Establishing the Humboldt Penguin SSP:
a report from Coordinator P. McGill-Harelstad

At the annual meeting of the Humboldt Penguin Species Survival Plan in September 1987, it was announced that Patricia McGill-Harelstad had been appointed the Species Coordinator. Although Humboldt penguins had been listed as an SSP species for several years, there had never been a coordinator appointed. Studbook Keeper Steve McCusker has moved from Washington Park Zoo to Reid Park Zoo but is maintaining the Studbook duties for the present.

Further organization of this SSP program is beginning; recently, all institutions listed in the studbook have been contacted about officially participating in the SSP. Memoranda of Participation or Applications for Non-member Participation are being sent to the respective zoos and aquariums. When these have been returned, the Propagation Group will be established from all Participating Institutions. Stanley Park Zoo of Vancouver, British Columbia, has added its Humboldt

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A Survey for Our Readers insert
Magellanic Penguins of Patagonia

Dr. P. Dee Boersma began her Spheniscid penguin research with work on the Galapagos penguin in the 1970’s. For the past 5 years she has studied S. magellanicus, primarily at Punta Tombo, Argentina, where she will be returning this fall. When we spoke with her, she had just returned from a visit to Peruvian researchers at nesting colonies of S. humboldtii. Despite her busy schedule, she was kind enough to write the following article for SPN, presenting some observations on factors affecting future survival of Magellanic (and other) penguins.

Every August, Magellanic penguins clamber up the beaches at Punta Tombo, Argentina, to begin another breeding season. Hundreds of thousands of penguins line beaches hardly more than a stone’s throw from a city of more than 40,000 people. The abundance of wildlife and its accessibility makes Punta Tombo a popular stop for tourists. Last year, the Office of Tourism estimated that more than 30,000 people came to the 210 hectare reserve that extends like a finger into the South Atlantic Ocean.

In 1981, a Japanese company put forward a plan to harvest 400,000 penguins yearly for Argentina. This produced a public outcry in Argentina. Realizing little was known about the number of penguins or what management alternatives should be considered for the tiny reserve, Wildlife Conservation International and the Office of Tourism in the Province of Chubut began the Magellanic Penguin Project.

Five years later, we know that even large colonies are vulnerable to natural environmental perturbations. In 1984, less than 1% of the breeding penguins were able to fledge chicks, in large part because of unusually cold weather and poor food. Reproductive success is variable and has ranged from a high of 55% to the low of less than 1%. Such high variability in reproductive success, coupled with high mortality of juveniles, points out the importance of protecting the adult breeders.

As humans place greater demands on the area, protecting penguins becomes more difficult. For example, oil tanker traffic results in a sporadic coiling of birds. In February, 1987, about 10% of the penguins standing on a beach at a breeding colony at Cabo Dos Bahias were spotted with oil. In June, 1988, about 600 penguins were found oiled and dead near Punta Norte on the Peninsula Valdes. Oil development and transport continue to increase along the Argentine coast, so it is likely that the oiling of penguins will become a larger problem in the future.

At the same time, fishing along the huge continental shelf of Argentina by Russia, Korea, Taiwan, Japan, Poland and Argentina is also increasing. There is little control and knowledge about the quantity and type of fish these fisheries are removing and how this will affect the wildlife along the coast of Argentina. We do know that 4% of banded penguins found dead were trapped in fishing nets, which suggests that nets are an important source of mortality for adult birds.

Differences in Spheniscus breeding biology, differences in how humans use the marine and terrestrial environments, and differences in where penguins live will require different management to secure penguin populations. Conservation of penguins will require protection of both the marine and terrestrial environments penguins use, and will need to be based on the natural history of each species.

This is especially difficult for a species like the Magellanic penguin, which migrates thousands of kilometers each year, crossing international borders and passing through areas of high human use. For example, individual Magellanic penguins banded at Punta Tombo, Argentina, have been captured just south of Rio de Janeiro, Brazil—almost 30 roundtrip distances of more than 2500 nautical miles. Most species of Spheniscus, which breed in the nonbreeding period, breed in almost any month if food is available, and can be seen on beaches near breeding sites throughout the year. In contrast, Magellanic penguins are highly seasonal breeders, present at their colonies for no more than 8 months each year. Once Magellanic penguins leave the breeding colonies and head north, they only come ashore when they are starving, sick, or oiled. Colony sites are not as important to Magellanic penguins in the nonbreeding period as they are to other Spheniscus penguins.

All the Spheniscus penguins breed in relatively dry environments even though they live close to the ocean. Most individual birds prefer to nest in burrows. In Zoos, where it is difficult to keep humidity low and where adults often return to the nest while still wet, high humidity, which fosters fungal and bacterial growth, may lower adult and chick survival. Humboldt penguins are likely to be the most vulnerable to diseases fostered by high humidity because they live along the coast of Peru and northern Chile, one of the driest environments that occurs along any marine coast. Captive nesting success of Humboldt penguins might be increased if nest sites had low humidity and were guano free, characteristic of most nests in the wild. For all Spheniscus penguins, adult survival is critical as these penguins are relatively fast breeders, laying two eggs at each breeding attempt. Breeding frequency varies with

SPN September, 1988 page 2
First International Conference on Penguins
Convenes in New Zealand

The first International Conference on Penguins was held in Dunedin, New Zealand, from 16-19 August 1988. Hosted by Dr. John Darby and Dr. Lloyd Davis of the University of Otago, the meeting was attended by nearly 80 scientists representing nine countries. After a stimulating keynote address by Dr. Bernard Stonehouse, papers presented over the four day period focused on nearly all aspects of penguin biology including behavior, demographics, physiology, foraging, energetics, captive maintenance, radiotelemetry, and fossils. The conference provided a forum for the first truly interdisciplinary synthesis of contemporary penguin research in the field, laboratory, and in zoos.

Several papers on Spheniscid penguins were presented. Dr. Dee Boersma, of the University of Washington, Seattle (USA), spoke about the breeding biology and colony development of Magellanic penguins at Punta Tombo, a study site at which she has been working for over a decade. According to Dr. Boersma, the presence of the Magellanic penguin at this site appears to be a relatively recent trend in their distribution range. Likely affected by changes in food distribution and/or changes influenced by phenomena such as El Nino, it appears that Magellanic penguins have moved in numbers to inhabit the Punta Tombo region only within the last 100 years.

Dr. Carolien Scholten, of the Emmen Zoo, Netherlands, reported on respective roles of male and female Humboldt penguins in mate and nest-site choice. According to Dr. Scholten, in a zoo setting and in the wild, trends are comparable: males determine the location of the nest site and females determine choice of mate.

Christina Slager, of the California Academy of Sciences, San Francisco (USA), described the penguin habitat at the Steinhart Aquarium, a facility that has been very successful in breeding Black-footed penguins. At this facility, penguins are induced to double- and triple-clutch by removal of early clutches of eggs for artificial incubation and hand-rearing, thus maximizing reproductive output from the colony. General husbandry in the facility, hand-rearing protocols, and chick growth data were also discussed.

Dr. Rory Wilson, of the Institut für Meereskunde, Kiel, West Germany, presented a paper on the foraging ecology of Spheniscus penguins. Dr. Wilson described two types of dives, traveling and searching, used by Spheniscus penguins during foraging. Traveling dives are approximately 20 seconds in duration and are relatively shallow. Searching dives are more effective for prey location, are deeper, and are up to 240 seconds in duration. Almost all birds forage within 25 km of their breeding island; as chicks get larger and food demands increase, parent birds travel farther to forage.

Selected papers from the conference will be published in a book forthcoming from Academic Press. Publication of abstracts from the conference papers will be announced in a subsequent edition of this newsletter.

Plans for a second International Conference on Penguins have already begun. Dr. John Croxall of the British Antarctic Survey has been designated as preliminary coordinator.

Sue Ellis-Joseph, Ph.D.
Assistant Curator of Birds
Lincoln Park Zoo
Chicago IL (USA)

RECENT PUBLICATIONS

Magellanic Penguins, cont'd

the species. The Galapagos penguin may lay eggs up to 3 times in a little more than a year, while the Magellanic penguin breeds but once each year. Humboldt penguins are relatively intermediate between these two species and, like the Jackass penguin, have two breeding seasons each year. The natural history of these birds in the wild may provide clues that help captive propagation. Small changes in adult survival may mean the difference between success and failure in the quest to sustain these birds in the wild and in zoos.

P. Dee Boersma
Professor, Institute for Environmental Studies and Zoology
University of Washington
Seattle, Washington
USA

[Editor's note: Dr. Boersma's reference to "guano free" Humboldt nests may seem puzzling, since this species formerly nested by burrowing into old guano deposits. In our telephone conversation this was clarified when Dr. Boersma described the Humboldt nests she had recently seen as being clean and free of fresh guano because the penguins defecated outside their nests—a behavior that is unfortunately not always characteristic of captive Humbolds.]

Humboldt SSP Report, cont'd

penguin population to the Studbook. Last September (1987), New York Zoological Park announced their intention of dispersing their Humboldt penguins and have since sent their birds to the St. Louis and Milwaukee County Zoos. With these 2 changes, the Studbook now represents 11 institutions.

The Studbook is in the final stages of preparation; publication is expected by early July 1988. The Studbook is now in the Odum program, IBM format.

Of the 398 Humboldt penguins listed in the Studbook, half (199) are wild-caught birds. Of these, 85 are still living. Of the birds that are captive-hatched or of unknown parentage, 67 are currently living. More detailed analysis of the population characteristics will be available for discussion at the Annual SSP meeting in Milwaukee in September 1988. A questionnaire about aspects of husbandry, particularly causes of death, hatching failure, and pre-fledging mortality, has recently been distributed to all institutions participating in the Studbook. During the next 4 months, goals for the program include assembling this information, identifying some of the husbandry concerns, beginning analysis of founder representation, and preparation for discussion at the upcoming Annual SSP Meeting which will focus on identifying particular problems for the captive population.

P. McGill-Harelstad
SSP Coordinator
Brookfield Zoo
Chicago, Illinois
USA

From the Editors, cont'd

There is no subscription charge; though, due to the cost of overseas air postage, we do ask that individuals at the same institution share one copy if possible. Our mailing list for this first issue numbers 117 zoological institutions, and about two dozen researchers and other individuals. Those wishing to be added to our mailing list may write to the address on this page; on the other hand, if your institution no longer houses Spheniscid penguins and has no strong interest in them, please notify us so that we can keep the mailing list current.

Acknowledgements

The first issue of SPN, and the accompanying survey, have benefitted from the suggestions and support of many individuals. Special thanks to those who contributed articles, and to artist Ann Munson for graciously allowing us to reproduce her fine penguin drawing as our logo; to the primate department staff at the Dallas and Columbus Zoos for encouragement when this project was in the early stages; and, at Washington Park Zoo, to Jan Barker, Karen Dale, Dave Kato, Nancy King, Jill Mellen, General Curator Dennis Pate, Dr. Michael J. Schmidt, DVM, and Director Y. Sherry Sheng, for their assistance and support.
Spheniscus Penguins in United Kingdom Zoos
from September 30, 1986 to September 30, 1987

The Royal Zoological Society of Scotland performs a valuable service by compiling an annual survey of all penguin species held in U.K. zoos. We are pleased to reprint, with their generous permission, the Spheniscus penguin entries from the most recent survey.

<table>
<thead>
<tr>
<th>Zoo</th>
<th>Eggs laid</th>
<th>Chicks hatched</th>
<th>Survived</th>
<th>Total Birds as of 30/09/87</th>
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<tr>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Spheniscus demersus</td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td>Blackpool</td>
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<td>0</td>
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<td>Bristol</td>
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<td>3</td>
<td>2</td>
<td>13 (5. 6. 2)</td>
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<tr>
<td>Fota Cork</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4 (0. 0. 4)</td>
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<td>London R. P.</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>34 (0. 0. 34)</td>
</tr>
<tr>
<td>Paignton</td>
<td>12</td>
<td>5</td>
<td>4</td>
<td>25 (6. 6. 13)</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>35</td>
<td>11</td>
<td>9</td>
<td>79 (11.12. 56)</td>
</tr>
<tr>
<td>Percentage hatched = 31%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage reared = 81%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Humboldt penguin</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spheniscus humboldti</td>
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<td></td>
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<td></td>
</tr>
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<td>Colwyn Bay</td>
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<td>7 (0. 0. 7)</td>
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<td>Chester</td>
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<td>15</td>
<td>12</td>
<td>37 (0. 0. 37)</td>
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<td>13</td>
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<td>20 (9. 9. 2)</td>
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<td>8 (0. 0. 8)</td>
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<td>Whipsnade</td>
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<td>21</td>
<td>17</td>
<td>52 (20. 20. 12)</td>
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<td><strong>TOTAL</strong></td>
<td>103</td>
<td>49</td>
<td>34</td>
<td>126 (30. 30. 66)</td>
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<tr>
<td>Percentage hatched = 47%</td>
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<td></td>
</tr>
<tr>
<td>Percentage reared = 69%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What Makes a Studbook Tic (sic)?

For most of us, studbooks and other statistical compilations seem to appear, simply and effortlessly, like Minerva springing full-grown from the brow of Zeus. In the following article, Humboldt Studbook Keeper J. Stephen McCusker takes a humorous look at the subject, and shows us just how far from simple and effortless this creation actually is.

Ah yes, the glory, prestige, and fame involved in being a studbook keeper. Horsefeathers! The fact is that beginning a studbook for exotic animals is enough to make a normal (or not so normal) person crazy. You have to be nosy, pushy, inquisitive, persistent, patient, insensitive, a bit of a sleuth, a good guesser, and basically a nuisance. Otherwise, you're never going to get any data of any sort, ever! And your studbook will be real crumby with no data!

After approval for a studbook has been granted, you spend a great deal of time devising the perfect data sheet. You want it to be complete so you get all the necessary data, but you also want it to be simple so that busy people will be willing to fill in the blanks and return the data in a timely fashion. Why anyone would think that this utopian scenario is achievable is beyond me. Perhaps I was crazy before I started this studbook adventure.

There are some people who are eager to cooperate. They send you all their data, perfectly formatted, within days of your request. Unfortunately, by the time you have (or think you have) all the data gathered and ready to collate, the early data is outdated. And so you have to keep going back to the cooperative folks time after time to get current information; they get real tired of being cooperative.

Some folks think that in an effort to save time (at least that's their sorry excuse) they should give you data on the ol' telephone. That usually means they are too busy, or perhaps too lazy, to write down the information. Or, heaven forbid, it may mean they can't decipher your simple data sheet. Yikes! Regardless of why they want to use the phone, it doesn't work; the phone has a way of reducing your data to guano soup.

Other folks try to reinvent the data sheet. You've made it as clear and simple as possible in an effort to urge people to respond and they still insist on making it difficult: date of death in date of acquisition column; today's date where date of hatching should go; name of person filling in data where house name of animal should go; sex of bird curator in space where sex of animal should go. You end up with a wild caught, female sire that hatched in the curator's office, four months before it was imported from Mule Shoe, Texas. So, you put on your Joe Friday hat, delve into the data, and try to come up with nothing but the facts. Fortunately, a little detective work usually produces the necessary information.

Others never send you any data. In which case you have to try to get it yourself. This is not only time consuming and difficult, but it usually turns out to be fruitless. Usually the data is so questionable that you simply delete the animal or animals from the studbook and, of course, from the SSP.

So, once you feel like you've got all the data you are going to get (which I might add is very different from all the data you need), it is then time to put the studbook in a nice, easily accessible format. This is where computers come in handy (sometimes), but that's another story.

You begin by making the studbook numbering system sequential; that is, with order and meaning. You know, the older the entry, the lower the number. And so you assign studbook numbers to all your present entries. Perfect, everything has a number and it makes sense. Then, after months of writing, calling, badgering, and waiting, you finally get data from Joe Billy Bob's We got 'em You Pet 'em Park. His animals (though none of them have individual identification) were all imported sometime between 1946 and 1951. So much for your sensible numbering system.

You plug Joe Billy Bob's data in as best you can; if possible at this stage you hit a few magic keys and rearrange a few studbook numbers; you send some rough draft copies to a couple of studbook gurus for their approval; you implement their comments (which, if you were not attentive from the beginning, could take months); you figure out how to get the piece printed and bound; and presto - you're done; ready for publication, mailing, and a rubber room!

The saving grace and the reason they let you out of the rubber room after only a short stay, is that studbooks are necessary tools. Our efforts to conserve wild species and to maintain genetic diversity rely heavily on the use of studbooks.

For me the hard part is over. The Humboldt penguin studbook is published. Now all I have to do is monitor and maintain the data in a timely fashion; and perhaps seek some medical advice on this awful tic I've developed.

J. Stephen McCusker
Director, Reid Park Zoo
Tucson, AZ (USA)

Brief notes

Fleas as a force for conservation

Egging for Jackass eggs (on the Falkland Islands, circa 1930) is not very popular, for although the eggs when fresh are more like hen eggs than those of either of the other species [gentoo and rockhopper], and are very good for eating, they are difficult to collect in large numbers, and the collector runs the risk of being smothered in Jackass fleas, which will remind him unpleasantly for several nights of his otherwise enjoyable expedition.

—Cobb, 1933; quoted in Murphy, Oceanic Birds of South America, vol. 1:441. "Jackass penguin" here describes S. magellanicus.

Dietary notes

Fauvety (1888, 332) reports that in Patagonia the coastal waters about the Jackass Penguins colonies usually support a good growth of kelp (Macrocystis pyrifera). This seaweed is favorable to the existence of cuttlefish, organisms which appear to constitute the principal food of the penguins during the season of breeding and the rearing of the young. Throughout this period, Fauvety found no other food in the stomachs examined.

The chart above shows only a small part of the information contained in the Studbook. It presently covers 398 individuals, living and dead, and for each, gives information under the following headings: Studbook ID number, sex, name, birth date, Sire's number, Dam's number, present location, date of arrival, house ID number and/or band color, status (dead or alive), death date if applicable, and inbreeding status. For the group, information includes a listing of founder stock, a breakdown of all offspring under their sires and dams, and the population age structure for both sexes.

The January 1989 issue of the Studbook will contain complete information for the 1987-88 breeding season, and will be summarized in the March 1989 SPN.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Males</th>
<th>Females</th>
<th>Unknown</th>
<th>Founders</th>
</tr>
</thead>
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<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Brookfield (Illinois)</td>
<td>2</td>
<td>3</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Cleveland (Ohio)</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>11</td>
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<td>Milwaukee (Wisconsin)</td>
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<td>3</td>
<td>3</td>
<td>5</td>
</tr>
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<td>Niagara Falls (N.Y.)</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Philadelphia (Pennsylvania)</td>
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<td>5</td>
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<td>Washington Park (Oregon)</td>
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<tr>
<td>Sea World (California)</td>
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<td>8</td>
<td>15</td>
<td>23</td>
</tr>
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<td>Seattle (Washington)</td>
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<td>4</td>
</tr>
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<td>St. Louis (Missouri)</td>
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<td>6</td>
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<td>1</td>
</tr>
<tr>
<td>Vancouver (B.C., Canada)</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Waimanolo (Hawaii)</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>48</td>
<td>56</td>
<td>47</td>
<td>84</td>
</tr>
</tbody>
</table>
Status of the Humboldt Penguin in Chile following the 1982-83 El Nino


Our thanks to Frank Todd for permission to reprint this article.

INTRODUCTION

The Humboldt or Peruvian penguin (Spheniscus humboldti) and the even rarer Yellow-eyed Penguin (Megadyptes antipodes) of southern New Zealand and associated subantarctic islands are the only endangered species of penguins. In the 1800's, the total population of the Humboldt Penguin may have numbered in the "hundreds of thousands" (Murphy, 1936; Vogt, 1940), but until IFCB sponsored a comprehensive census of the Chilean population in 1981-82 the status of the species there was virtually unknown. Commencing at the Peruvian border and extending south to 34 degrees S, Araya (1983) checked all potential rookery, molting and roosting sites. Based on the number of adults seen and the number of active burrows (actually counted or extrapolated), Araya estimated the breeding population at 8,800 birds. The addition of penguins observed at sea or not associated with a rookery, brought the total up to 10-12,000. Hayes (1985) estimated the breeding population at 14,000.

RESULTS

Tarapaca (18° 20' S-21° 26' S): The initial census indicated that this region was not one of the more important breeding areas for S. humboldti, even though the major Chilean fishing ports are located there. Only 129 penguins were recorded in this region prior to the El Nino. In 1984, 28 adults and four juveniles were seen. The only known active rookery is located at a sea cave (Cueva del Cabalito), a few kilometers north of Iquique, where we saw two juveniles and nine adults. Eight empty nests, apparently recently occupied, were located within the cave.

Antofagasta (21° 26' S-25° 18' S): We recorded 365 penguins in this sector in 1981-82 (48 adults, 191 juveniles and 126 of undetermined age). In 1984, only 57 penguins could be located (2 adults, 7 juveniles and 47 of undetermined age).

Atacama (25° 18' S-26° 09' S): The largest existing rookery in the world is on Isla Pan de Azucar, which was occupied by 6,000 adults in 1981-82. In July 1984 only 42 adults were seen, several of which were incubating eggs which appeared to be fresh. In November 1984, we saw 131 penguins in the colony; because some burrows were occupied, this figure is undoubtedly conservative.

By October 1986, we estimated the population at 2,570 adults, suggesting a steady recovery (Oyarzo, pers. comm.). Isla Pan de Azucar has recently been included within the Chilean National Parks system and is currently afforded a degree of official protection.

Coquimbo (26° 09' S-32° 15' S): On Isla Grande we counted 58 adult penguins in 1981-82. Fifty percent of the birds were nesting on the surface, as opposed to underground in burrows as is more typical of the species. On the 1984 census, 21 penguins were at sea and at least 13 more adults ashore, seven of which were occupying burrows; two containing single chicks and four with eggs. Surface nesting is risky; a large chick (5-6 weeks) seen on the surface on November was later found dead; it had apparently been killed by a Crested Caracara (Polyborus plancus).

We were unable to reach Isla Cima Cuadrada in 1984 where 180 penguins were counted in 1982. All but three were adults.

Isla Chanaral (29° 01' S) is one of the more important Chilean rookeries. It is also of interest because it appears to be the northern breeding limit of the closely-related Magellanic Penguin (S. magellanicus). In 1981-82, 1,750 S. humboldti were associated with the island, as compared to only 218 in November 1984; 84 penguins on the rocks along with 67 active burrows, which would account for 134 breeding adults. A few had eggs, but most nests
Status of the Humboldt Penguin in Chile, cont'd

contained chicks ranging in age from 2-10 weeks, the majority of which were between 4-8 weeks of age.

In November 1985, there were at least 600 Humboldt Penguins in Isla Chanaral. Breeding was in progress with approximately 30% of pairs on eggs and 65% with chicks (40% small downies, 32% with medium-sized downies, and 28% with large downies). In addition, at least eight Magellanic Penguins were present. In October 1986, the penguin population was up to 1,000. Of 109 birds counted along one beach, 21 were juveniles.

A small but important rookery in Isla Choros held 96 adults in 1981-82; eggs and one chick were observed at that time. In 1984, only 32 penguins were seen along with four active burrows; two with chicks of 6-8 weeks and one with two fresh eggs.

We were unable to visit Isla Pajaros (29° 35'-71° 33' W) until November 1984. These islands are infested by thousands of rats (Araya, 1983), which probably pose a significant threat to ground-nesting birds. We could land only on the larger southern island where we saw 560 penguins, a number we believe to be conservative. At least 27 nests were occupied, most containing chicks. Within a large cave, which was only accessible by sea, 41 chicks ranging in age from three to nine weeks were seen. An additional 64 penguins were observed on the smaller island, where a landing was not possible.

At Isla Huevo and the nearby islets of Verde and Blanca, 72 penguins were present during the pre-El Nino census. In 1984, 64 were counted on Isla Huevo, and nesting was in progress. At least 17 active burrows were located there, containing both eggs and chicks (2-8 weeks of age). Twenty-nine penguins (26 adults and 3 juveniles) occupied Isla Verde with four adults and two juveniles on Isla Blanca. Trivelli (pers. comm.) recorded 274 penguins on these islands in October 1985.

Valparaiso (32° 15' S-34° 00' W): This constitutes one of the most densely populated regions of Chile. Isla Cachagua, which on paper at least is afforded official protection, accommodated at least 1,500 Humboldt and 28 Magellanic penguins in 1982. Two years later in November 1984, 1,055 S. humboldti were seen, along with a single S. magellamicus.

Isla Concon is a tiny island near Vina del Mar. Its not particularly important as a rookery site, but is significant as it is used regularly by molting penguins and is a nesting ground for other seabirds. In December 1981, 75 to 80 penguins were on the island. In January 1982, between 250 and 500 penguins were either ashore or in the water adjacent to the island. Most of those on the island were in advanced stages of the molt.

In November 1984 and January 1985, 12 and 7 penguins were present. Subsequently the island was invaded for more than a month by a college class (25-) and as a result the large colony of Peruvian Brown Pelicans (Pelecanus thagus) was totally abandoned. The formerly numerous nesting Guanay Cormorants (Phalacrocorax bougainvillii) were absent as well. However, the more adaptable Kelp Gulls (Larus dominicanus) were still present and breeding as were Inca Terns (Larosterna inca) and a few pairs of Red-legged Cormorants (P. guinardi). While we were carrying out the 1985 census, a boatload of tourists arrived from the nearby resort of Vina del Mar. This apparently happens more frequently than we have previously thought. Our efforts are continuing to have this island designated a national refuge.

In mid-August 1985, the number of Humboldt Penguins observed around Isla Concon had increased to 150-200, and a few pairs had started to nest. Pelicans and cormorants had also begun to reoccupy the island. In September 1986, we found 23 occupied penguin nests, more than we had ever recorded previously. At least 50 penguins were seen in the island, including some juveniles. According to local fishermen, several hundred penguins had recently been observed in Valparaiso Bay.

Prior to 1984, we were unable to check Isla Pajaros Nino (33° 21' S). The island, now known as Algarrobo, has been linked to the mainland by a causeway and a marina has been constructed. Despite a significant amount of human disturbance, the colony is surprisingly productive. In November 1985, 1,000 penguins were present, compared to 400 in 1977 and 530 in 1984. At least 190 burrows were occupied, both in the rocks along the artificial causeway and the former island, containing eggs or chicks, some of which were nearly fledged. An additional 210 burrows were noted which were either too deep to see down into or which were not occupied, but appeared to be active. At least 5 burrows were occupied by pairs of Magellanic Penguins.

DISCUSSION

There can be little doubt the numbers of Humboldt Penguins, as well as other seabirds, showed a major drop subsequent to the 1982-83 El Nino. In Chile, the Humboldt Penguin population plunged from 10-12,000 birds in 1982 to about 2,800 actually accounted for following it in 1984, a decrease of 72-76%. Hays (1986) reported that the number of Humboldt Penguins observed in Peru declined by 65%, from 6-8,000 birds in early 1982 to 2,100-3,000 in 1984, a decrease similar to that experienced in Chile. Tovar and Cabrera (1985) indicated that in Peru alone, the population of guano birds (Guanay Cormorant, Peruvian Booby, and Peruvian Brown Pelican) fell from an estimated 6 million adults in March 1982 to 2,230,000 by the end of the year and to less than 500,000 by mid-May 1983. Chick and juvenile mortality was particularly extensive.

By 1985, the penguins were beginning to recover, at least in some colonies (Table 1). Isla Pan de Azucar increased to 2,570 adults by October 1986, versus 42 in July 1984, and at Isla Chanaral the population rose from 218 in 1984 to 1,000 in 1986. If all colonies are increasing at similar rates (43% and 57% respectively of the pre-El Nino counts) the current (1986) Chilean total could approximate 5,000 and 6,000 penguins.

This figure, although only half of that prior to El Nino, represents an increase of approximately 50% within four years, which is too great to be attributed to reproduction alone. It could be due to immigration from other Chilean, or even Peruvian, colonies, or to the return of old birds, which may have remained at sea. In any event, it is unlikely that most of the 7-10,000 penguins not accounted for immediately subsequent to the El Nino perished. We suggest that they were elsewhere and as conditions continually improved, commenced to re-occupy the rookeries.

Discovery of a few breeding Humboldt Penguins at Isla Punihuil, Chiloé Islands, more than 900 kilometers south of their previous range, was unexpected. It is conceivable that small numbers have been there all along and simply overlooked since this is a poorly studied area. Another possibility is that this is a
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recent range expansion prompted by the effects of the REL Nino. In either case, it does suggest that other islands south of 33°S may also be occupied by breeding Humboldt Penguins. If so, the population of this species might be somewhat greater than the current figures indicate.

CONCLUSIONS:

The breeding population of Humboldt Penguins in Chile dropped immediately with the onset of the unusually severe 1982-83 El Nino and by 1984 was approximately 75% lower than before the El Nino. By 1986, however, there had been a substantial recovery. We estimate the current population at 5-6,000 penguins, or about 50% of the mid-1982 numbers. If the Peruvian colonies have recovered at a similar rate, the total population probably does not exceed 10,000 individuals. The apparent rapid recovery on the rookeries suggests that while the breeding potential was severely compromised subsequent to the 1982-83 El Nino, direct mortality was not nearly as extensive as initially feared. This supposition is supported by the fact that we did not see any penguins which appeared to have died as a result of malnutrition.

It would seem then that even relatively small populations are capable of recovery assuming that several severe El Ninos do not occur back to back. Human related activities, such as overfishing, disturbance and direct persecution, could also be factors influencing recovery. For example, in 1984, at least 55 Humboldt Penguin carcasses were observed on Isla Pan de Azucar with longitudinal cuts across the breast and belly. It was not determined whether or not the penguins were being taken for food or bait.

Additional census work is recommended, including all appropriate habitat south of 33°S to Chiloe Island. All major colonies should be afforded official protection.

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[We regret that due to considerations of space and difficulty of reproduction, two maps and a table accompanying this article have been omitted. The table summed up the same census statistics contained in the article.]