men to each a holiday, armed them with rifles and supplied them with between $100 and $500 worth of ammunition, sent them off to the rookery to kill sea-lions. The first trip was made in the second or third week in May, and a thousand rounds of ammunition were used. Hundreds must have been killed, but only three noses were taken home. The second hunt took place in the first week in June. This time 200 muzzles were obtained, and it was estimated that 750 altogether must have been killed. The muzzles were handed in to the fishery officer for the bounty of $2, which was placed on sea lions last year by the Department of Fisheries, $5,750 being set aside for that purpose. This bounty was all used up early in June, many muzzles being brought in after the bounty money had all been paid out.

Of the 2,875 sea lions for which bounty was paid, 1,150 were killed at or near the Sea Otter group at the mouth of Rivers Inlet, 1,646 on the East and West Haycocks (islands in the cape Scott group) and the few remaining at various spots along the coast. Beside the number mentioned from the Haycocks, 671 were brought in too late for bounty. (These figures were supplied by Mr. F. H. Cunningham, Chief Inspector of Fisheries, the list including the number to whom bounty was paid, the number and the location where obtained. See Appendix B).

In the two years, therefore, there is positive evidence that 4,071 sea lions were killed, 3,549 in 1915, and 525 in 1914. According to the statements of Fisheries Overseer Saugstad at Rivers inlet, and Boyd at Bella Bella, through whom most of the bounty was applied for, there would certainly not be more than 50 per cent saved of those killed. Of the adults, there might not be more than one in ten, but among the pups there would be quite a large proportion. Approximately 75 per cent of the muzzles brought in were from pups. In the localities alone in which sea-lions were killed for bounty in 1914 and 1915, at a conservative estimate there must have been 8,000 killed, of which approximately 6,000 were pups. The number killed in Barkley sound and at isolated spots elsewhere would add materially to this number. At such a rate, extermination would not seem far off. In fact it was practical extermination of the 1915 increase on the Sea Otter and Haycock rookeries.

Comparing these numbers with the estimated number for the whole coast, 11,000, given by Dr. Newcombe as seen in 1913, it would seem that an estimate based on the numbers that may be seen at the rookeries and hauling-out places, must be too low. Even during the pupping season, all the lions will not be on the rookeries at the same time, for while the adult male and female may fast at such a time, there is no evidence that immature individuals do so, and the probability is that they feed then as they do at other times of the year. During the rest of the year, it is known that at times all the members of a herd may be away from the rookery or hauling-out place at one time, but there is no assurance that all of them are ever on the rocks at the same time. Certainly there are times when some are on the rocks and others are in the water, since that has been observed by the commissioners on different occasions. If they are not all on the rocks at the same time, an estimate based on the number seen at any one time would not take into account those in the water.

Consider the case of Solander island for example. In the investigation by Dr. Newcombe in 1913, since at times there were no lions whatever visible, doubt was expressed as to its being a rookery (there is now conclusive evidence that it is), although at other times upwards of one thousand were seen there. Even when a thousand of them were on the rocks there may have been many more scattered about, actively feeding or in search of food.

Taking it for granted, therefore, that 11,000 was a fair estimate in 1913 for the number of sea-lions that could be seen at the rookeries and hauling-out places, it is evident that to this number, an addition must be made, amounting to an unknown percentage of the whole number, to get at the total number in British Columbia waters.

13. COMMERCIAL USES TO WHICH SEA-LION CARCASSES MIGHT BE PUT.

From evidence of manufacturers and sea-lion hunters the suggestion was conveyed to the commissioners that there was an economic and commercial value in sea-lion hides, whiskers, and carcasses. Under the bounty system the whole carcass of a sea-lion, with the exception of the muzzle, is disregarded, thrown into the sea, or left on the rookeries or hauling-out grounds to putrify, so far as any effort is made by the Government to utilize it. Much time was spent and many persons interviewed in obtaining definite information as to the feasibility of utilizing sea-lion carcasses for commercial purposes, with the happy result, however, of its being demonstrated that the hide of a sea-lion is eminently suitable for tanning into leather, from which durable and serviceable gloves and boots to-day are being made; that the whiskers have a value of 25 cents a piece to Orientals; and that the flesh can be rendered into oil and guano, for which a good market is ever available. While it was impossible, owing to the short time at the disposal of the commissioners, to investigate this side of the problem in an exhaustive manner, on account of the great distances from Vancouver and Victoria to San Francisco and New York, where comprehensive and accurate corroboration of the commercial uses of the carcasses of sea-lions can be obtained, yet sufficient evidence was discovered to point to the conclusion that in killing sea-lions the economic value of their entire carcasses should be taken into consideration, so that, if it were found possible and feasible, then the monetary returns from the disposal of the carcasses in the form of hides, whiskers, oil, and guano would at least equal and possibly, with care, exceed the amount of the bounty offered by the Government. It is in the mind of the commissioners that if such a consummation could be reached, a real service to industry and the country could be rendered. It is in this direction that the commissioners desire to pursue their inquiries during the coming year.

What turn that inquiry might take is indicated by the fact that Mr. W. F. Robinson, president of the Robinson Fisheries Company, manufacturers, producers, and distributors of fish oil and fish fertilizer, Anacortes, Washington, writing to the commission under date of August 11, 1915, says: "We have never yet had the carcasses of sea-lions to use in our fertilizer plant, but could do so if we had them, as we understand they grow to a very large size. Unless the expense of obtaining the sea-lions is too great, or your works are not near the source of production, we believe they could be handled to advantage."

Messrs. Anderson and Miskin, 118 Seymour street, Vancouver, in answer to an inquiry from the commission, wrote the following letter, in which it is understood that the oil from the sea-lions corresponds to seal oil:

> "Replying to your telephonic inquiry re our requirements of seal oil, we are buyers of the same quality as is produced in Newfoundland from the blubber of the young harps (hair seal). It is principally used in miners' lamps, and must be free of moisture. If we get the right quality, we can use 500 to

700 tons per annum. Samples are usually submitted before we purchase, or it is guaranteed to be the finest quality, and what is termed 'water white.' Straw and coloured oil, which is much cheaper, we handle a small quantity of. Oil from old harps is very much darker than what is produced from the young ones.

"There is a good market for seal oil in United Kingdom, and we have no doubt whatever that, if the stuff can be produced on the Pacific coast, it would be to our mutual advantage. If a small trial lot was sent home on consignment through us, it would enable our friends to judge of the character of the oil, and if not suited for their purposes there would be no difficulty in disposing of it in the open market. If, on the other hand, it did suit them, they would doubtless be willing to make a contract for the quantity we have already stated, under guarantee of quality equal to consignment parcel, of which sealed samples could be retained here."

As to guano obtained from fish, whales, and other sea animals, its price is in the neighbourhood of $40 a ton. It is used as a fertilizer, and also manufactured into chicken food. The demand is steady and growing. Similar guano, it is thought, could be made from the carcasses of sea-lions.

In relation to the manufacture of sea-lion hide products, the commission is indebted to R. C. Grinnell, British Columbia Glove Company, Eburne, Point Grey, for valuable information obtained during an interview on October 22. Mr. Grinnell speaks from personal knowledge as in his factory he has made gloves, boots, and moccasins from sea-lion hides. In fact, he has built up a small but substantial business in leather goods made from sea-lion hides. Naturally, therefore, he is emphatic in his declaration that sea-lions are of commercial value, especially for their hides.

In 1913 he took a hunting trip to Haycock islands and got 500 hides which, when green and salted, weighed almost 200 pounds apiece. These hides he tanned in the ordinary way and made into gloves in his factory which in the fall of that year was situated at Coquitlam. In tanning the hide reduces about 75 per cent, and when tanned runs from an inch to a quarter of an inch in thickness. It is thin under the flippers but it is thicker on the belly than on the back. In making the hide into leather it may be split into three layers, and when thus split can be readily manipulated. From this leather, chrome-tanned leather gloves are made. From the hide of a fair-sized male, 2½ to 3 dozen pairs of gloves may be made, but taking an average of male, female and pup, only about 25 square feet of leather can be obtained, enough to make one dozen pairs of gloves. The range of gloves made runs from the fine automobile gloves or gauntlets to the heavy loggers' mittens, the former selling at $21 a dozen pairs and the latter from $10.50 to $15. No better material can be obtained for loggers' mittens, as the hide of the sea-lion by nature is of fine fibre, tough, strong, flexible, and of close grain, enabling it to keep out water, while still retaining its pliability. The other gloves as well are very durable and serviceable. On the day following the interview, Mr. Grinnell brought into the secretary's office two pairs of gloves made from sea-lion hide, tanned in his own factory and made up in the interval. One pair was from the hide of a sea-lion pup, this selling at $1.50 or, by the dozen, $12.50; the other was from an adult, selling at $1.75 a pair, or $13.50 a dozen. The secretary bought the two pairs, and has them on exhibition in his office at present. With eight or nine men working, twenty-five to fifty pairs of gloves a day are made. More men are wanted, as the output could easily be increased. Glove business from sea-lion hides is a good business. There is a ready market in Canada for all the factory can turn out.

The moccasins that Mr. Grinnell makes from the sea-lion hides give good satisfaction. They are pliable and fit snugly to the foot. The price is $26 per dozen

pairs. Boots from these hides stand water as well as rubber boots. A pair were made for a customer, who has to wade through water and chemical liquor all the time while at work, and even here they gave excellent satisfaction. For boot purposes, green hides are better than dry hides, but all sea-lion hides are good.

Mr. Grimmell would be glad to consider a proposal to buy all the sea-lion hides that could be delivered to him, and is sure if he could get the supply at a fair price he could build up a large industry. He would be willing to pay 5 cents a pound for green hides if he were guaranteed 5,000 hides. If he could get hides in large enough numbers to make it worth while he could ship them to San Francisco, as he has a standing order to ship any hides he can get at 6 or 7 cents a pound for green hides of females and pups and 2 cents a pound for males, but he has to pay the freight. It would take 5,000 per annum to satisfy this demand.

If the lions can be obtained, the skinning is a simple matter. A good man can skin a lion in from fifteen to twenty five minutes and should be able to skin three or four an hour. He would thus make good wages if he could get steady work for the day at 25 cents a skin.

Mr. Grimmell is of the opinion that the oil from the sea-lion alone should make it worth while saving the carcass, and the remainder of the carcass made into guano or chicken food should command a good price.

P. H. McMullen, representing the McMullen Hide and Fur Company, 956 Powell street, Vancouver, said he would handle any quantity of sea lion hides at a price similar to that suggested by Mr. Grimmell.

H. BOUNTY PAYMENTS FOR KILLING SEA-LIONS.

By good fortune the commission interviewed A. K. Sinclair, 2940 Ontario street, Vancouver, a sea-faring man, an old sealer and perhaps the pioneer sea-lion hunter for profit in British Columbia. He tells the sea-lion story from a different viewpoint, that of the hunter. In May, 1914, he was on a hunting trip for Hibbard & Stewart, hide dealers, 958 Powell street, Vancouver, as skipper of the schooner *Tahadi*, the agreement being that he was to receive 5 cents a pound for green salted sea-lion hides, delivered in Vancouver.

He was at Rivers inlet on May 25, 1914, where, he states, he organized the plan mentioned elsewhere in this report by which the canners there gave $1,050 in bounty in an effort to diminish the depredations of the sea-lions by killing off a number of them.

Sinclair had to wait about a week for good weather before he could get on the Virgin rocks. From his anchorage in Schooner Retreat, every day he spied out the land until conditions were ripe. On June 5 or 6 he made a landing on the Virgin rocks from a dory. The sea-lions made as if they would prevent his landing, but after killing five or six of them from the dory he and one hunter succeeded in getting on the rocks. They left one man on the schooner and one man in the dory not far from the rocks. It was breeding season, and all the sea-lions stayed on the rocks when the landing was made. The lions were not frightened, they did not stampede, they seemed indifferent to the visitors. If any sea-lions slid off the rocks on the approach of the hunters they returned to the rocks after the hunters landed.

The hunters shot all the cows and bulls they could within that radius, and cut the tails from all they had killed to collect the bounty. They started killing at 6 in the morning and finished at 2 in the afternoon. At the end of the killing, 750 tails were counted. They then turned back to Rivers inlet, declared enough tails to collect $1,050 and hoping that more bounty might be put up they did not reveal the possession of a greater number.

After Sinclair and his crew had collected the bounty they went back to the Virgin rocks and skinned some of the sea-lions for their hides. They got about 2,000 pounds, when the weather turned bad and prevented any further landings. The wind came in from the west every day about 10 a.m. and kept blowing steadily and strong until evening, when it died down. All that they got from the hides on this trip amounted to $60, but they had the $1,050 bounty money besides.

The following year, leaving Vancouver on May 12, Sinclair with two others took the 40-foot gasoline schooner *Allintoo* up the coast to hunt for sea-lions. They got a few near Smiths inlet. On May 16 they were off Virgin rocks, but very few sea-lions were in sight. They arrived at Rivers inlet May 20, where they tried to get the canners again to put up a bounty fund, but the canners had decided to go hunting sea-lions on their own account. Sinclair describes the hunting party from the canneries as composed of sixteen or twenty men armed with "pop guns," twenty-two rifles, revolvers, and other firearms. They left Rivers inlet 2 a.m. one Sunday, went to Virgin rocks, and got back about four in the afternoon. They were not successful, as they had begun too early. Four noses were all they had. (The bounty mark had been changed from tails to noses.) Later, many other parties from Rivers inlet went out to Virgin rocks, until from much shooting the sea-lions got scared off. On June 3 Sinclair and his crew got fourteen noses after making a landing on Virgin rocks. He found the sea-lions timid, for as soon as they saw the launch they got off the rocks into the water, and even the mothers left their young when the hunters landed. "The sea-lions went off like sheep." He was dissatisfied with Virgin rocks and went to Calvert island, where he anchored, and got four noses one day, ten another, and eight another. In all he got fifty-seven noses, and landed at Rivers inlet, where he collected on them in the name of George Allen. Fifteen noses he brought to Vancouver and collected on them there.

Mr. Sinclair declares that to make a success of sea-lion hunting it is necessary to be able to land on Virgin rocks every day or every other day. He says that if there had been a bounty in 1914 he could have killed 90 per cent of those on Virgin rocks. If he had been offered $2,500 to clear the sea-lions off Virgin rocks in 1914 and protect the Rivers inlet fisheries he would have accepted it and done the job completely. The proper way to attack these animals to reduce their numbers is to get the old ones first. When females are pupping the old sea-lions never leave the rocks to feed or do anything else. The bull sea-lions are as thin as rakes after the cows are done pupping, at which time they are all very voracious. If it is desired to exterminate the sea-lions, all the rookeries should be hunted at the same time. During the pupping season they are easily fooled, since they persist in staying on the breeding grounds. Sinclair would take six or seven good shots and reach the rocks about June 1. He would hide three men on the rocks with orders to shoot only the old ones and to shoot to kill, aiming at the spot just below the ear. The old ones will not leave the rocks at this time if they are not fired at from the water, and the pups cannot, for they are not strong enough, as they are suckled by the mothers for ten days or two weeks after birth. When the adults are killed the pups can readily be clubbed, and if not they would die of starvation.

Sinclair is of the opinion that bounty should not be paid unless the hide were brought in, as the hide could be sold for more than the bounty. He would be willing to hunt sea-lions, collecting a bounty on the hide of $1 for pups, $3 for females, and $5 for bulls. He says also that bounty paid on sea-lions killed at a long distance from any locality where fishing is in operation is money thrown away. He thinks East Haycocks, Tree Nob island, Butterworth rocks, Massett, Banks island, Price island, Bonilla banks, and Aristazable island are too far away from Rivers inlet to allow sea-lions from them to be the cause of depredations to fishing.

An article appeared in the *Pacific Motor-Boat*, Seattle, Wash., in November, 1915, treating of sea-lion hunting by motor-boat in Oregon, so pertinent to the Canadian

inquiry that, with the permission of the publisher, Mr. Miller Freeman, it is reproduced in part:—

"A rather unique industry is carried on each year in motor-boats off the coast of Curry county, Oregon. The Rogue River reef and the Cape Blanco reef are each year combed for sea-lions, and the work of killing them is often hazardous and dangerous.

"The killing is not done for amusement, but for profit, the skins being valued at from $4 to $6 each, and some other portions of the carcass being of sufficient value to make the average for each animal killed between $5 and $6.

The annual slaughter does not take place until the young are born, usually in July and August. This plan of leaving the pups insures a supply for the hunters the next year and there is no danger of the disappearance of the sea-lions from the vicinity where they are sought.

The largest rocks in the Blanco reef are off shore from three to seven miles and the hunters must go well prepared. It is possible they might be obliged to stay about the rocks two or three days at a time, for the ocean occasionally becomes so rough the small boats are obliged to stay in the lee until the weather improves.

Until late years the hunters used rowboats in which to seek the lions and sometimes were on the rocks several days before they could return ashore at Port Orford, the nearest town. Recently, however, gasoline boats are utilized altogether in hunting. It is customary to go from shore to the rocks where the sea-lions make their home, in a small open craft, and, after making a kill, the skins are picked up from the reef by a larger craft, the gasoline schooner *Tramp*, a 15-ton boat of Marshfield. Captain John Swing has transported the sea-lion hides in the *Tramp* from the two reefs for the past ten years, trans-shipping them for San Francisco at Coos Bay.

The average number of hides secured each season varies from 300 to 1001, the hunters feeling they have done a profitable season's work if they make a clear profit of $1,000, since the season is only for a month, and the time goes quickly while they are engaged. The hides are used by manufacturers for belting. They are prepared by salting them heavily but not tanned until they reach their destination at San Francisco. The skins are heavy, the hunters finding them occasionally weighing 150 pounds when secured from an animal of extraordinary size.

Taking the skins from the sea-lions is an occupation that calls for quick and expert ability. A good skinner can take a hide off in from five to seven minutes, when working at ordinary speed. Robert Forty and James Crewe each has a record of skinning a common-sized animal in three and a half minutes. While there is no means of weighing the sea-lions, the hunters estimate their weight from 1,500 to over 3,000 pounds. The larger the pelt, of course, the better the price is secured."

Thus it will be seen that in paying a bounty of $2 for each muzzle of a slain sea-lion and disregarding the hide and carcass, there is lost an opportunity to encourage the prevention of fisheries depredations and at the same time, by means of a business organization centered in the government officials, make the sea-lion, through its hide and carcass, pay the bounty and more. When further facts are obtained concerning methods of organization, aiming at killing for commercial purposes the sea-lion carcass, the commission should be able to outline a plan that would achieve that economical and conservative result.

15. CONCLUSIONS AND RECOMMENDATIONS.

The commissioners are satisfied that as the numbers of sea-lions in or near Rivers inlet increased from 1911 to 1913, the were present in sufficient numbers to be a serious menace to the fishing industry, although there was no diminution in the pack until 1913. Thus the pack for 1910 was 129,398 cases, for 1911, 101,066 cases, and for 1912, it amounted to 137,697 cases; in 1913 there were only 68,096 cases put up, the smallest pack since 1901. This was the year in which it was found useless to fish farther out towards the mouth of Rivers inlet than the entrance to Draineys inlet. The fact that the fishermen had to stop all fishing in this region on account of the number of fish taken out of the nets and the amount of damage done to gear is backed up by the fact that the cannery managers of the five outer canneries in the inlet were willing to put up their own money in 1911 as a bounty that the number of sea-lions might be reduced. Coincident with the decrease in the number brought about in this way in 1914, the pack went up again, amounting to 109,052 cases. While the fluctuation from year to year is always evident, the great decrease in the pack for 1913 can scarcely be accounted for on that basis. In 1915 a bounty of two dollars per muzzle was placed on sea-lions by the Department of Fisheries. This might have been expected to help out the Rivers inlet canneries, and probably it did so as the pack 146,838 cases, slightly surpassed the previous high record of 1912. Of this pack, over 130,000 cases were sockeye, over 27 per cent of the total sockeye pack for the province for this year. Since such a pack is worth approximately $1,200,000, it is certainly worth conserving.

However, as this bounty of two dollars was an indiscriminating bounty, its success was not unqualified. It is true that many sea-lions were killed in the vicinity of Rivers inlet, but it is also true, as shown in this report, that more than twice the number were killed at points too far distant from Rivers inlet to have any effect on the fishing there, not because sea-lions, on occasion, do not travel so far, but that at, and for some time after, the pupping season, they remain in the vicinity of the rookery, and this season corresponds with the time of the sockeye run in Rivers inlet. Furthermore, it is commonly believed that the numbers in the Sea Otter rookery have greatly increased since the lions were driven from Triangle island after the erection of the lighthouse and the installation of a wireless plant there. If this is true, the killing of so many sea-lions on the East and West Haycocks in 1915 will tend to drive those uninjured away from these islands and hence it might increase the numbers in the Sea Otter rookery, thus doing harm rather than good to the Rivers inlet fishing. Since only the muzzle was required to obtain the bounty, it was possible for a very few individuals to kill a sufficient number on the rookeries in a very short time to take up all of the bounty, whether these lions were doing any harm or not, consequently, in other cases where sea-lions, likely to be doing harm, were killed, there was no bounty available. As an example, the Barkley sound fishermen had made complaints of depredations by sea-lions but as the whole available bounty was used up in June, while the sea-lions did not come into Barkley sound until the first of November, the Barkley sound fishermen received no benefit whatever from the bounty. If the skins and carcasses had been made use of, such wholesale killing in such a short period would not have been possible, and some return might have been obtained from the money expended.

The opinion is still held by eminent scientific men that it has not yet been proved that fish is an important item of the food of sea-lions. Drs. Merriam, Evermann and Hornaday have been much quoted in this regard. These men and others, during the California controversy, refused to put any faith in the statements of the fishermen regarding the sea-lion depredations. The period covered by the researches of the commission has been a limited one but even in this limited period sufficient

evidence was obtained to prove that during a certain time of the year at least, food fish are eaten in large quantities by grey sea-lions. As in this instance the statements of the fishermen are definitely corroborated, there is evidently a fair basis for accepting other statements upon which there is general agreement, provided always that allowance must be made for a bias, natural to those interested in this as in any other question. It is on account of this bias that the evidence from independent witnesses is always desirable. Taking that into consideration, it is recommended that the commission should continue to study the life-history of the sea-lion, particularly during the breeding season, which corresponds to the time of the big run of sockeye at Rivers inlet. This should be accomplished with comparative ease but the habits during the remainder of the year cannot be so readily ascertained as in such investigation many difficulties will have to be overcome.

The amount of food required just after the pupping season cannot be considered as an index for the rest of the year. That taken by the sea-lions in Barkley sound in November and December would be much nearer the average. The results of feeding in captivity do not help much as opinions differ so markedly. Thus, as previously quoted, Hornaday states that 12 pounds a day or less is sufficient food for an adult male sea-lion, while Scammon says, the keeper at Woodward's Gardens, San Francisco, informed him that he fed a male and a female sea-lion, regularly, every day, fifty pounds of fresh fish. [1] In any case, the amount of food required by a sea-lion in captivity, where its movements are necessarily much restricted, might be very different to the amount required by one during the active life out in the sea, where, in many instances, the food is so plentiful that there is great temptation to eat more than actual necessity calls for.

The presence of dogfish remains in the stomach of a sea-lion caught in Barkley sound opens up a large question that should be investigated, particularly in view of the statement that the dogfish cease to bother the herring nets as soon as the sea-lions appear in the neighbourhood. While a definite comparison of the damage done to the herring fishery by the dogfish and the sea-lion is impossible, this at least can be said: while it does not pay to fish for herring when the dogfish interfere and the sea-lions are absent, it does pay to do so when the reverse is the case. If the disappearance of the dogfish is in any sense due to the presence of the sea-lion, the sooner the matter is investigated the better.

Although at the present time no other species is so much a pest as the dogfish, there are other undesirable species, and while the commission has no definite information as to the relation of any of these to the sea-lion, the possibility of the sea-lion's maintaining equilibrium in such cases is worthy of consideration.

While the commissioners recommend that sea-lions should be driven away or greatly reduced in numbers where it is evident that they are doing appreciable damage, they are not satisfied that there is any necessity for decreasing the numbers at other rookeries, except after some organized plan by which the pups could be free from injury, as in the case mentioned off the Oregon coast, in order that the industrial value of the sea-lions should be conserved, and more particularly in view of the possible friendly offices of the sea-lion that suggest further inquiry. Even in the case where it is considered necessary to diminish the number of sea-lions materially, the monetary value of the hide and carcass should be taken into consideration in any plan adopted.

CHARLES F. NEWCOMBE.
WM. HAMAR GREENWOOD.
C. McLEAN FRASER.

[1] Scammon, C. M. Marine Mammals of the Northwestern Coast, 1874, page 135.

PART II.

REPORT AND CONCLUSIONS OF THE SEA-LION INVESTIGATION, 1916.

In order to ascertain the effect upon the sea-lion population of the bounty of $2 per head which was placed upon them early in the year 1915, and the desirability or otherwise of continuing it, the commission appointed by the Biological Board of Canada considered it advisable: (1) to procure the number of individuals killed in order to obtain the bounty, (2) to visit the rookeries in order to make an estimate of the number of sea-lions still remaining in the province (3) to visit all localities from which complaints had been sent of depredations by these animals, and (4) to investigate, as far as possible, the nature of the food of the sea lions, as grave doubts had been expressed by well-known men of science as to whether food fish formed any part of their diet, some authorities even stating that their principal food consisted of animals which are enemies of fish used by man.

The lateness of the season when the commissioners were first able to commence their labours and the unsuitability of the valuable government vessel for approaching the rookeries placed at their disposal, prevented them from completing the programme thus sketched. The number of sea-lions killed was obtained with approximate accuracy; a great deal of information was procured from the various fishing stations as to the damage done by them during the fishing season and a beginning was made in the line of inquiry as to whether sea-lions do or do not eat food fish at one of the points at which complaint was made of their interference and destructive habits.

The rookeries, however, were not adequately examined, nor had the commissioners any opportunity of personally investigating the food question at Rivers inlet, one of the most important salmon fisheries on the coast and one from which the most urgent complaints of damage had emanated, and also that one in the neighbourhood of which by far the greatest number of sea-lions, pups and adults, had been slaughtered early in 1915.

It was therefore pointed out by the commissioners in their report for 1915 that it was their opinion that, with the object of completing the task originally proposed by them, their work should be resumed in 1916 early enough to be on Rivers inlet fishing ground during part of the salmon season and also in time to visit the rookeries when the sea-lions were assembled to bear their young, in order to be able to make as accurate an estimate of their numbers as possible.

The lack of facilities for communication with Rivers inlet made it difficult to decide on the most suitable time to visit this locality. The regular mail service and the telegraph and telephone communication made it an easy matter to get data as to conditions at Barkley sound, but at Rivers inlet telegraph and telephone communication is lacking and mail arrives but once a week.

From reports already received the commission was led to believe that sea-lion depredation occurred both before and after the pupping season in early June. Since it was desirable to get as full information as possible as to the numbers of sea-lions at the different rookeries, it seemed possible that this could be obtained during the trip in which the Rivers inlet question was to be considered.

For the twofold purpose especially, a 45 foot motor launch, the *Emoh*, was chartered, with Captain Massey commanding. Leaving Vancouver on June 21 and Departure Bay the following morning, a start was made for Rivers inlet, and

Wadhams was reached on June 24. On this part of the trip, as well as throughout the remainder of it, advantage was taken of every opportunity to confirm or add to the information already received.

Contrary to expectations, there was no sign of any sea-lions in the inlet and no word of any being seen, singly or in herds, as they had been reported early in the season in other years. Since, therefore, there was no immediate prospect of carrying on personal investigation in Rivers inlet, the commission proceeded to make a survey of the various rookeries.

17. SURVEY OF THE ROOKERIES.

I. The Sea Otter Group.

In the first place attention was directed to the rookery on the Sea Otter group of islands, near the entrance to Rivers inlet. Manager Lurig offered to send out a Wadhams Cannery boat with its crew and others armed with rifles to shoot some sea-lions for inspection. The offer was accepted, and on June 25 the rookeries were visited.

On Pearl rocks, the first of the group to be visited (see fig. 2), there were about 250 sea-lions, about 50 of them being pups. As the sea was smooth, a landing was made from a row-boat, on the largest of the rocks, and a female, 7 feet 1 inch long, which had been shot, was opened and examined, but the stomach was empty. Here, as on the other rocks in this group, the pups were very young, some of them newly born, and none of them yet able to take to the water or to swim properly if they did get in.

Watch rock (see fig. 3), was next visited, but on this there were three adults. Two of these were shot and examined. They were both small males, one of them 7 feet 6 inches in length (see fig. 5) and the other 8 feet 1 inch. The stomachs were empty.

Finally the Virgin group was visited. This group consists of three larger rocky islands and other smaller ones. There were lions on all, a total number of at least 2,500, of which nearly 1,000 were pups. One male, 10 feet 4 inches long (see fig. 13), was examined, with the same result as in the other cases.

Evidently it was no use trying to learn what the sea-lion takes as food by examining the stomachs of those killed on the rookeries, and hence the members of the commission wished for no further slaughter. The boat crew were not satisfied with this, however, and many more were made to suffer. The adults all took to the water at the sound of the first volley if they had not already done so on the near approach of the boat, but they come to the surface at short intervals, rising until the head, neck and shoulders are visible, at which time they offer a target to the marksmen. The young pups are very helpless, so that they may easily be approached and many of these were clubbed to death. (It was in this way that most of them were killed for bounty the previous year.) Several photographs of pup groups were obtained on both Pearl and Virgin rocks (see figs. 6-12).

II. The East Hancocks.

On the following day, June 26, the rookeries to the northwest of Vancouver island, on what is sometimes known as the cape Scott group of islands, were visited. On the way from Rivers inlet, sea-lions were again seen on the islands of the Sea Otter group, but no attempt was made to get near enough to make an estimate of the number. Channel rock to the southward of Pearl rocks was showing slightly above water and on it there were about twenty-five sea lions.

In the cape Scott group, the West Hancocks were first visited but no sea-lions were visible. The East Hancocks, however, presented the most wonderful sight of

the whole trip. For a considerable distance above the water's edge, the rocks everywhere were lined with sea-lions. The lowest estimate made as to the number was 6,000. The pups here were larger and hence, in such a number, it was difficult to distinguish them from the yearlings and small females. For that reason the number of pups could not be approximated. As it was pouring rain unfortunately photography was out of the question.

No rookeries have been reported from the larger islands, Lanz and Cox, therefore, although the shores were scanned with glasses from a distance, no closer examination was made. Triangle island, which formerly was the base for a large rookery, no longer supports one. The island was not visited but by means of wireless communication the commission was assured that no breeding took place there in 1916.

In the open ocean for miles around Haycocks, sea-lions were seen, singly or in small groups, the last of these for the day about 14 miles away in the direction of Quatsino sound.

III. Solander Island.

The rookery at Solander island, off cape Coop, was examined the following day, June 27. The day was fine and the sea smooth. The *Emoh* was left in the offing, while two members of the commission in the boat's dinghy, rowed over to the rookery in the hope that some photographs could be obtained before there would be much commotion among the members of the herd. Such hopes were vain for so timid were these huge beasts that even the approach of this small boat struck them with terror and they began to tumble off into the water, consequently, in order to show any large portion of the number, long range photographs had to be taken (see figs. 16, 17). Three or four of the large bulls remained to be seen at shorter range, swaying from side to side and uttering most deafening roars. Some of their most faithful consorts remained with them almost to the last. One in particular seemed very loath to go (see fig. 21). He was probably the largest of the herd, and one of the largest seen at any of the rookeries, but he, too, finally took the plunge. His total length must have been over 12 feet and his weight over a ton. (Dr. Newcombe in his sea-lion report for 1913, gives the actual weight of a 12-foot sea-lion, brought into Alert bay, April 26, 1913, as 2,240 pounds.)

In the water the animals seem to have less fear, and when a score of them came up at the same time, near together (see fig. 23), and in close proximity to the small boat, to give their deep roar in unison, one felt that it was as well that they did not realize the extent of their powers.

This rookery was not a large one, so that the number, little in excess of 500, could be fairly accurately counted. Here again the pups were large enough to take to the water, and they were among the first to do so; hence the relative number could not be definitely estimated.

On June 28, while returning from Sea Otter cove to Rivers inlet, sea-lions were seen at cape Russell and other points between this and cape Scott.

IV. Cape St. James.

There remained one large rookery, that on the rocks off cape St. James, at the southern extremity of the Queen Charlotte islands, and a start was made for this on June 29. In the neighbourhood of Estevan island, engine trouble developed to such extent that it was necessary to go to Prince Rupert for repairs. This made a delay of some days.

On July 9, Butterworth rocks, to the northwest of Stephens island, were visited, as this is a well-known hauling-out place, but not a rookery. Two sea-lions were seen.

Those were 150 miles from the nearest known rookery. They disappeared into the water while the boat was still at long range, but they appeared to be of good size. They could hardly be breeding adults so far away from a rookery, and there were no pups on the rocks. They were probably bachelor males, such as were seen and examined on Watch rock in the Sea Otter group.

Hecate strait was crossed on July 11, and cape St. James reached on July 13. Here again the day was fine and the sea smooth, with the exception of a certain amount of swell. Thus near approach was possible, and some photographs were obtained (see figs. 30-33), but no attempt was made to land. There were only about 1,000 sea-lions on the rocks, and the pups could not readily be distinguished from the other members of the herd. Individuals in the water were seen as far away as Scudder point, 25 miles distant from the rookery.

On the return, Rivers inlet was reached on July 17.

IS A COMPARISON OF THE ENUMERATIONS OF 1913 AND 1916.

While the rookeries are still under consideration, it is well to compare the enumeration here made with that made by Dr. C. F. Newcombe and W. A. Newcombe in 1913[1]. A table of comparison will serve as a basis for bringing out special points.

Rookery	1913		1916.	
	Date.	Number.	Date	Number
Cape St. James	June 12, 13	2,000	July 13	1,000
Sea Otter group				
Pearl rocks	June 21, 22	1,350	June 25.	250
Watch rocks	June 22,	112	June 25.	3
Virgin rocks	[illegible] 28, 29,			
	[illegible] 2	2,300	June 25.	2,500
Cape Scott group				
Triangle island	July 15, 19.	300	None breeding.	
East Hay rocks	Aug. 17, 25	3,200	June 26.	6,000
Solander island	July 24	None seen	June 27	500

To this should possibly be added about thirty-five, which were seen by the commissioners off Hope island, September 3 and 4, 1915, where it may be, as the Nawhitti Indians aver, there is a small rookery. This was not visited either in 1913 or 1916.

There is little difference in the total estimate in the two cases, but a comparison of the individual rookeries bears out the statement made in the earlier report that to get the extent of the whole sea lion population, the number seen on the rookeries must be increased by an unknown number representing those in the water at the same time.

Taking the cape St. James rookery in the first place, if the whole 1913 herd was on the rocks when Dr. Newcombe made the enumeration and the whole 1916 herd was on the rock when the commissioners made the enumeration, there is no accounting for the reduction of the numbers as no raids were made on the rookery for the bounty in 1915 and very few were killed that could have belonged to the herd. The discrepancy is even greater than would appear from the above figures. The 1913 enumeration was made on June 12 and 13, when, as was stated in the report, but few pups had been born. In 1916 the enumeration was made a month later, when the pups of the year would not only all be born, but all able to take to the water. To make a more correct

[1] Provincial Fisheries Department's Report, British Columbia, 1913, pp. 3131-3145, with 16 plates.

comparison it would be necessary to add about 500 to the 1913 number for the pups that were born in that year. Unless in the meantime there was an epidemic, or an extensive migration took place, neither of which is probable, the number on the rocks on July 13, 1916, did not by any means represent the whole herd. The fact that several were seen at various points even up to 25 miles from the rookery, bears this out. It is even probable that the two bachelor males (?) seen on Butterworth rocks belonged to this herd.

In this connection mention should be made of a conversation which the commissioners had at Claxton on July 15, with a Haida Indian, Timothy Tait, belonging to the Ninstints tribe, who is recognized by the Haida as the principal owner of the cape St. James rookery. He said that he didn't think the placing of the new light house on the island of cape St. James had made any difference to the rookery, to which, as usual, he had paid several visits during the year (he had killed a number of sea-lions for food). He said he and his people found scattering pups at all times of the year, although the months of June and July were the most productive.

Coming next to the Sea Otter group, the only exact comparison of the two years can be made in the case of the Pearl rocks and Watch rock, since the time of the year almost exactly coincides. The large reduction shown in 1916 was to be expected from the number of onslaughts made on this portion of the rookery in the interval. Watch rock, which was a breeding place in 1913, evidently is one no longer. The portion of the rookery on Virgin rocks shows no material difference. Apparently the number killed has not materially decreased the size of the herd, unless, since the 1913 count was made over two months later in the year, it is quite possible a smaller percentage of the whole number was on the rocks.

In the spring of 1892, when J. M. Macoun, C.M.G., was acting on the Behring Sea Commission to make an enumeration of the fur seals, he visited these rocks and some notes in his diary, which he kindly put at the disposal of the commission, helps out in this comparison. On May 12, writing of the Virgin group, he says: "The largest island was then approached, and, as the sea-lions, by which it was covered, did not take alarm, a careful estimate was made of their numbers. Making allowance for all possible kinds of error, I can safely say, there were 1,500 on the one island, and more than 2,000 in the group." As this estimate was made on May 12, no pups of the year could have been counted. Hence the number, over 2,000, must be compared with the number apart from the pups, estimated at 1,500, in 1916. If this indicates anything, it is that, instead of a natural increase, which should be considerable in fourteen years, there has been a decided decrease here as on Pearl rocks. The difference of the attitude of the sea-lion towards mankind is striking. After seeing so many exhibitions of timidity in 1916, it is hard for the commissioners to realize that, not so very long since, the sea-lion did not take alarm at the approach of a boat, even at a time distant from the pupping season.

In the cape Scott group, the reduction in number on Triangle island, noted in 1913, has continued to the ultimate conclusion, as now no lions breed on the island. At the East Haycocks, the figures would indicate a great increase in number during the three years, when, as a matter of fact, there should have been a great decrease, since 2,280, from which the muzzles were taken, were killed, besides many that were not retrieved. During the summer of 1913, Mr. Grinnell and his men hunted the sea lions on and around the Haycocks, until they had secured 500 hides. The surprise, therefore, is not that W. A. Newcombe did not see more than he did when he visited this rookery late in August, but that he saw as many as he did, after so much hunting. The large number seen on the rocks in 1916 did not represent the whole herd, since, as has been stated, numerous lions were seen in the water and on the rocks from cape Russell to cape Scott.

Considering, finally, the Solander island rookery, it will be noted that Dr. Newcombe saw none when passing on July 20, and that others passing near the same

time, notably Captains Gillam and Tromp, who took special notice, at Dr Newcombe's request, saw no sign of any, hence it was supposed that it was not a breeding place. Since on June 27 the pups were large enough to take to the water, they are able evidently to feed for themselves by July 20, and the whole herd was away from the rookery. The majority of them must have been away even on June 27, as there were not nearly so many on the rocks as there were on September 11, 1915, when it was estimated that there were upwards of 1,000 visible. At that time the lions were present both on Solander island proper and the small outlying rock (see fig. 15), while on June 27 they were entirely confined to the outlying rock.

The number that haunt Barkley sound cannot well be counted here. If they are from the British Columbia rookery, they have probably been counted in with the others, as which is more probable, they come from the Jagged islet rookery, off the Washington coast, they cannot properly find a place in this enumeration.

Summing up the whole matter, although the enumeration in 1913 as well as that in 1916 was as well done as it could be, by making a single visit or few visits to each rookery, there are little data for comparison of the relative numbers in the two years. The estimate on the rookeries is slightly higher in 1916 than in 1913, but that is largely because in the majority of cases the visit was made at a more opportune time. It would not be legitimate to draw the conclusion from the figures that the number of sea-lions was greater in 1916 than in 1913, especially in the face of the fact that many animals had been killed in the intervening period. The only instance where a direct comparison could be made, viz., at Pearl and Watch rocks, there was evidence of a decided diminution. While in round numbers 10,000 fairly well represents the sea-lions on the rocks at the rookeries, there is a large number besides these, possibly even as great a number or greater, scattered over a wide area along the whole coast.

19. THE RIVERS INLET SITUATION.

Having finished the examination of the rookeries, the whole attention of the commissioner was turned to the Rivers inlet situation. The return from Queen Charlotte islands on July 17 should have been at the height of the season for sockeye, the special fish for the sea-lion during which time the depredations are most serious. Judging from the number reported in previous years, the commissioner concluded that here should be no difficulty in getting several sea-lions, shot right in the fishing area, that the stomachs might be examined at a time there would be every chance of seeing the quantity and nature of the food before it would be digested to any extent.

From the outset, however, the prospects were none too promising. The season was wet and backward, the fish were running low, so that catches were very small. Although sea-lions were reported in the inlet, they were much less numerous than in preceding years, but torn nets and mutilated fish were shown to indicate that they still were doing damage.

At several canneries along the inlet there were Indians who had hunted fur seals. If any of these could be obtained to shoot and spear the sea-lions, the best results could be expected. Because of the poor season, every available man was required to fish, and it proved no easy matter to get any of them to undertake sea-lion hunting. After some delay, a Sitka Indian, Louis, agreed to try his luck, but no one with experience could be obtained to go with him. The best that could be done was to hire an Indian boy, Jimmie, as boat puller. These two were supplied with a boat from one of the canneries, a rifle, ammunition, and a spear and taken down to where some of the outermost nets in the inlet were drifting, as it was here that the most damage was reported. They were out with the nets on Wednesday and Thursday nights, July 19 and 20 (the lions did not bother in the daytime), while the *Emoh* was moored at the Goose Bay fishing camp near by. Neither sound nor sight of sea-lion was noticed on either occasion, although the fishermen still reported their presence.

The following detailed reports were obtained from the fishermen in the neighbourhood on Thursday morning:-

Boat 4397 reported seeing two sea-lions near the nets the previous night.

Boat 4867 reported being bothered the previous night by the sea-lions, but not as much as the night before.

Boat 4901 reported that sea-lions had torn the net the previous night.

Boat 4876 reported that sea-lions had been seen all afternoon the day before down by the point.

Boat 1381, manned by a Jap, reported no trouble.

Boat 1405, also manned by a Jap, reported that sea-lions were on the net the night before between 8 and 9 o'clock.

Boat 4791 reported no trouble the previous night, but some the night before.

Boat 4588 reported that fish had been taken from the net and eaten about 11 o'clock the previous night. Claimed by fisherman that he had lost 50 fish in a week, shown by the heads and tails left in the net.

Boat 1398, manned by a Jap, reported that he had seen sea-lions in the net about 10 o'clock in the morning.

Boat 4945, from the Good Hope cannery, reported disturbance by sea-lions in the net the previous night.

An independent boat reported that he had seen sea-lions in the inlet at 1 o'clock the previous afternoon.

Boat 4870, a Good Hope cannery boat, reported having seen sea-lions during the night.

Boat 4874 reported having noticed sea-lions in the inlet the previous night at 9 o'clock.

Boat 1116 reported that fish had been eaten by sea-lions on the net at 8 o'clock the previous night.

Boat 1153, manned by a Jap, reported that he had not been bothered with sea-lions.

Boat 1391, manned by a Jap, reported having seen sea-lions in the fishing area at 11 o'clock the previous night.

After the negative results of Wednesday and Thursday nights, Manager Inrig and Net Foreman Anderson (it may be mentioned here that cannery managers and men, especially those at Wadhams where the commission made its headquarters, gave every assistance in the investigation consistent with the serious demands on their time occasioned by their own interests) intimated that some of the white fishermen would be willing to give assistance. Accordingly, several of them were supplied with ammunition and a substantial reward was offered for each sea-lion brought in. Louis went out with one of these fishermen to be right at the net as Jimmie in the meantime had been discarded. Friday night proved no better than the others, although some torn nets and mutilated fish were still shown as evidence of the sea-lions' presence.

The weekly close season lasts from 6 a.m. on Saturday to 6 p.m. Sunday. The net foreman offered the use of two nets for Saturday night if permission could be obtained from Fisheries Overseer Saugstad, the idea being that if two nets, and only two, were put up Saturday evening, all the inducements for the sea-lions would be centred around those nets. Mr. Saugstad readily granted permission and arrangements were made to carry the plan into effect. Two men were assigned to each boat. S. Simmons of Sea Otter cove, V.I., went with Louis in the one boat, while G. Bjerregard, of Holberg, V.I., and J. C. Holm, of Campbell river, V.I., manned the other. From long experience these men were thoroughly acquainted with fishing

conditions in the outer part of the inlet. The commissioners, as on previous occasions, remained near by in Goose bay. Early in the morning the men were picked up but no sea-lions had been shot and there was little evidence of their presence except the remains of three sockeye and one humpback that were found in the nets. A photograph was taken of these remains (see fig. 34.) It is a very good and instructive to compare this photograph with one taken at the Canada Fish and Cold Storage plant at Prince Rupert, September 8, 1915, which shows the way in which salmon are mutilated by hair seals (see fig. 35.)

20. LITTLE EVIDENCE OF SERIOUS DAMAGE IN 1916.

After a week of negative results there was no encouragement to stay longer and the commission prepared to depart on the following morning. As the fishermen would all be fishing again on Sunday night, they were encouraged to make a final effort to get sea-lions while the commissioners were still in the neighbourhood. The *Emoh* anchored in Goose bay for the night, and in the morning (July 24), since there were no results reported, a start was made for home at 4.30. As the fishermen were still confident that sea-lions could be captured in the inlet, they were assured that the offer of reward would hold good until the end of the season, if the stomachs were sent to the Biological station for examination. No claim has yet been made for such reward.

21. PROBABLE AMOUNT OF INJURY DONE BY THE SEA-LION.

It will be seen from the above account that the commission spared no pains to get concrete evidence on the situation at Rivers inlet. If a week of such endeavour at the height of the season could produce no positive results, there was no hope that a whole season's residence there would do so. Such being the case, the commission feels justified in stating that, as far as the 1916 season was concerned, the sea-lions were not a very decided menace to the fishing in the inlet. The *Emoh* travelled several miles up and down the inlet every day during the sojourn there, and only on one occasion was there seen a trace of a sea-lion, and at that time only one was seen. The majority of the men that fished in the outer part of the inlet were questioned, none of whom reported having seen more than four or five. The sea-lion is undoubtedly to blame for some torn nets and mutilated fish, but that he alone is to blame is open to question. On account of his bad reputation, all the blame is put on him whether he deserves it or not. It might be mentioned that nets are commonly torn at other fish centres where the men scarcely know what a sea-lion looks like. All the fishermen agree in declaring that the damage in 1916 was much less than in the previous years. If any further evidence is needed to show that the commission is more than justified in making this stand, it is supplied by a letter to the secretary from Mr. Frank Imrie, dated November 19, after the close of the fishing season. It reads as follows:

To the Secretary of the Sea Lion Commission,
Room 929 Birks Building, Vancouver, B.C.

DEAR SIR,—As manager of the British Columbia Packers' Canneries, Wadhams and Brunswick, at Rivers inlet, I can speak with knowledge of the depredations of the sea-lions in former years to the commercial fisheries at Rivers inlet. Up to two years ago these depredations were great, and in terms money, costly to the canneries.

But the expenditure of a few thousand dollars on launches by the Federal Government, two years ago, resulted in many sea-lions, both young and old,

being killed at and on the rookeries in the Pacific, and besides that a thorough scare being thrown into all the sea-lions frequenting the waters adjacent to Rivers inlet. The sea-lions, always timid, became exceptionally timorous in the presence of man, and shunned rather than sought the fishing areas. This to my mind was due to the hunting of sea-lions induced by the offer of a bounty.

In the year 1916 the sea-lions were not excessively harmful. They did not bother the fishing operations at Rivers inlet to any great degree, and not at all as they did three years ago. This I attribute to the effect of the hunting under the bounty system, and also to the fact that before the season opened for fishing the sea-lions on the Sea Otter group of rookeries were pretty thoroughly scared by being shot at and in some cases killed by fishermen at Rivers inlet. I think they have lost their voraciousness and courage to appear where man is and where fishing operations are being carried on at Rivers inlet.

Now I do not think the sea-lions should be killed off as long as they remain as quiet as they did this year, for their hides may still be made use of for commercial purposes and their carcasses turned into hen food or fertilizer, but I do think that the Federal Government, through the Fisheries Overseer at Rivers inlet, might spend two hundred dollars a year on ammunition to be served out to the fishermen for them to make a scare raid on the Sea Otter group of rookeries every year before the salmon fishing begins, in order to terrorize the sea-lions and make them fearful of man. This would keep them away from the fishing operations throughout the season and protect the fish and the gear of the fishermen. Don't kill off the sea-lions, but strike terror into them.

If this communication is of any use to you, you are at liberty to do with it as you wish.

Yours faithfully,

FRANK INRIG.

VANCOUVER, B.C.,
November 19, 1916.

There are still large numbers of sea-lions along the British Columbia coast. On the rookeries alone over 10,000 were seen in June and July, 1916. The [illegible] estimate is not sufficiently accurate as an index of the whole number to show reduction that took place by the slaughter of 8,000 sea-lions in 1914-15 and to [illegible] extent in 1915, except in the case of some of the rocks of the Sea Otter group, where extensive diminution was indicated.

The menace to the fishing industry in Rivers inlet, so much complained of in previous years, had largely disappeared in 1916.

The Steller sea-lion undoubtedly eats large quantities of food fishes at certain times of the year, but for the remainder of the year there is little or no evidence as to what he does eat. Since it has been shown that fish not used as food as well as squid and devil fish are eaten, he cannot at all times be the epicure that some people would have us believe. Although he requires animal food, it is probable that he will take any kind available in quantity sufficient to satisfy his hunger. It is even possible that in helping to keep down other injurious species he does more good than harm to the fishing industry, provided he can be kept away from the nets or other fishing gear. Reference has been made to the influence the sea lion may have on the dogfish question and the dogfish is not the only carnivorous species that is taken as food.

22. SUGGESTED CONTROL OF DESTRUCTION OF SEA-LIONS.

The economic side of the question has been discussed and it is not necessary to refer to it again except to mention two points. The first is that the price of leather is rapidly going up, thus adding force to the argument as to the value of sea-lion skins. The second is with reference to the sea-lion carcass. It has been truly said that the flesh should make good fertilizer and poultry food, but it must be remembered that up to the present, plants for producing marine animal fertilizer on this coast have not been especially noted for their financial successes. Sea-lion carcasses cannot be taken to any of the fertilizer plants now in existence and made use of at a profit. With the processes now in use, it would not pay to erect a fertilizer plant to make use of fish offal at Rivers inlet or any other fishing centre where the fishing season is so short. No line of economic research in connection with the fishing industry on this coast offers a more promising field than that to do with the elimination of waste or rather the transmutation of waste products to products of commercial value at a cost that will ensure a reasonable profit on the outlay. When cheaper methods of producing fertilizer and poultry food have been worked out, the sea-lion carcass may become an important factor.

The commissioners have no hesitation in stating that they can see no valid reason at present at any rate for adopting any plan looking toward total extermination of the Steller sea-lion. Even when its depredations were most serious it has been shown that these can be reduced to a negligible quantity in a comparatively short time. Since that is so, it should not be a difficult matter to keep the depredation at a minimum. It may be well that, as Manager Inrig has suggested, this could be done by spending $200 for ammunition each year to scare them away and terrorize them. If it could be done at Rivers inlet it should be done equally well at Barkley sound, possibly better since the lions come in there apparently in a single group about the first of November. If this were done it should be under the control of the Federal Department of Fisheries, as Mr. Inrig suggests. If the scare is not sufficient, it might be advisable to materially reduce the numbers of sea-lions at the rookery responsible for the depredation, when the menace became threatening. In either case the operation should be so controlled that the greatest commercial value could be obtained. Indiscriminate and promiscuous killing should not be tolerated.

While the number of sea-lions is as great as it is at present, it might be legitimate to allow the killing of a certain number each year as in the case of all other species of commercial value, provided that not more than the number which would represent the annual increase were taken, under conditions that would ensure conservation.

CHARLES F. NEWCOMBE.

WM. HAMAR GREENWOOD.

C. McLEAN FRASER.

SESSIONAL PAPER No. 38a

23. APPENDIX A.

1. FORMAL QUESTIONS SUBMITTED TO SALMON CANNERS AND OTHERS.

SEA-LION COMMISSION.

(Appointed under Authority Biological Board of Canada.)

1. Are Sea-Lions injurious to the Fisheries of British Columbia?.....
2. Have your own fishing operations ever been injured or interfered with by them?...
3. Please state the nature of such damage this year and the estimated loss:

Gear ..	..	..	..	..	$.....
Mutilated fish	..	..	..		.....
Diverted run of fish	..	..			.....

4. Other years?.....
5. Is the lessened run of fish (if any) attributable to Sea-Lions?.....
6. Has the Herring Fishery been interfered with this year by Sea-Lions?.....
7. Have you noticed any steady increase year by year to the amount of injury caused by Sea-Lions?.....
8. Are Sea-Lions of any commercial value?.....
9. Do they assist your fisheries in any way?.....

[Methods of dealing with Sea-Lions if considered to be injurious to the Fisheries of B.C.]

1. Do you recommend complete extermination or merely a reduction in numbers?....
2. Could your company deal with this question in your neighbourhood without Government aid?.....
3. If not, in what manner could the Government most effectually aid you?.....
   - [A] By employing hunters under Government supervision?.....
   - [B] By offering a bounty open to all willing to hunt?.....
   - [C] By providing money or ammunition to be expended under the control of the fishing companies?.....
4. Can you give information as to the existence of Rookeries or other places frequented by Sea-Lions in your neighbourhood?.....
5. What is the best time for killing them?.....
6. What is the best method?.....
7. What is the best evidence on which to pay the bounty?.....
   (At present the muzzle is taken as proof.)
8. Should the bounty be paid for pups, or adults, or both?.....
9. What has been the effect on the bounty for killing Sea-Lions upon this year's fishing?.....
10. Have you any remarks or suggestions to make not covered by the above list of questions?.....
11. Have you examined the contents of Sea-Lion stomachs?.....

II. FORMAL LETTER SENT BY THE SECRETARY OF THE COMMISSION TO CANNERS AND OTHERS.

SEA-LION COMMISSION.

To the Manager,

Dear Sir,—On behalf of the Sea-Lion Commission appointed under the authority of the Biological Board of Canada, we invite your cordial assistance in getting information and opinions regarding the alleged depredations of these animals.

It has been stated that sea-lions destroy fish and fishing gear and interfere with the free prosecution of fishing operations by means of seine nets and other appliances.

It has been suggested that the sea-lions be exterminated or so thoroughly attacked to death by man as to frighten them away from their depredatory raids, and that this be encouraged by giving a bounty of two dollars ($2) a sea-lion, such bounty to be paid on presentation of the muzzle of the animal as voucher for its extinction.

We will be glad if you will answer the questions set out in the enclosed form to the best of your knowledge and belief, and add any observations you may think fit. It has been suggested that the canneries, where any depredations from sea-lions occur, might be left to handle the problem themselves without any idea of government bounty, on the assumption that fishermen attached to the canneries would protect their own interests.

Your speedy attention to the requests made on you in this letter and enclosed form will be appreciated and will assist the sea-lion commissioners in the preparation of their report on the whole question.

APPENDIX B.

NUMBER of Sea-Lions on which bounty has been paid in British Columbia for the fiscal year 1915-1916.

Name of Claimant.	Number Paid For.	Where Killed.	Amount of Bounty paid.
			$ cts.
Andrew Spalding	24	Banks island	48 00
Henry Rudland	1	Butterworth rocks	2 00
George Jones	1	Massett	2 00
J. W. Robinson	11	Price island	22 00
John Wootten	20	Calvert island	40 00
Henry Brown	12	Bonilla banks	24 00
Wm. Leighton	1	Tree Nob island	2 00
Peter Robinson	1	Stephens island	2 00
David Parnell	2	Butterworth rocks	4 00
George Allen	15	Virgin rocks	30 00
J. Wootten	342	Sea Otter group	684 00
Jas. Robinson	2	Aristazable island	4 00
J. Wootten	49	Sea Otter group	98 00
F. S. Carpenter	1	Price island	2 00
Henry Brown	2	Bonilla banks	4 00
A. Goodman	50	Virgin rocks	100 00
L. H. Hogan	97	" "	194 00
Geo. Allen	57	" "	114 00
D. McLennan	63	" "	126 00
J. Wootten	1,174	East Haycocks	2,348 00
Dan. McCloskey	153	Pearl and Virgin rocks	306 00
F. S. Carpenter	26	Price island	52 00
Spruce Marten	2	Seymour inlet	4 00
Lake Joe	51	Virgin rocks	102 00
Jacob White	82	Sea Otter group	164 00
Chief Schwish	1	Village island	2 00
James Rush	1	Uchulet	2 00
Wm. Taylor	2	Otter point	4 00
Dan. Quital	1	Duncan bay	2 00
Jacob White	442	East Haycocks	884 00
Albert Thompson	180	Virgin rocks	360 00
Tom George	1	Smith's inlet	2 00
Benson Keatta	1	Ahousat	2 00
Wm. Fatty	1	Ahousat	2 00
Joe Hayes	1	Long Beach	2 00
Joe Williams	2	" "	4 00
Joe Martin	2	Cape Cod	4 00
Abram Jeffries	1	Thormanby island	2 00
Totals	2,875		5,750 00

EXPLANATION OF FIGURES.

1. Wadhams cannery, Rivers inlet. The *Emoh* is the white boat in the right foreground.

2. The largest of the Pearl rocks.

3. Watch rock.

4. The largest of the Virgin rocks after all the adult sea-lions had taken to the water.

5. Male sea-lion killed on Watch rock.

6-12. Groups of sea-lion pups on Pearl and Virgin rocks.

13. Male sea-lion killed on one of the Virgin rocks, and two pups.
(2-13 were taken June 25, 1916.)

14. A figure to show the position at Solander island relative to cape Cook.

15. Solander island.

16-18. The outlying rock at Solander island, taken as the sea-lions were leaving it.

19-22. Remnants of the herd, showing some of the largest males.

23. Sea-lions in the water at Solander island.
(14-23 were taken June 27, 1916.)

24. A figure to show the relative position of cape St. James island, on which the lighthouse is situated, to the main island, Kunghit. Four groups of rocks extend in a chain southward from cape St. James.

25. A figure to show the position of the first two groups of rocks relative to cape St. James island.

26. The first group of rocks south of cape St. James island.

27. The second group.

28. The third group.

29. The fourth and final rock. It was on the second and third of these groups that the sea-lions were seen in abundance.

30-33. Views of the sea-lion herd on the rocks at cape St. James.
(24-33 were taken July 9, 1916.)

34. The remains of three sockeye and one humpback (the largest piece being the humpback) taken from a net in Rivers inlet July 23, 1916, said to have been mutilated by sea-lions.

35. Remains of salmon taken from the nets near Prince Rupert, September 8, 1915, said to have been mutilated by hair seals.

36. Scow on which Dr. Newcombe and Mr. Patch examined sea-lions in December, 1915, near Kildonan cannery, Barkley sound.
(Photos 1-35 by C. M. Fraser, 36 by C. F. Newcombe.)

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

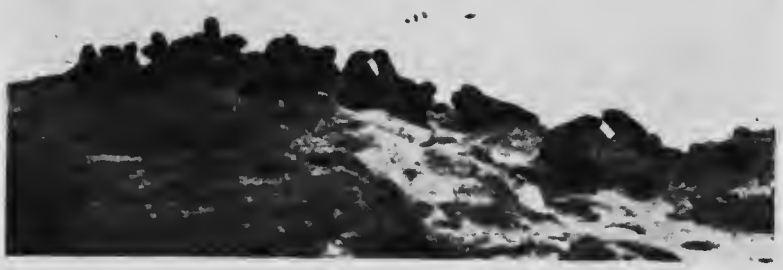

Fig. 8.

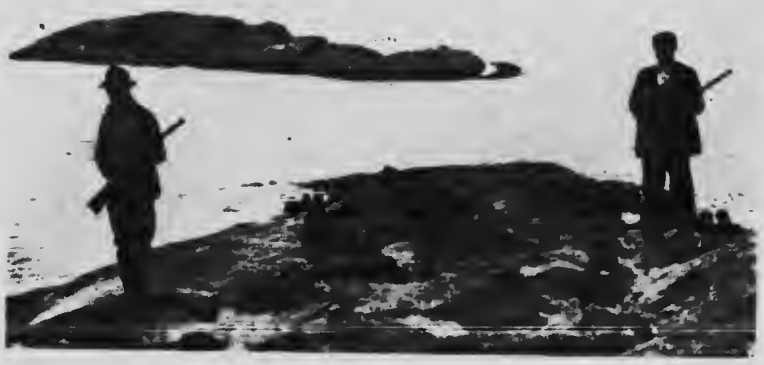

Fig. 9.

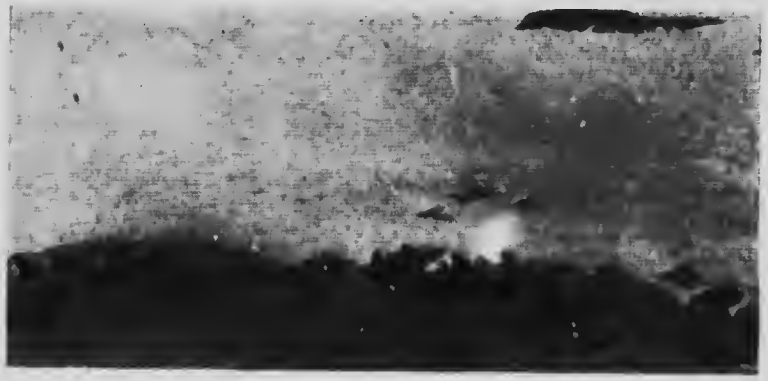

Fig. 10.

Fig. 11.

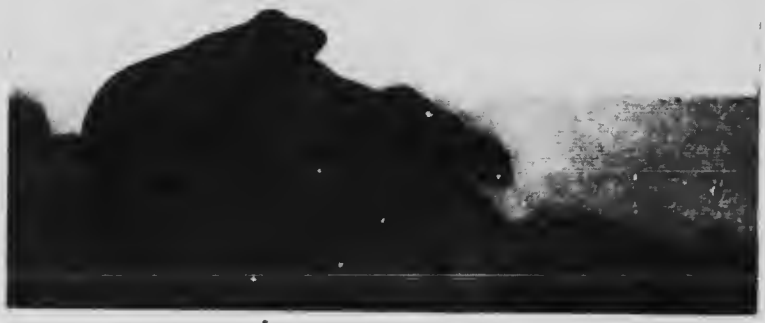

Fig. 12.

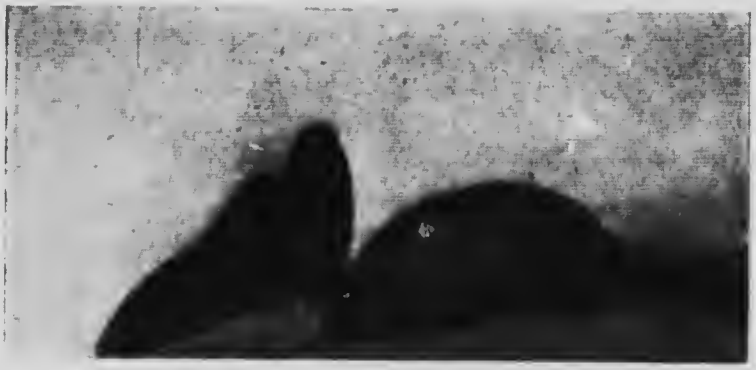

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17

Fig. 18

Fig. 19.

Fig. 20.

Fig. 21.

Fig. 22.

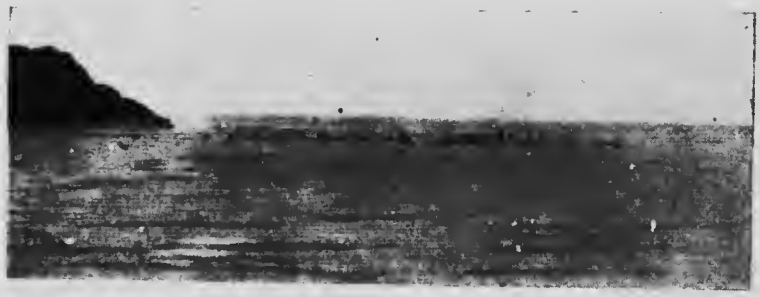

Fig. 23.

Fig. 24.

Fig. 25.

Fig. 26.

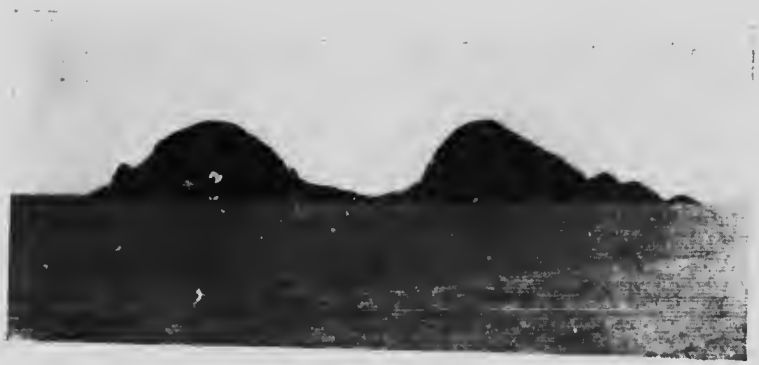

Fig. 27.

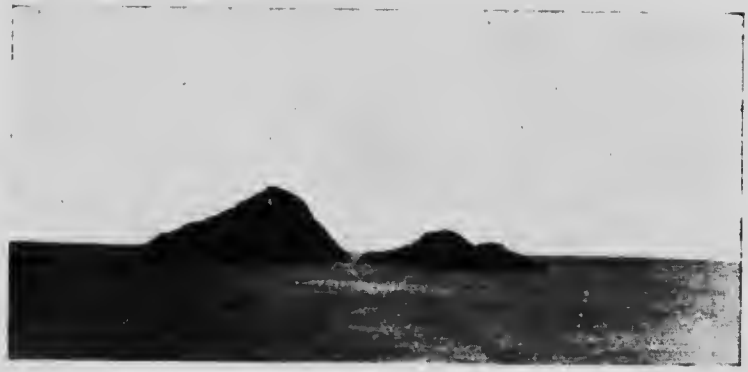

Fig. 28.

Fig. 29.

Fig. 30.

Fig. 31.

Fig. 32.

Fig. 33.

Fig. 34.

Fig. 35.

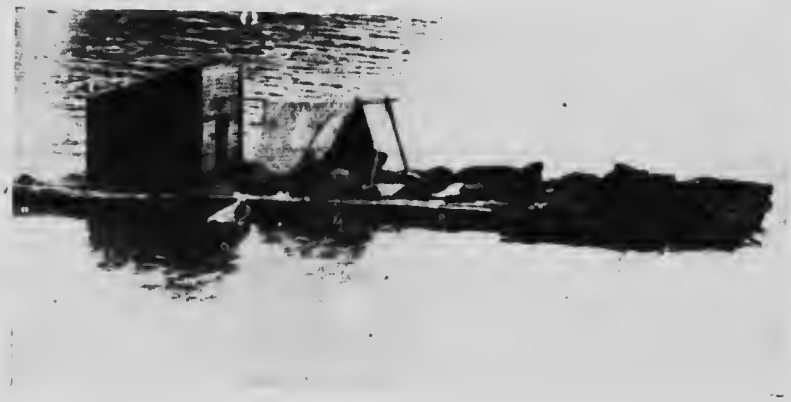

Fig. 36.