

1986

## A Review of the Management and Current Status of Northern Fur Seals of the Pribilof Islands

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A REVIEW OF THE MANAGEMENT AND CURRENT STATUS  
OF NORTHERN FUR SEALS OF THE

PRIBILOF ISLANDS

BY

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A MAJOR PAPER SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF MARINE AFFAIRS

UNIVERSITY OF RHODE ISLAND

1986

## ABSTRACT

The North Pacific fur seals of Alaska's Pribilof Islands have been subjected to commercial harvest for nearly 200 years. The harvest has been regulated under international agreement almost continuously since 1911; first under the 1911 North Pacific Fur Seal Convention, and following that under the 1957 Interim Convention on Conservation of North Pacific Fur Seals. Both Conventions banned pelagic sealing and divided the restricted land harvest among the four member states, the United States, Canada, Japan, and the Soviet Union. Management under the 1911 Convention resulted in a steady increase in the severely depleted fur seal herd, restoring the population to pre-exploitation levels. The 1957 Convention was less successful in achieving its stated population goal, and expired in 1984 when the U.S. voted against re-ratification.

The Pribilof fur seal population, now protected under the Marine Mammal Protection Act, has been declining steadily since 1974. While evidence indicates that entanglement in discarded fishing gear plays a major role in the decline, research into this and other factors affecting fur seal population dynamics is necessary. International cooperation and regulation of disposal of fishing gear at sea may be required in order to effectively protect the northern fur seal herd.

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A REVIEW OF THE MANAGEMENT AND CURRENT STATUS  
OF NORTHERN FUR SEALS OF THE PRIBILOF ISLANDS

Introduction

The North Pacific fur seals of Alaska's Pribilof Islands have been subjected to commercial harvest for nearly 200 years. In 1786 Russian fur traders transferred natives from the Aleutian Islands to the Pribilofs to conduct the harvest under Russian supervision. With the U.S. purchase of Alaska in 1867, exploitation of fur seals was conducted first by private U.S. companies, and later by the U.S. government.

The fur seal harvest has been regulated under international agreement almost continuously since 1911. The 1911 North Pacific Fur Seal Convention,<sup>1</sup> an agreement between the United States, Canada, Japan, and the Soviet Union, was followed by the 1957 Interim Convention on the Conservation of North Pacific Fur Seals,<sup>2</sup> a similar agreement between the same four states. Both Conventions banned pelagic sealing, and provided for distribution of sealskins from land harvests among the four member governments. In addition, the treaties provided for international scientific research programs designed to further an understanding of fur seal biology and population

dynamics.

While the fur seal industry was a profitable business throughout the first half of the twentieth century, the past few decades have seen a decline in demand for seal pelts, as well as an increase in public opposition to the harvest. In the U.S., opposition to the harvest has been based on both a general sentiment against killing marine mammals, and on the questionable role of the federal government in supporting the commercial harvest.

In response to public pressure and the increasing costs involved, the federal government began plans to withdraw funding for the Pribilof program in the early 1980's. In 1985 the U.S. Senate voted against continuation of the Interim Convention, which thus expired, ending commercial sealing on the Pribilofs.

The Pribilof seal herd has been declining steadily since 1974. While it is likely that the decline is the result of a combination of factors, evidence supports the theory that entanglement in discarded fishing gear is the primary contributing factor.

This paper will summarize the history of northern fur seal management, and examine the impacts of past management strategies on the fur seal population. Potential explanations for the current population decline will be considered, along with possible means of addressing the decline through new or existing legal channels.



### Biology of the Northern Fur Seal

The North Pacific fur seal (Callorhinus ursinus) is a member of the family Otariidae, the eared seals. Adult males average 2.13 m in length and weigh 180-272 kg; females typically weigh 43-50 kg and reach an average length of 1.42 m.<sup>3</sup> Northern fur seals have a maximum life span of about 25 years; however the average life span is about 2 years for males and 4.6 years for females.<sup>4</sup> Females mature sexually between 5 and 6 years of age and reach a breeding peak of one pup per year between 7 and 14 years of age.<sup>5</sup> The gestation period is about one year and includes a delayed implantation of about 4 months.<sup>6</sup> Males become sexually mature at age 4 or 5, but rarely breed before age 10.<sup>7</sup>

Northern fur seals are found only in the North Pacific Ocean and Bering Sea. Their range extends from the subarctic waters of the North Pacific to southern latitudes of about 32°N in the eastern Pacific, and 36°N in the western Pacific (Fig. 1).<sup>8</sup> Some fur seals may be found throughout their range in every month of the year, their distribution and abundance varying seasonally. Fur seals spend the greater part of the year at sea, normally ranging from 70-130 km offshore.<sup>9</sup> Many immature seals of both sexes remain at sea for the first year or two of life; beyond age two, the great majority return to the island of their birth for the breeding season.<sup>10</sup>

Breeding takes place during the summer months, on

islands off the U.S., Japan, and the Soviet Union. About 72% of the current estimated northern fur seal population breed on the Pribilof Islands in the Bering Sea.<sup>11</sup> About 17% are found on the Commander Islands (the Asian extension of the Aleutian chain), and 6% breed on Robben Island in the Okhotsk Sea.<sup>12</sup> Small breeding herds are also known to occur on the Kurile Islands in the western North Pacific, San Miguel Island off California, and Bogoslof Island in the Aleutian chain.<sup>13</sup> Although intermixing among the various breeding groups is sufficient to maintain a common gene pool, the extent of interbreeding is limited, and for management purposes the breeding groups may be considered as distinct populations.<sup>14</sup>

Among the five Pribilof Islands, fur seal rookeries are found only on St. Paul, St. George, and Sea Lion Rock.<sup>15</sup> Eighty percent of the Pribilof fur seal population breed on the island of St. Paul.<sup>16</sup> Adult males begin arriving at the rookeries in early May, followed by the arrival of younger males in descending order by age. Some immature males may arrive as late as September. Breeding males establish territories where they will typically mate with 40-50 females.<sup>17</sup> By mid-June pregnant females begin to appear at the rookeries, where they give birth to a single pup within 24 hours of arrival.<sup>18</sup> Until weaning in October or November, the female repeats a cycle of nursing the pup for 4 to 6 days, then leaving the rookery to feed for 4 to 5

days.<sup>19</sup> Adult females mate with territorial males about one week after giving birth.<sup>20</sup>

In July and August immature seals arrive at the islands, where they will remain for only a few weeks. During this time these animals occupy an area landward of the main rookeries, with limited access to the sea. Thus they are easily separated from the breeding herd during harvests.

In October the herd begins to leave the islands for winter foraging grounds. Last to depart are the pups and older seals, which begin leaving in early November. By late November only about 30% of the population remains in the vicinity of the Pribilofs, while some members of the herd have already completed their migration across the Gulf of Alaska and are beginning to appear off the coasts of southeastern Alaska, British Columbia, and Washington.<sup>21</sup> During the southern migration, fur seals are generally found in small groups, traveling close to the edge of the continental shelf and within the limits of the Exclusive Economic Zones of the U.S. and Canada.<sup>22</sup>

Nearly all mature males spend the winter in the Gulf of Alaska, the Bering Sea, or the vicinity of the Aleutian Islands.<sup>23</sup> Young males and females of all ages may be found throughout their range in winter and spring, but tend to winter in the southerly areas.<sup>24</sup> In February and March, fur seals are most abundant in coastal waters from California to

Sitka, Alaska.<sup>25</sup> Spring migration begins in March in the southern extent of the range off California, proceeding northward along the coast. During the northward migration, fur seals tend to follow a fairly direct route from the coastal waters of Oregon, Washington, and British Columbia, across the North Pacific Ocean toward the eastern Aleutians. Animals following this route pass outside of the U.S. and Canadian EEZs, a fact of potential significance for the future of the fur seal herd.<sup>26</sup>

Fur seals are opportunistic feeders, preying on the most available prey species throughout their range. Analyses of stomach contents have shown evidence of over 50 species of fish and 10 species of squid in their diets.<sup>27</sup> In the Bering Sea/Aleutian area fur seals have been estimated to consume 12 to 13.5 percent of their body weight per day in fish and squid.<sup>28</sup> Over 80 percent of the biomass of prey consumed in this area consists of gonatid squid, capelin, and walleye pollock.<sup>29</sup> Some fur seal prey items are important commercial species, while others may be important prey for other marine mammals, fishes, and seabirds. Aside from humans, the northern sea lion is probably the most important direct competitor for many of the same prey species as fur seals.<sup>30</sup>

Adult fur seals are preyed upon by man and possibly killer whales and large sharks. Northern sea lions and occasionally arctic foxes, are known to prey on fur seal

pups.<sup>31</sup>

### The Pribilof Islands

The Pribilof Islands are located in the southeastern Bering Sea (between 169°30' and 170°30'W and 56°30' and 57°16'N), 340 km northwest of Unalaska Island in the Aleutians, the closest neighboring point of land.<sup>32</sup> The island group consists of two major islands, St. Paul and St. George, and three small islets; Otter Island, Walrus Island, and Sealion Rock (Fig. 2). The islands of St. Paul and St. George occupy 114 km<sup>2</sup> and 92 km<sup>2</sup>, respectively.<sup>33</sup> They are rugged and bare, shaped by volcanism and persistent winds. Both St. Paul and St. George are characterized by coastlines of precipitous cliffs, caused by marine erosion.

Temperatures on the Pribilofs range from 37 to 51°F in summer and 19 to 36°F in winter.<sup>34</sup> Although precipitation is relatively light (averaging 25 inches per year), humidity is high, and the islands are often wrapped in fog.<sup>35</sup>

In addition to fur seals, wildlife of the Pribilof region includes several other marine species, and a few terrestrial species. Only three species of land mammals are native to the Pribilofs; the arctic fox, the shrew, and the lemming.<sup>36</sup> Reindeer were introduced to the islands in 1911, and currently number about 400 on St. Paul, and about 20 on St. George.<sup>37</sup>

Several species of seals and whales inhabit the waters of the Pribilof region. Sea otters, extremely abundant in the area when the Pribilofs were discovered, had been exploited to extinction from the region by 1840.<sup>38</sup> An attempt in the 1960's to reintroduce sea otters to the Pribilofs has been marginally successful, with occasional sightings occurring on St. George.<sup>39</sup>

The Pribilof Islands lack sizeable streams, and therefore lack anadromous fish. The fish resources of the Eastern Bering Sea region include various species of bottom fish (pollack, perch, cod, and blackcod), flounders, and halibut.

Vast numbers of seabirds of at least 191 species inhabit the Pribilof Islands.<sup>40</sup> It has been estimated that nearly 2,800,000 marine birds nest on the Pribilofs, primarily on the steep cliffs found along much of the coast.<sup>41</sup>

#### History of Fur Seal Exploitation on the Pribilofs, 1786-1957

Russian fur hunters discovered the Pribilof Islands in 1786, at which time the fur seal herd is estimated to have numbered over 2 million.<sup>42</sup> Natives from the Aleutian Islands of Atka and Unalaska were transferred to the Pribilofs to assist in the annual harvest on St. Paul and St. George Islands, under Russian supervision.<sup>43</sup> In 1786 40,000 seals were killed, and for the next several years the

harvest was totally uncontrolled, without regard to sex, size, or number of animals taken.<sup>44</sup>

A rapid decline of the herd was somewhat reduced following the consolidation of many rival companies into the Russian-American company in 1805. The company prohibited harvesting in 1806 and 1807; the hunt was resumed on St. George in 1808, and on St. Paul in 1810.<sup>45</sup> This and subsequent closed seasons in the 1820's slowed the decline of the herd to some extent, but further measures were necessary in order to prevent commercial exhaustion of the species. From 1835 to 1867, the killing of female seals was prohibited, while the harvest of males was restricted by the imposition of size limits.<sup>46</sup> As the herd gradually grew in size, the allowed take of surplus males was increased proportionately.

In 1867 the U.S. purchased Alaska from Russia, thereby acquiring the Pribilof seal herd, as well as responsibility for the approximately 375 Aleuts residing on the islands at the time.<sup>47</sup> The fur seal population at this point is estimated to have been roughly 2 million, equal to the estimated size of the herd prior to exploitation.<sup>48</sup>

During the first two years of U.S. ownership, several American companies participated in an uncontrolled slaughter on the islands. An estimated 300,000 seals were taken in 1868 alone.<sup>49</sup> In 1869 the U.S. government proclaimed the Pribilofs as a special reservation for

protection of fur seals, limiting the 1869 harvest to 86,000 seals.<sup>50</sup> Additional restrictions were established in 1870 when Congress passed an act to prevent the extermination of fur-bearing animals in Alaska.<sup>51</sup> Under the provisions of this act, the U.S. Treasury was authorized to lease sealing privileges on the islands, subject to rules and regulations stipulated in the act. Restrictions included a maximum annual quota of 100,000 seals, and bans on killing females and seals under one year of age, pelagic sealing near the islands, and the use of firearms in killing seals on land. In addition, this law established rules regarding rental fees and taxes to be paid by the leasing firm.

The first 20-year contract under this system was awarded to the San Francisco-based Alaska Commercial Company (ACC). Under the terms of the contract, the ACC paid an annual rental fee of \$55,000 and a tax of \$2.62 1/2 for each skin taken.<sup>52</sup> In addition, the company was required to furnish dwellings, schools, medical services, and specified food and supplies for the islands' Aleut inhabitants. Harvesting was allowed only from June through October, and was subject to the restrictions mentioned above.

The ACC was able to harvest the annual quota of 100,000 seals almost every year during its 20-year lease; the total kill on both islands during this period amounted to 1,981,623 seals.<sup>53</sup>

From 1890 to 1909 the seal hunt was administered by



another San Francisco-based firm, the North American Commercial Company (NACC). A harvest quota of 60,000 seals was established for the first year of the contract, but the actual take in 1890 was only 28,059.<sup>54</sup> The destructive results of increased pelagic sealing were becoming increasingly apparent.

The pelagic sealing industry first gained commercial viability in 1868, and remained an exclusively American and Canadian industry throughout the 1870s.<sup>55</sup> Between 1872 and 1878 the annual pelagic catch averaged only 5,400 seals, an amount which had little impact on the productivity of the herd.<sup>56</sup> Within a few years Japanese pelagic sealers, subsidized by their government, had moved in to the Bering Sea and were taking increasingly larger numbers of seals. By 1885 the total annual pelagic catch in waters off the Northwest coast of North America and in the Bering Sea, had increased to 23,040.<sup>57</sup>

In 1886 the U.S. claimed exclusive control over the eastern Bering Sea, in an effort to put an end to pelagic sealing there.<sup>58</sup> Conflicts arose with Great Britain when the U.S. seized several Canadian sealing vessels in the area in the late 1880's. The matter was eventually taken to the Paris Tribunal of Arbitration, where negotiations gave rise to a treaty between the U.S. and Great Britain in 1892.<sup>59</sup> Regulations established under the terms of this agreement prohibited pelagic sealing within 60 miles of the Pribilofs,

and pronounced a closed season on pelagic sealing between 1 May and 31 July. These restrictions were largely ineffective, due in part to the fact that female fur seals often forage at distances greater than 60 miles from the rookeries. Furthermore, the Japanese pelagic sealing industry was rapidly expanding in the Bering Sea, diminishing the potential benefits of reduced pelagic sealing by the U.S. and Canada.

In 1897 the U.S. again attempted to reduce pelagic sealing, through the passage of laws prohibiting pelagic sealing by U.S. nationals in waters of the Pacific Ocean north of 35°N, and prohibiting the importation of fur seal skins obtained by pelagic sealing.<sup>60</sup> These actions also did little to reduce the pelagic catch; between 1889 and 1909, over 600,000 seals were taken by the pelagic sealing industry, nearly twice the number harvested on land during the same period.<sup>61</sup>

Pelagic sealing is generally accepted as the primary cause of the fall of the Pribilof herd between the 1880s and early 1900s. The danger in this practice is that it allows indiscriminate killing, regardless of season, sex, or age. Both pregnant and immature females are killed, as well as nursing females, whose pups are then likely to starve or die of disease contracted in their weakened state. During the height of pelagic sealing, the number of pup deaths due to starvation sometimes reached several thousand per year.<sup>62</sup>

By the time the contract with the NACC expired in 1909, the U.S. government was ready to make substantial changes in its fur seal management policy. Contractual obligations with leasing companies were interfering with governmental attempts to reach international agreements regarding pelagic sealing and other management issues. In 1910 the federal government took over the fur seal business, passing a law in April of that year aimed at the protection of Alaska's fur seal fisheries.<sup>63</sup>

This law provided for a government monopoly of the fur seal harvest, to be conducted and supervised by the Department of Commerce and Labor. It prohibited the harvest of female seals, and of male seals under one year of age, unless necessary for food for the island residents. A maximum of 95 percent of the 3 year old bachelors could be taken in any one year. Skins were to be sold in the best market, subject to the provisions of any subsequent agreements made by the U.S. In addition to taking over the fur seal harvest, the government also took over responsibility for the care of the native inhabitants of the Pribilofs.

By 1911 the Pribilof seal herd had been reduced to approximately 300,000 animals.<sup>64</sup> Pelagic sealing threatened to reduce the herd even further, to the point of commercial exhaustion. The annual yield from pelagic sealing, which had averaged 48,554 skins from 1890 to 1896, had been

reduced to an average of 14,336 skins in the period 1904-1909.<sup>65</sup> The effects on the seal population were reflected in the decline of the pelagic sealing fleet; for example the Canadian fleet of 41 vessels in 1897 numbered only 5 vessels by 1910.<sup>66</sup>

The seal herd of the Commander Islands was suffering a similar decline from the effects of pelagic sealing in that area since 1891.<sup>67</sup> This threat to the Russian fur seal industry provided impetus for the Russian government to negotiate in an agreement to restrict pelagic sealing.

Early attempts at an international agreement for the protection of fur seals had failed largely due to the Canadian position in the industry. Canada was the main beneficiary of the pelagic sealing industry, possessing no land rookeries of her own. While a ban on pelagic sealing would enhance the value of the land industries of the other three states involved, the Canadians' main interests were in pelagic sealing. As the situation worsened, Canada finally was willing to accept an international agreement, but only if such an agreement would provide compensation to Canada for foregoing pelagic sealing in the interests of the states owning rookeries.<sup>68</sup> Negotiations between the U.S., Great Britain (representing Canada), Japan and Russia resulted in the North Pacific Fur Seal Convention of December 15, 1911, signed by the four attending parties.

### The 1911 Convention

The 1911 Convention was the first international treaty designed to protect and restore a marine species. Under the provisions of the treaty, which was to remain in force for a minimum of 15 years, pelagic sealing was prohibited in waters of the Pacific Ocean north of 30°N, except by subsistence hunters using traditional methods. Japan and Canada were each to receive 15 percent of the sealskins taken on the Commander Islands, and 15 percent of those taken on the Pribilof Islands. Canada, Russia, and the U.S. were each to receive 10 percent of the skins taken on the then Japanese-owned Robben Island. Article XIV provided that, if the seals resorted to Canadian territory for breeding purposes, the Canadian government would be required to deliver 10 percent of the land harvest to each of the other three states involved.

The minimum annual delivery of Pribilof sealskins to Canada and Japan was set at 1,000 each, and in years when commercial taking of skins might be prohibited, the U.S. government agreed to pay each government \$10,000. At the close of the convention negotiations, the U.S. advanced \$200,000 to both Canada and Japan, as advance payment on sealskins to be taken in the future. This was to enable these states to compensate their citizens engaged in pelagic sealing who were forced out of business by the new convention. After a period of 14 years, 12 months written

notice by any of the 4 parties could terminate the treaty.

In 1912, the first year of the new international conservation regime, the Pribilof herd numbered approximately 216,000.<sup>69</sup> Commercial harvests on the islands were prohibited from 1912 until 1917, in order to allow for growth of the herd. During this period, seals could be killed only for food, clothing, and boat skins for the native population. Commercial harvesting was resumed in 1917, under a provision that for the next 10 years a minimum of 5,000 3 year old males would be reserved each year to join the breeding herd.

The annual harvest between 1919 and 1940 varied between 15,000 and 65,000, with a total of 1,036,337 seals taken between 1912 and the expiration of the treaty in 1941.<sup>70</sup> By 1940, the Pribilof herd had increased in size to 2,185,136.<sup>71</sup> The herd size and number of sealskins taken annually under the 1911 treaty are shown in Table 1 and Figure 3. In October of 1940 Japan formally withdrew from the treaty, claiming that the growing seal herd was damaging her offshore fisheries. Japan nevertheless expressed concern for the protection of the fur seals on a reasonable basis, and a willingness to conclude a new agreement.<sup>72</sup> At this point the war in the Pacific intervened, preventing potential regrowth of a pelagic sealing industry, and disrupting the Pribilof harvests. In June of 1942 the Pribilof Aleuts were evacuated to

southeastern Alaska; normal seal harvests were not resumed until their return in 1944.

Following the expiration of the 1911 Treaty, the Pribilof herd was protected to a limited extent by an agreement between the U.S. and Canada, which banned pelagic sealing in the central and eastern North Pacific Ocean.<sup>73</sup> This treaty remained in force for 17 years, until a new agreement was reached.

By 1954, the U.S., Canada, Japan and the U.S.S.R. had begun negotiations to formulate a new fur seal treaty. The 1911 Convention had demonstrated that an international agreement could be an effective means of restoring a valuable natural resource, as well as providing substantial economic gain for the parties involved. While the U.S. incurred most of the costs involved with the commercial harvest and enforcement of convention provisions, the share of profits to the U.S. was also the largest. However the economic gain for Canada and Japan was also significant. Proceeds to these states had grown steadily with the increase in the herd and the commercial take. In 1938 Canada and Japan each received 8,755 fur seal skins, without incurring any costs.<sup>74</sup> The share to each state was greater than their combined pelagic catch had been in any single year between 1904 and 1911.<sup>75</sup> Russia, which had been only a passive participant in the Convention since the Revolution of 1917, had a continued interest in renewing the ban on

pelagic sealing because of the threat it posed to the Commander Islands herd.<sup>76</sup>

In 1957 the four parties signed the Interim Convention on Conservation of North Pacific Fur Seals. The Convention remained in force until October 1984; fur seal management under the terms of this agreement is discussed below.

#### The 1957 Convention

The Interim Convention took into account Japan's concern regarding damage to fisheries, in its management goal of maintaining the fur seal population "at the levels which will provide the greatest harvest year after year, with due regard to their relation to the productivity of other living marine resources of the areas..."<sup>77</sup> The Convention banned pelagic sealing except for research and subsistence purposes, and called for extensive study of fur seal biology and ecology by the party governments.<sup>78</sup> The U.S. and the Soviet Union were authorized to conduct commercial harvests in the rookeries under their jurisdiction. From each annual harvest, both the U.S. and the U.S.S.R. were required to deliver 15 percent of the total number of sealskins taken to Canada, and another 15 percent to Japan.<sup>79</sup>

The Convention provided for the establishment of the North Pacific Fur Seal Commission, composed of one member



from each of the four parties.<sup>80</sup> Duties of the Commission included making recommendations regarding the annual allowable harvest and formulating research programs designed to achieve the objectives of the Convention.<sup>81</sup>

According to a 1985 report by the National Advisory Committee on Oceans and Atmosphere (NACOA), the determination of harvest levels under the 1957 Convention was often based on forecasts of the numbers of sub-adult males expected to return to the rookeries. Forecasts estimate the return of seals to the breeding grounds by age class. Such numbers cannot be accurately predicted due to the uncertainty of factors influencing survival at sea, such as predation, entanglement, and natural environmental fluctuations.<sup>82</sup> In many cases non-scientific criteria, such as the convenience of harvest dates for shipment of skins, the preferences of fur company managers, and other commercial interests, have also influenced the determination of harvest levels. Harvest level determination was seen by NACOA as one of the most significant problems of the Interim Convention. Effective management requires that greater consideration be given to the available scientific data.

Annual harvests of females were conducted between 1957 and 1968, based on the scientific theory that the production of fewer pups would lead to increased pregnancy rates and increased pup survival rates, and ultimately, a greater sustained harvest. More than 300,000 females were

harvested during this period, but the expected results were never seen.<sup>83</sup>

Commercial harvests were conducted on the Pribilofs every year between 1957 and 1984, typically beginning in late June and continuing for 5 to 6 weeks. Except for the female harvest mentioned above, the harvest focused on sub-adult males between the ages of two and six years; 90 percent of those taken were in the 3 to 4 year age class.<sup>84</sup> (Figure 4)

In 1972 the four parties to the Convention agreed to end all harvesting on St. George; the island was designated a sanctuary, where biological and ecological studies could be carried out. From 1973 through 1983, the annual harvest on St. Paul Island averaged about 26,700 male seals.<sup>85</sup> During this time, public opposition to the harvest was growing. Pressure from animal welfare groups prompted studies on the humaneness and effectiveness of various methods of killing. Methods tested included carbon dioxide poisoning, electrocution, shooting, and the use of drugs. After more than a decade of study, it was concluded that the traditional method of killing seals by stunning them with a blow to the head, quickly followed by insertion of a knife into the heart, is the most humane method.

The Interim Convention has not been successful in terms of maintaining its specified population goal. The objective of the Convention was to achieve "maximum

sustainable productivity" of the North Pacific fur seal herd, to "provide the greatest harvest year after year."<sup>86</sup> Based on empirical information for fur seals and comparisons with other species, the population at which maximum productivity would occur is about 60 percent of the carrying capacity of the ecosystem.<sup>87</sup> However, maximum production of sub-adult males, the harvested sector of the population, requires a higher population level than that which provides maximum productivity of the population as a whole, since only a small number of males breed with many females and only males are harvested. The maximum sustainable yield of sub-adult males is believed to occur when the population is at or above 90 percent of the carrying capacity of the ecosystem.<sup>88</sup> The 1984 Pribilof population, estimated at about 50 percent of the carrying capacity, may actually be as much as 40 to 50 percent below the level of maximum sustainable productivity of sub-adult males.<sup>89</sup>

Another problem with the Convention is that it was not designed to take into account the changing circumstances concerning the fur seal pelt market. Maximum productivity of fur seal pelts is no longer economically profitable, due to the drastic plunge in the world market for sealskins in recent years. In 1982, major European market importers reduced sealskin purchases by one half over 1981.<sup>90</sup> In 1985, inventory backlogs of processed northern fur seal pelts went back to 1982.<sup>91</sup>

Wholesale prices of seal pelts fell 39 percent between 1973 and 1982, while the net return to the U.S. government dropped 40 percent.<sup>92</sup> In 1984, it cost the government about \$1.1 million to conduct the commercial harvest on the Pribilofs.<sup>93</sup> Increasing subsidies to the commercial harvest served to deepen existing concerns about the role of the government in the harvest. Many felt that the government did not belong in the fur seal business, whether operating for a profit, or subsidizing a loss.

In addition to changes in the seal pelt market, there have been substantial changes in public sentiment concerning the harvest. While there was little opposition to the harvest when the Convention was negotiated, this is no longer the case; public concern for protection of wildlife, and of marine mammals in particular, has increased dramatically in the past two decades.

In spite of some shortcomings, the Convention may be viewed as having been successful in some respects. By regulating the harvest on land and banning pelagic sealing, the Convention may have prevented severe depletion of the North Pacific fur seal herd. Although pelagic sealing had been prevented previously by the 1911 Treaty and following that, by the occurrence of war in the Pacific, the threat of a return to commercial pelagic sealing remained. In addition to banning pelagic sealing by the four member states, the Convention also played a potential role in

preventing pelagic sealing by other states interested in exporting fish products to the U.S. Under the Pelly Amendment to the Fishermen's Protective Act, the U.S. government may ban the importation of fish products from a foreign nation if the Secretary of Commerce certifies that that nation is conducting fishing operations in such a way as to diminish the effectiveness of international fishery conservation agreements, including those concerning marine mammals.<sup>94</sup>

Another important contribution of the Convention is its provision for a coordinated program of international scientific research, through which much valuable data has been collected. The cooperative effort demonstrated by the parties to the Convention may serve as a model for future agreements concerning international management of marine resources.

#### Current Status of the Pribilof Fur Seal Herd

The 1984 population of Pribilof fur seals was about 871,000; since 1974, the population has declined at an average rate of 8 percent.<sup>95</sup> by 1980, the number of pups born on the Pribilofs was less than 50 percent of the levels of the 1940's and early 1950's.<sup>96</sup> (Figure 5) With the exception of the Commander Islands, similar population declines have been occurring in all of the major breeding areas.<sup>97</sup>

Several explanations have been suggested to account for the decline in the Pribilof fur seal population. These fall into three major categories, depending on whether they contribute to reduced reproductive rates, increased mortality rates or emigration. Emigration is unlikely to account for the herd decline, based on the low rates of exchange between populations. Other suggested explanations include: reduced reproductive rates; the harvest of females between 1956 and 1968; the commercial harvest; pollution, in the form of substances toxic to fur seals; predation; disease; natural population fluctuations; and conflicts with commercial fisheries. While it is unlikely that the population decline can be attributed entirely to just one of these factors, studies indicate that entanglement in discarded fishing gear may be the single factor contributing most to the herd reduction. Each potential factor listed is discussed briefly below.

Existing data do not support the hypothesis that reduced reproductive rates have caused the decline in the number of pups born. Studies show no significant declines in pregnancy rates among older females from the 1950's through the 1970's.<sup>98</sup>

Major declines in the Pribilof herd size in the past have been associated with the harvesting of females. The first occurred under Russian rule in the late 1700's when seals were harvested indiscriminately. Following a period

of protected status for females, the herd increased in size until the late 1800's when renewed harvesting of females resulted in a second decline. With prohibition of the female harvest in the early 1900's, the herd once again increased in size. Between 1956 and 1968 more than 300,000 females were harvested, under the assumption that production of fewer pups would result in increased pregnancy rates, increased pup survival rates, and ultimately, a sustained harvest of a greater number of males and females.<sup>99</sup> This population increase did not occur as anticipated; instead, the Pribilof population decreased from over 2,000,000 in the early 1950's to about 1,140,000 by 1970.<sup>100</sup> Although there were slight increases in the number of pups born between the late 1960's and mid 1970's, the rates of increase were not comparable to those seen subsequent to previous harvests of females.<sup>101</sup> Considering the time which has elapsed since the end of the last female harvest, it seems unlikely that the current population decline is due to adverse effects of this harvest.

The commercial harvest of subadult males, conducted each year from 1957 through 1984, has been suggested as a cause for the population decline. However, the population underwent a major increase between the early 1900's and the 1950's, while similar commercial harvests were being conducted; therefore it seems unlikely that the current decline can be attributed solely to the harvest.

Furthermore, the St. George herd, which has been protected from commercial harvest since 1973, is currently declining at about the same rate as the St. Paul herd.<sup>102</sup> While it is reasonable to suspect that any harvest at all will only further reduce an already declining population, it has been argued that the harvest may actually benefit the herd by contributing to the maintenance of environmental conditions favorable for population growth.<sup>103</sup> Although scientists agree that there is inadequate evidence on which to evaluate the long-term impact of the commercial harvest on the seal population, the consensus of the Standing Scientific Committee of the North Pacific Fur Seal Commission is that the harvest is probably not contributing to the herd decline.<sup>104</sup>

Mortality of seals for the first 20-22 months at sea has been estimated since 1950.<sup>105</sup> During the high population period of the 1950's, mortality rates varied between 54% and 82% with a mean of 66%.<sup>106</sup> Between 1960 and 1970, a time when the population was declining, mortality varied between 53% and 66% with a mean of 63%.<sup>107</sup> Since 1970 estimated mortality rates have increased, reaching levels comparable to some of the higher rates observed in the 1950's. Current rates are nearly 70%.<sup>108</sup>

Studies of increased mortality rates among juvenile males show a correlation between estimated survival at sea and survival of pups on land, between 1950 and 1965.<sup>109</sup>



Estimated survival during this period differs very little from values expected according to the correlation; however, since 1965, the estimated survival differs significantly from the expected value. While survival of pups on land has continued to increase, survival at sea has declined. Estimated survival at sea for each year class since 1965 is below that expected from the correlation; since 1972, the difference between estimated and expected survival rates has been 15-20%.<sup>110</sup>

Survival of two to five-year-old males is estimated through examination of the age structure of the commercial harvest. An index of survival is calculated by relating the numbers of animals of one cohort to the number of animals of the same cohort taken the previous year. Analysis of survival through this method demonstrates an increasing trend in survival during the period over which the population declined in response to the female harvest, followed by a decrease in survival of two to five-year-old animals since 1970.<sup>111</sup>

The above data indicates that the recent decline in the northern fur seal population is due to a decline in the survival between the time animals leave land and return for reproduction.

Increased mortality could be caused by toxic substances in the environment, such as heavy metals and organic pesticides. However, current evidence indicates

that the levels of measured contaminants in the tissues of fur seals have not increased coincident with the declining population.<sup>112</sup>

Similarly, there is no evidence indicating that increased predation is contributing to increased fur seal mortality. Predators of northern fur seals include the Stellar sea lion and the killer whale. Sea lion abundance in the southeastern Bering Sea appears to be declining, while there is no data available on the size of the killer whale population of the area.<sup>113</sup>

The occurrence of disease in natural populations usually causes steep population declines followed by gradual increases, a pattern not seen in the Pribilof fur seal herd. Although there was an increase in the incidence of Leptospirosis (a bacteria induced disease affecting the kidneys) in the mid 1970's, the impact of this disease on mortality is not known.<sup>114</sup> In general, the incidence of disease among fur seals during the period of recent population decline has remained the same or declined.<sup>115</sup> There is therefore no basis on which to conclude that disease is a major factor in the herd decline.

It is possible that the Pribilof fur seal herd is progressing through a natural population fluctuation, a phenomenon often seen in populations of small-bodied animals. Fluctuation in the population of any species in the fur seal ecosystem could affect the fur seal population.

However, such fluctuations are normally short-term events, and would be unlikely to explain the twelve year decline in the fur seal population.<sup>116</sup>

Interactions between fur seals and commercial fisheries can be divided into two categories--those which directly affect the fur seal herd, including incidental take and entanglement in fishing gear; and indirect effects resulting from a reduction of prey availability.

The Japanese salmon fishery of the Bering Sea and North Pacific Ocean accounts for the predominant number of fur seals taken incidental to commercial fishing.<sup>117</sup> It is estimated that between 100 and 1,000 fur seals are currently taken each year in this fishery.<sup>118</sup> Several other fisheries operate in the Pribilof region, but levels of incidental catch related to these are not documented. However, the available estimates indicate that fur seal mortality resulting from incidental take is not a primary factor in the observed population decline.<sup>119</sup>

Entanglement in discarded fishing gear, notably in fragments of trawl netting, appears to be a major contributing factor to the recent fur seal population decline. Although estimates of entanglement-caused mortality involve some assumptions, several factors have been found to be consistent with the hypothesis that entanglement is a major cause of fur seal mortality.<sup>120</sup> These include observed declines in pup production and

numbers of adult males, which correlate with observed increases in numbers of entangled seals.

Since at least 1936 fur seals on the Pribilofs have been observed entangled or caught in debris, including rubber bands, cords, strings, and rawhide.<sup>121</sup> In the early 1960's fishing effort in the North Pacific Ocean and Bering Sea increased, along with an increase in the use of synthetic nonbiodegradable fibers in fishing nets and packing bands.<sup>122</sup> The presence of net fragments on harvested seals has been monitored since 1965, and after a steep increase in the late 1960's, has remained fairly constant for several years.<sup>123</sup> (Figure 6) About two thirds of the pieces of debris found on harvested animals are fragments of trawl net webbing, while the remaining one third consist primarily of plastic packing bands.<sup>124</sup>

Observed entanglement rates since 1967 average about 0.4 percent of the Pribilof herd, with a low of 0.15 percent in 1967 and a high of 0.72 percent in 1975.<sup>125</sup> However, this says little about the impact of entanglement on animals at sea. Entanglement rates observed on land involve only those animals in pieces of trawl net fragments and plastic packing bands small enough to allow them to swim back to the islands. Analysis of the size composition of debris found on harvested animals, drifting at sea, and washed up on beaches, indicates that the small pieces found on harvested animals are only a fraction of the debris that fur seals

encounter at sea.<sup>126</sup> Presumably, entanglement in larger net fragments is more likely to result in death by impairing the animal's ability to hunt and thus leading to starvation.

In a study of debris found on beaches of Amchitka Island, Alaska, approximately 83% of the debris consisted of trawl net fragments as determined by weight.<sup>127</sup> Using published information concerning the rate at which plastics were discarded in the open ocean, this study suggests that approximately 1445 metric tons of plastic trawl gear, with an average weight of approximately 10 kg, were dumped into the Bering Sea and Aleutian area each year in the early 1970's.<sup>128</sup> This indicates that there may have been roughly 145,000 trawl fragments discarded each year. Depending on the degree to which these fragments become concentrated or dispersed in the areas of fur seal feeding and migration routes, they could present a significant threat to the seals. Models based on distribution and abundance of debris of various sizes, in conjunction with the entanglement rate observed during the harvest, indicate entanglement-caused mortality rates in excess of 5 percent to 10 percent per year.<sup>129</sup> Such levels of mortality may be sufficient to account for the observed population decline.<sup>130</sup>

A reduction in the amount of food available has been suggested as a contributing factor to the decline of the Pribilof herd. Evidence does not support this hypothesis. Estimates of commercial fisheries catch in the range of the

Pribilof fur seals do not indicate a decrease in food supply. In fact, current groundfish biomass estimates for the northern part of the fur seal's range are either equivalent to, or slightly above, levels estimated before any substantial increase in commercial fisheries in the area.<sup>131</sup> Because fur seals are opportunistic feeders, they would be expected to adjust readily to changes in the composition of prey items, if such changes were occurring.

Changes in food availability would normally result in changes in the length of the feeding cycle of fur seals at sea. No such change has been observed in the length of feeding cycles of Pribilof seals observed currently as compared with those of the 1960's.<sup>132</sup> Reduced mean body size and reduced growth rates are also typically seen when a population's food supply is limited. On the Pribilofs, average body size of both male and female fur seals has increased during the period of population decline.<sup>133</sup> Thus the available evidence does not suggest a reduction in prey availability for the Pribilof herd.

In summary, the principal factor behind the current population decline appears to be increased mortality at sea, caused by entanglement in fishing debris. The hypothesis of entanglement as a major cause of at sea mortality is consistent with and supported by data concerning pup production and numbers of adult males.

With the lapse of the Interim Convention, North

Pacific fur seals in waters under U.S. jurisdiction are now protected under the Marine Mammal Protection Act (MMPA) of 1972.<sup>134</sup> The MMPA establishes a moratorium on the taking of all marine mammals by persons subject to U.S. jurisdiction, with a limited number of exceptions. "Taking" means harassing, hunting, capturing, killing, or attempting to harass, hunt, capture, or kill any marine mammal.<sup>135</sup> Importation of marine mammals or their products is also prohibited in most cases.

Alaskan Natives are exempted from the taking prohibitions, provided that the species taken is not depleted, and that the taking is for subsistence purposes only. A "depleted" species or population stock, as determined by the Secretary of Commerce, is one which: "A) has declined to a significant degree over a period of years; B) has otherwise declined and that if such decline continues, or is likely to resume, such species would be subject to the provisions of the Endangered Species Conservation Act of 1969; or C) is below the optimum carrying capacity for a species or stock within its environment."<sup>136</sup> The Secretary may establish regulations for the taking of depleted species by Natives. The Pribilof seal population is currently well below the optimum carrying capacity of its environment. Therefore any subsistence harvest conducted by the Pribilof natives must be regulated by the National Marine Fisheries Service of the Department

of Commerce.

Additional exceptions to the MMPA moratorium concern taking for scientific purposes, and taking incidental to commercial fishery operations.<sup>137</sup> Permits are required in both cases, and must specify the number, location, and manner in which animals will be taken.<sup>138</sup>

The MMPA also serves to reduce incidental take by foreign commercial fishing operations; fish may not be imported from any country in which the fishing technology results in a greater level of incidental take than is allowed by U.S. standards.

The MMPA **states** that the primary objective of management of marine mammals should be "to maintain the health and stability of the marine ecosystem," and "whenever consistent with this primary objective, it should be the goal to obtain an optimum sustainable population keeping in mind the optimum carrying capacity of the habitat."<sup>139</sup> The objective to obtain an optimum sustainable population leaves little room for discretion on the part of the Secretary responsible for issuance of permits. The responsibility to prove that a population is at or above its optimum sustainable population, and may therefore be subject to taking, rests with the party wishing to exploit that population. Thus the MMPA protects the Pribilof seal herd from harvesting activities beyond those allowed for subsistence and scientific purposes. However, it does not



address the matter of entanglement which, as discussed above, may be the most significant threat to the survival of the Pribilof herd.

Furthermore, while northern fur seals are protected from harvesting under the MMPA in U.S. waters, the act has limited impact on activities affecting fur seals in waters beyond the bounds of the U.S. exclusive economic zone. Canadian law currently bans pelagic sealing within its 200-mile Fishing Zone, thus providing some protection to the herd. However, during migration, a large portion of the seal population passes well outside the U.S. and Canadian 200-mile zones. There exists some risk that these animals may become subject to pelagic sealing, although the risk is generally considered to be quite small. Due to high operating costs and negative market conditions for seal pelts, it is doubtful that any country could conduct pelagic sealing economically. Japan, the only country likely to even consider a return to pelagic sealing, is highly dependent on commercial fisheries in both U.S. and Soviet waters, and would be unlikely to engage in activities which might threaten access to these fisheries.

Furthermore, it has been argued that after 75 years of almost continuous international prohibition of pelagic sealing, a resumption of pelagic sealing would be in violation of what has become customary international law.<sup>140</sup> Although this is debatable, there seems to be a general

agreement that pelagic sealing operates against principles of sound resource management.

Currently, the National Marine Fisheries Service is working with the State Department and other organizations in attempts to develop a new international management regime.<sup>141</sup> Both the MMPA and the potential for a new international agreement offer possible means to address the current fur seal population decline. Unless steps are taken to reduce the amount of fishing debris discarded at sea, the Pribilof fur seal population is likely to experience a continuing decline. A comprehensive research program is necessary in order to more clearly define the extent of the entanglement problem and to develop solutions to it. Data are needed concerning both the amounts and kinds of gear involved, as well as locations where the problem may be focused.

An international agreement could serve the important function of providing for international cooperation in research related to the entanglement problem, as well as the continuation of scientific research in fur seal biology and population dynamics. Due to the lapse of the 1957 Convention and the disbanding of the Fur Seal Commission, scientists were unable to meet and exchange information in 1986, for the first time in nearly 30 years.<sup>142</sup> Research conducted on northern fur seals in the past has provided the basis for management of the species. In light of the

current population decline, such research may be a key element in establishing an effective strategy to preserve the fur seal herd.

The U.S. might be able to regulate disposal of fishing gear at sea through amendments to the MMPA, or through international fishery agreements by which foreign fleets are granted fishing rights within the U.S. Fishery Conservation Zone. Either approach could be used to impose restrictions on allowable catch or on fishery imports for states not adhering to established regulations.

Legal steps toward solving the entanglement problem will be meaningless without effective enforcement. In order to cite someone for a violation of regulations, that violation must be seen. Therefore enforcement of regulations concerning disposal of debris at sea would require putting observers on the water, which would in turn require substantial amounts of money. Funding will be an important element in both research and enforcement of any regulations which may be established to deal with protection of the fur seal herd from entanglement.

#### Conclusion

Since the discovery of the Pribilofs in 1786, the islands have been administered according to the economic interests of first the Russians and then the Americans. In the early years of U.S. rule, pressure to prove the economic

value of Alaska was a powerful influence on the evolution of Pribilof management policies. Because revenues were directly related to protection of the seal resource, a strong interest existed in natural resource conservation. The 1911 Convention proved successful as a means of restoring a depleted resource, while at the same time providing maximum economic gain for the parties involved. Management under the 1911 agreement resulted in restoration of the severely depleted herd to a population approximately equal in size to the pre-exploitation population. The ban on pelagic sealing was the key management element of the 1911 Convention, and may have been crucial to the continued existence of the herd at commercially exploitable levels.

The 1957 Convention has been less successful, partially due to the changing circumstances in the sealskin market and the growth of public opposition to commercial exploitation of fur seals. In addition, the recent unexplained decline in the Pribilof herd has complicated management efforts.

The Pribilof fur seal herd has been declining steadily since 1974. Such a population decline could be due to reduced reproductive rates, emigration, or increased mortality rates. Studies do not support the hypothesis of reduced reproductive rates in the herd. Emigration is also not considered to be a likely cause for the population decline, due to the low rate of exchange between northern

fur seal populations. Evidence indicates that the current decline is due to increased rates of fur seal mortality at sea. Although several factors may contribute to mortality at sea, recent studies suggest that entanglement in discarded fishing gear is a major factor in the Pribilof herd decline.

Exploitation of northern fur seals is now prohibited under the Marine Mammal Protection Act. While the MMPA severely restricts harvesting of fur seals, it does not address the entanglement issue, and thus may not provide adequate protection of the herd. The entanglement problem could be approached through amendment of the MMPA or other existing laws to establish regulations concerning disposal of fishing gear at sea.

Expiration of the 1957 Convention leaves the seal herd subject to pelagic sealing, and disrupts the international exchange of scientific information which has provided the basis for population management in the past. A new agreement should be negotiated to continue the ban on pelagic sealing, and promote continued cooperation in scientific research efforts, especially those directed at determining the cause for the current fur seal population decline. In addition, efforts should be undertaken at the international level to reduce the amounts of fishing gear discarded at sea, as the incidence of entanglement appears to be a serious threat to the future of the northern fur

seal.

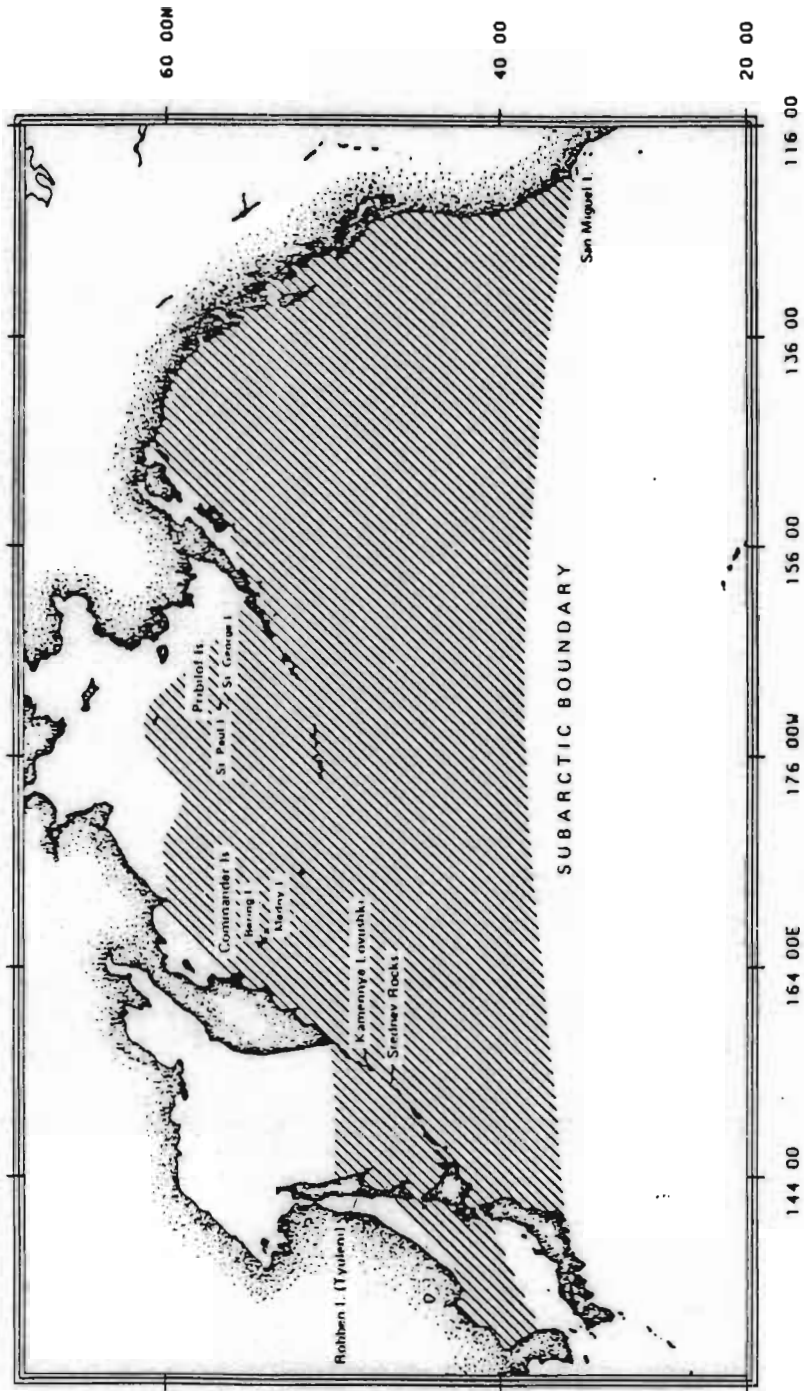


Figure 1. The general ocean distribution and breeding islands of the North Pacific fur seal.  
 (From Kajimura, 1984)

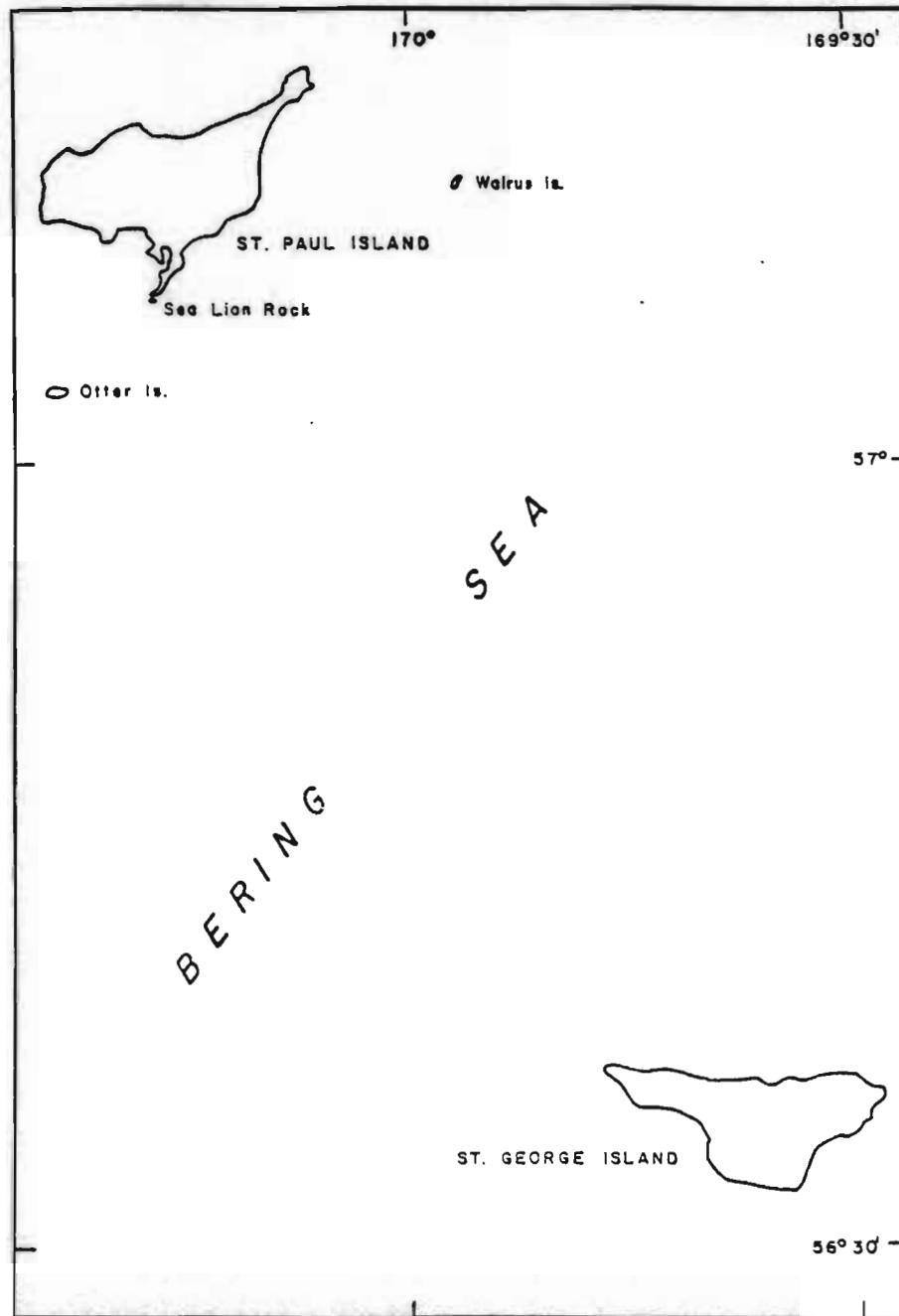


Figure 2. The Pribilof Islands.  
(From Veltre and Veltre, 1981)



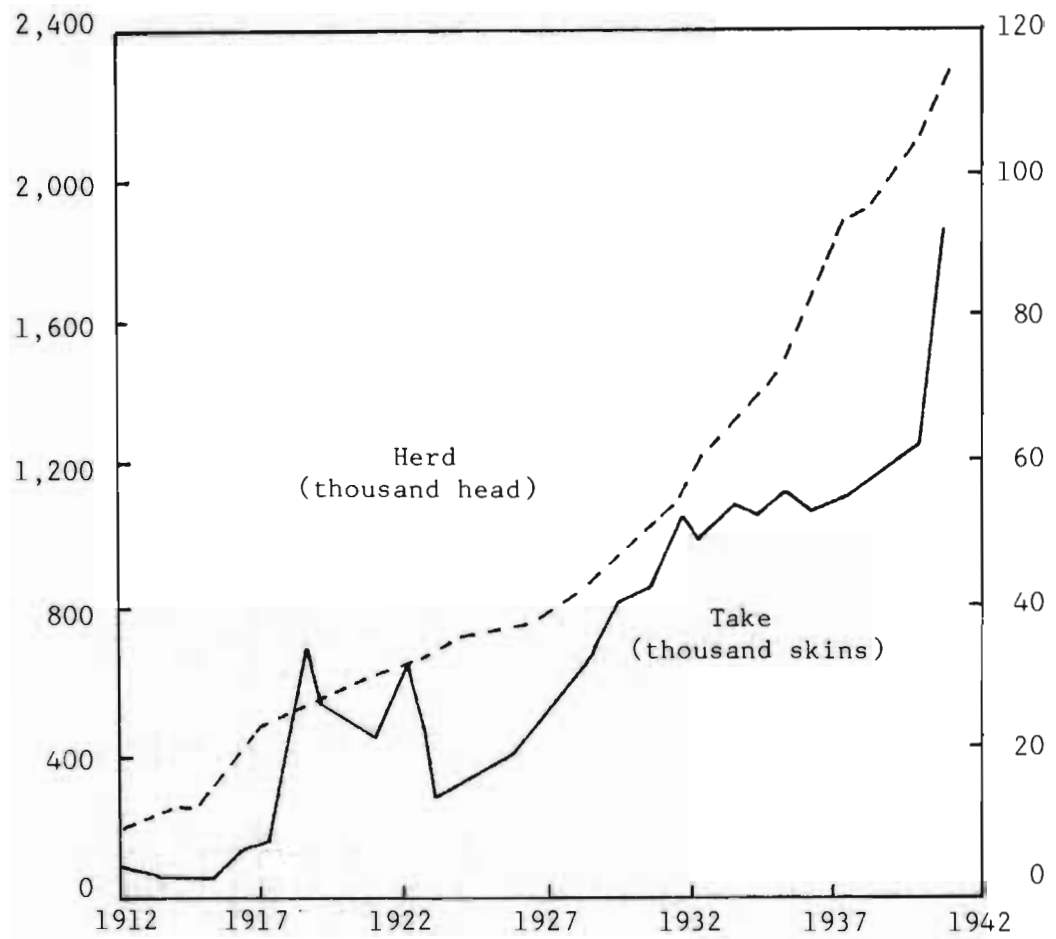


Figure 3. Pribilof Islands fur seal herd and annual take of sealskins, 1912-1941.  
(From Tomasevich, 1943)

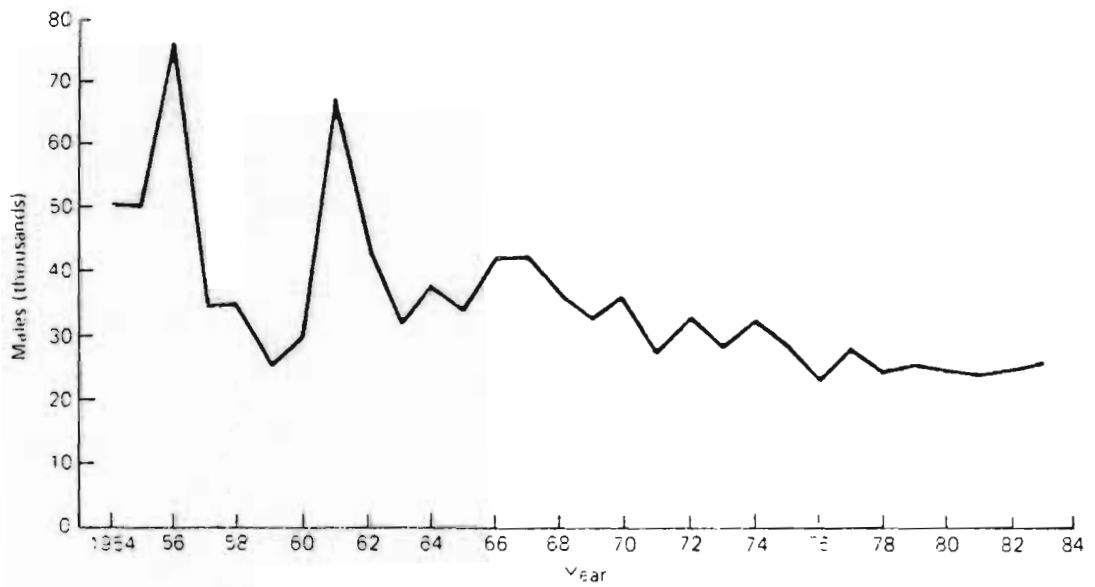


Figure 4. Harvest of subadult male fur seals from St. Paul Island, 1954-1983.  
(From Fowler, 1985)

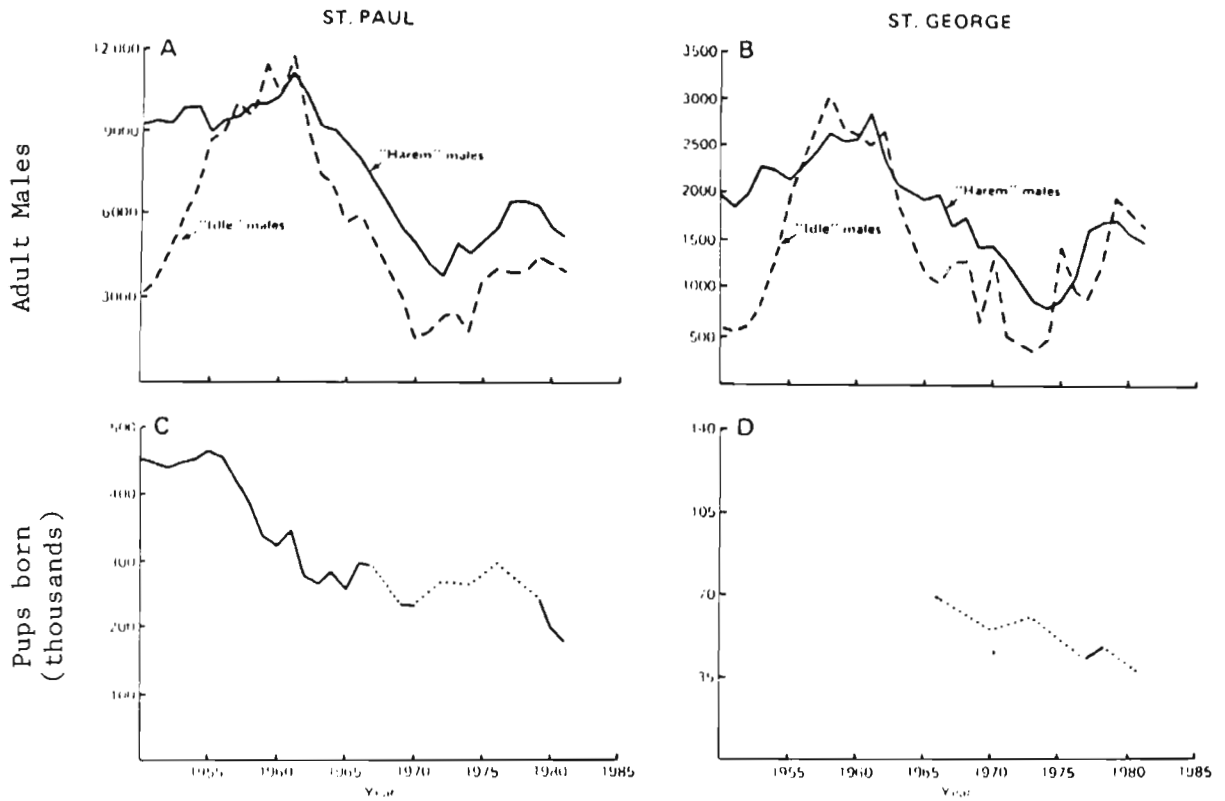


Figure 5. Observed declines in the fur seal population of the Pribilof Islands as indicated by number of pups and large males for both St. Paul and St. George Island, 1950-1981. Dotted lines are for periods during which data are not available for consecutive years. (From Fowler, 1985)

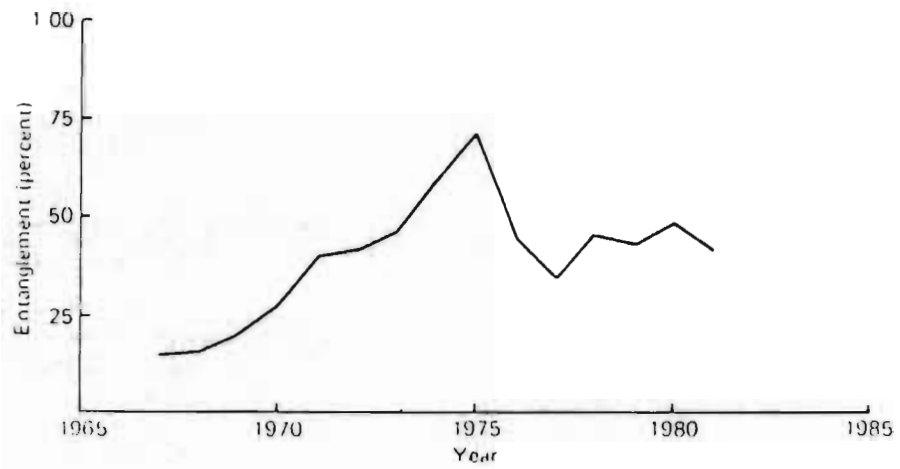


Figure 6. The percent of harvested animals which were entangled in debris, St. Paul Island, 1967-1981.  
(From Fowler, 1982)

Year	Animals in herd	Sealskins obtained	Year	Animals in herd	Sealskins obtained
1912	215,738	3,764	1927	808,870	24,942
1913	268,305	2,406	1928	871,513	31,099
1914	294,687	2,735	1929	971,527	40,068
1915	363,872	3,947	1930	1,045,101	42,500
1916	417,281	6,466	1931	1,127,082	49,524
1917	468,692	8,169	1932	1,219,961	49,336
1918	496,432	34,890	1933	1,318,568	54,550
1919	524,235	27,821	1934	1,430,418	53,470
1920	552,718	26,648	1935	1,550,913	57,296
1921	581,443	23,681	1936	1,689,743	52,446
1922	604,962	31,156	1937	1,839,119	55,180
1923	653,008	15,920	1938	1,872,438	58,364
1924	697,158	17,219	1939	2,020,774	60,473
1925	723,050	19,860	1940	2,185,136	65,263
1926	761,281	22,131	1941	2,338,000	95,013

Table 1. Pribilof Islands fur seal herd and annual take of sealskins, 1912-1941.  
(From Tomasevich, 1943)

NOTES

<sup>1</sup>1911 North Pacific Fur Seal Convention. U.S. Dept. of State. 1928. The preservation and protection of fur seals. Treaty Ser. 564. 7 pp.

<sup>2</sup>1957 Interim Convention on Conservation of North Pacific Fur Seals, 8 UST 2283; TIAS 3948; 314 UNTS 105.

<sup>3</sup>Fowler, C.W. 1985. Status Review: Northern Fur Seals (Callorhinus ursinus) of the Pribilof Islands, Alaska. Background paper submitted to the 28th Annual Meeting of the Standing Scientific Subcommittee of the North Pacific Fur Seal Commission, March-April 1985.

<sup>4</sup>U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 1984. Marine Mammal Protection Act of 1972, Annual Report 1983/84. National Advisory Committee on Oceans and Atmosphere. 1985. North Pacific Fur Seals: Current Problems and Opportunities Concerning Conservation and Management.

<sup>5</sup>Fowler 1985, supra note 3. NOAA 1984, supra note 4.

<sup>6</sup>NOAA 1984, supra note 4.

<sup>7</sup>NOAA 1984, supra note 4. Fowler 1985, supra note 3.

<sup>8</sup>NACOA 1985, supra note 4.

<sup>9</sup>Kajimura, H. 1984. Opportunistic feeding of the Northern Fur Seal, Callorhinus ursinus, in the Eastern North Pacific Ocean and Eastern Bering Sea. U.S. Dept. of Commerce, NOAA Technical Report NMFS SSRF-779.

<sup>10</sup>Scheffer, V.B. 1950. Experiments in the marking of seals and sea lions. Spec. Sci. Rept. Wildl. No. 4, U.S. Fish and Wildlife Service.

<sup>11</sup>Fowler 1985, supra note 3.

<sup>12</sup>Ibid.

<sup>13</sup>Lloyd, D.S. et al. 1981. Discovery of northern fur seals (Callorhinus ursinus) breeding on Bogoslof Island, Southeastern Bering Sea. Arctic 34(4):318-320.

<sup>14</sup>Chapman, D.G. 1981. The Northern Fur Seal--An Example of Complexity, pp. 193-204 in P.A. Jewell and S. Holt (eds.), Problems in Management of Locally Abundant Wild Mammals. Academic Press, New York.

<sup>15</sup>Kajimura 1984, supra note 9.

<sup>16</sup>Busch, B.C. 1985. The War Against the Seals. McGill-Queen's University Press, Kingston, 374 pp.

<sup>17</sup>Fowler 1985, supra note 3.

<sup>18</sup>Ibid.

<sup>19</sup>Ibid.

<sup>20</sup>Ibid.

<sup>21</sup>Kajimura 1984, supra note 9.

<sup>22</sup>Kajimura 1984, supra note 9. NACOA 1985, supra note 4.

<sup>23</sup>Kajimura 1984, supra note 9.

<sup>24</sup>Ibid.

<sup>25</sup>Ibid.

<sup>26</sup>NACOA 1985, supra note 4.

<sup>27</sup>Kajimura 1984, supra note 9.

<sup>28</sup>Harry, G.Y. and J.R. Hartley. 1981. Northern fur seals in the Bering Sea, pp. 847-867 in D.W. Hood and J.A. Calder (eds), The Eastern Bering Sea Shelf: Oceanography and Resources. U.S. Dept. of Commerce, Boulder.

<sup>29</sup>Ibid.

<sup>30</sup>Ibid.

<sup>31</sup>NOAA 1984, supra note 4.

<sup>32</sup>Veltre, D. and M. Veltre. 1981. A Preliminary Baseline Study of Subsistence Resource Utilization in the Pribilof Islands. Alaska Dept. Fish and Game, Juneau.

<sup>33</sup>Ibid.

<sup>34</sup>Johnson, S.H. 1978. The Pribilof Islands, A Guide to St. Paul. Tanadgusix Corporation, St. Paul, AK., 49 pp.

<sup>35</sup>Ibid.

<sup>36</sup>Veltre and Veltre 1981, supra note 32.

<sup>37</sup>Ibid.

<sup>38</sup>Ibid.

<sup>39</sup>Ibid.

<sup>40</sup>Ibid.

<sup>41</sup>Ibid.

<sup>42</sup>NACOA 1985, supra note 4. Busch 1985, supra note 16.

<sup>43</sup>Roppel, A.Y. and S.P. Davey. 1965. Evolution of fur seal management on the Pribilof Islands. J. Wildl. Manage. 29:448-463.

<sup>44</sup>Busch 1985, supra note 16. Elliott, H.W. 1884. Report on the seal islands of Alaska. U.S. Govt. Printing Office, Washington, D.C. 188 pp.

<sup>45</sup>Tomasevich, J. 1943. International Agreements on Conservation of Marine Resources. Stanford U., Calif., 297 pp.

<sup>46</sup>Roppel and Davey 1965, supra note 43.

<sup>47</sup>NACOA 1985, supra note 4.

<sup>48</sup>Tomasevich 1943, supra note 45.

<sup>49</sup>Roppel and Davey 1965, supra note 43.

<sup>50</sup>Tomasevich 1943, supra note 45.

<sup>51</sup>An act to prevent the extermination of fur-bearing animals in Alaska of 1870; for text, see U.S. Congress, House, Committee of Expenditures in the Department of Commerce and Labor, Investigation of Fur-Seal Industry of Alaska, Hearings, 62nd Cong., 1st sess., on H.Res. 73, No. 10, pp. 462-81.



<sup>52</sup>Roppel and Davey 1965, supra note 43. Tomasevich 1943, supra note 45.

<sup>53</sup>Chapman 1981, supra note 14.

<sup>54</sup>Tomasevich 1943, supra note 45.

<sup>55</sup>Roppel and Davey 1965, supra note 43.

<sup>56</sup>Tomasevich 1943, supra note 45.

<sup>57</sup>Ibid.

<sup>58</sup>Ibid.

<sup>59</sup>Treaties, Conventions, International Acts, Protocols, and Agreements between the United States of America and Other Powers, 1776-1909 (S.Doc. 357, 61st Cong., 2nd sess., 1910), I, 748-49.

<sup>60</sup>Tomasevich 1943, supra note 45.

<sup>61</sup>Roppel and Davey 1965, supra note 43.

<sup>62</sup>Tomasevich 1943, supra note 45.

<sup>63</sup>An Act to protect the seal fisheries of Alaska, and for other purposes. 1910. 36 U.S. Stat.L. 326-28.

<sup>64</sup>Harry and Hartley 1981, supra note 28.

<sup>65</sup>Tomasevich 1943, supra note 45.

<sup>66</sup>Ibid.

<sup>67</sup>Ibid.

<sup>68</sup>Ibid.

<sup>69</sup>Ibid.

<sup>70</sup>U.S. Dept. of Interior. 1944. Alaska fishery and fur seal industries in 1943. Annual Rept., U.S. Govt. Printing Office, Washington, D.C., 57 pp.

<sup>71</sup>U.S. Dept. of Interior. 1941. Protection and utilization of fur seals of the Pribilof Islands, Alaska. Fish and Wildlife Service Memorandum I-77.

<sup>72</sup>Tomasevich 1943, supra note 45.

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- <sup>73</sup>NACOA 1985, supra note 4.
- <sup>74</sup>Tomasevich 1943, supra note 45.
- <sup>75</sup>Ibid.
- <sup>76</sup>Ibid.
- <sup>77</sup>Interim Convention, preamble, supra note 2.
- <sup>78</sup>Interim Convention, Arts. II and III, supra note 2.
- <sup>79</sup>Interim Convention, Art. IX, supra note 2.
- <sup>80</sup>Interim Convention, Art. V(1), supra note 2.
- <sup>81</sup>Interim Convention, Art. V(2), supra note 2.
- <sup>82</sup>NACOA 1985, supra note 4.
- <sup>83</sup>Chapman 1981, supra note 14.
- <sup>84</sup>NACOA 1985, supra note 4.
- <sup>85</sup>Ibid.
- <sup>86</sup>Interim Convention, preamble, supra note 2.
- <sup>87</sup>Fowler 1985, supra note 3.
- <sup>88</sup>Fowler, C.W. 1981. Comparative population dynamics in large mammal populations, pp. 437-456 in C. W. Fowler and T.D. Smith (eds.), Dynamics of Large Mammal Populations. John Wiley and Sons, New York.
- <sup>89</sup>NACOA 1985, supra note 4.
- <sup>90</sup>Ibid.
- <sup>91</sup>Ibid.
- <sup>92</sup>Ibid.
- <sup>93</sup>Ibid.
- <sup>94</sup>Pelly Amendment to the Fishermen's Protective Act. 22 U.S.C. sec. 1978.
- <sup>95</sup>NACOA 1985, supra note 4.

<sup>96</sup>NOAA 1984, supra note 4.

<sup>97</sup>Ibid.

<sup>98</sup>Goebel, M.E. and R.L. Gentry. 1984. The use of longitudinal records of tagged females to estimate fur seal survival and pregnancy rates. Background paper submitted to the 27th meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission, Moscow, U.S.S.R., April 1984.

<sup>99</sup>Chapman 1981, supra note 14.

<sup>100</sup>NACOA 1985, supra note 4.

<sup>101</sup>Fowler 1985, supra note 3.

<sup>102</sup>Ibid.

<sup>103</sup>NACOA 1985, supra note 4.

<sup>104</sup>Fowler 1985, supra note 3.

<sup>105</sup>Ibid.

<sup>106</sup>Ibid.

<sup>107</sup>Ibid.

<sup>108</sup>Ibid.

<sup>109</sup>Ibid.

<sup>110</sup>Ibid.

<sup>111</sup>Ibid.

<sup>112</sup>Goebel and Gentry 1984, supra note 98.

<sup>113</sup>Braham, H.W., R.D. Everitt, and D.J. Rugh. 1980. Northern sea lion population decline in the eastern Aleutian Islands. J. Wildl. Manage. 44:25-33.

<sup>114</sup>Fowler 1985, supra note 3. NACOA 1985, supra note 4.

<sup>115</sup>Fowler, C.W. 1982. Interactions of northern fur seals and commercial fisheries. Transaction of the 47th North American Wildlife and Natural Resources Conference, pp. 278-292.

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- 136 MMPA Sec. 3(1), supra note 114.
- 137 MMPA Sec. 101, supra note 114.

<sup>138</sup>MMPA Sec. 104, supra note 114.

<sup>139</sup>MMPA Sec. 2(6), supra note 114.

<sup>140</sup>NACOA 1985, supra note 4.

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