

Distribution and abundance of sea lions (*Otaria byronia*) and fur seals (*Arctocephalus australis*) in Peru

By PATRICIA MAJLUF and F. TRILLMICH

Departamento de Biología, Universidad Peruana Cayetano Heredia, Lima, and Max-Planck-Institut für Verhaltensphysiologie, Abteilung Wickler, Seewiesen

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Abstract

Based on official censuses between 1968 and 1979 along the whole Peruvian coastline, distribution of the South American sea lion and South American fur seal in Peru is described. While sea lions are quite evenly distributed along the whole coastline, most fur seals are concentrated in three large colonies S of 13° S. Sea lion and fur seal populations are estimated at about 20 000 each. Census data suggest that sea lion population, despite great local fluctuations, has remained approximately stable while the fur seal population may have increased during the last years. However, it has certainly increased within the last 30 years. Conservation problems are pointed out.

Introduction

Two species of Otariids occur in Peru: The South American Fur Seal (*Arctocephalus australis* Zimmermann, 1783; here referred to as "fur seal") and the South American Sea Lion (*Otaria byronia* De Blainville, 1820; "sea lion"). These two species are distributed all around southern South America, from Brazil (Rio de Janeiro) to the Strait of Magellan, Chile, and also occur in the Falkland Islands (SCHEFFER 1958; CABRERA and YEPES 1960; KING 1964; LAWS 1973).

The presence of sea lions in Peruvian waters has been known for a long time. Its breeding range in Peru extends from the Chilean border northwards to Lobos de Tierra (SCHEFFER 1958; CABRERA and YEPES 1960; GRIMWOOD 1969). Formerly the Galápagos Islands were included in the range of the South American Sea Lion (CABRERA and YEPES 1960; KING 1954) but this was based on a skull misidentification by ALLEN (ORR 1966). Only a single correctly identified dead specimen of *Otaria byronia* was found in Galápagos (WELLINGTON and DE VRIES 1976).

Formerly the northern breeding limit of fur seals on the Pacific coast was thought to be in northern Chile, and the southern parts of Peru were supposed to be visited by them only rarely (SCHEFFER 1958; KING 1964). CABRERA and YEPES (1960) mention that *A. australis* has about the same range as the sea lion but they do not give any details about its distribution in Peru. The Galápagos Islands were also regarded as part of the range of *A. australis* but the fur seals there are now considered a separate species (*A. galapagoensis*; REPENNING et al. 1971). Recently GRIMWOOD (1969) found fur seals up to 13°49'S (Isla San Gallán) with some vagrant animals occurring north of there. REPENNING et al. (1971) state that fur seals occur northwards as far as Lima; but this was given only as an easy geographic reference instead of the actual northern distributional limit at Pisco (REPENNING, pers. comm.).

PIAZZA (1969) mentions that originally seal populations were much larger in Peru and were diminished considerably in 1951. Unfortunately he does not give more specific information on the former abundance of the two species. Seal skin exportation figures



Fig. 1. Coastline of Peru with some of the most important Otariid colonies mentioned in the text

(species not given) for Peru between 1925 and 1946 were several tens of thousands annually (Table 2). As up to 95,209 skins were taken in a single year, without an immediate population crash, populations at that time must have numbered several hundred thousand animals (MAJLUF 1980).

As the present distribution and abundance of both species in Peru is essentially unknown, an analysis of official but unpublished data from 1968–1979 is attempted here. The data on which this account is based and some additional data are given in finer detail in MAJLUF (1980).

Material and methods

Between 1968 and 1979 various Peruvian governmental authorities attempted complete censuses of the pinniped populations along the whole Peruvian coastline (The exact sources of the information are given in the Acknowledgements). These censuses can serve only as a population index because of the following problems: 1. They were made at different times of the year, before, during or after the mating seasons of the two species; 2. they were made over a period of many days, the distant islands viewed from boats, or walking or driving along the accessible coast, disregarding fluctuations in numbers due to thermoregulatory movements of the animals or mass movements induced by disturbances; 3. not all colonies were included in all censuses; 4. instead of counting, some colonies were estimated only; numbers of pups were generally estimated; 5. Occasional errors in species identification are thought to be very likely; 6. colonies may not always have been censused over their entire area; censuses of offshore islands and islets are especially prone to error, as they were often made from mainland using binoculars, and include only the side visible from the coast.

Pinniped censuses by the guards of guano bird reserves may be more reproducible as these men are completely familiar with the sites. Only these censuses have been analysed for estimates of the sex ratio.

The exact location of pinniped colonies was determined (from maps of the Instituto Geografico Militar (1:250 000) with the help of Dr. A. VILDOSO who has taken part in many censuses. He also made available counts made by himself and Dr. A. PIAZZA in 1961, 1963 and 1964. As these counts are incomplete we have included this information only to round off the picture of species distribution, and to evaluate population trends in a few specific sites.

We have ourselves visited Punta Arquillo (Paracas) and Punta San Juan as well as the Ballestas Islands (P. M. only).

Results

The distribution of fur seals and sea lions in Peru

The fur seal

The fur seal colonies in the Paracas National Reserve (Isla San Gallán, Punta Arquillo, Punta Lechuzas) are presently the furthest north breeding places of fur seals in Peru (Fig. 1; exact longitudes and latitudes for all sites mentioned are given in the Table 1). Isla Mazonca is the site furthest north where fur seals have been seen. The highest number observed there was 16 individuals (1977).

The distribution is given in more detail in Fig. 2. There is a great concentration of fur seals between 15° and 16° S representing the two largest colonies known in Peru: San Fernando and San Juan (Table 3 and Fig. 4). The range of fur seals coincides well with the

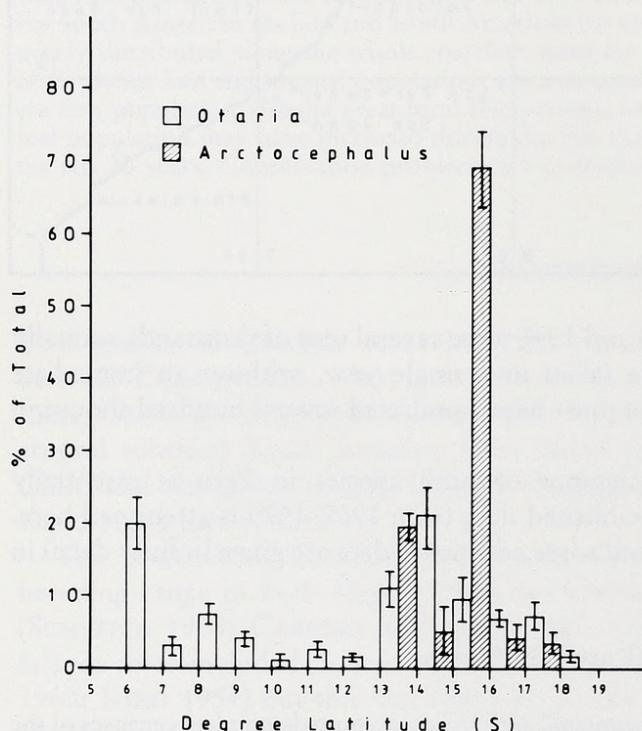


Fig. 2. Latitudinal distribution of sea lions and fur seals from censuses of 1968 to 1979. The columns give the average percentage (1968–1979 for *Otaria*, 1971–1979 for *Arctocephalus*) of the total population of each species by degree latitude

area of lowest sea surface temperatures on the Peruvian coast, caused by nearshore upwelling of cold waters (ZUTA et al. 1978). Near the three most important fur seal colonies, offshore sea surface temperatures in Feb. and May 1974 respectively were 15° and 18° in Paracas, 14° and 15° in San Fernando and 14° and 13° in San Juan (ZUTA et al. 1978). Such low sea surface temperatures are uncommon north of Lima and may partly explain the distribution pattern of fur seals in Peru.

The sea lion

Sea lions breed as far north as Lobos de Tierra and Lobos de Afuera (Table 4). Non-breeding sea lions have been observed farthest north on Isla Foca (Fig. 1) where in 1974 and 1977 up to 47 individuals were counted. The distribution of sea lions along the Peruvian coast is far more uniform than that of fur seals (Fig. 2 and Table 4). The most important colonies occur from Lobos de Tierra and Lobos de Afuera in the north to Morro

Table 1

Location of main colonies in Peru and other sites mentioned in the text

Name of site	Lat. S	Long. W	<i>Arctocephalus</i>	<i>Otaria</i>
Isla Foca	5° 13'	81° 12'		m
Isla Lobos de Tierra + Islotes	6° 26'	80° 51'		+
Isla Lobos de Afuera + Islotes	6° 58'	82° 42'		+
Isla Macabi	7° 48'	79° 30'		+
Islas Guañape + Islotes	8° 32'	78° 58'		+
El Dorado	9° 12'	78° 35'		+
Isla Mazorca + Islotes N. E.	11° 23'	77° 45'	m	+
Isla Pachacamac + Islotes Farallones	12° 19'	76° 53'		s
Isla Asia	12° 48'	76° 37'		s
Islas Chincha (Norte, Centro + Sur)	13° 39'	76° 24'		s
Islas Ballestas (Norte, Centro + Sur)	13° 44'	76° 24'		+/-
Isla San Gallán ^{1, 2}	13° 49'	76° 27'	s	+/-
Peninsula de Paracas ¹	13° 54'	76° 22'	+	s
Isla Zárate ¹	13° 59'	76° 18'		+/-
Morro Quemado ¹	14° 20'	76° 09'		+
Isla Infiernillo	14° 39'	75° 56'	+/-	+/-
Puntas + Islote San Fernando	15° 09'	75° 21'	+	s
Punta San Juan	15° 22'	75° 12'	+	+
Punta Lomas	15° 34'	74° 51'	m	s
Punta Vilcayo	16° 02'	74° 00'		s
Punta Lobos	16° 06'	73° 54'		s
Punta Atico	16° 14'	73° 42'	s	s
Punta + Islote Oscuyo	16° 17'	73° 29'		s
Islote Hornillos	16° 53'	72° 17'	s	+/-
Jesus y Cocotea	17° 16'	71° 32'		+/-
Punta Coles	17° 42'	71° 23'	s	+/-
Morro Sama	18° 00'	70° 53'		s

¹ Belong to Paracas National Reserve - ² San Gallán = Sangayan (GRIMWOOD 1969).
 + = Very important colony; s = small colony; +/- = colony with great fluctuations in numbers; m = migrants only.

Table 2

Yearly export of seal skins from Peru between 1925 and 1946

The species identity of the skins is unknown¹

Year	No. of skins	Year	No. of skins	Year	No. of skins
1925	10,528	1931	73,325	1937	92,454
1926	36,333	1932	47,792	1938	22,568
1927	97,564	1933	5,489	1939	20,865
1928	72,760	1934	49,765	1942	10,400
1929	95,209	1935	54,429	1943	5,600
1930	49,215	1936	36,462	1946	25,494

¹ Source: Estadística General de Aduanas (Exp. Sección 1, Tercer Grupo) and Anuario del Comercio Exterior del Perú (Exp. Sección 1, Segundo and Tercer Grupo)

Quemado and San Juan in the south. The coast south of 13° harbours about 55 % of all sea lions in Peru and is more densely colonized than the northern coast between 5° and 13° S. The zone between 10° and 13° has a very small population of sea lions only. This is presumably due to its proximity to many small fishing towns and the many disturbances emanating from the densely populated Lima area.

The greatest sea lion colonies are also found near zones of upwelling. There is a cold water tongue extending towards the southwest near Lobos de Tierra and Lobos de Afuera, another between 9° and 10° S and a third in the north and we find a higher percentage of the total sea lion population here (Fig. 2). From this it appears very likely that sea water temperature and the correlated productivity of the sea play an important role in determining the distribution of sea lions in Peru.

Abundance of fur seals and sea lions

Fig. 3 gives the totals from the censuses between 1968 and 1979 for each species and for the sum of both. For all three curves correlation of numbers with time is positive. This trend becomes obvious within the last 3 census years; but this may in part be caused by higher census effort and slightly improved standardization of censuses within this period. These trends are not significant for the species taken singly, but for the sum of both the correlation between total numbers and time reaches significance ($r = 0.899$; $n = 6$; $p < 0.05$). The proportion of fur seals in the total has increased during the census years from on average 33 % (1971–1974) to 45 % (1977–1979). This may indicate that the apparent

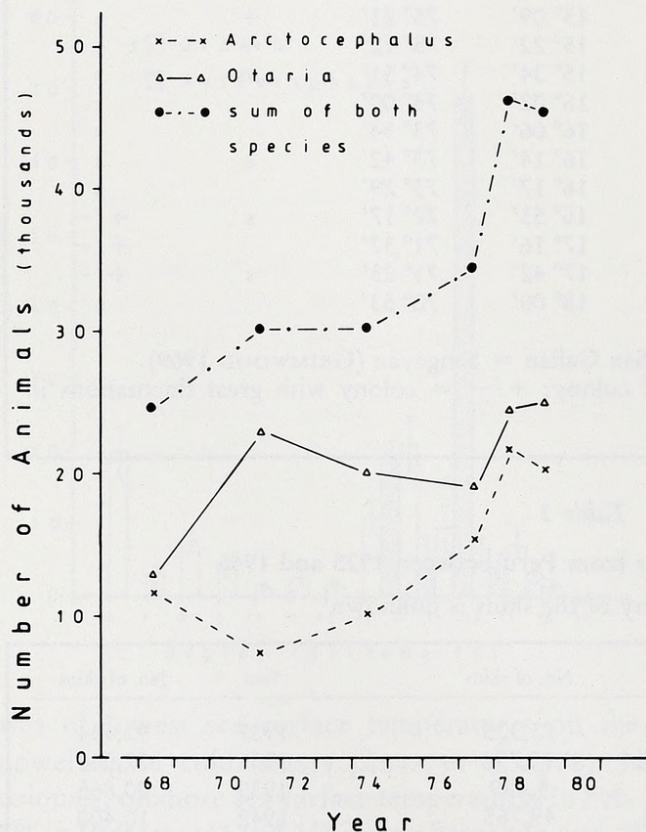


Fig. 3. Numbers of sea lions and fur seals and sum of both species. (Censuses 1968–1979)

increase in numbers is mainly due to fur seals. Clearly the rise in fur seal numbers from about 10 000 in 1968/71 to about 20 000 in 1978/79 (Table 3) stems largely from population growth in the colonies in Paracas, San Fernando and San Juan (Fig. 4). Numbers of sea lions are much more evenly distributed along the whole coastline of Peru (Table 4 and Fig. 2). Although there are a few large colonies the smaller colonies contribute substantially to total numbers. The total of sea lions in Peru apparently is more or less stable at about 20 000 animals (Fig. 3).

The great fluctuations within almost every single colony of either species (Tables 3 and 4) are most likely largely due to census errors (see methods). For example: 1. the population of fur seals in San Juan according to the census figures increased abruptly from 5605 in Dec. 1977 to 14 303 in Dec. 1978, while the guard at San Juan (M. ROJO) counted 7100 and 8600 respectively. 2. At Punta Coles the census per-

sonnel counted 1411 fur seals (Table 3) and between 570 and 1400 sea lions (1977, Table 4), whereas the guard (J. CANASAS) there never counted more than 260 fur seals and 117 sea lions (Fig. 5). Disturbances during the censuses and illegal killings between census times could also be responsible for the sometimes wild fluctuations. Considering the errors inherent in the census methods (see Methods) the totals of about 20 000 fur seals and 25 000 sea lions in 1979 have to be regarded as a relative index of population size (CAUGHLEY 1978, p. 14),

Table 3

Numbers of *Arctocephalus australis* censused along the Peruvian coast from 1968 to 1979

The most important colonies are documented individually, all small colonies are combined under "Other places"

Latitude (°S)	Name of colony	1968	1971	1974	March 1977	Dec. 1977	1978	1979
13°–14°	Paracas	3 885	1 637	2 237	2 745	1 747	3 632	4 246
14°–15°	Infiernillo	902	1 279	–	182	–	346	550
15°–16°	San Fernando	6 720	3 150	1 181	1 746	8 334	2 974	4 500
	San Juan	–	329	5 147	6 783	5 065	14 303	9 644
16°–17°	Atico	–	21	140	70	210	–	163
	Hornillos	–	26	646	–	26	24	805
17°–18°	Coles	–	295	154	1 411	59	254	178
	Other places	299	515	663	312	12	191	169
Total		11 806	7 252	10 168	13 249	15 453	21 724	20 255

Table 4

Numbers of *Otaria byronia* censused along the Peruvian coast from 1968 to 1979

The most important colonies are documented individually, all small colonies are combined under "Other places"

Latitude (°S)	Name of colony	1968	1971	1974	1975	March 1977	Dec. 1977	1978	1979
6°–7°	Lobos de Tierra	2 461	1 999	2 875	401	950	2 186	4 200	2 308
	Lobos de Afuera	1 994	1 510	2 862	1 011	1 498	1 400	2 600	1 863
7°–8°	Macabí	18	65	2 000	77	212	1 181	1 369	318
8°–9°	Guanape	1 038	1 018	3 417	1 126	868	943	732	2 394
9°–10°	Dorado	–	–	860	530	–	–	845	1 600
11°–12°	Mazorca	448	684	213	478	4	1 268	1 733	1 952
12°–13°	Pachacamac	–	45	179	367	104	247	101	54
13°–14°	Chinchas	1 795	1 147	12	406	138	138	–	213
	Ballestas	380	360	114	593	982	641	–	2 150
	San Gallán	–	376	911	608	558	2	581	1 232
	Paracas	–	–	873	225	–	804	17	65
	Zárate	–	479	–	–	–	704	–	1 384
14°–15°	Morro Quemado	2 952	7 604	83	7 324	4 528	683	2 786	3 066
	Infiernillo	–	648	816	745	–	–	1 674	912
15°–16°	San Juan	400	–	284	701	211	3 103	5 836	3 294
16°–17°	Atico	–	9	17	143	–	14	221	144
	Oscuyo	–	–	264	554	268	402	198	360
	Hornillos	–	1 524	–	596	1 374	762	795	417
17°–18°	Jesus y Cocotea	–	–	455	377	1 110	1 083	470	439
	Coles	–	800	1 660	1 370	570	1 400	–	73
18°–19°	Morro Sama	–	351	207	230	212	990	253	223
	Other places	1 321	4 191	1 940	1 947	1 273	945	137	593
Total		12 807	22 810	20 042	19 809	14 860	18 896	24 548	25 054

perhaps closer to a minimum than to a maximum estimate of actual population size. The methodological caveats apply even more strongly to data from single colonies where only averages over several years can give a useful index.

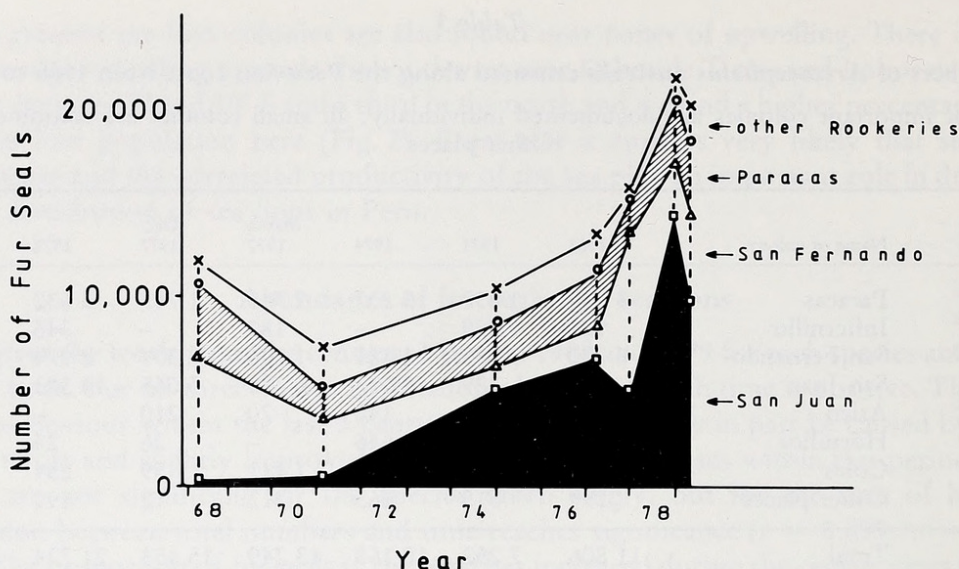


Fig. 4. Contribution of the three largest colonies to the total population of fur seals in Peru

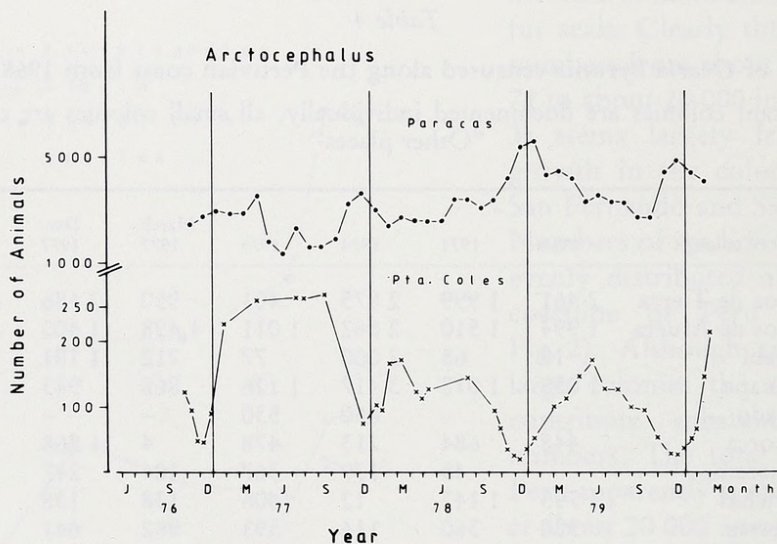


Fig. 5. Fluctuations in fur seal numbers in a breeding colony (Paracas, above) and a non-breeding colony (Punta Coles, below) over the course of the years

Differences between breeding and non-breeding colonies

The fur seals

As we have no information for a single breeding colony, on both sex ratio and fluctuation in numbers, we take as examples the numbers from censuses in the colony at Punta Arquillo ($13^{\circ}55'10''$ S), Paracas, and use the sex ratios as determined from counts made at San Juan. As a non-breeding colony we take the example of Punta Coles, a much smaller colony further south (Fig. 1) for which we have both information on sex ratio and number fluctuation. Punta Coles has been counted almost every fortnight, Punta Arquillo once a month and San Juan only about once every 7 weeks.

Changes in fur seal numbers in a breeding colony (Punta Arquillo) correspond inversely to those observed in a non-breeding colony (Punta Coles) (Fig. 5). While Punta Arquillo has highest numbers in Dec. and Jan., at the end of the breeding season, numbers at Punta Coles are lowest at this time of the year.

Sex ratios also differ between breeding and non-breeding colonies. There is a tendency for sex ratios ($\sigma : \varphi$) at San Juan (breeding colony) to be lowest around the breeding season (Dec./Jan.) and highest around June/Sept. Such a trend is exactly what one expects in such a highly polygynous species, but the data are suggestive only. Averaged over the whole year, the sex ratio at San Juan is 1 : 2.16 ($\sigma : \varphi$) ($n = 22$; standard error of the mean $s_{\bar{x}} = 0.13$) which is significantly ($p < 0.01$) lower than at Punta Coles where it is 1 : 1.1 ($n = 62$; $s_{\bar{x}} = 0.03$).

The sea lion

Detailed data on fluctuation in numbers of sea lions in a breeding colony are presently not available.

The comparison of sex ratios between breeding and non-breeding colonies (data obtained at San Juan and Punta Coles between Nov. 1976 and Feb. 1980) shows an even more marked difference than in the fur seals. In San Juan sex ratio was 1 : 5.09 ($n = 25$; $s_{\bar{x}} = 0.39$) while in Punta Coles it was 1 : 1 ($n = 47$; $s_{\bar{x}} = 0.04$) ($p < 0.01$).

Discussion

Although these data have been collected without giving much consideration to methodological problems (see EBERHARDT et al. 1979) we feel confident that the distribution data as summarized in Fig. 2 quite accurately reflect the actual distribution of both species in Peru. The distribution of sea lions determined from these data also agrees with GRIMWOOD's report (1979). The finding that the distribution pattern correlates reasonably with the distribution of upwelling areas along the Peruvian coast supports this conclusion. Of course some colonies may have gone undetected as the Peruvian coast is extremely inaccessible from land in many places.

The interpretation of numbers counted, however, is much more problematic. All such counts are most susceptible to disturbances (previous to or during the count), to changes in experience and effort of census personnel, and to timing of the census with respect to time of year and of day. We therefore interpret these figures with the utmost caution.

From the analysis of the counts of the last 10 years it is still impossible to conclude with certainty that the populations of Otariids in Peru have increased within this period. However, it appears sure that over the last 30 years the fur seals have extended their range and increased in numbers.

PIAZZA (1969) reported Paracas as the only site where a few fur seals could be found in 1951, although he had visited San Juan and other colony sites in southern Peru. Most likely the Paracas colony was found first because it is also most accessible. Later, in the counts made by PIAZZA, VILDOSO and TOVAR (made in 1961, 1963 and 1964) Paracas was still the most important fur seal colony but a few small colonies were found south of there. GRIMWOOD (1969) reported Paracas as the only breeding colony with about 2000 animals but estimated a total fur seal population of 4000–5000 (GRIMWOOD 1968 in LAWS 1973). He did not refer to San Juan and San Fernando as fur seal breeding sites although the latter site was mentioned as a small colony of *Otaria* in 1966 (GRIMWOOD 1969), suggesting that fur seals must have been very rare there at that time.

At present both species enjoy legal protection; but there is no enforcement of the law. Even their protected status is questioned time and again mainly because of the alleged damage done to the fishery especially by sea lions, but also because of economic interests in the exploitation of fur seals for pelts. It is often claimed that the populations recently have increased dramatically and need to be checked to keep down economic damage to the fishery. The available data provide no basis for this claim. The actual damage to the fishery has never been objectively estimated. Nevertheless the fishery lobby tries to bring about

the annulment of the protection of these species, which would again put both in immediate danger of – at least local – extinction.

Although the numbers of fur seals appear to have increased over the last years and are much higher than anyone expected, the population is very vulnerable due to the fact that about 90 % of all fur seals are concentrated in three colonies. At least one of these sites is a National Reserve (Paracas), and another a guano bird reserve, which provide them a certain protection. But San Fernando, the third large colony of fur seals, is protected only by its inaccessibility.

During the breeding season, the decrease in numbers at non-breeding places and the increase in the breeding colonies points to some movement of fur seals along the Peruvian coast; but the extent of this migration and distances covered cannot even be guessed at present.

There is still some poaching of fur seals and illegal trade with furs. These two factors do not yet appear to endanger the population seriously. At sea, fur seals do not normally approach fishing boats as sea lions do (VAZ-FERREIRA 1979) and thus are much less subject to persecution by small boat fishermen. However, every effort should be made to keep the few large colonies undisturbed and well protected, because any change in these sites will have tremendous influence on the whole fur seal population in Peru.

Sea lions are safer from extinction at present because they are much wider and more evenly distributed in Peru than fur seals. Unfortunately they have this habit of following fisher boats. Also concentrations of sea lions indicate to the fishermen the presence of fish schools which are then surrounded with nets (M. ROJO, pers. com.). Sea lions near boats or enclosed in the nets are often shot or even dynamited. Bulls appear to be more prone to this persecution, which may partly explain the more female biased sex ratio among adult sea lions as compared to that in fur seals. Injured sea lions (especially bulls) are frequently seen in all colonies. Persecution at sea and slaughter on land may easily exterminate the species, at least locally; rigorous protection in a few sites, perhaps not near major fishing villages, may be of crucial importance to the survival of the species in Peru.

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Zusammenfassung

Verbreitung und Häufigkeit von Seelöwen (Otaria byronia) und Seebären (Arctocephalus australis) in Peru

Die Verbreitung von Seebären und Seelöwen in Peru wird beschrieben. Diese Beschreibung gründet sich auf Zählungen entlang der gesamten peruanischen Küste, die zwischen 1968 und 1979 durch Gruppen von Beauftragten verschiedener Ministerien durchgeführt wurden.

Seebärenkolonien existieren nur südlich von 13° S. Herumstreifende Tiere wurden am weitesten nördlich auf der Insel Mazorca angetroffen. Etwa 90 % der bekannten Seebärenpopulation ist in drei großen Kolonien konzentriert, Paracas, San Fernando und San Juan (Fig. 5). Insgesamt wurden etwa 20 000 Seebären gezählt (Table 1).

Seelöwenkolonien existieren südlich von 5° S. Diese Art ist weit gleichmäßiger entlang der peruanischen Küste verteilt als die Seebären (Fig. 2). Südlich von 13° S steigt die Dichte der Seelöwen etwas an. Seebären- und Seelöwenkolonien kommen vor allem in Küstenbereichen vor, in denen kaltes Tiefenwasser durch Aufströmung an die Oberfläche gelangt.

Es läßt sich nicht sicher sagen, ob die Populationen beider Arten in den letzten 10 Jahren zugenommen haben. Der gesetzliche Schutz beider Arten müßte strenger überwacht werden, wenn die Populationen ihre frühere Größe wieder erreichen sollen.

Resumen

Se da una descripción de la distribución del Lobo Fino o de Dos Pelos de Sudamerica y del Lobo Chuzco o de Un Pelo de Sudamerica, hecha en base a los censos hechos por varias entidades oficiales entre 1968 y 1979 a lo largo de la costa peruana.

Las colonias reproductoras del lobo fino se encuentran al sur de los 13° S. Algunos individuos han sido vistos algo más al norte en Isla Mazorca. Aproximadamente el 90 % de la población conocida de lobo fino se encuentra en tres colonias, Paracas, San Fernando y San Juan (Fig. 5). Se ha registrado un total aproximado de 20 000 lobos finos (Table 1).

El lobo chuzco se reproduce hasta los 5° S con una distribución bastante más uniforme que la del lobo fino. Al sur de los 13° S hay una concentración ligeramente mayor. Se ha contado aproximadamente 25 000 lobos chuzcos (Table 2). Las principales colonias de lobos fino y chuzco se concentran en las zonas de afloramiento (upwelling) de la corriente de Humboldt.

Todavía no se puede hablar de un aumento en las poblaciones en los últimos 10 años, pero para que ambas especies recuperen sus niveles anteriores, debe de aumentarse la protección legal existente.

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Authors' addresses: PATRICIA MAJLUF, Departamento de Biología, Universidad Peruana Cayetano Heredia, Apartado 5045, Lima, Perú; Dr. FRITZ TRILLMICH, Max-Planck-Institut für Verhaltensphysiologie, Abt. Wickler, D-8131 Seewiesen, FRG



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