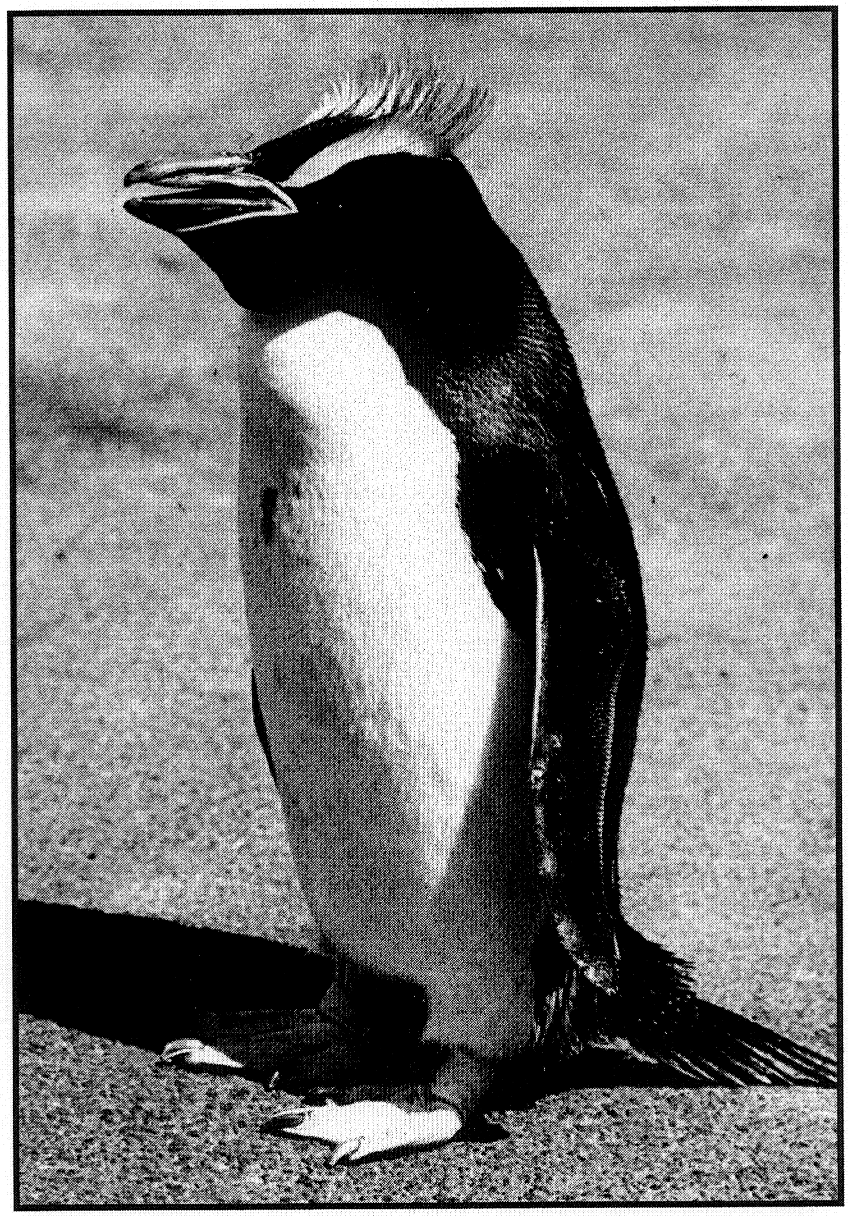
PENGUIN

Conservation Assessment & Management Plan



Report from the Workshop held 8-9 September 1996
Cape Town, South Africa

A Collaborative Workshop
British Antarctic Survey
SCAR Bird Biology Subcommittee
Percy Fitzpatrick Institute of African Ornithology
Conservation Breeding Specialist Group, IUCN/SSC

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Dedicated to the Memory of
Jody Todd

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Penguin Conservation Assessment & Management Plan

Introduction and Overview

Introduction

Reduction and fragmentation of wildlife populations and habitat are occurring at a rapid and accelerating rate worldwide. For an increasing number of taxa, the results are small and isolated populations at risk of extinction. A rapidly expanding human population, now estimated at 5.25 billion, is expected to increase to 8 billion by the year 2025. This expansion and concomitant utilization of resources has momentum that cannot be stopped, the result being a decreased capacity for all other species to exist simultaneously on the planet.

In many parts of the Southern Hemisphere, habitat destruction and the over-exploitation of wildlife have become increasing threats to the survival of natural environments. As wildlife populations diminish through habitat loss, fragmentation, environmental change and other factors, their ecological roles in ensuring a well-balanced, regulated and sustainable ecosystem also are reduced. Still, most conservation actions are directed toward the protection of habitat and reserves, rather than the conservation and management of the wildlife components that also are critical to the long-term survival of ecosystems.

To ensure viable ecosystem functions, biologists and wildlife managers realize that management strategies must be adopted that will reduce the risk of extinction. These strategies will be global in nature and will include habitat preservation, intensified information gathering in the field, investigations regarding the ecological roles of key species, the development of improved biological monitoring techniques, and in some cases, scientifically managed captive populations that can interact genetically and demographically with wild populations.

Conservation Assessment and Management Plans (CAMPs)

Within the Species Survival Commission (SSC) of IUCN-The World Conservation Union, the primary goal of the Conservation Breeding Specialist Group (CBSG) is to contribute to the development of holistic and viable conservation strategies and management action plans. Toward this goal, CBSG is collaborating with agencies and other Specialist Groups worldwide in the development of scientifically based processes, on both a global and regional basis, with the goal of facilitating an integrated approach to species management for conservation. One of these tools is called Conservation Assessment and Management Plan (CAMP).

CAMPs provide strategic guidance for the conservation of threatened taxa. This may include recommendations for field investigations and improved data-gathering methods, and the application of intensive management techniques that increasingly are required for survival and recovery of threatened taxa. The CAMP process ensures an objective overall view of the status of the taxa in question with the intent of improving the effectiveness and synergy of conservation efforts. CAMPs are also one means of testing the applicability of the new IUCN Red List criteria for threat (Mace and Stuart 1994) as well as the scope of their applicability. Additionally, CAMPs are an attempt to produce ongoing summaries of current data for groups of taxa, providing a mechanism for recording and tracking of species status.

CAMP recommendations are broad-based: of paramount importance are those recommendations related to field surveys, applied investigations and *in situ* conservation and management programs. Ultimately, the survival of taxa in the wild will depend on the availability of field data regarding the status of natural populations, the ecological role of the species (and its interdependence on other taxa), life history parameters, and applied investigations related to management and conservation. Where such data are lacking, a primary recommendation of the CAMP will be to stimulate their collection.

In addition to management of taxa in their natural habitat, conservation programs leading to viable populations of threatened species may sometimes need a captive component. In general, captive populations and programs can serve several roles in comprehensive conservation: 1) as genetic and demographic reservoirs that can be used to reinforce wild populations either by revitalizing populations that are languishing in natural habitats or by re-establishing by translocation populations that have become depleted or extinct; 2) by providing scientific resources for information and technology that can be used to protect and manage wild populations; and 3) as living ambassadors that can educate the public as well as generate interest in and funds for *in situ* conservation.

Captive management programs should only be developed in conjunction with ongoing field investigations and holistic conservation initiatives. It should be emphasized that captive breeding is not the answer to the extinction crisis and should not be viewed as a complete solution. It is one option along a continuum of strategic options for population recovery. If implemented, these programs should be part of an integrated species management plan that includes habitat management, limiting factors management, field research, and public education. A recovery effort that is not part of a comprehensive population management program in the wild does not have a high probability of making a meaningful contribution to conservation.

This document does not intend to promote the establishment of captive programs in isolation from *in situ* programs. Rather, it is proposed that, when captive populations can assist species conservation, captive and wild populations should, and can be, intensively and interactively managed together. For instance, with the development of appropriate techniques, interchanges of animals between captive and wild populations can be undertaken as needed and as feasible to maintain genetic and demographic viability of the species in the wild.

Penguins

Penguins are among the most popular and well-studied avian groups. Restricted to the Southern Hemisphere, penguin taxa range from Antarctica to the Galapagos Islands. Of the 17 recognized species of penguins, five previously have been considered Vulnerable by IUCN-The World Conservation Union (IUCN 1996). The species are: Fiordland Penguin *(Eudyptes pachyrhynchus)*, the Snares Island Penguin *(E. robustus)*, the Erect-crested Penguin *(E. sclateri)*, the Yellow-eyed Penguin *(Megadyptes antipodes)*, and the Galapagos Penguin *(Spheniscus mendiculus)*. Additionally, the United States Department of the Interior lists the Galapagos Penguin as Endangered. The Humboldt Penguin (*S. humboldti)* is listed on Appendix I and the African Penguin (*S. demersus)* is listed on Appendix II of the Convention for International Trade in Endangered Species (CITES).

Penguins are dependent on the marine as well as the terrestrial environment. Current threats include but are not limited to: habitat loss because of introduced grazers; introduced predators; human encroachment on habitat; climate changes; competition with fisheries; and marine pollution including oil pollution and heavy metal contamination (see below).

Penguins have been targeted as high priority by many conservation groups and other parties including, but not limited to, the Scientific Committee on Antarctic Research (SCAR), BirdLife International, the New Zealand Department of Conservation (NZDOC), the Wildlife Conservation Society (WCS) and the IUCN-CBSG. The Scientific Committee for Antarctic Research (SCAR) provides a forum for discussion and co-ordination of ornithological research in the Antarctic.

The Penguin CAMP Process

The CAMP process assembles expertise on wild and captive management for the taxonomic group under review in an intensive and interactive workshop format. The purpose of the Penguin Conservation Assessment and Management Plan (CAMP) workshop was to assemble all relevant data on status and trends of penguin populations in light of the threats they face and thereby to assist in developing a conservation strategy for these species. In 1992, a draft Penguin Conservation Assessment and Management Plan (CAMP) was generated at a workshop in New Zealand (Boersma *et al.* 1992) and its preliminary results presented to the Second International Penguin Conference at Phillip Island, Australia. In order to provide a substantive review and update of the original draft document, with wide participation from the penguin research community, a second Penguin CAMP workshop was held on 8-9 September 1996 just following the Third International Penguin Conference in Cape Town, South Africa. Thirty-seven people from 10 countries (Appendix I) participated in the two-day event, which was generously sponsored by Sea World, Inc. and the New England Aquarium.

Prior to the workshop, the taxon data sheets from the first CAMP were reviewed via fax and email by species-based committees (Appendix II) identified by the CAMP workshop organizing committee. A taxon editor headed each species committee with responsibility for final compilation of the sheets for his/her particular taxon. The Bird Biology Subcommittee (SCAR) had prepared new data sheets for Antarctic species at its meeting in 1994. These committees extensively revised the taxon data sheets prior to the workshop; these were then compiled in a workbook for CAMP workshop participants. Using that material as background, the workshop focused on updating and compiling all available information concerning the status of the 20 penguin taxa being reviewed. Taxon data sheets can be found in Section 3 of this report.

Participants in the CAMP worked together to make the assessments and recommendations contained within this document. These assessments and the recommendations of the working groups were circulated to the entire group to reach consensus, as represented in this document. Summary recommendations concerning research management, field initiatives, assignment of all taxa to threatened status, and captive breeding were supported by the participants in the working groups.

CAMP Workshop Goals

The goals of the CAMP workshop were:

1. To review the population status and demographic trends for all penguin species, to test the applicability of the New IUCN Red List criteria for threat, and to discuss management options for these taxa.

2. To provide recommendations for *in situ* management, research and information-gathering for all reviewed taxa, including: field investigations; surveys, population monitoring and investigation of limiting factors; taxonomic studies; recommendations for PHVA workshops; more intensive management in the wild; or other specific research.

3. To provide recommendations for *ex situ* management and research for the taxa, if needed, including husbandry, maintenance of viable captive populations of the more threatened species (where appropriate, feasible, and desirable) and the development of collaborative captive/field programs.

4. Produce a review draft Penguin Conservation Assessment and Management Plan, presenting the assessments and recommendations from the workshop for distribution to and review by workshop participants and all parties interested in penguin conservation.

The New IUCN Red List Categories

The threatened species categories previously used in IUCN Red Data Books and Red Lists were in place, with some modification, for almost 30 years (Mace *et al.* 1992). The Mace-Lande criteria (Mace and Lande 1991) were one developmental step in an attempt to make those categories more explicit. These criteria subsequently have been revised and formulated into the new IUCN Red List Categories (IUCN 1996) which currently are being used in the CAMP process. BirdLife International used a very similar version of the criteria to prepare *Birds to Watch 2* (Collar et al. 1994), from which bird listings were derived for the 1996 IUCN Red List of Threatened Species (IUCN 1996).

During the CAMP workshop, 20 penguin taxa were evaluated on a taxon-by-taxon basis in terms of their current and projected status in the wild to assign priorities for conservation action or information-gathering activities. Data used in this evaluation were based primarily on a best-estimate basis as gathered by workshop participants, and may be subject to further review by other experts in the field.

The New IUCN Red List Categories provide a system that facilitates comparisons across widely different taxa, and is based both on population and distribution criteria. These criteria can be applied to any taxonomic unit at or below the species level, with sufficient range among the different criteria to enable the appropriate listing of taxa from the complete spectrum of taxa, with the exception of micro-organisms (Mace *et al.* 1992).

Specific information on the categories and their use are presented in Section 2, with the complete reference found in Section 5. The New IUCN Red List Categories are: Extinct (EX); Extinct in the Wild (EW); Critically Endangered (CR); Endangered (EN); Vulnerable

(VU); Conservation Dependent (CD); Lower Risk (LR); Data Deficient (DD); Not Evaluated (NE).

Definitions of these criteria are based on population viability theory. In assessing threat according to the New IUCN Red List criteria, workshop participants also used information on the status and interaction of habitat and other characteristics (Table 5, Section 2). Information about population trends, fragmentation, range, and stochastic environmental events, real and potential, also were considered. The process for making these assessments is presented in Figure 2, Section 2.

To assist in making recommendations, participants in the workshop were encouraged to be as quantitative or numerate as possible for two reasons: 1) CAMPs ultimately must establish numerical objectives for viable population sizes and distributions; 2) numbers provide for more objectivity, less ambiguity, more comparability, better communication, and, hence, cooperation. During the workshop, there were many attempts to estimate if the total population of each taxon was greater or less than the thresholds for the numeric criteria for the IUCN Categories of Threat. In some cases, current population estimates for taxa were unavailable or available for species/subspecies within a limited part of their distribution. In all cases, if presented, conservative numerical estimates were used. **When population numbers were estimated, these estimates represented first-attempt, order-of-magnitude educated guesses that were hypotheses for falsification. As such, the workshop participants emphasized that these estimates should not be authoritative for any other purpose than was intended by this process.** The New IUCN Red List categories for the taxa examined during this CAMP exercise are presented in Table 1.

The results of the workshop were startling and alarming. Of all the penguin species, only those in the Antarctic do not seem to be facing grave, documented declines or other problems that put them at serious risk. Even species living in the Antarctic are not secure in perpetuity – the threats that have put the other penguin species at risk appear to have spread to the boundaries of the Antarctic Circle. Whereas the 1996 IUCN Red List considered only fivepenguin species to be threatened, penguin biologists at the present workshop consider 12 taxa (10 species) to fall under one of the IUCN Categories of Threat and two as Near Threatened.

Several of these assessments represent changes from the assessments reported in the 1996 IUCN Red List. (It should be noted that the assessments made in the 1996 IUCN Red List were made well in advance of its publication). Of specific concern to penguin biologists is the change in category of threat for Galapagos Penguins (from Vulnerable to Endangered). If this species' population is as small as recent data suggest, this change is particularly worrying because it lives in a nominally protected area. Population data for this species need to be verified by census in the near future. Also of specific concern is the Snares Island Penguin. This single-site species has a relatively small population size; most populations of congeneric species have decreased dramatically and, by extrapolation, this species may actually be in a much worse situation than reflected in this document. It also is disturbing that some of the more globally abundant species (Rockhopper, Macaroni and Magellanic Penguins) have declined in abundance over the last three generations, and qualify for Vulnerable and Near Threatened status. Combined, data for all these species suggest that the state of the global ocean is of major concern.

Table 1. Penguin Taxa and IUCN Red List Categories.

Species	Common Name	IUCN Category
Eudyptula minor albosignata	White-flippered Penguin	Endangered
Eudyptes sclateri	Erect-crested Penguin	Endangered
Spheniscus mendiculus	Galapagos Penguin	Endangered
Eudyptes robustus	Snares Island Penguin	Vulnerable
Eudyptes pachyrhynchus	Fiordland Penguin	Vulnerable
Eudyptes schlegeli	Royal Penguin	Vulnerable
Eudyptes chrysocome chrysocome	Southern rockhopper Penguin	Vulnerable
Eudyptes c. filholi	Eastern rockhopper Penguin	Vulnerable
Eudyptes c. moseleyi	Northern rockhopper Penguin	Vulnerable
Megadyptes antipodes	Yellow-eyed Penguin	Vulnerable
Spheniscus humboldti	Humboldt Penguin	Vulnerable
Spheniscus demersus	African Penguin	Vulnerable
Eudyptes chrysolophus	Macaroni Penguin	Near Threatened
Sphensicus magellanicu	Magellanic Penguin	Lower Risk/ Near Threatened*
Aptenodytes forsteri	Emperor Penguin	Lower Risk
Aptenodytes patagonicus	King Penguin	Lower Risk
Pygoscelis adeliae	Adelie Penguin	Lower Risk
Pygoscelis antarctica	Chinstrap Penguin	Lower Risk
Pygoscelis papua	Gentoo Penguin	Lower Risk
Eudyptula minor	Little Penguin	Lower Risk

*some populations

Threats to Penguins

Penguins should not be viewed in isolation from their environment. The situation facing these and other marine organisms is a foretaste of that which will be faced in the future. A variety of factors combine to make penguins particularly susceptible to population declines – even extinction – resulting from the unprecedented levels of human activity occurring today (see Boersma and Stokes 1995, for an excellent review of threats to penguins. This section is condensed from that review, with permission from the authors). Perhaps one of the biggest problems is simply a lack of information, both on the part of scientists as well as the general public, about the interactions of the various factors at play in the marine ecosystem as well as how they affect the organisms living within that environment.

Penguins spend more than half of their lives in the water, and return to land only to reproduce and molt. During the breeding season they are restricted to relatively small coastal areas of the marine environment where they forage to feed their young. Penguins eat small fish, crustaceans, and squid and are sensitive to changes in the distribution and abundance of their prey species. They also are likely to come into contact with marine pollution because they spend much of their time at the sea surface, where petroleum, plastics, and other pollutants are concentrated. In addition, penguins are large, flightless, relatively easily approached by humans, and generally aggregate in colonies to which they return for each breeding season. They also have delayed maturity and lay only one or two eggs per breeding attempt. Taken together, these characteristics make penguins especially vulnerable to a variety of human-caused threats such as climate change, marine pollution, introduced predators, competition with fisheries, human exploitation and habitat loss and degradation associated with human resource use. These threats tend to increase penguin mortality and reduce reproductive success. Even small decreases in adult survivorship can, over several years, substantially reduce penguin numbers and eventually could result in extinction.

Climate Change and Marine Perturbations

Penguins are adapted to survival in a variable environment. Their long reproductive life span and their ability to accumulate large fat reserves quickly and to fast for long periods make them well-adapted to short-term fluctuations in food availability. However, they may encounter difficulty adapting to long-term or acute changes in the marine environment. Furthermore, their large body size makes them dependent on areas of high productivity. Thus, although penguins are adapted to environmental variability, long-term deterioration of environmental conditions that favor penguins are likely to decrease penguin populations. Strong fidelity to their breeding colony and nest also makes penguins vulnerable to deterioration of environmental conditions on land as well as in the local marine environment.

The most well known marine perturbation is the El Niño Southern Oscillation (ENSO), which when well developed causes seabirds to fail to reproduce. In the most extreme cases, adults die. Galapagos Penguins, Humboldt Penguins, African Penguins and Magellanic Penguins have been particularly affected by ENSO events.

There continues to be debate concerning the rate and degree to which humans are modifying climate and the extent to which these changes may affect the highly productive Southern Hemisphere currents on which penguins depend (Boersma and Stokes 1995). Projections indicate that human-caused global warming over the next several decades is likely to result in rapid and large changes in climate, which in turn are likely to be accompanied by changes in sea temperature and ocean currents. The sensitivity of penguins to environmental change suggests local, regional, and global climate change could have profound impacts on the distribution, abundance, and composition of penguin populations (Boersma and Stokes 1995).

Temperature, turbulence, water movement, and nutrient availability are thought to be among the important parameters accounting for much of the variability in fish biomass (Parrish *et al.* 1983). By influencing prey availability, changes associated with climate ultimately may determine penguin distribution and abundance (Boersma and Stokes 1995). Most penguins have relatively restricted diets, and as long as high productivity areas remain, they likely will be able to exploit these. How a particular species of penguin will fare when its prey base changes (whether climate-based or not) is not easily predictable, but it is clear that climate change is a potential threat to which all penguins are vulnerable (Boersma and Stokes 1995) (Table 2).

Fisheries Interactions

The recent and rapid increase in commercial fishing effort in the oceans of the Southern Hemisphere appears to be the source of several threats to penguins. Increased mortality from capture in fishing nets is a growing problem (Boersma *et al.* 1990). Penguins often drown in set nets, and are maimed or killed in seine nets. Commercial fisheries also apparently have changed the structure of marine communities through over-harvest of selected species (Crawford 1987). These changes have resulted in declines in populations of penguins along the coasts of Perú and western South Africa in the last twenty years. These penguin populations appear unlikely to recover because the changes in the structure of these communities do not appear to be readily reversible (Boersma and Stokes 1995).

Potential competition with, or secondary effects from interactions with, commercial fisheries is a problem likely to exacerbate over time, particularly as the industry harvests smaller fish (Boersma and Stokes 1995). Competitive interactions between seabirds and commercial fisheries have been documented in many of the world's oceans (Schaefer 1970, Crawford and Shelton 1978, 1981, Furness 1984, Croxall and Lishman 1987), and potential competition with commercial fisheries has been identified as a potential problem for many penguin species (Burger and Cooper 1984, Boersma *et al* 1990, Norman *et al.* 1992a) (Table 2).

Changes in prey abundance attributable to commercial fishing probably are mainly local, but competition for remaining prey species is likely to become increasingly important and widespread (Boersma and Stokes 1995). Humans currently use more than 40% of all the net terrestrial primary productivity (Vitousek *et al* 1986). How much of the marine productivity is being appropriated for human use is not known, however, the amount is increasing. As humans harvest more fish (including bait fish), exploit new species of marine life, and discard more by-catch and offal into the ocean, they will play an increasing role in modifying seabird population composition and abundance (Boersma and Stokes 1995). Based on recent trends, humans' use of marine habitats is likely to have an increasingly harmful effect on penguins over time.

Oiling and Marine Pollution

Penguins also are suffering from the increasing ability of humans to modify the marine environment. For nearly all penguin species, oiling and marine pollution are important threats (Table 2). Oil pollution from chronic tanker discharge and accidental spills is a cause of mortality for nearly all temperate penguin species and has been implicated in the decline of African Penguins (Crawford *et al.* 1995a) as well as the annual death of 40,000 Magellanic Penguins along the southern coast of Argentina (Gandini *et al* 1994). As oil is developed in more remote locations and transported greater distances, penguins will be at greater risk (Boersma and Stokes 1995). The 1989 oil spill from the tourist boat Bahia Paraiso in the Antarctic demonstrated that remoteness is becoming less effective in protection of the penguins' marine environment from humans. As fishing, tourism, oil development, and other human activities are conducted farther afield, even penguins in the Antarctic will be increasingly threatened.

Pollutants other than oil also are a growing problem for some species (Frost *et al.* 1976, Berruti *et al.* 1989). Many chemical by-products of human activities such as pesticides, heavy metals, and plastics eventually reach the ocean; ingestion of these substances can compromise the health of penguins. Since penguins are typically high on the food chain, those materials that tend to bio-magnify (e.g. lead, mercury, some pesticides) are especially likely to pose problems as the marine environment becomes more polluted. Entanglement in fishing tackle, plastic 'six pack' rings, and other human-generated materials are known to cause the death of some Galapagos, Peruvian, African, Little Blue, and Yellow-eyed Penguins. Even when ingestion of plastic, metal and glass does not kill penguins, it is likely to have sub-lethal effects. As reflected in Table 2, these types of problems appear to be more common for temperate penguins because they live in areas more densely populated and utilized by people.

Human Disturbance and Interference

Humans are traveling in ever increasing numbers to previously remote areas in all parts of the world. For example, tourism in the Antarctic increased from under 300 people per year in the 1950's, to around 1500 people/year in the 1980's, and more than 5,500 people per year in the early 1990's (data from Enzenbacher 1993). In temperate regions, the rise in tourism has been even faster. In the early 1970s, 14 people visited the penguin colony at Punta Espinosa, Fernandina in the Galapagos Islands every two weeks; in the 1990s more than 200 people visit the area on most days (Boersma and Stokes 1995). At the penguin colony at Punta Tombo, Argentina tourism has increased from several dozen people per year in the 1960's to more than 50,000 per year in the 1990's (Boersma and Stokes 1995). These numbers are of particular concern because most visitation is concentrated in the small areas of critical penguin breeding habitat.

Nonetheless, the direct impacts on penguins can be slight when tourism is properly managed. Trampling of burrows and loss of eggs, chicks or adults due to tourism is of minor importance at Phillip Island (Dann 1992), the site of a Little Blue Penguin colony that is a major tourist attraction, located a short drive from Melbourne, Australia. Penguins appear to habituate to humans and, if well-controlled, human presence appears to have little impact on reproductive success of habituated birds (Hiltrun Ratz and Chris Lalas, pers. comm.; Yorio and Boersma 1992). However, penguins that do not regularly see humans can be adversely affected by visitation (e.g., Yorio and Boersma 1992, Wilson *et al.* 1991). If not properly controlled, tourism and other development near or around penguin colonies can decrease penguin numbers because of increases in predation, desertion, and trampling of nests (Boersma and Stokes 1995). Steps need to be implemented to minimise the risk of rehabilitated penguins returning disease to wild colonies as well.

Despite the best intentions, scientific programs also can cause populations of penguins to decline. Some breeding populations of Adelie Penguins are known to have decreased from banding, counting, and disturbance associated with scientific studies (Thompson 1977, Ainley *et al* 1983, Wilson *et al* 1990, Woehler *et al* 1991). Recent awareness of this problem, along with the development of less invasive techniques and methods of observation (e.g., automatic weighing devices, radio telemetry, and non-lethal food sampling) have reduced the impact of scientific investigations. Nonetheless, any human activity at a colony has the potential to cause mortality, reduction of reproductive success, and/or degradation of the nesting area. The value of any human activity at a colony must be weighed against the potential costs to the birds, and, if found to be worthwhile, the activity must be monitored and carefully managed to minimize its effects.

Several penguin species, particularly African and Humboldt Penguins, are important guano-producing seabirds. Guano is a valuable fertilizer, and is harvested periodically from many seabird colonies, particularly those on islands in desert regions. Most burrowing seabirds are negatively affected by guano harvests because the guano is often scraped from the island down to bedrock, making it impossible for the birds to construct burrows. The decline in the Humboldt Penguin has been attributed to guano harvesting along with other forms of taking and disturbance (Hays 1986). The impact of guano harvesting has become more severe as harvesting has become more frequent and thorough, while the number of seabirds has declined, making the accumulation of guano slower. Guano harvesting and a lack of suitable substrate also have been found to cause increased mortality of African Penguin chicks (Wilson and Wilson 1989; Ross and Randall 1990).

Introduced predators

Penguins breed primarily on remote islands and along expanses of desert and Antarctic coastline where there are relatively few natural predators. Predation by introduced species appears to be a factor in the decline of both mainland and island populations of many species (Dann 1992; Stahel and Gales 1987; Croxall 1987; Boersma 1976). Introduced mammalian predators not only decrease reproductive success of penguins but also lower adult and juvenile survival. In New Zealand for example, predation by stoats *(Mustela erminea)*, ferrets *(M. putorius)*, dogs *(Canis familiaris)*, and cats *(Felis catus)* has contributed to the decline of Yellow-eyed Penguins (Darby and Seddon 1990). There also may be problems with introduced diseases associated with introduced species, which could be damaging to penguin populations (Morgan *et al.* 1985). Where introduced predators can be extirpated, island seabird populations may increase and species composition can change (e.g., Bailey 1992).

Habitat Loss

Penguin breeding colonies are being lost in some areas because of human encroachment, erosion, deforestation, mining, agricultural uses, and other human-caused modifications of the landscape including clearing of native vegetation, fires, and development. Additionally, as fur seal populations increase, they encroach on breeding areas for some penguins.

Hunting and Penguin Egg Harvesting

While collection of eggs and harvesting of adults by humans is no longer a serious threat to most penguins, some species continue to be hunted despite the fact that it is illegal to kill penguins in most countries. Humboldt Penguins continue to be killed for food and for fish bait in Chile and Peru, a significant factor in the present precariousness of that species' existence. Similarly, in Australia, Little Blue Penguins are illegally taken for food and crayfish bait (Dann 1992). Better education and enforcement of existing laws can help reduce illegal taking of penguins and their eggs and chicks (Boersma and Stokes 1995).

Figure 1 diagrams the various high priority concerns identified by workshop participants. Potential and actual threats to specific penguin taxa, as determined by workshop participants, are presented in Table 2.

Figure 1. High priority concerns for penguin conservation.

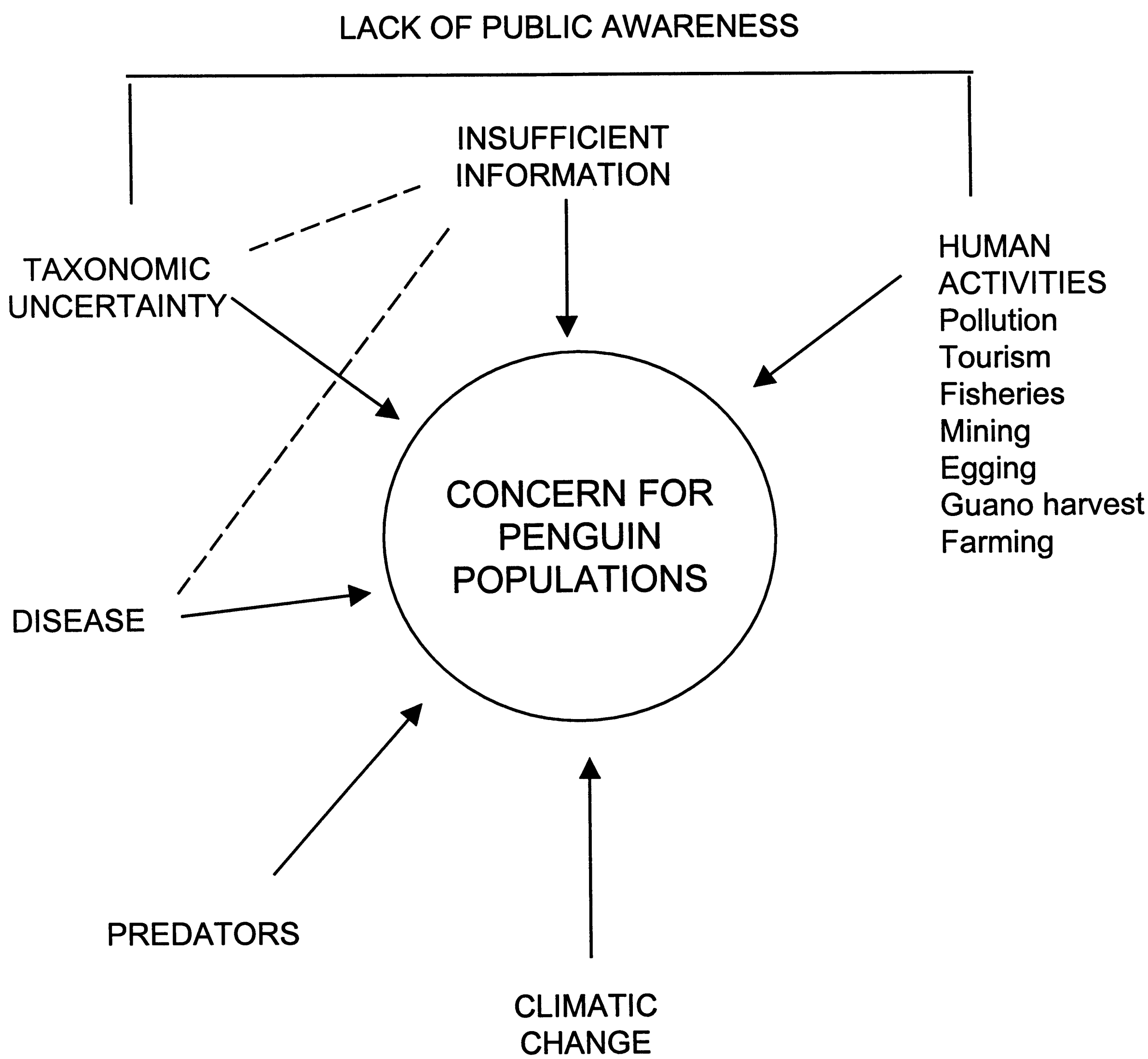

Table 2. Actual (solid cells) and potential (cells with vertical lines) facing penguin taxa, as determined by Workshop participants. See individual taxon accounts in Section 3 for further detail.

TAXON	IUCN Category	Climate change	Fisheries interaction	Oiling	Marine pollutants	Marine perturbations (ENSO)	Predation by exotics	Habitat loss	Human disturbance/ interference	Hunting	Egging	Catastrophes	Disease
Aptenodytes forsteri Emperor penguin	LR	■	|||										
Aptenodytes patagonicus King penguin	LR	|||	|||	■									
Pygoscelis adeliae Adelie penguin	LR	|||	|||		|||				|||				|||
Pygoscelis antarctica Chinstrap penguin	LR	|||	|||		|||				|||				|||
Pygoscelis papua Gentoo penguin	LR	|||	|||		■				■				
Eudyptes c. filholi E. rockhopper penguiin	VU	|||	|||		■		|||						|||
Eudyptes c. chrysocome S. rockshopper penguin	VU	|||	|||	■	■	|||			■				
Eudyptes c. moseleyi N. rockhopper penguin	VU	|||	|||								|||		
Eudyptes schlegeli Royal penguin	VU	|||	|||		|||		|||					|||	|||
Eudyptes chrysolophus Macaroni penguin	VU	|||	|||	|||	|||								
Eudyptes pachyrhynchus Fiordland crested penguin	VU	■	|||		■	■	■		■				
Eudyptes robustus Snares crested penguin	VU	|||	|||		■		|||						
Eudyptes sclateri Erect-crested penguin	EN	■	|||		|||	■							
Eudyptula minor Little penguin	LR	|||	■	|||	|||		■	■				■	|||
Eudyptula m. albosignata White-flippered penguin	EN	|||	■				■						
Megadyptes antipodes Yellow-eyed penguin	VU	|||	■			■	■	■	■			■	|||
Spheniscus humboldti Humboldt penguin	VU	■	■	■	■	■		■	■	■	■		
Spheniscus mendiculus Galapagos penguin	EN	|||	■	■	■	■	■		■				
Spheniscus magellanicus Magellanic penguin	LR	|||	■	■	■	■	■	■		■	■		
Spheniscus demersus African penguin	VU	■	■	■	■	|||	■	■	■			|||	|||
TOTAL (real / potential)		5 / 15	7 / 13	6 / 2	9 / 4	6 / 1	7 / 3	5 / 0	7 / 2	2 / 0	2 / 1	2 / 2	0 / 7

Recommendations for Intensive Management and Research Actions

Although penguins are among the best-studied birds in the world, there is insufficient information about many of the interactive factors affecting their survival (Figure 1). For example, several crested penguin species have not been surveyed for decades; many of these are single-site species with relatively small populations. Declines in numbers for other congenerics have been documented and it is possible that some species may face a more serious situation than presently is known. For this reason, many of the recommendations for research and management activities for taxa reviewed in this workshop include surveys and monitoring, along with investigations into limiting factors. These include investigation of the extent of fisheries conflicts, pollution effects, studies on foraging location and ranges, as well as studies focusing on other pressures. For those threatened species that may be more negatively affected, workshop participants recommended additional measures. These include the management and protection of habitat, as well as research and management aimed at controlling or eliminating the factors that limit species populations.

The development of coordinated efforts (possibly with governmental assistance and fisheries management programs) to ameliorate or even negate the effects of threats such as fisheries interactions and marine pollutants on penguin populations need to be carried forward. Combined with these, community-based environmental education programs can be a useful tool to augment the effectiveness of conservation initiatives.

For all taxa reviewed at the Penguin CAMP workshop, recommendations were generated for the kinds of intensive action necessary for conservation, both in terms of management and research. Population and Habitat Viability Assessment (PHVA) workshops, to develop comprehensive and achievable management plans, also were recommended for some species. PHVA workshops provide a means of assembling available detailed biological information on the respective taxa, evaluating the threats to their habitat, development of management scenarios with immediate and 100-year time-scales, and the formulation of specific management plans with the aid of simulation models.

Workshop participants attempted to develop an integrated approach to the management and research actions needed for the conservation of penguin taxa. In all cases, an attempt was made to make management and research recommendations based on our knowledge of the various threats affecting the taxa.

With only partial understanding of underlying causes for decline in some taxa, it is sometimes difficult to clearly define specific management actions needed for the conservation. Therefore, "research management" increasingly will become a component of conservation and recovery activities. Research management can be defined as a management program which includes a strong feedback between management activities and an evaluation of the efficacy of the management, as well as response of the taxa to that activity. The frequent need for survey information to evaluate population status emphasizes the need to quickly implement intensive survey methodologies, especially for some of the crested penguin species. Other types of research activities that can enhance our ability to manage these species in the future, such as investigation of foraging locations and ranges, also were identified. The highest priority research and management activities as identified by workshop participants for each of the threatened (and Near Threatened) penguin taxon are listed in Table 2. Longer-term priority activities are listed on the individual taxon data sheets for each species in Section 3. Workshop participants wish to emphasize that further investigation into population status, demography, and dynamics is urgently needed and will help to develop further management activities that will minimize threats and their effects on these species. For those species that were indicated as being in need of a PHVA workshop in the near future, we wish to urge immediate planning for those evaluations.

Captive Breeding Recommendations

During the CAMP workshop, all taxa were evaluated relative to their current need for captive propagation. Recommendations were based upon a number of variables, including: immediate need for conservation (population size, IUCN Red List status, population trend, type of captive propagation program), need for or suitability as a surrogate species, existing captive populations, and determination of difficulty as mentioned above. Based on all of the above considerations, in addition to threats and population trends, recommendations for captive programs were made (Table 4). Most taxa were not in need of a captive breeding program for conservation purposes, but, rather, were recommended for a "Level 3" program for education and research purposes. Populations for all taxa recommended for a Level 3 program already exist in captivity.

CAMP Document Review

The preliminary CAMP document generated at the workshop was reviewed by a group of "volunteer" editors who participated in the CAMP workshop. Further review and comment will take place after the distribution of this report to a broader audience which includes penguin biologists, wildlife managers, Specialist Group members, academic scientists, regional captive programs, and other interested parties worldwide. This document may be revised and updated in conjunction with the International Penguin Conferences held every four years. As with all CAMP reports, this will should considered a "living" document to be updated as world situations change.

Table 3. High priority research and management activities for Threatened penguin taxa (Endangered and Vulnerable status)

Rockhopper Penguin *Eudyptes chrysocome spp.* VU

Eastern *E.c. filholi*
- investigate taxonomic status (New Zealand vs. Indian Ocean)
- determine status and trends at Crozet/Heard/Macquarie/Prince Edward Islands
- carry out demography and foraging ecology studies
- PHVA recommended

Southern *E.c chrysocome*
- determine status and trends in Argentina/Chile/Falklands/Malvinas
- study demography and foraging ecology
- determine impact of hydrocarbon exploration/exploitation
- determine impact of tourists (especially in Argentina)
- impact of removals for captive collections
- PHVA recommended

Northern *E.c. moseleyi*
- determine status and trends at Tristan da Cunha/Gough; re-survey Amsterdam/St. Paul Islands
- carry out foraging ecology studies
- determine impact of human-penguin interactions at Tristan da Cunha

Royal Penguin *E. schlegeli* VU
- carry out studies of demography and foraging ecology
- delimit marine element of biosphere reserve
- determine status and trends of population
- remove introduced predators

Fiordland Penguin *E. pachyrhynchus* VU
- repeat census to establish population trends over geographic range
- quantify the effect of introduced predators
- determine foraging range and diet composition
- PHVA recommended

Snares Penguin *E. robustus* VU
- carry out detailed survey for population trends
- study foraging ecology with reference to breeding chronology and success and potential sea temperature changes
- PHVA recommended

Erect-crested Penguin *E. sclateri* EN
- census Auckland Island and Bounty Island to determine extent of decline
- study foraging ecology with reference to breeding chronology and success and potential sea temperature changes
- carry out basic life history studies to obtain basic data
- PHVA recommended

Yellow-eyed Penguin ***Megadyptes antipodes*** **VU**

- publication of results of existing studies
- evaluation of implemented management techniques
- conduct a PHVA with particular focus on assessing the species' tolerance to predation

White-flippered Penguin ***Eudyptula minor albosignata*** **EN**

- resolve taxonomic status
- refine population estimates in New Zealand
- identify and obtain resources for habitat management, including predator control
- PHVA recommended

Humboldt Penguin ***Spheniscus humboldti*** **VU**

- very high priority to conduct a PHVA with appropriate agencies from Chile and Peru
- complete population assessment
- protect breeding locations and enforce existing regulations funding and support of wardens
- regulate guano harvest (Peru)
- predator control

Galapagos Penguin ***S. mendiculus*** **EN**

- decrease use of fishing nets within foraging range
- decrease effects of human disturbance in breeding areas
- control predators and decrease further predator introductions
- PHVA recommended

African Penguin ***S. demersus*** **VU**

- continue monitoring colonies
- secure food base
- sufficient escapement of prey fish from fishing nets
- management of oiling and rehabilitation procedures
- PHVA recommended

Table 4. Captive Program Recommendations for Penguin Taxa

Level 3 program:

Aptenodytes forsteri	Emperor Penguin
Aptenodytes patagonicus	King Penguin
Pygoscelis adeliae	Adelie Penguin
Pygoscelis antarctica	Chinstrap Penguin
Pygoscelis papua	Gentoo Penguin
Eudyptes chrysocome chrysocome	Southern Rockhopper Penguin
Eudyptes c. moseleyi	Northern Rockhopper Penguin
Eudyptes chrysolophus	Macaroni Penguin
Spheniscus humboldti	Humboldt Penguin
Spheniscus demersus	African Penguin

Pending Recommendations from a PHVA workshop:

Eudyptes chrysocome filholi	Eastern Rockhopper Penguin
Eudyptes pachyrhynchus	Fiordland Penguin
Eudyptes robustus	Snares Island Penguin
Eudyptes sclateri	Erect-crested Penguin

Postscript

The successful conservation of wild species and ecosystems necessitates the development and implementation of active management programs by people and governments living alongside that ecosystem. The recommendations contained within this document are based on conservation need only; adjustments for political and other constraints are the responsibility of the various national and international agencies charged with the preservation of flora and fauna.

The participants of the Penguin CAMP wish to emphasize that we do not view any of the recommendations contained in this document as "stand-alone" initiatives. Rather, the reader is encouraged to see these activities as components of the overall, urgent need for the conservation of marine and terrestrial ecosystems. Many of the penguin species are excellent candidates (as bio-indicators, key species, or flagship species) to help facilitate larger-scale conservation programs. We therefore urge continuing and heightened levels of research, monitoring, and management of protected areas and other natural ecosystems within all range areas in which penguins are found.

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Taxon Data Sheet Categories

A Guide to the Taxon Data Sheet Categories

The Conservation Assessment and Management Plan (CAMP) taxon data sheet is a working document that provides information that can be gather data used to assess the degree of threat and to recommend conservation action. The first part of the sheet summarizes information on the status of the wild and captive populations of each taxon. It contains taxonomic, distributional, and demographic information useful in determining which taxa are under greatest threat of extinction. This information can be used to identify priorities for intensive management action for taxa.

SCIENTIFIC NAME: Scientific names of extant taxa: genus and species (or subspecies where appropriate).

IUCN CATEGORY: Status according to the New IUCN Red List criteria
- CR = Critically Endangered
- EN = Endangered
- VU = Vulnerable
- CD = Conservation Dependent
- LR = Lower Risk
- NT = Near Threatened
- DD = Data Deficient
- NE = Not Evaluated

BASED ON: Indicate which of the New IUCN Red List criteria were used to assign a category of threat (see Table 5):
- PR = Population reduction (A1a, or A2b, etc.)
- EO = Extent of occurrence (B1, or B2a, B3c, etc.)
- PE = Population estimates (C1, or C2a, etc.)
- NM = Number of mature individuals (D)
- PX = Probability of extinction (E)

CITES: List the CITES Appendix on which the species is listed, if appropriate.

OTHER: List whether the species has been assigned threatened status in other venues, e.g., nationally or in other conservation assessments.

TAXONOMIC STATUS: This indicates the taxonomic status of the extant taxa. Taxonomic uncertainties may be discussed in this section. Subspecies not considered separately should be listed here along with their distribution.

CURRENT DISTRIBUTION (BREEDING AND WINTERING): List the geographical extent of the breeding and wintering locations of the species.

HISTORICAL DISTRIBUTION: List the historical distribution of the species.

EXTENT OF OCCURRENCE: List the actual size of the area in which the species occurs, if possible. Also list the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred, or projected sites of present occurrence of a taxon, excluding cases of vagrancy (Figure 1). This measure does not take account of discontinuities or disjunctions in the spatial distributions of taxa. Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

A: < 100 km2
B: 101 km2 - 5,000 km2
C: 5,001 km2 - 20,000 km2
D: larger than 20,001 km2

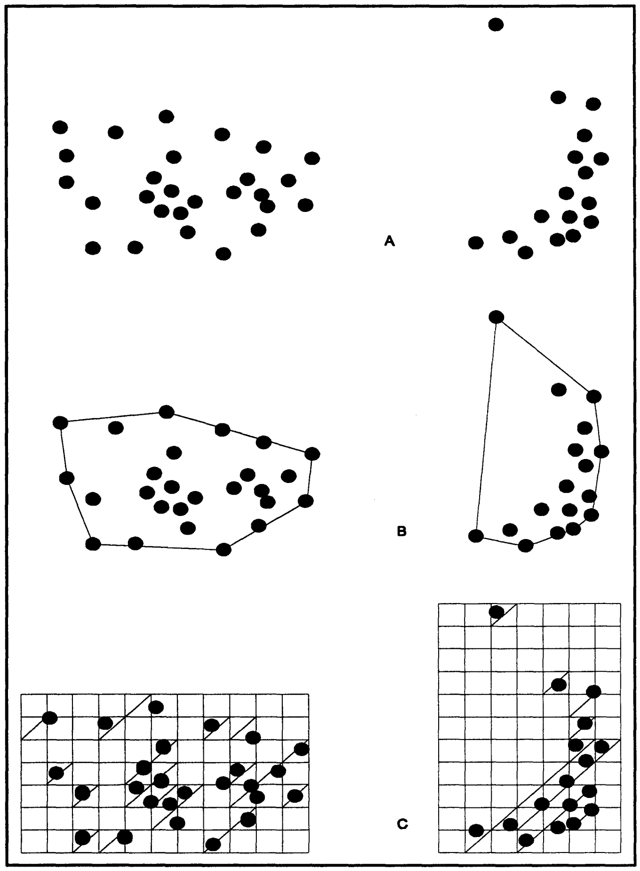

Fig. 1. Two examples of the distinction between the extent of occurrence and area of occupancy. (a) is the spatial distribution of known, inferred, or projected sites of occurrence. (b) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (c) shows one measure of area of occupancy which can be measures by the sum of the occupied grid squares.

AREA OF OCCUPANCY: List the area within the 'extent of occurrence' which is actually occupied by a taxon, excluding cases of vagrancy. The measure reflects the
fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of a taxon (e.g., colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relent biological aspects of the taxon. The criteria include values in km2, and thus to avoid errors in classification the area of occupancy should be measured on grid squares or equivalents which are sufficiently small (see Figure 1).

AREA OF OCCUPANCY:

A: < 10 km2
B: 11 km2 - 500 km2
C: 501 km2 - 2,000 km2
D: larger than 2,001 km2

 # LOCATIONS: Note the number of locations in which the taxon is found. If the population is fragmented, indicate "F" after the number of locations.

POPULATION TRENDS - % CHANGE IN YEARS OR IN GENERATIONS: If possible, list the trend of the population (stable, declining, or increasing). If possible, list the percent of change over a particular time frame (e.g., 10 or 20 years) or number of generations. Specify the number of years or generations over which the decline has occurred, e.g., 10%/2g or 20%/20 years.

GENERATION TIME: Indicate the number of years in a generation. A generation is defined as the average age of parents in the population.

WORLD POPULATION: List the estimated numbers of individuals or pairs (specify which) in the wild. If specific numbers are unavailable, estimate the general range of the population size.

REGIONAL POPULATION(S): List the estimated number of individuals or pairs (specify) in any particular region for which there are data, followed by the location.

DATA QUALITY:
List the actual age of the data used to provide the population estimates, if possible. Also list the type of data from which the estimates are provided.
1 = Reliable census or population monitoring
2 = General field study
3 = Informal field sightings
4 = Indirect information (trade numbers, habitat availability).

Any combination of above = different data quality in parts of range.

RECENT FIELD STUDIES: List any current or recent field studies, the name of the researcher and the location of the study.

THREATS: List immediate or predicted events that are or may cause significant population declines. These may include those below, and also others identified at the workshop:
- A = Aircraft
- C = Climate
- D = Disease
- Dp = Decline in prey species
- Dr = Drowning
- F = Fishing
- G = Genetic problems
- H = Hunting
- Hf = Hunting for food
- Hm = Hunting for medicine
- Ht = Hunting for trophies
- Hyb = Hybridization
- I = Human interference, persecution, or disturbance
- Ic = Interspecific competition
- Ice = Interspecific competition from exotics
- Il = Interspecific competition with domestic livestock
- L = Loss of habitat
- La = Loss of habitat because of exotic animals

Lf = Loss of habitat because of fragmentation
Lp = Loss of habitat because of exotic plants
M = Marine perturbations, including El Niño and other shifts
N = Nutritional disorders or problems
P = Predation
Pe = Predation by exotics
Ps = Pesticides
Pl = Powerlines
Po = Poisoning
Pu = Pollution
S = Catastrophic events
Sd: drought
Sf: fire
Sh: hurricane
St: tsunami
Sv: volcano
T = Trade for the live animal market
Tp: trade for parts, including skins
W = War

TRADE:
Was the species present in Trade according to CITES records? If so, list year(s).

COMMENTS: Note any additional information that is important with respect to the conservation of the species.

RECOMMENDATIONS:

RESEARCH MANAGEMENT:
It should be noted that there is (or should be) a clear relationship between threats and subsequent outlined research/management actions. The "Research/Management" column provides an integrated view of actions to be taken, based on the listed threats. Research management can be defined as a management program which includes a strong feedback between management activities and an evaluation of the efficacy of the management, as well as response of the bird species to that activity. The categories within the column are as follows:

T = Taxonomic and morphological genetic studies
Tl = Translocations
S = Survey - search and find
M = Monitoring - to determine population information
H = Husbandry research
Hm = Habitat management - management actions primarily intended to protect and/or enhance the species' habitat (e.g., forest management)
Lm = Limiting factor management - "research management" activities on known or suspected limiting factors. Management projects have a research component that provides scientifically defensible results.
Lr = Limiting factor research - research projects aimed at determining limiting factors. Results from this work may provide management recommendations and future research needs

Lh = Life history studies
O = Other (record in detail on taxon data sheet)

PHVA: Is a Population and Habitat Viability Assessment process recommended to develop an intensive management/recovery plan for the species?

Yes, No, or Pending further data from surveys or other research.
NOTE**A detailed model of a species' biology is frequently not needed to make sound management decisions.

CAPTIVE PROGRAM RECOMMENDATIONS:

Level 1 (1) - A captive population is recommended as a component of a conservation program. This program has a tentative goal of developing and managing a population sufficient to preserve 90% of the genetic diversity of a population for 100 years (90%/100). The program should be further defined with a species management plan encompassing the wild and captive populations and implemented immediately with available stock in captivity. If the current stock is insufficient to meet program goals, a species management plan should be developed to specify the need for additional founder stock. If no stock is present in captivity then the program should be developed collaboratively with appropriate wildlife agencies, SSC Specialist Groups, and cooperating institutions.

Level 2 (2) - Similar to the above except a species/subspecies management plan would include periodic reinforcement of captive population with new genetic material from the wild. The levels and amount of genetic exchange needed should be defined in terms of the program goals, a population model, and species management plan. It is anticipated that periodic supplementation with new genetic material will allow management of a smaller captive population. The time period for implementation of a Level 2 program will depend on recommendations made at the CAMP.

Level 3 (3) - A captive program is not currently recommended as a demographic or genetic contribution to the conservation of the species/subspecies but is recommended for education, research, or husbandry.

No (N) - A captive program is not currently recommended as a demographic or genetic contribution to the conservation of the species/subspecies. Taxa already held in captivity may be included in this category. In this case species/subspecies should be evaluated either for management toward a decrease in numbers or for complete elimination from captive programs as part of a strategy to accommodate as many species/subspecies as possible of higher conservation priority as identified in the CAMP or in SSC Action Plans.
Pending (P) - A decision on a captive program will depend upon further data either from a PHVA, a survey, or existing identified sources to be queried.

LEVEL OF DIFFICULTY: What is the level of difficulty in maintaining the species in captive conditions?

1 = Least difficult. Techniques are in place for capture, maintenance, and propagation of similar taxa in captivity, which ostensibly could be applied to the taxon.

2 = Moderate difficulty. Techniques are only partially in place for capture, maintenance, and propagation of similar taxa in captivity, and many captive techniques still need refinement.

3 = Very difficult. Techniques are not in place for capture, maintenance, and propagation of similar taxa in captivity, and captive techniques still need to be developed.

EXISTING CAPTIVE POPULATION: Number of individuals in captivity according to the International Species Information System. Please add other information, when available, as the numbers listed in ISIS comprise only a portion of the captive population.

SOURCES: List sources used for information for the above data. (Author's name, year, title of article or book, journal, issue, and page numbers).

SPECIES EDITOR/COORDINATOR FOR CAMP: Name of the person(s) responsible for coordinating information for the CAMP.

CONTRIBUTORS: List the names of the people who contributed information for this taxon data sheet.

Assigning New IUCN Red List Categories

Each taxa reviewed during the CAMP process is assigned a New IUCN Red List Category of Threat. The process of assigning a taxon to a category of threat relies heavily on the data concerning threats, population numbers, trends, and distribution. The steps in making these evaluations are illustrated in Figure 2. For taxa suspected to be threatened (Critically Endangered, Endangered, or Vulnerable), criteria listed Table 5 are used to make the assignment to a threat category. The criteria used to make the assessment (e.g., A1a, B1, D, etc.) are recorded on the Taxon Data Sheet under "Based on." For further information, consult Section 5 for the original IUCN reference on the IUCN Red List Categories.

IUCN: Status according to New IUCN Red List criteria:

EXTINCT (EX)
A taxon is **Extinct** when there is no reasonable doubt that its last individual has died.

EXTINCT IN THE WILD (EW)
A taxon is **Extinct in the Wild** when it is known only to survive in cultivation, in captivity, or as a naturalized population (or population) well outside the past range.

CRITICALLY ENDANGERED (CR)
A taxon is **Critically Endangered** when it is facing an extremely high risk of extinction in the wild in the immediate future as defined by the criteria listed in Table 1 (A through E).

ENDANGERED (EN)
A taxon is **Endangered** when it is not Critical but is facing a very high risk of extinction in the wild in the near future, as defined by the criteria listed in Table 1 (A through E).

VULNERABLE (VU)
A taxon is **Vulnerable** when it is not Critical or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by the criteria listed in Table 1 (A through E).

LOWER RISK (LR)
A taxon is **Lower Risk** when it has been evaluated and does not qualify for any of the categories Critical, Endangered, Vulnerable, Susceptible, Conservation Dependent, or Data Deficient. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **CONSERVATION DEPENDENT (CD)**
   Taxa which do not currently qualify under any of the categories above may be classified as **Conservation Dependent.** To be considered Conservation Dependent, a taxon must be the focus of a continuing taxon-specific or habitat-specific conservation program which directly affects the taxon in question. The cessation of this program would result in the taxon qualifying for one of the threatened categories above.

2. **NEAR THREATENED (NT).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

3. **LEAST CONCERN (LC).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD)
A taxon is **Data Deficient** when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A population this category may be well-studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is not a category of threat.

NOT EVALUATED (NE)
A taxon is **Not Evaluated** when it has not yet been assessed against the criteria.

Figure 2. The process for deriving IUCN Red List Categories

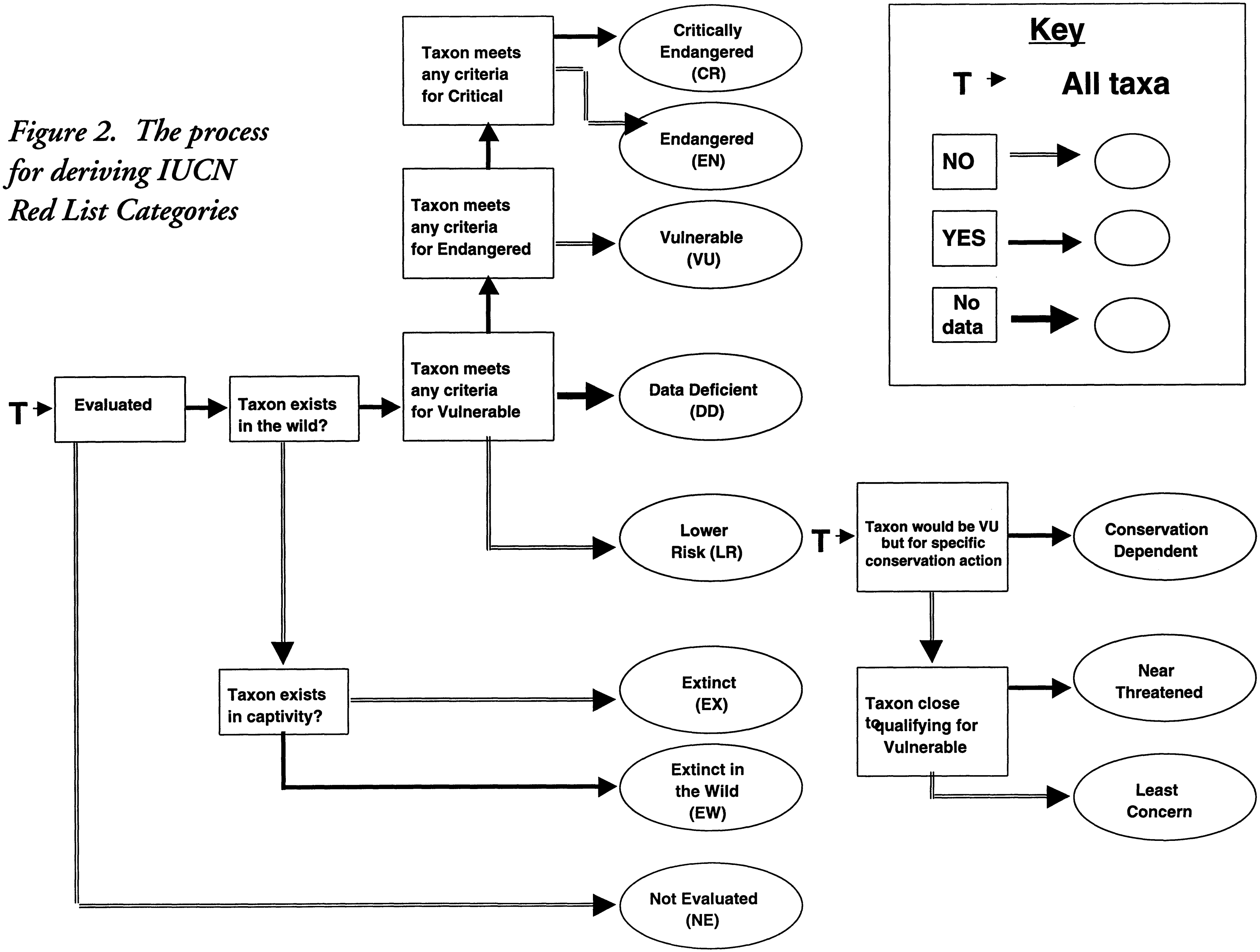

Table 5. Assigning New IUCN Red List Categories of Threat

ANY of the following criteria may be used to assign categories:	CRITICALLY ENDANGERED	ENDANGERED	VULNERABLE
A. Population reduction	1) ≥ 80% decline in last 10 yrs or 3 generations based on:	1) ≥ 50% decline in last 10 yrs or 3 generations based on:	1) ≥ 50% decline in last 20 yrs or 3 generations based on:
	a) direct observation OR b) index of abundance appropriate for the taxon OR c) decline in area of occupancy, occurrence and/or habitat quality OR d) actual or potential levels of exploitation OR e) introduced taxa, hybridization, pathogens, pollutants, competitors or parasites		
	OR	OR	OR
	2) ≥ 80% decline/10yrs or 3 generations predicted in near future based on (b), (c), (d), or (e) above	2) ≥ 50% decline/10 yrs or 3 generations predicted in near future based on (b), (c), (d), or (e) above	2) ≥ 50% decline/20 yrs or 3 generations predicted in near future based on (b), (c), (d), or (e) above
B. Extent of occurrence	Est. <100 km² or area of occupancy est. <10 km², AND TWO of the following:	Est. <5,000 km² or area of occupancy est. <500 km², AND TWO of the following:	Est. <20,000 km² or area of occupancy est. <2,000 km², AND TWO of the following:
	1) Severely fragmented OR single location.	1) Severely fragmented OR ≤ 5 locations	1) Severely fragmented OR ≤ 10 locations
	2) Continuing decline observed, inferred, or projected in ANY of the following: a) extent of occurrence b) area of occupancy c) area, extent, and/or quality of habitat d) # of locations or subpopulations e) # of mature individuals		
	3) Extreme fluctuations in ANY of the following: a) extent of occurrence b) area of occupancy c) # of locations or subpopulations		
C. Population estimates	Est. <250 mature indivs. AND:	Est. <2,500 mature indivs. AND:	Est. <10,000 mature indivs. AND:
	1) Decline ≥25% within 3 yrs or one generation, whichever is longer	1) Decline ≥15% within 5 yrs or 2 generations, whichever is longer	1) Decline ≥20% within 10 yrs or 3 generations, whichever is longer
	OR	OR	OR
	2) Continuing decline, observed, projected, or inferred in mature individuals AND population structure EITHER a) no pop. w/>50 mature indivs. OR b) all indivs. in single subpop.	2) Continuing decline, observed, projected, or inferred in mature individuals AND population structure EITHER a) no pop. w/>250 mature indivs. OR b) all indivs. in single subpop.	2) Continuing decline, observed, projected, or inferred in mature individuals AND population structure EITHER a) no pop. w/>1,000 mature indivs. OR b) all indivs. in single subpop.
D. # of mature individuals	Est. < 50 mature individuals	Est. < 250 mature individuals	1) Est. < 1,000 mature individuals OR 2) Area of occupancy < 100km² or <5 locations
E. Probability of extinction	≥ 50% within in 5 yrs or 2 generations, whichever is longer	≥ 20% within 20 yrs or 5 generations, whichever is longer.	≥ 10% within 100 yrs

Taxon Data Sheets

Aptenodytes forsteri

STATUS: New IUCN Category: Lower Risk
CITES: Not listed

Taxonomic Status: Species

Current Distribution (breeding and wintering): Antarctic: Ross Sea to Antarctic Peninsula
Concentrated Migration Regions: Recent evidence (Kooyman *et al.* in press) of northwards dispersal of post-breeding birds towards Antarctic Polar Front. Vagrants have occurred at most sub-Antarctic islands.

Extent of Occurrence: D

Area Occupied: D

Number of Locations: Woehler (1993) lists approximately 39 colonies at 35 breeding sites.

Population Trends - % Change in Years or Generations:
Trend over past 100 years: The colony at Pointe Geologie monitored annually for number of breeding birds and breeding success, since end of 1950s. Population stable until mid 1970s, then declined steeply (Jouventin and Weimerskirch 1991); stable since end of 1980s. The population size of the Auster colony has remained stable over the last eight years. Numbers of breeding pairs at Taylor Glacier are in close agreement with those obtained in the mid-1970s, indicating stability at this colony for at least 20 years (G.G. Robertson unpublished data). Colonies in the Ross Sea may be increasing currently (G.L. Kooyman unpublished data).

Generation Time: Assumed c. 15 years.

World Population: Woehler (1993) indicates a minimum breeding population of 195,400 pairs. Counts from the 1992-1994 seasons (G.L. Kooyman *in litt.*) for the Ross Sea area (Cape Roget, Coulman Island, Cape Washington, Cape Crozier) represent an additional 22,700 pairs, raising the total to 218,100.

Note that most populations occur in isolated regions of the Antarctic coast and are logistically difficult to visit, particularly during winter when the most reliable estimates of the number of breeding birds can be made.

Data Quality: 1

Recent Field Studies: Comprehensive ecological studies of the Auster and Taylor Glacier colonies on the Mawson Coast. Research aimed at quantifying the inter-annual variation in population size and breeding performance, chick mortality patterns, diet composition, food and energy consumption rates, foraging ranges and diving behavior of penguins through the Antarctic autumn, winter and spring.

Kooyman *et al.* have studied population characteristics, foraging behavior, chick mortality, fledging success, and leopard seal predation at Cape Washington annually since 1986. In 1992 comparative studies at Cape Roget, Coulman Islands and Cape Crozier were begun and will continue at least through 1996/97. Kirkwood and Robertson (1997) also have recently studied foraging patterns.

Threats: Greatest threat likely global climate change and associated changes in sea ice extent and possibly human disturbance. There is no commercial fishing for any of the main prey of Emperor Penguins. However diet of immatures, and of adults outside breeding season, is unknown. There is a potential threat if fishing for *Pleuragramma* was to be started, but the CCAMLR regulations in respect of new and developing fisheries offer potentially strict controls on this. New data (Kirkwood and Robertson 1997) on winter diet show krill to be the Emperor penguin's main food, in contrast to silverfish (*Pleuragramma* spp.) in spring and summer. Therefore, there is a potential for interaction with Antarctic krill fisheries, although these currently are at low levels, especially in areas frequented by Emperor Penguins.

Trade: Not currently in trade

Comments: No serious concerns at present. Birds are protected from direct human interference to a large extent by their winter breeding habit and the remoteness of most colonies from Antarctic stations. Long-term concerns are the effects of global atmospheric change on the dynamics of the fast sea-ice sheet on which the birds gather to breed, the effects of global change on the structure and function of the marine food web, and the potential impact of commercial fishing for *Pleuragramma* in the waters utilized by the penguins for foraging.

There seems to be a trend to milder weather along the Victoria Land Coast. If this continues, sea ice breeding habitat may begin to break up before fledging. At present, the sea ice disintegrates about two or three weeks after fledging. With the use of large Russian icebreakers for tourism, the Ross Sea colonies could become targeted for tourist visits and potential associated disturbance (however, ice breakup/breakout could present problems for tourism).

RECOMMENDATIONS:
Research Management: Need for research on Emperor Penguins aimed at disentangling the effects of natural variation in ecological systems from human induced change to those systems, since research of this kind will improve the predictive capability of relevant management agencies responsible for addressing the concerns mentioned above. Knowledge of the diet of Emperor Penguins outside the breeding season and in open-water habitats is particularly needed to assess potential relationships with commercial fishing operations.

Annual censusing of selected colonies should continue for at least the next 10 years, as well as monitoring of fast ice conditions through the summer. Continuation of monitoring and associated research at Pointe Geologie, Auster/Taylor and Cape Washington is particularly important. Some means of determining recruitment success should be devised and implemented.

PHVA: No

Level of Difficulty: 2
Existing Captive Population (ISIS): 57

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

Contributors: J.P. Croxall, G.L. Kooyman, P. Jouventin, G. Robertson, H. Weimerskirch, E.J. Woehler

Aptenodytes patagonicus

STATUS: New IUCN Category: Lower Risk
CITES: Not listed

Taxonomic Status: Species

Current Distribution (breeding and wintering): Marion and Prince Edward Islands, Crozet, Kerguelen, Heard, Macquarie, South Georgia, Falkland Islands

Concentrated Migration Regions: Satellite-tracking data indicate that Crozet birds forage predominantly 500-800 km south of the islands and travel further in a similar direction in winter (Jouventin *et al.* 1994). South Georgia birds mainly move north to the Polar Frontal Zone (O. Olsson *et al.* unpublished).

Extent of Occurrence: D

Area Occupied: D

Number of Locations: Woehler (1993) lists 11 breeding sites (islands) with 81 colonies. There are five new colonies at South Georgia (P.A. Prince, S. Poncet unpublished data) and breeding at the South Sandwich Islands was recorded for the first time in 1995 (Prince and Croxall 1996).

Population Trends - % Change in Years or Generations: SCAR (1992) gave estimates of increases ranging from 5-25% per annum for populations at Crozet, Kerguelen, Heard, Macquarie and South Georgia. Bingham (1995) reports an increase of 12% p.a. between 1981 and 1994 at the Falkland Islands.

Trend over past 100 years: New data using satellite imagery for Ile des Cochons, Crozet Islands, indicate that the world's largest colony of King Penguins increased from 300,000 pairs in the early 1960s to 500,000 pairs in 1988 (Guinet *et al.* 1995). With 100,000 pairs breeding now at Possession Island (Weimerskirch *et al.* 1992) the total population for the Crozet group is at least 700,000 pairs. New data from Heard Island in 1993 reported an estimated population of 16,345 pairs, an increase of 12,545 over the 1986/87 count (G.G. Robertson *in litt.*). At Macquarie Island the most recent estimate of 110,000 breeding pairs in the main colony and about another 20,000 pairs in three permanent and seven ephemeral colonies is an increase of 76,000 pairs over 1984 estimates (D.E. Rounsevell, unpublished data). On the basis of incomplete surveys the South Georgia population is now c.400,000 pairs, an increase of 11% p.a. since 1985/86 (P A Prince, S. Poncet *in litt*). The Falkland Islands population is now estimated at 350-400 pairs (Bingham 1995, 1996, 1998), a rapid expansion from the c. 100 pairs recorded during the1980/81 (Bingham 1995). Many more birds are now visiting the coasts of Tierra del Fuego to molt and it is anticipated that breeding could commence there before too long (C. Venegas *in litt.*).

Generation Time: Assumed 15 years.

World Population: Woehler (1993) indicates an annual breeding population of 1,070,800 pairs. New data above give a revised total annual breeding population of 1,638,445 pairs. This is probably an underestimate, because all populations with adequate data are known still to be increasing in numbers (van Heezik *et al.* 1994).

Regional Population(s): See above and Woehler (1993).

Data Quality: 1

Recent Field Studies:

1. Heard Island

1. Moore, G.J. and Robertson, G.G. 1993. Population parameters of the King penguin (*Aptenodytes patagonicus*) at Heard Island over the 1992/1993 breeding seasons: population size, patterns of chick mortality, fledging patterns, and morphometrics.
2. Moore, G.J. and Robertson, G.G. 1993. The diet of King Penguins (*Aptenodytes patagonicus*) at Heard Island over the 1992 breeding season: diet composition, feed mass and feed frequency.
3. Moore, G.J. and Robertson, G.G. 1993. Energetics of King Penguin chicks, from early brood to fledging at Heard Island.
4. Moore, G.J. and Robertson, G.G. 1993. Energetics of chick feeding King Penguin adults from early brood to fledging at Heard Island.
5. Moore, G.J. and Robertson, G.G. 1993. Diving ecology of the King Penguin (*Aptenodytes patagonicus*) at Heard Island for 1992/93: adults feeding chicks from brooding to fledging.

The above preliminary reports are contained in Green (1993), available at the Australian Antarctic Division Library.

2. Macquarie Island

Ongoing monitoring of breeding population carried out by the Tasmanian Parks and Wildlife Service.

3. Prince Edward Islands

Six-year study of breeding interval of a banded population ended May 1994. September counts of chicks in all small to medium colonies at Marion Island to continue annually.

4. South Georgia

Studies of population dynamics (using implanted transponder tags), parental provisioning performance, diet and feeding ecology by O. Olsson (University of Stockholm), in collaboration with the British Antarctic Survey, from 1990/91 until 1995/96 (Olsson 1995, 1996; Olsson and North 1997; Olsson and Brodin in press).

5. Crozet Islands

King Penguin reproduction, foraging and endocrinology has been extensively studied on Possession Island, Crozet Islands (Cherel *et al.* 1994, Jouventin and Lagarde 1996, Jouventin and Mauget 1996, Jouventin *et al.* 1994, Mauget *et al.* 1994). Ongoing program carried out by CNRS Chizé on population dynamics include annual counts of all colonies in January during egg stage, and in September to estimate breeding success, recapture of banded birds in a small study colony monitored since 1986. Also studies of foraging ecology and population ecology (using implanted transponder tags together with bands; Le Maho *et al.* 1994).

Threats: Hundreds of oiled King Penguins were reported on Possession Island in winter 1992. Interactions with substantial commercial fisheries for myctophid fish (the main prey of King Penguins at all breeding sites) were a potential threat, especially at South Georgia, in the late 1980s-early 1990s. Fishing effort has been much reduced, or absent, in recent years. King penguins are susceptible to disturbance, which has led to mortality on at least one occasion, from aircraft overflights at low altitude (Cooper *et al.* 1994.)

Trade: Not currently in trade (but see below concerning sale of wild-caught birds).

Comments: The King Penguin population on Heard Island was decimated earlier this century (Downes *et al.* 1959, Budd 1975). Small breeding populations re-established in the 1960s and have continued to increase since (Budd 1975, Gales and Pemberton 1988, Woehler and Johnstone1991, Moore and Robertson 1993). The Spit Bay south colony, the largest on the island, is doubling in size every 2.7 years (Gales and Pemberton 1988). The remaining four colonies are increasing more slowly. King Penguins are rapidly increasing on Heard Island and there are no immediate threats to the population. As Heard Island is visited infrequently with no fixed base, effects from direct human disturbance are minimal.

The population on Macquarie Island is continuing to expand (Rounsevell and Copson 1982, unpublished data). Four new permanent colonies have been established since 1974 besides the expansion of the main colony. The island is part of the Macquarie Island Nature Reserve, which is a restricted area requiring entry permits; however the Reserve only extends to the low water mark and protection under the Tasmanian Wildlife Regulations 1971 out to three nautical miles. While there has been little or no commercial exploitation of marine resources within the 200 nautical mile zone around Macquarie Island, fishing in 1994/95 and 1995/96 accounted for several thousands of tons of catch.

Although the South Georgia population continues to increase and the marine environment has a degree of protection under CCAMLR, the substantial commercial harvest of myctophid fish, the staple diet of King Penguins, in the past gave cause for concern. This fishery has not been operating in the South Georgia area since 1992 so current concerns are somewhat diminished, though the potential for substantial competition between penguins and fisheries still exists.

In the Falklands tourists regularly visit the main colony. The present rules governing this seem adequate to minimize disturbance but these should be reviewed if tourist visits and numbers increase. In southern Chile there are several reports of the visiting, molting birds being caught and sold to zoos. Transport of these birds overseas (e.g., to Singapore) is difficult, especially given the transit through the tropics and mortality apparently has occurred. This situation is a source for concern and investigation.

RECOMMENDATIONS:

Research Management: At Heard Island there is now baseline information detailing the feeding ecology of King Penguins in the absence of a fishery. The King Penguin population

At Macquarie, monitoring of the breeding population and recording of breeding sites should continue. Knowledge of the foraging areas of breeding birds and the distribution of the non-breeding birds will be essential for the long-term management of the population if regional marine resources are utilized in the future.

At Marion Island census of large colonies by aerial photography; on Prince Edward Island ground census of incubating birds.

At South Georgia research into the feeding areas of King Penguins throughout the year in relation to the location of myctophids and fishing, together with surveys to estimate myctophid stock abundance, are needed. The penguin population needs reassessing at 5-10 year intervals.

At Crozet, long term population studies should be continued.

At Kerguelen, new censuses of colonies monitored in the mid 1980s should be carried out to reassess population status.

Investigation is needed of the status of species in Tierra del Fuego and adjacent areas. An appropriate conservation management plan should be developed. In the meantime, sites where molting aggregation occur regularly should be given official protection.

PHVA: No

Captive Program Recommendation: Level 3
Level of Difficulty: 2
Existing Captive Population (ISIS): 319 (26.56.215)

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

Contributors: M. Bingham, J.P. Croxall, J. Cooper, G.R. Copson, P. Jouventin, G.L. Kooyman, O. Olsson, P.A. Prince, G. Robertson, K.R. Thompson, H. Weimerskirch, E.J. Woehler

Pygoscelis adeliae

STATUS: New IUCN Category: Lower Risk
CITES: Not listed

Taxonomic Status: Species

Current Distribution (breeding and wintering): Coastal Antarctic continent, Antarctic Peninsula, South Shetlands, South Orkneys, Bouvet, Balleny, and Peter Island

Extent of Occurrence: D

Area Occupied: D

Concentrated Migration Regions: Broadly confined to pack and marginal ice zone outside the breeding season. Vagrant to sub-Antarctic islands.

Number of Locations: Woehler (1993) lists 177 sites comprising some 1,030 colonies.

Population Trends - % Change in Years or Generations:
Trend over past 100 years: The most extensive data are for the Ross Sea (and especially Cape Bird) (44% of total population). Here, colonies may have declined pre-1970, remained stable through the next decade, increased significantly during the 1980s but are decreasing currently (SCAR 1996). Elsewhere on the Antarctic continent the limited data broadly suggest population stability, at least in the 1980s, or increases between the late 1950s to mid 1980s (e.g. Woehler *et al.*, 1991), or in the late 1980s. Recent (1992, 1993) counts from the Australian Antarctic Territory (AAT: with 27% of the total population) indicate that the populations at several colonies have increased over the last 5 years, the only exception being at sites subject to frequent visits from personnel from nearby stations and from visiting ships (Woehler *et al.* 1994). Numbers in the AAT appear to be stable or increasing (Woehler & Johnstone 1991, Woehler 1993).

The population at Pointe Geologie, Adelie Land, has increased steadily during the past 10 years despite colony destruction by construction of airstrip (Micol and Jouventin in prep.). At sites on the Antarctic Peninsula and nearby island groups, the evidence of increases between the 1950s and late 1970s is unequivocal. Thereafter, depending on site, populations have either fluctuated substantially but remained generally stable overall, or decreased locally. Populations monitored at Admiralty Bay, King George Island, South Shetlands from 1976 to present were highly variable but stable until the late 1980s, then declined sharply. Mean population counts from 1990 to present are 30% lower than mean counts for 1976 to 1988. This recent decline in numbers is paralleled by a concurrent 50% decline in recruitment rates of young Adelie Penguins (W.Z. Trivelpiece, S. Trivelpiece, submitted MS). Some decreases may have been due to human disturbance but declines at many sites (e.g., Anvers Island area) cannot have been caused in this way. Adelie Penguin population changes may be especially closely linked to changes in the physical environment, particularly ice cover (Croxall *et al.*

1988; Fraser *et al.* 1992; Trathan *et al.* 1996), but these relationships are not necessarily on an immediate or proximate basis.

Generation Time: Estimated 10 years

World Population: Woehler (1993) indicates a total minimum breeding population of 2,465,800 pairs.

Regional Population(s): See Woehler (1993).

Data Quality: 1

Recent Field Studies:
1. Australian Antarctic Territory (AAT)
Foraging ecology, breeding biology and CCAMLR Ecosystem Monitoring Program (CEMP) - both automated (using implanted PIT tags and weighbridges) and manual - at Mawson (Knowles Kerry); diving characteristics at Davis station (Graham Robertson/Yutaka Watanuki); aerial photographic surveys at Mawson coast and Vestfold Hills (Davis); endemic and introduced disease and genetic relatedness of colonies (Knowles Kerry *et al.*); effects of human disturbance at Casey (Melissa Giese; Eric Woehler); marine pollutants at Davis (Nico van den Brink).

2. Ross Sea
Collaborative research between Australia and Italy on breeding biology and ecology and CEMP monitoring at Edmonson Point – Knowles Kerry (Australia), Simonetta Corsolini (Italy). Annual aerial surveys of population size, complemented by recording breeding success at selected colonies conducted by Landcare, New Zealand. A new project, involving use of implanted transponder tags and weighbridges to monitor population reproductive performance (productivity, condition) and diet, is being undertaken by collaboration between US and New Zealand scientists (Peter Wilson, David Ainley). Studies of breeding behavior (including sperm competition and satellite tracking: Lloyd Davis, Fiona Hunter).

3. Antarctic Peninsula
Studies, as part of the CEMP, recording some or all of population size, breeding success, adult weight at arrival, diet, foraging trip duration, chick weight at fledging are being conducted by Argentina at Laurie Island, South Orkney Islands, Esperanza, Antarctic Peninsula, Stranger Point, King George Island; by USA (AMLR) at Anvers Island, Antarctic Peninsula; by Chile and Germany at Ardley Island, King George Island (Ulbricht and Zippel 1994); and by UK (BAS) at Signy Island, South Orkney Islands. Long-term studies (1976-present) involving most, if not all, CEMP parameters plus detailed demographic studies at Point Thomas, King George Island, South Shetland Islands (W.Z. Trivelpiece *et al.*). Studies of foraging ecology at Esperanza Station by German and Argentinean scientists (e.g. Wilson *et al.* 1989, 1991).

4. Adelie Land
Annual census of population of Pointe Geologie archipelago, Adelie Land. Studies on effect of colony destruction on population dynamics (T. Micol and P. Jouventin in prep.). Satellite-tracking of breeding birds (France/Australian cooperative program).

5. Other
Studies of foraging ecology have been conducted by the Alfred-Wegener-Institut and Institut fur Meeresforschung, Kiel, Germany at Ardley Island, King George Island, South Shetland Islands.

In Japan the NIPR is studying diving and foraging ecology at Syowa station, Enderby Land in addition to annual recording of some CEMP parameters.

Threats: Potential threats to the Adelie Penguin populations in the AAT include: expansion of the krill fishery operating in the region, introduction of disease, direct human disturbance (e.g. construction of bases, expansion of tourism, helicopters and other aircraft, local researcher-induced effects), and marine pollutants such as organochlorines.

Existing and potential threats to Adelie Penguin populations in the Peninsula area are a) the persistent, restricted location of commercial krill fishing in waters adjacent to breeding populations during their breeding seasons (Agnew and Phegan 1995); b) oil pollution and other marine pollutants such as organochlorines; c) direct human disturbance, especially in the vicinity of stations (and particularly on King George Island) and at sites frequently visited by tourists.

Trade: Not currently in trade

RECOMMENDATIONS:
Research Management: Regular aerial surveys of penguin populations in as many locations as possible. Research into foraging locations and ranges during both the breeding season and winter in relation to krill fishing grounds, krill availability and seasonal sea ice variations. Effects of food availability and sea ice extent on breeding success. Effects of human disturbance at individual, colony and population levels. Long term monitoring of specific indicator colonies in various locations to determine natural variations in breeding success. Genetic studies to determine the relatedness of different populations together with studies of recruitment and migration of birds into and between colonies. Research into ingestion of marine debris and accumulation of pollutants. Regulation of tourist activities.

PHVA: No
Captive Program Recommendation: Level 3
Level of Difficulty: 2
Existing Captive Population (ISIS): 221

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

Contributors: J.P. Croxall, L.S. Davis, W. Fraser, K.R. Kerry, D. Patterson, G. Robertson, W.Z. Trivelpiece, P. Wilson, E.J. Woehler

Pygoscelis antarctica

STATUS: New IUCN Category: Lower Risk
CITES: Not listed

Taxonomic Status: Species

Current Distribution (breeding and wintering): Antarctic Peninsula, South Sandwich, South Orkneys, South Shetlands, South Georgia, Bouvet, Balleny, and Peter Island.

Extent of Occurrence: D

Area Occupied: D

Number of Locations: Woehler (1993) lists 232 sites comprising about 780 colonies

Population Trends - % Change in Years or Generations:
Trend over past 100 years: Major population increases (at faster rates than for Adelie Penguins) were generally characteristic of the 1950s to mid 1970 period. From 1970 to 1990 most of the few data indicated substantial fluctuations or, at most, a very reduced rate of continued increase. There was little evidence of colonization of new sites or significant increases at the edge of the species breeding range. Recent data (SCAR 1996) for the Antarctic Peninsula suggest that at least the best-studied populations have decreased over the last 5-10 years. Chinstrap Penguin fluctuations are also undoubtedly influenced by changes in the physical environment (Croxall *et al.* 1988; Fraser *et al.* 1992; Trathan *et al.* 1996) but possibly to a lesser extent than Adelies and with less clear simple correlations.

Generation Time: Estimated 10 years

World Population: Woehler (1993) provided an estimate of minimum breeding populations of 7,490,200 pairs, but this depends substantially on the estimated 5,000,000 pairs at the South Sandwich Islands, which has never received an adequate survey.

Regional Population(s): See Woehler (1993).

Data Quality: 1/2

Recent Field Studies: As part of the CCAMLR Ecosystem Monitoring Program, some or all of breeding population size, breeding success, adult mass at arrival, diet, chick mass at fledging have been measured by USA (AMLR) at Seal Island, Elephant Island group (1988-1995), and UK (BAS) at Signy Island, South Orkney Islands (1976-continuing). In addition the US AMLR program and two German institutes (Alfred-Wegener-Institut and Institut fur Meereskunde, Kiel) have studied feeding ecology at Seal Island, Elephant Island group and Ardley Island, respectively. Long-term studies (1976-present) involving most, if not all, CEMP parameters plus detailed demographic studies at Point Thomas, King George Island, South Shetland Islands

(W.Z. Trivelpiece *et al.*). Studies of breeding biology, behavior and energetics (e.g. Moreno *et al.* 1994; Moreno and Sanz 1996) by Spain at Deception Island, started in 1990/91, are continuing.

Threats: Populations of this species are currently stable or have decreased somewhat in recent years. Threats and concerns are similar to those noted for Adelie Penguin.

Trade: Not currently found in trade

RECOMMENDATIONS:
Research Management: Survey of populations at the South Sandwich Islands is of paramount importance. Other recommendations are as for Adelie Penguin.

PHVA: No

Captive Program Recommendation: Level 3
Level of Difficulty: 2
Existing Captive Population (ISIS): 161

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

Contributors: J.P. Croxall, W. Fraser, J. Moreno, D. Patterson, G. Robertson, W.Z. Trivelpiece, E.J. Woehler

Pygoscelis papua

STATUS: New IUCN criteria: Lower Risk
CITES: Not listed

Taxonomic Status: Species

Current Distribution (breeding and wintering): Marion and Prince Edward Islands, Crozet, Kerguelen, Heard, Macquarie, South Georgia, Falklands and Antarctic Peninsula, South Orkney, South Shetland, and South Sandwich Islands.

Extent of Occurrence: D

Area Occupied: D

Number of Locations: Woehler (1993) reports 90 sites comprising some 250 colonies (excluding South Georgia (278 colonies) and the Falklands (81 colonies)).

Population Trends - % Change in Years or Generations:
Trend over past 100 years: Bingham (1998) reports that the Falkland Islands population is now approximately 81,000 pairs. The 1995/96 survey in the Falklands suggested a decline to 65,000 pairs (41%) from the 100,000-110,000 pairs estimated in the 1980's (Bingham, 1996); hence the population seems to be fluctuating. Annual breeding counts of selected breeding sites around the Falkland Islands suggested that much of this decline had occurred during the late 1980s and early 1990s, with low breeding success also observed during that period (Bingham 1994a, 1994b, 1995). The population at Bird Island, South Georgia has fluctuated greatly (between 2,000 and 6,000 pairs) over the last 20 years but has possibly decreased overall by about 20%. Populations on the Antarctic Peninsula have mainly increased, often by 20-40% over the last decade (SCAR 1996). Population data elsewhere suggest stability or slight increase. The Macquarie population may have increased substantially, from 4,700 pairs in 1984 to 6,820 pairs in 1992/93 but this needs confirming.

Generation Time: Estimated 10 years

World Population: Woehler (1993) estimated a minimum breeding population of 314,000 pairs. The bulk of the population is at South Georgia (33%, comprising about 105,000 pairs; P.A. Prince, S. Poncet unpublished data) and the Falkland Islands (21%) where a survey in 1995/96 estimated 65,000 pairs (Bingham 1996). Revised figures above and in SCAR (1996) suggest current total population of 317,000 pairs.

Regional Population(s): See Woehler (1993).

Data Quality: 1
Recent Field Studies: At Macquarie Island population studies (Tasmania, NPWS) and foraging ecology studied in 1993/94. Other studies on foraging ecology carried out by M.A. Hindell, Department of Zoology, University of Tasmania. Research on the annual cycle of reproductive

and stress hormones has not been undertaken since 1993 (formerly carried out by H.R. Burton, Australian Antarctic Division, P. Kosiorek, Department of Polar Ecology, Institute of Ecology, Lomianki, Poland).

At Marion Island CEMP monitoring started in May 1994 and will continue initially for three years. A comprehensive population census will also be conducted. Counts in 1994/95 and 1995/96 were 1352 and 1310 pairs.

Extensive studies of breeding performance, diet and foraging ecology have been published recently (Bost and Jouventin 1990a, b; 1991a, b, Bost *et al.* 1994) for Crozet and Kerguelen. Ongoing program of annual population monitoring on Possession Island, Crozet Islands, started in 1986.

As part of Falkland Islands Seabird Monitoring Programme (FISMP) established by Falkland Conservation in 1989/90 (Thompson 1993), breeding numbers, breeding success rates, chick growth and diet monitored annually at a number of study sites. Since 1991/92 geographical coverage for this species has been greatly extended through the recruitment of volunteers who undertake annual counts of incubating pairs and chicks (Bingham 1995).

As part of the CEMP, some or all of breeding population size and success, chick diet and mass at fledging are recorded annually by UK (BAS) at Bird Island, South Georgia, and Signy Island, South Orkney Islands (e.g. Croxall *et al.* 1988, Croxall and Rothery 1995, Williams and Rodwell 1992). Long term studies (1976-present) involving most CEMP parameters plus detailed demographic studies are continuing at Admiralty Bay, King George Island, South Shetland Islands (W.Z. Trivelpiece *et al.*).

Research on foraging ecology has been carried out at Ardley Island and Bird Island by German and UK (e.g. Williams *et al.* 1992a, b) researchers, respectively. On Cuverville Island, Antarctic Peninsula, research on responses to natural and human-induced disturbance during the incubation period conducted during the 1994/95 season (Nimon and Stonehouse, 1996; Nimon *et al.* 1996). Current studies on skua-penguin interactions by K. Crosbie (Scott Polar Research Institute, University of Cambridge).

Threats: Disturbance by humans, local pollution, potentially fisheries interactions.

Trade: Not currently in trade

Comments: Macquarie Island has Reserve status and control programs are currently being implemented for introduced vertebrates. The introduced weka (*Gallirallus australis*) is now considered eradicated, and no longer a threat to eggs and chicks (G. Copson pers. comm.). Cats continue to be eradicated (but only at the rate of increase, so the population is stable) but are not considered to be a significant threat (G. Copson pers. comm.). P. Kosiorek (pers. comm.) considers rats to be a threat, in that they take eggs, but G. Copson (pers. comm.) does not think their impact is significant.

Some Gentoo Penguins seem extremely sensitive to human disturbance. Populations at some locations, e.g., Macquarie Island and Marion Island, are reported to desert their nest, leaving contents exposed, at high human-penguin threshold distances. Extreme care must be taken in the conduct of CEMP studies with such populations. However, experienced personnel on

Macquarie Island consider that the supervised tourist visits ashore and operation of zodiacs there has had negligible impact on penguins (J. Scott pers. comm.; G. Copson pers. comm.). Gentoo Penguins at Heard Island, South Georgia and on the Antarctic Peninsula seem less susceptible to detrimental impacts of humans on foot near their breeding sites. Recent studies on Antarctic Peninsula suggest that a human observer has no significant effect on incubating Gentoo Penguins (Nimon *et al.* 1995) and even large visitor groups maintaining a 5m distance may produce little response (A.J. Nimon in prep.).

At the Falkland Islands, Gentoo Penguins are potentially affected by offshore trawl fisheries for *Loligo gahi* squid and various finfish species (Thompson 1989, 1993; Bingham 1995). A few colonies are visited by tourists, effects undocumented but not thought to be significant. Egging for human consumption, under local license, is apparently declining. The potential development of an offshore oil extraction industry within the next decade is of concern, both with respect to direct impacts (e.g., oil spills) and indirect effects of increased human population and associated infrastructure.

As a year-round resident at most breeding localities and being confined to inshore waters, the species is especially vulnerable (and more so than most other penguins) to local pollution and disturbance.

RECOMMENDATIONS:
Research Management: More baseline census and monitoring studies are required, together with research on population dynamics, particularly to assess the significance of years of poor fledging success and/or recruitment (see Croxall and Rothery 1995). Studies of population genetics would be particularly appropriate. Although some recent work has assessed the effects of human visitors on Antarctic Peninsula Gentoo Penguins, further work on these and other populations is desirable. Gentoo Penguins breeding at all Southern Indian Ocean sub-Antarctic Islands are particularly sensitive to human disturbance, so research programs, including those for CEMP, need adjusting accordingly.

PHVA: No

Captive Program Recommendation: Level 3
Level of Difficulty: 2
Existing Captive Population (ISIS): 303 (52.61.190)

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

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Eudyptes chrysocome filholi

STATUS: New IUCN Category: Vulnerable
Based on: A1a, A1c
CITES: Not listed

Taxonomic Status: Subspecies (Note that there are morphological differences between birds from Indian Ocean and New Zealand populations; further taxonomic work required).

Current Distribution (breeding and wintering): Marion and Prince Edward, Crozet, Kerguelen, Heard, and islands south of New Zealand: Macquarie, Campbell, Antipodes, Auckland Islands

Concentrated Migration Regions: Anecdotally sighted at sea south of the Antarctic Polar Front.

Number of Locations: Woehler (1993) lists eight islands or island groups (see above).

Population Trends - % Change in Years or Generations:
Trend over past 100 years:

1. Campbell Island - decrease of 94% since the 1940's reported by Cunningham & Moors (1994) attributable to rising sea surface temperatures causing euphausiids to move offshore, affecting the availability of prey to Rockhoppers and subsequently chick growth and survival. Effects of occasional rat predation on chicks and disease *(Pasteurella multocida)* may be contributing factors in some years. Currently there is a major fishery for southern blue whiting (a common prey species) in the New Zealand subantarctic. Expect continued decline.

2. Antipodes Islands - New data available from Alan Tennyson (*in litt.*) indicates further decline from 1990. Decrease from 86 colonies in 1972/73 to approximately 76 in 1989/90, numbers in later count unknown. Numbers in earlier count are a very rough estimate based on molting birds seen in March 1973. R.H. Taylor estimated that Rockhopper Penguins comprised about 15% of the total numbers of this species as they nest with erect-crested Penguins. R.H. Taylor estimates that there may have been a decline of both species from the 1950's equal to that at Campbell.

3. Auckland Islands - Decrease from estimated 5,000-10,000 pairs in 1972/73 to current population of 2,700-3,600.

4. Macquarie Island - population trends unknown.

Generation Time: Assumed to be 15-20 years.

World Population: Woehler (1993) indicated that the combined breeding populations of the Prince Edward Islands (c. 172,052), Crozet Islands (152,800), Kerguelen (85,500), Heard and MacDonald Islands (>10,000), Macquarie Island (100,000-300,000), Campbell Island (51,500), Auckland Island (5,000-10,000), and Antipodes Islands (50,000) is at least 832,000 pairs. At Marion Island, the actual breeding population was estimated to be 173,000 pairs in 1994 and 150,000 pairs in 1996 (R.J.M. Crawford *in litt.*). In 1973/74, there were 212,000 breeding pairs; in 1976/77 an estimated 93,000 pairs (Watkins 1987). An intensive, albeit incomplete, survey of Heard Island in 1993 (Green 1993) reported 8,042 pairs, suggesting that the earlier estimate of 10,000 pairs was fairly realistic. Recent surveys at the Auckland Islands (Cooper 1992), indicating a population of 2,700-3,600 pairs, reveals a substantial decline since the 1970s in line with that for Campbell Island.

Regional Population(s): See above.

Data Quality: 1

Recent Field Studies: A three-year research program commenced at Macquarie Island in 1993/94 (C. Hull, in prep). The program examines the foraging ecology (diet, foraging behavior, foraging ranges) of Rockhopper and Royal Penguins simultaneously and seeks to quantify the degree of resource partitioning between these closely related species. The results of this study have prompted a collaborative program between C. Hull, M. Hindell, P. Moors and the New Zealand Department of Conservation (P. Moore and D. Cunningham) to census the entire population at Macquarie and establish long-term monitoring techniques. Concurrent studies will be carried out on aspects of diet and foraging behavior at Macquarie and Campbell Island with an attempt to ascertain differences and explore reasons for the decline at Campbell Island. Other recent studies involved patterns of egg loss (St. Clair & St. Clair 1996 in press), the impact of investigators on breeding success (Hull and Wilson 1996a) and the use of morphometrics for sexing Rockhopper Penguins (Hull and Wilson 1996b).

Recent research at Heard Island included data on diet and diving behavior, but there are current plans for further work at Heard.

At Prince Edward Islands ongoing counts of breeding production and success in three small colonies at Marion Island (Cooper *et al.* 1997) There has been a complete island census in 1994/95 which will be repeated in 1997 (J.M. Crawford, *in litt.*). There also is ongoing work with food samples to monitor prey type (N. Klages).

Threats: Pollution, including plastics, in the marine environment; potential threats if predators introduced to Heard and McDonald Islands. Potential threats include disease, climatic change, predation by rats and cats on Campbell and Macquarie Islands. It is important to eradicate rats on Campbell, pigs on Auckland, cats on Macquarie and feral mammals on the Kerguelen Islands. Another potential threat may be fishing around Macquarie Island if euphausiids, myctophids or squid are taken. It also may be important to regulate/prohibit domestic poultry being allowed on penguin islands. Long-term threats include marine pollution and possible changes to the marine food web from global warming.

Trade: Not currently found in trade

Comments: Macquarie Island - During the 1994/95 season, a small number of Rockhoppers arrived at the island (on both the east and southern coast) with damage to feathers that appeared consistent with a pollutant such as diesel fuel; this is being seasonally monitored. The penguins in the worst condition suffered massive edema, had lost waterproofing of feathers, showed bleeding around the eyes and beak and were in poor condition. Samples of feathers, eye swabs and photographs showed nothing conclusive. The condition of the feathers was not consistent with bunker oils. It is possible that the problem was disease-related but nothing conclusive was found. Only a couple of sites were reported on, related to the presence of human observers able to survey colonies, hence it is unknown to what extent it occurred in other colonies or the actual number of birds affected.

Rockhopper Penguins are difficult to census accurately and there is a pressing need for reliable census information to determine population trends. This is highlighted by the recent decline of Rockhopper Penguin populations on Campbell and Antipodes Islands and by the general lack of reliable information on population trends at other breeding sites.

This subspecies was classified as Vulnerable under the criterion for population reduction (≥ 50% decrease in the past 20 years or 5 generations based on direct observation and actual or potential levels of exploitation). With more data, however, the subspecies may merit a more endangered status. Local extinctions, if current trends continue, are possible.

RECOMMENDATIONS:
Research Management: Research priorities include systematic and long-term estimates of population size and reproductive performance and a detailed year-round understanding of the foraging ecology of Rockhopper Penguins, including information on foraging ranges (to allow an assessment of likely interaction with future commercial fishing operations, and the relationship to oceanographic variables to explore any effect of rises in sea surface temperature. An understanding of the distribution of prey of this species also in relation to rises in sea surface temperature would be of value). Emphasis should be placed on determining the size and status of populations of the different islands. Genetic comparison of populations from different islands is needed. In particular, differences between the Indian and other populations should be examined. If these populations attain subspecific status this would make the New Zealand Rockhoppers Endangered under the new IUCN Red List categories of threat.

Campbell Islands - continued monitoring with periodic re-measurement of colonies, periodic food sampling to monitor prey type, regular surveillance of colonies for predation and disease, and continued measurement of sea temperature.

Antipodes Islands - baseline survey to determine population numbers. Food samples to monitor prey type.

Auckland Islands - census based on ground surveys to establish baseline for future monitoring. Food samples to monitor prey type.

Prince Edward Islands - Complete census of incubating birds and colony mapping at Prince Edward Island; inclusion of species within CEMP study, at same level of intensity as for Macaroni Penguins.

Macquarie Island - census of population numbers needed.

PHVA: Yes

Captive Program Recommendation: Pending PHVA
Level of Difficulty: 2
Existing Captive Population (ISIS): 2 (Edinburgh Zoo)

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

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Eudyptes chrysocome chrysocome

STATUS: New IUCN Category: Vulnerable
Based on: A1a, A1c
CITES: Not listed

Taxonomic Status: Subspecies.

Current Distribution (breeding and wintering): Falkland Islands, southern Chile, southern Argentina. Distribution at sea outside the breeding season is unknown.

Number of Locations: Woehler (1993) lists breeding at 12 islands or island groups: South Georgia, Falklands (86 colonies), Chile (≥14 sites).

Extent of Occurrence: D

Area of Occupancy: D

Population Trends - % Change in Years or Generations:
Trend over past 100 years: See below, especially for Falkland Islands

Generation Time: Assumed 15-20 years

World Population: Woehler (1993) estimated a total population of about 700,000 pairs, divided between the Falkland Islands (90%) and South America. New data (Bingham 1996, 1998) indicate a total population of 475,000 pairs (63% in the Falklands) with a few pairs in Argentina, the rest (37%) in Chile.

Regional Population(s):
1. Falkland Islands
Bingham (1996) estimated a total breeding population of 300,000 pairs (in 36 colonies), based on a 1995/96 survey. This means that the Falkland Islands population has crashed to just 10% of the size reported by Bennett (1933), with much of this decline having occurred in the 1980s and early 1970s (Bingham 1994c, 1995, 1996). Extensively using data from the 1930s, the breeding population was estimated in 1984 as 2,500,000 pairs (Croxall *et al.* 1984). In 1989, following new surveys, the population was reassessed as 540,000-700,000 pairs (K. Thompson *in litt.*). There was a dramatic decline at a number of colonies from 1986 to 1992, post-dating an earlier die-off of molting adults in 1985/86 (Keymer 1988). Thus two colonies at New Island declined from several tens of thousands in 1986 to 4,000 pairs in 1992 and 250 pairs to 35 pairs and at Beauchene Island the colony had declined from 300,000 pairs in 1980 (Smith and Prince 1985) to 71,500 in 1991 (K. Thompson *in litt.*). Similar reports from land owners and visitors to other colonies indicate that breeding numbers have crashed generally throughout the Falklands, though some other of the largest colonies (e.g., on Steeple Jason Island) had not then been reassessed.

2. Argentina
The distribution and abundance of the Rockhopper Penguin has been poorly evaluated in

Argentina. Rockhoppers are known to breed only at Isla Pinguino (47°45'S, 65°54'W) and Staten Island (54°40'S, 64°30'W). The colony at Isla Pinguino, located 25 km off Puerto Deseado, Province of Santa Cruz, which was first described in 1985, consists of 450 breeding individuals. Breeding numbers increased from 1985 to 1990 at a rate of 27% per year (Frere *et al.* 1993), well exceeding the maximum endogenous rate of increase.

3. Chile
Reports (Venegas 1984, 1991; Soto 1990) indicate that the Chilean population has remained essentially stable. Woehler (1993) estimated 175,000 pairs for the Chilean population. Based on new surveys in 1996/97 of almost all Chilean breeding sites, M. Bingham (*in litt.*) estimated 165m,000 pairs (± 15%). A survey carried out by Schiavini and Frere during 1995 (unpublished data) reports at least 3 colonies on Staten Island with approximately 10,000 pairs. The islands of Diego Ramirez and the Ildefonso group hold the majority of the total population. A recent visit to Ildefonso by Venegas estimated less than 10,000 pairs (with no evidence of decline), while Isla Noir is probably the largest Chilean breeding site with around 70,000 pairs (35%) in 1996/97 (Bingham *in litt.*), followed by Diego Ramirez with c. 60,000 pairs. There is evidence that adults of this species (probably this subspecies) are being exported from Chile (A. Simeone pers. comm.)

Data Quality: 1

Recent Field Studies: In the Falklands, Bingham (1996) carried out a comprehensive 1995/96 survey suggesting continuing decline throughout the 1980's (see above). Censuses of breeding population size in some colonies and studies of diet and adult mass at molt are conducted annually. Studies on this species were carried out at Isla Pinguino, Argentina in the late 1980s. In Chile some population surveys have been carried out in the 1980's. Studied of brood reduction were carried out on New Island, Falkland Islands (Lamey 1993; St. Clair 1996; St. Clair & St. Clair 1996 in press).

Threats: Fisheries activities, human disturbance, pollution (especially oil).
1. Falklands
Commercial fisheries for *Loligo gahi* squid may potentially affect pre-molt adults at some sites (Thompson 1993). A few colonies are regularly visited by tourists, principally by cruise ships. These affects are undocumented but not thought to be significant. Egg collection, under local license, for human consumption is now very limited and apparently declining. Some oiled birds are occasionally reported from the western colonies. The potential development of an offshore oil extraction industry within the next decade is of considerable concern, both with respect to potential direct impacts (e.g., oil spills) and the likely indirect affects of increased human population and associated infrastructure, particularly in coastal areas. Effects of offshore activities and pollution on penguins outside the breeding season (when they likely range widely over the Patagonian Shelf) could be very substantial. The Falklands population suffered mortality in 1986 similar to that recorded for Puerto Deseado, which was attributed to starvation (Keymer 1988).

2. Argentina
Oiled Rockhopper Penguins are frequently found along the Argentine coast, from Buenos Aires to Tierra del Fuego (P. Gandini and E. Frere unpublished data). Preliminary studies of Rockhoppers in the Puerto Deseado area showed that their diet consists mainly of squid *(Illex* spp.*)* and to a lesser extent of euphausiids *(Euphausia* spp.*)* (P. Gandini and E. Frere

unpublished data). Given the fast growing squid fisheries in South Atlantic coastal shelf areas, Rockhopper Penguin populations may be affected in the near future.

During 1986, 800 Rockhopper Penguins were found dead near Puerto Deseado, Santa Cruz. Penguins had no signs of oil, and appeared to have starved. The cause of this death is unknown, but it was suggested to be due to over-fishing (Capurro *et al.* 1986). Isla Pinguino was declared a Provincial Reserve in 1986. Even though it is legally protected, no control or management measures have been undertaken. Human activities in the Isla Pinguino area have shown a dramatic increase in the last two decades. Human population at Puerto Deseado has doubled in the last decade, mainly due to the establishment of fishing industries. This has resulted in increased pollution and human activities near seabird colonies. Additionally, ecotourism is a fast growing activity in Puerto Deseado. Attempts have been already made to land on Isla Pinguino and visit seabird colonies.

Trade: Not currently found in trade

Comments: This subspecies was classified as Vulnerable under the criterion for population reduction ($\geq$ 50% decrease in the past 20 years or 5 generations based on direct observation and actual or potential levels of exploitation). With more data, however, the subspecies may merit a more threatened status. Local extinctions, if current trends continue, are possible.

RECOMMENDATIONS:
Work is needed on the taxonomic status of this taxon.

Research Management:
1. Falklands
Continued monitoring especially to form baselines against which to assess any future impact of oil exploration and exploitation and its associated infrastructure. As feasible more detailed work to attempt to determine more accurately the current status of the population and possible causes of the massive decline. Vital to obtain data on the offshore distribution of breeding and non-breeding birds of this species, both during and outside the breeding season.

2. Argentina
Improve knowledge of the distribution and abundance of Rockhopper Penguins along the Argentine coast; surveys and censuses are needed for the Tierra del Fuego region and Staten Island. Analyze the potential impact of oil leases, along the Argentine coast, on Rockhopper Penguin populations. Evaluate and monitor the current impact of oil pollution on Rockhopper Penguins along the Argentine coast. Evaluate diet, foraging behavior and foraging ranges, especially in relation to interactions with fisheries. Conduct studies of breeding performance and analyze factors affecting breeding success at the colony in Isla Pinguino. Monitor the Isla Pinguino colony, given the increase in human-related activities in the area, especially fishing and ecotourism activities. Develop and implement a management plan for the Isla Pinguino Provincial Reserve with particular attention to regulation of tourist activities and restriction of disturbance/interference from other sources.

3. Chile
Future surveys to monitor all colonies now surveyed and assess population trends are a high priority.

PHVA: Yes

Captive Program Recommendation: Pending PHVA results
Level of Difficulty: 2
Existing Captive Population (ISIS): 177 (42.35.100)

Sources: See references pages 62-68.

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Eudyptes chrysocome moseleyi

STATUS: New IUCN Category: Vulnerable
Based on: A1a, A1c
CITES: Not listed

Taxonomic Status: Subspecies

Current Distribution (breeding and wintering): Tristan da Cunha, Gough, St. Paul and Amsterdam Island

Extent of Occurrence: B

Area Occupied: B

Number of Locations: Two island groups (Tristan da Cunha/Gough, Amsterdam/St. Paul)

Population Trends - % Change in Years or Generations:

Trend over past 100 years: Some evidence of substantial declines at Nightingale Island (Tristan da Cunha group) (Woehler 1993) and severe decreases at all colonies on Amsterdam and St Paul (P. Jouventin and H. Weimerskirch *in litt.*).

Generation Time: Assumed to be 15-20 years.

World Population: Woehler (1993) reports a world population of 350,000 breeding pairs (84% at Tristan da Cunha/Gough).

Regional Population(s): Woehler (1993) summarizes population data for Tristan da Cunha (149,000-159,000 - though this depends heavily on the 1973 estimate for Middle Island), Gough (144,235), Amsterdam (50,000) and St Paul (5,000), giving a minimum breeding population of c. 348,000 pairs. Censuses at all eight colonies at Tristan da Cunha in September-October 1992 by Sgt. C. Glass revealed a total of 3,343 occupied nest sites (J. Cooper *in litt.*).

Data Quality: 1

Trade: Not currently found in trade

Recent Field Studies: Annual censuses are being undertaken at most colonies on the main island of Tristan da Cunha , but show no clear trends (J. Cooper *in litt.*). Yves Cherel began a study on Amsterdam Island; one aspect is foraging ecology but the study may focus on other topics. The latter work is ongoing. Yves Cherel also is comparing foraging behavior between Northern and Southern Rockhoppers.

Threats: Potential threats include drift netting and egging (the latter especially at Nightingale Island). Global warming and rising sea-surface temperature is also a potential threat.

Comments: Tristan colonies should be formally protected as Sanctuaries in terms of Tristan da Cunha Conservation Ordinance. Currently only one, Jew's Point Gulch, is protected formally (Williams & Stone 1981). This colony had 357 pairs in 1992: c. 10% of total. Rockhopper Penguins are formally protected from human exploitation at Tristan, but sanctuary status will give added protection for their breeding habitats.

Penguin egging at Nightingale Island should be restricted to the first-laid egg that does not usually hatch. Nightingale Island requires a management plan to, *inter alia*, restrict penguin egging to below sustainable levels.

Inaccessible Island is to be proclaimed a nature reserve. It then requires a management plan, which, *inter alia*, will allow for the conservation of penguins.

The local commercial rock lobster and non-commercial finfish fisheries do not seem to cause harm to penguins by oiling, entanglement or competition (Ryan 1991), but drift-netting in the South Atlantic has caused mortalities in the past (Ryan and Cooper 1991).

Reasons for population decreases at Amsterdam and St Paul are unknown (P. Jouventin and H. Weimerskirch *in litt.*).

RECOMMENDATIONS:
Research Management: Nightingale and its islets are in need of a survey of penguin distribution and numbers (this will be exceedingly difficult given the dense tussock in which the birds breed).

Egging at Nightingale should be assessed in terms of sustainability, and quotas set if necessary.

The diet of the Rockhopper Penguin in the Tristan Islands should be studied to allay Islanders' fears that they are competing with the rock lobster fishery.

Complete island censuses at all breeding islands should be undertaken at regular intervals.

PHVA: No

Captive Program Recommendation: Level 3
Level of Difficulty: 2
Existing Captive Population (ISIS): 58 (22.24.12)

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

Contributors: J. Cooper, J.P. Croxall, P. Jouventin, C. Hull, D. Keith, D. Laughlin, C. C. St. Clair, H. Weimerskirch,

Eudyptes schlegeli

STATUS: New IUCN criteria: Vulnerable
Based on: D2

CITES: Not listed

Taxonomic status: Species, as indicated by preliminary DNA work (K.-A. Edge unpublished data, *in litt.* to C. Hull). Taxonomic clarification is needed; considered by some to be a subspecies of *E. chrysolophus* (e.g., Christidis and Boles 1994). Morphometric data show significant differences in measurements between Royal and Macaroni Penguins (Woehler 1995; Hull in press *Marine Ornithology).*

Current Distribution (breeding and wintering): Macquarie Island

Concentrated Migration Regions: Anecdotal evidence suggests that migration areas may run from Tasmania to the Antarctic pack ice. It appears that juveniles may be migrating farther north. During the breeding season, birds from one colony may move up to 600 km. from breeding sites.

Area Occupied: B; 150 km^2

Number of Locations: 1

Population Trends - % Change in Years or Generations:

Trend over past 100 years: Population numbers have recovered from earlier hunting and the species is probably the most numerous penguin on Macquarie Island.

Generation Time: Estimated 15-20 years.

World Population: Endemic to Macquarie Island where the population in 1984/85 was estimated as 850,000 pairs in 57 colonies ranging from 75,000 to 160,000 pairs (Woehler 1993).

Regional Population(s): not relevant

Data Quality: 1

Recent Field Studies: A 14-year study was conducted by Robert Carrick in the 1960s and 1970s (Carrick 1972 and unpublished data). D. Murray is attempting to write up Carrick's data. Recent research has included studies of diet, brood reduction, social behavior, aspects of breeding biology (Cassady St. Clair *et al.*), the cost of colony location on breeding success (Hull & Wilson 1996b), foraging ecology (C.Hull, in prep). The foraging ecology of the species will be studied as part of a collaborative program examining the use of Antarctic Polar Frontal Zone around Macquarie Island by predators (other predators include Rockhopper Penguins, King Penguins, fur seals and elephant seals). Data also will be collected on oceanographic details of the frontal zone and on the distribution and abundance of prey (via fishing trawls) in this region. This work will begin in the 1996/97 season.

Threats: Fishing for Patagonian toothfish was initiated around Macquarie Island in the 1994/95 season. While this is not a prey item of Royal Penguins, there is the possibility that other fisheries will be initiated. Fishing of euphausiids, squid or the myctophid *Krefftichthys anderssoni* could have substantial impact on this species. D. Williams (Australian Antarctic Division) and found no evidence of penguin by-catch from vessels fishing around Macquarie. Very limited threat from feral cat predation, especially in view of commitment to remove predators from Macquarie Island. There is an ANARE base on the island and the potential for disease spread (e.g., Newcastle disease and others) exists. Aircraft traffic is very strictly controlled from the base. This species is found at one location and subsequently may be extremely susceptible to catastrophic events (human-induced or natural). Marine pollution is a potential threat.

Trade: Not currently found in trade

Comments: M. Hindell and C. Hull carried out a census on Royals around Macquarie Island in 1996/97.

RECOMMENDATIONS:
Research Management: Give effect to commitment to remove predators from Macquarie Island. Further taxonomic (including genetic) research may be needed, to confirm the correct taxonomic rank. Complete census of incubating birds and mapping of colonies at Macquarie Island is needed. Systematic monitoring of population size and biological variables would be of considerable value. Knowledge of its distribution outside the breeding season is a high priority.

Research into demography and reproductive performance, linked to foraging ecology, would be most valuable. Using such data to help delimit the effective marine boundaries of the proposed Biosphere Reserve is vital.

PHVA: No

Captive Program Recommendation: No
Level of Difficulty: 2
Existing Captive Population (ISIS): none

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

Contributors: J.P. Croxall, M. Hindell, C. Hull, D. Keith, D. Laughlin, C. C. St. Clair, E.J, Woehler

Eudyptes chrysolophus

STATUS: New IUCN Category: Near Threatened
Based on: Close approach to criteria A1a, A1c
CITES: Not listed

Taxonomic Status: Species

Current Distribution (breeding and wintering): Southern Ocean islands - Falklands, South Georgia, South Sandwich, South Orkneys, South Shetlands, Bouvet, Prince Edward, Marion, Crozet, Kerguelen, Heard Island; also the Antarctic Peninsula (very local) and southern Chile.

Area Occupied: C

Number of Locations: Woehler (1993) records 48 sites with 216 colonies.

Population Trends - % Change in Years or Generations:
Trend over past 100 years: SCAR (1992) indicated that South Georgia and Bouvet populations probably had increased substantially in the 1960s and the early 1970s but had decreased on average by about 1% per annum since the mid-1970s. Detailed monitoring of colonies at Bird Island, South Georgia indicate that the population there has halved since 1976/77 (when c. 70,000 pairs, BAS unpublished data) and this is supported by recent surveys at colonies on the Willis Islands (P.A. Prince and S. Poncet unpublished data). Thus the South Georgia population is nowadays probably no more than about 2.7 million pairs, compared with former estimates of c.5.4 million pairs. Populations at Kerguelen increased by about 1% per annum between 1962 and 1985 (Weimerskirch *et al.* 1989) but no subsequent data are available.

Generation Time: Estimated to be 15-20 years.

World Population: Woehler (1993) indicated a minimum estimated breeding population of 11,841,600 pairs. If the South Georgia population is no more than about 2.7 million pairs, total estimated population is likely around 9,000,000 pairs.

Regional Population(s): Main populations at Ile de Pingouins, Iles Crozet, Heard, McDonald Islands (1,000,000 pairs at each) and especially at the Willis Islands, South Georgia (2.5 million pairs). All estimates derive from fairly imprecise surveys. On Marion Island, about 4,000 pairs breed. Approximately 50 pairs breed in the Falkland Islands (Bingham 1998).

Data Quality: 1

Recent Field Studies: At Bird Island, South Georgia, population size at two colonies have been monitored annually since 1977 by BAS, with diet, adult mass at arrival, chick fledging mass and breeding success recorded at one colony; these data are contributed to CEMP. Similar studies by USA (AMLR) at Seal Island, Elephant Island group (1988-95) have now ceased. A new site for the US AMLR CEMP work is now being sought, although it is unlikely to include a population of Macaroni Penguins of studiable size.

At Marion Island, population and breeding success in three small colonies is undertaken. One study colony decreased in size between 1979/80 and 1995/96. The other colonies remained stable (Cooper *et al.* 1977). CEMP monitoring (of breeding population size and success, chick growth and diet) commenced in May 1994 at Marion Island.

At Heard Island, work in 1992 by K. Green (summaries in the Heard Island report (Green 1993). Work in the 1950s by Gywnn on breeding biology, in particular egg details, was recently published (Gwynn 1993a, b).

Threats: At its main breeding sites no obvious threats exist beyond those concerns general to Southern Ocean species, involving existing and potential impact of commercial fishing, oceanographic change, oil pollution etc. Possibly similar threats outside breeding season, but wintering grounds unknown.

Trade: Not currently found in trade

Comments: None

RECOMMENDATIONS:
Research Management: Censuses of incubating birds are required at a number of island and island groups including off southern Chile, Prince Edward Island, Heard, and MacDonald Islands is needed. Systematic monitoring of population size and biological variables will be of considerable value at more colonies. Knowledge of its distribution outside the breeding season is a high priority. Research into demography, reproductive performance and foraging ecology to address the cause of population change is particularly needed. This species offers the potential for study using a variety of modern techniques e.g., implanted transponders, automatic weighbridges etc., by virtue of its highly colonial habit and traditionally restricted access routes to many colonies.

PHVA: No

Captive Program Recommendation: Level 3
Level of Difficulty: 2
Existing Captive Population (ISIS): 143 (37.36.70)

Sources: See references pages 62-68.

Species Editor/Coordinator for CAMP: J.P. Croxall

Contributors: J. Cooper, J.P. Croxall, G.R. Copson, C. Hull, P. Jouventin, G. Robertson, P.A. Prince, H. Weimerskirch, E.J. Woehler

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Eudyptes pachyrhynchus

STATUS: New IUCN Category: Vulnerable
Based on: A1a, C1, C2a
CITES: Not listed
Other: Listed as Vulnerable in *Birds to Watch 2* (Collar *et al.* 1994)

Taxonomic status: Species

Current Distribution (breeding and wintering): Breeding distribution –West and Southwest Coast of South Island of New Zealand and associated offshore islands including Stewart Island;

Wintering distribution – Immature, molting, and wintering birds also reported from Southland and Otago coasts, Snares Islands, occasionally Wellington, Canterbury, Westland, Campbell Island, Southeast Australia (especially Victoria and Tasmania)

Concentrated Migration Regions: offshore waters south west of South Island, New Zealand; poorly known

Historical Distribution: Oliver (1955) has records of breeding north up to the Cook Straits and perhaps on the southernmost part of the North Island; question exists as to whether the current range may be refugia rather than optimal availability of the habitat.

Extent of Occurrence: B (occurs along approximately 38 000 km2 of coastline)

Area Occupied: B (estimate; difficult to determine from patchy distribution)

Number of Locations: Distribution is patchy between Jackson Bay and Stewart Island along southwest coast and offshore islands, see recent population surveys (McLean and Russ 1991; McLean *et al.* 1993; Russ *et al.* 1992; Studholme *et al.* 1994 and McLean *et al.*, in press) for presence at specific locations; 12 (fragmented) major nesting areas (of approximately 100 nests or greater) include Codfish Island, Solander Island, Breaksea and adjacent islands, Shelter Island, Yates Point, Cascade Point and the coast north, Jackson's Head, Open Bay Island, the coasts south of the Paringa River, Hope River and Gorge River, and Martins Bay.

Population Trends - Study population on Open Bay Island estimated to have declined by 33% between 1988 and 1995 (a decline may have occurred over many years on Solander Island (Cooper *et al.* 1986).

Trend over past 100 years: Unknown, but historical data from Richard Henry (c.1890) reports "thousands" of individuals whereas current colonies seldom number over 100 nests.

Generation Time: Unknown, probably 10-20 years

World Population: 2500 - 3000 nests annually (McLean *et al.*, in press)

Regional Populations: (all are minimum estimates based on observed birds and nests)
Doubtful Sound to Milford Sound - 283 birds; 65 nests (McLean and Russ 1991)
Dusky and Breaksea Sounds - 106 birds; 46 nests (Russ *et al.* 1992)
Breaksea Island, Chalky and Preservation Inlets - 425 birds, 215 nests (McLean *et al.* 1993)
Stewart Island and offshore Islands - 300 birds, 115 nests (Studholme *et al.* 1994)
Bruce Bay to Yates Point including Open Bay Island: 1410 nests (McLean *et al.*, in press)

Data Quality: 1

Recent Field Studies: Defining study at Jackson Head (Warham 1974); several recent studies on Open Bay Island (St. Clair 1992, Murie *et al.* 1992; Studholme 1994); subsequent monitoring of three sub-colonies near Jackson Bay by the New Zealand Department of Conservation; recent survey of entire species range (above)

Threats: Climate, Decline in prey species, Fishing (through competition, accidental capture), Human interference, Marine perturbations, Predation (weka), Predation by exotics (cats, stoats, dogs), Pollution, Tourism.

Trade: Not currently found in trade.

Comments: This species tends to occur in small numbers in discrete locations throughout its range (McLean & Russ 1991), and tends to nest in discrete groups rarely exceeding 10 nests in an area of less than 1 hectare. The largest breeding population appears to be on Taumaka Island in the Open Bay Islands. Natural egg mortality is usually due to displacement or desertion; eggs and small chicks are also preyed upon by weka *(Gallirallus australis).* Weka, a flightless rail endemic to the mainland, may be threatened its native ranges (K-J. Wilson pers. comm.), though its introduction to offshore islands appears to have resulted in unusually dense populations. On Open Bay Island, 38% of egg mortality and 20% of young chick mortality was due to weka predation (St. Clair and St. Clair 1992). Additionally, weka uproot ground cover while foraging for insects and other prey. Older chick mortality most often results from starvation or exposure to bad weather or predation. B. Studholme noted an increase in chick predation by weka between 1991-1992 on Open Bay Island.

In addition to egg and chick predation by weka, threats include human disturbance at nest sites, road kill at highway crossings, and predation by introduced species such as dogs, stoats, and possibly cats. Fisheries pose potential threats though set nets and competition for squid. Molting birds are especially susceptible to predation by dogs.

RECOMMENDATIONS:
Research Management:
A subset of the recent extensive surveys (McLean *et al.* in press) should be repeated over the next decade to determine whether the population decline observed on Open Bay Island is occurring at other sites and with equal severity. Should the decline prove widespread, the species would satisfy the IUCN endangered status. Additional work is needed to quantify the effect of introduced predators on mainland and island sites to direct potential habitat or predator management. A detailed study of the foraging ecology (especially diet and foraging

range) of the species is needed to complement previous work (van Heezik 1989) and identify potential competition with commercial fisheries and effects of climatic variation.

Other work of lesser priorities include a population genetics analysis to determine the genetic exchange among discrete sub-populations. Preliminary blood samples have been collected (I. G. McLean, unpublished data) and further samples can be deposited in Peter Stockdale's pathology registry at Massey University, New Zealand. Additionally, long-term monitoring of representative populations is needed, ideally by banding and/or injectable microchips for at least a 5-year period, to further monitor population trends and estimate juvenile and adult mortality rates. Also useful would be sub-fossil archeological surveys of previous sites to identify former distribution and locate historical sites. The components of productive breeding habitat should be identified for potential future management. A Recovery/Management Plan needs to be developed, but it is recommended that no set nets be allowed near breeding colonies of penguins.

PHVA: Yes
Captive Program Recommendation: Pending results of PHVA
Level of Difficulty: 3
Existing Captive Population (ISIS): none listed in ISIS

Sources:
Collar, N.J., Crosby, M.J., and Stattersfield, A.J. 1994. *Birds to Watch 2: the world list of threatened birds.* Birdlife International, Cambridge.

Cooper, W.J., Miskelly, C.M., Morrison, K. and Peacock, R.J. 1986. *Notornis 33:* 77-89.

McLean, I.G. and Russ, R.B. 1991. The Fiordland crested Penguin survey, Stage I: Doubtful to Milford Sounds. *Notornis* 38*:* 183-190.

McLean, I.G., Studholme, B.J S. and Russ, R.B. 1993. The Fiordland crested Penguin survey, Stage III: Breaksea Island, Chalky and Preservation Inlets. *Notornis* 40*:* 85-94.

McLean, I. G., Abel, M. Challies, C.N., Heppelthwaite, S., Lyall, J. and Russ, R. B. In press. The Fiordland crested Penguin survey: Stage V, mainland coastline, Bruce Bay to Yates Point. *Notornis.*

Murie, J.O., Davis, L.S. and McLean, I.G. 1991. Identifying the sex of Fiordland crested Penguins by morphometric characters. *Notornis* 38*:* 233-238.

Oliver, W.R B. 1955. *New Zealand Birds.* A. H. & A. W. Reed, Wellington.

Russ, R.B., McLean, I.G. and Studholme, B.J.S. 1992. The Fiordland crested Penguin survey, Stage II: Dusky and Breaksea Sounds. *Notornis* 39: 113-118.

St. Clair, C.C. 1992. Incubation behavior, brood patch formation and obligate brood reduction in Fiordland crested Penguins. *Behavioral Ecology and Sociobiology* 31: 409-416.

St. Clair, C.C. and St. Clair, R.C.. 1992. Weka predation on eggs and chicks of Fiordland crested Penguins. *Notornis* 39: 60-63.

Studholme, B.J.S. 1994. Parent-offspring recognition in the Fiordland crested Penguin *(Eudyptes pachyrhynchus). New Zealand Natural Sciences* 21*:* 27-36.

Studholme, B.J.S., Russ, R.B.and McLean, I.G. 1994. The Fiordland crested Penguins survey: Stage IV, Stewart and offshore islands, and Solander Island. *Notornis* 41: 133-144.

Warham, J. 1974. The Fiordland crested Penguin Eudyptes pachyrhynchus. *Ibis* 116*:* 1-27.

van Heezik, Y. M. 1989. Diet of the Fiordland crested Penguin during the post-guard phase of chick growth. *Notornis* 36: 151-156.

Species Editor/Coordinator for CAMP: C. Cassady St. Clair

Contributors: C. C. St. Clair, C. Hull, D. Keith, D. Laughlin, I.G. McLean, P. Moore, C.M. Miskelly

Eudyptes robustus

STATUS: New IUCN Category: Vulnerable
Based on: D2
CITES: Not listed
Other: Listed as Vulnerable in *Birds to Watch 2* (Collar *et al.* 1994)

Taxonomic status: Species

Current Distribution (breeding and wintering): Breeding Distribution - Snares Island

Concentrated Migration Regions:

Historical Distribution:

Extent of Occurrence: Restricted to single island group

Number of Locations: 1

Population Trends - % Change in Years or Generations: Unknown

Trend over past 100 years: Unknown

Generation Time: Unknown

World Population: 23,250 breeding pairs during the 1985-86 season: 19,000 on Main Island, 3,500 on Broughton Island and 750 on Western Chain. (Miskelly *et al.* 1987)

Data Quality: 1

Recent Field Studies: There has been no focused field work carried out since the 1985-86 breeding season (Miskelly *et al.* 1987). Tim Lamey worked on Snares for one field season (Lamey 1992).

Threats: Potentially pollution, fisheries interactions and global climate change. If exploitation of oil and other minerals in the Antarctic ever becomes a reality, oil pollution is potentially a threat. Other potential threats would be a fishing boat accident that could spill oil, and changes in fisheries practices relating to competition for food resources. Currently, there is a major fishery for squid around the Snares. At present there are no introduced predators on the Snares; the potential for such remains a constant threat.

Trade: No

Comments: Available data suggest that the population is stable or possibly has increased since 1968. This species was classified as Vulnerable under the criterion for all mature individuals being in less than 5 locations, but there are no data on population trends. These data, if available, may indicate that the species merits a more threatened status.

RECOMMENDATIONS:

Research Management:

A detailed survey of the population is needed to compare with the previous census and thus determine current population trends in the two sub-populations (eastern and western). Declines similar to those that have occurred in nearby crested penguin populations would indicate an endangered status for this species. Studies of the foraging ecology of these populations are also needed to determine differences (taxonomic or behavioral) between sub-populations in relation to oceanographic variables, breeding chronology and reproductive success.

PHVA: Yes

Captive Program Recommendation: Pending results of PHVA
Level of Difficulty: 2
Existing Captive Population (ISIS): none listed in ISIS

Sources:

Collar, N.J., Crosby, M.J., and Stattersfield, A.J. 1994. Birds to Watch 2: the world list of threatened birds. Birdlife International, Cambridge.

Miskelly, C.M. *et al.* 1987. 1985-86 Snares Islands Expedition. Unpublished Report. University of Canterbury, Christchurch, New Zealand.

Lamey, T. C. 1992. Egg-size differences, hatch asynchrony, and obligate brood reduction in crested penguins. Ph.D. dissertation, University of Oklahoma, Norman, OK, USA.

Contributors: C. Challies and participants in the first Penguin CAMP (1992).

Eudyptes sclateri

STATUS: New IUCN Category: Endangered
Based on: B1, B2e
CITES: Not listed
Other: Category B (second priority species for conservation action) (Tisdall 1994). Listed as Vulnerable in *Birds to Watch 2* (Collar et *al.* 1994).

Taxonomic status: Species

Current Distribution (breeding and wintering): Breeding Distribution - Breeding only on the Antipodes and Bounty Islands

Concentrated Migration Regions: Unknown

Historical Distribution: Similar to current but used to breed at Campbell Island also.

Extent of Occurrence: Regional; "A" at breeding sites

Area Occupied: "A" at breeding sites

Number of Locations: 2

Population Trends - % Change in Years or Generations:
Trend over past 100 years: Decline (approximately 50%/20 years at Antipodes; 100%/20 years at Campbell; status unknown at Bounty and Auckland Islands.

Generation Time: Unknown but probably less than 20 years.

World Population: Estimated wild population: Auckland - one pair (1976); Bounty - 115,000 pairs on 8 islands (Robertson and van Tets 1982); Antipodes - very approximately 50,000 - 60,000 pairs on 3 islands (Tennyson and Taylor *in litt* 1995, Miskelly *et al* 1990)

Data Quality: 2 (awaiting more detailed analysis)

Recent Field Studies: Currently, there are no studies at the breeding grounds.

Threats: Marine perturbations (possibly also fishing, aircraft, pollution, and climatic changes)

Trade: No

Comments: Declining for unknown reasons but probably marine factors affecting survivorship. Listed as Endangered here based on distribution in less than five locations and an inferred and projected declining number of mature individuals.

RECOMMENDATIONS:
Research Management: Extensive surveys are needed at Auckland and Bounty Islands to

determine whether the population decline observed on the Antipodes is also occurring at these sites. A similar decline would confirm the endangered species status tentatively attached here. A second priority is to conduct the detailed foraging studies (including telemetry and diet sampling) recommended for other crested penguin species to determine foraging ranges, commercial fisheries competition, and oceanographic or climatic changes. Basic life history data is currently lacking and potentially needed to set further conservation and management priorities.

PHVA: Yes

Captive Program Recommendation: Pending results of PHVA
Level of Difficulty: 2
Existing Captive Population (ISIS): None listed in ISIS

Sources:

Collar, N.J., Crosby, M.J., Stattersfield, A.J., 1995. *Birds to Watch 2 - the World List of Threatened Birds.* Cambridge: Birdlife International.

Miskelly, C.M., Pollard, S., & Carey, P.W. 1990. Antipodes Island Report, University of Canterbury Expedition Report.

Robertson, C.J.R. & van Tets, G.V. 1982. The status of birds at the Bounty Islands. *Notornis* 29: 311-336.

Tisdall, C. (compiler). 1994. *Setting priorities for the conservation of New Zealand's threatened plants and animals.* Wellington: New Zealand Department of Conservation.

Tennyson, A. & Taylor, G. Unpublished data for the Antipodes Islands.

Species Editor/Coordinator for CAMP: A. Tennyson

Contributors: A. Tennyson, G. Taylor

Eudyptula minor complex (excluding *E. m. albosignata)*

STATUS: New IUCN Category: Lower Risk
Based on: taxon does not meet any criteria for vulnerable

CITES: Not listed

Taxonomic status: Species. Kinsky and Falla (1976) described six forms and attribute these to subspecies; their taxonomic status needs to be confirmed. *E. m. albosignata* is treated separately because of its distinct appearance and differing ecological characteristics.

Current distribution (breeding and non-breeding):
Breeding distribution - southern Australia from Perth to Coffs harbour and, in New Zealand, on the North, South, Stewart and Chatham Islands (Kinsky and Falla 1976, Marchant and Higgins 1990).

Australia
E. minor novaehollandiae - breeding distribution extends from the Shoalwater Island Group (Penguin and Carnac Islands), near Perth in Western Australia, across the southern coast (including Bass Strait and Tasmania), and up the east coast as far as South Solitary Island in New South Wales (near Coffs Harbour) (Blakers *et al.* 1984, Marchant and Higgins 1990). The northern limit of their distribution on both sides of the Australian mainland coincides with the summer isotherms of 20°C (Kinsky and Falla 1976, Marchant and Higgins 1990).

New South Wales
There are a number of large colonies in southern New South Wales, including Montague and Bowen Islands but the size and number of penguin colonies decreases northward (Priddel 1996). The northern-most breeding site on the NSW coast is probably at South Solitary Island, although it is unclear if penguins breed at this site every year. Consequently Delicate Nobby may be the northern-most site where penguins breed each year on the east Australian coast.

Tasmania
Large numbers of penguins breed on the islands of Bass Strait, particularly those in the Furneaux and Kent Groups and off the north west of the Tasmanian mainland. A few substantial colonies also occur off the east and southwestern coasts (White 1980, Ross *et al.* 1995, Brothers and Pemberton unpublished data) and small, scattered colonies occur on the northern and eastern coasts of the mainland.

Victoria
Estimates made in Victoria between 1978 and 1980 suggested that 30% of the State's population breed on Phillip Island, Gabo Island and the islands off Wilson's Promontory respectively (Harris and Bode 1981, Harris and Norman 1981). Most of the remaining 10% were at sites in western Victoria. More recent estimates have suggested that the total numbers of penguins in Victoria may be higher but the proportions remain much the same (Norman *et al.* 1996).

South Australia
Most of the penguins in South Australia breed on Kangaroo Island and the islands in Spencer Gulf and Gulf St Vincent. There is relatively little information available on the sizes of South Australia colonies (Copley 1996).

Western Australia
In Western Australia, the northern-most breeding site of penguins is at Carnac Island, just south of Perth. Apart from the Shoalwater Island Group, of which Carnac and Penguin Island are part, the other major breeding area for penguins in W.A. is in the islands of the Recherche Archipelago (Burbidge and Fuller in press). Penguins also breed in small numbers at various sites across the Great Australian Bight (Reilly 1978) but data are scant.

New Zealand (separately for "subspecies" described by Kinsky and Falla 1976.)
E. m. iredalei - Coasts and islands of the northern part of North Island from East Cape through the Bay of Plenty, Hauraki Gulf, and Northland to North Cape and south on the west coast to about Kawhia Harbour and possibly further south.

E. m. variabilis - Southern part of the North Island from Cape Kidnappers south to Palliser Bay through Cook Strait and north to Cape Egmont. On South Island from Karamea on the west coast north to Cook Strait and down the east coast to Kaikoura.

E. m. minor - Otago and Southland from Oamaru on the east coast south to Foveaux Strait, Stewart Island and outlying islands, west coast of South Island, north to Karamea.

E. m. chathamensis - Chatham Islands (Chatham, Pitt, South East, Mangere and Star Keys) (Kinsky and Falla 1976)

Non-breeding distribution- generally similar to breeding distribution; occasional Australian records as far north as Brisbane on the east coast and as far north as Dirk Hartog Island on the west coast (Marchant and Higgins 1990).

Concentrated Migration Regions: none

Historical Distribution: Large scale distribution probably unchanged though decline on a local scale: More widespread on the main islands of New Zealand in the past (Dann 1994a, Challies pers. comm.). Declines have been reported at a small number of Australian sites and two new sites have become established on the Australian mainland in the past 50 years.
Extent of Occurrence: Offshore distribution mainly within 30 km of coast.

Number of Locations: Australia at least 250 recorded (Dann *et al.* 1996). Breeds on most offshore islands in New Zealand and an unknown number of mainland sites (Marchant and Higgins 1990). Twenty sites were recorded from Otago (Dann 1994a).

Population Trends- % change in years or generations: unknown

Trend over past 100 years: circumstantial evidence indicates slight decrease in Australia; in New Zealand there has been substantial reduction on main islands but little apparent change on offshore islands.

Generation Time: Approximately 5 years (4.7 years estimated by Dann and Cullen 1990) for Phillip Island.

World Population: 700,000 - 1,200,000 birds
The world breeding population is thought to be between 350,000-600,000 birds, comprising 300,000 to 500,000 in Australia (Ross *et al.* 1995, Dann *et al.* 1996) and c. 50,000 to 100,000 in New Zealand (estimated from Robertson and Bell 1984). These figures are undoubtedly underestimates as new colonies are still being found. Bass Strait, with about 60% of the known breeding population, is the stronghold for the species in Australia.

Australia
The estimated breeding population in each State is as follows:-New South Wales (49,000 birds), Victoria (54,000), Tasmania (300,000), South Australia (67,000), and Western Australia (3,000), making a total of 473,000 breeding birds (Dann *et al.* 1996).

New Zealand
South Island. Otago - 4,000 breeding birds) between Waitaki River and Nugget Point (Dann 1994a). Stewart Island, Southland, west coast and northern coast - no data available. Codfish Island – possibly 4,000 birds (Challies, pers comm.).

North Island and Chatham Islands - no estimates available.

Dann and Cullen (1990) estimated that pre-breeding individuals constitute 57% of the Phillip Island population at the end of the breeding season. If these young birds are included, the all-age populations would be about double the estimated breeding populations.

Data Quality: Age 1-15 years, data quality variable between 1-4.

Recent Field Studies: Since Marchant and Higgins (1990), the most significant collections of material on Little Penguins have been published as 13 papers in a volume (91) of the journal *Emu* (Little Penguin Supplement *1992*), 16 abstracts of the Second International Conference on Penguins held on Phillip Island in August 1992 (Dann and Jessop 1992) and as four chapters in a book entitled The *Penguins: ecology and management* (edited by Dann, Norman and Reilly, published by Surrey Beatty and Sons, Sydney, 1995). A further review of the biology of Little Penguins was presented in *The Penguins* (T. D. Williams *1995*). Other recent papers include work on the size (Klomp and Wooller 1988a), surface nesting (Klomp *et al.* 1991) and chick adoption of Little Penguins on Penguin Island, WA (Wienecke 1995); radio tracking studies (Collins *et al.* 1994) and surveys of penguins at sea around Phillip Island (Dann *et al.* 1995), population estimates of Montague (Heyligers and Fullagar 1995) and Gabo Islands in Australia (Fullagar) and studies of breeding biology on Montague Island (NSW)(Weber 1994) and at Taiaroa Head in New Zealand (Perriman and McKinlay 1995).

In Australia, northern populations have been monitored (population dynamics, diet and foraging range, breeding success, mark-recapture) at Bowen Island since 1987 (Fortescue), Lion Island between 1991 and 1994 (Taronga Park Zoo) and Montague Island since 1994 (Weber and Klomp). Monitoring of breeding and survival are ongoing at Phillip Island (Dann, Jessop, Healey, Cullen and Penguin Study Group), Port Campbell National Park (Du Guesclin) and Rabbit Island (Penguin Study Group). Studies of foraging behavior (Collins, Cullen and Dann), diet (Chiaradia), and parasites and disease (Norman) are in progress at

Phillip Island, Victoria and at Penguin Island in Western Australia (Wooller, Cannell *et al.*). Daily attendance patterns and weights in relation to oceanographic and anthropogenic variables are being measured at Phillip Island (Chiaradia). In northern Tasmania, the effects of the Iron Barron oil spill are being monitored (Giese, Goldsworthy, Brothers and Gales) and the abundance and breeding distribution at various tourism sites is being measured (Robertson).

In New Zealand, surveys and monitoring at Punakaiki on the west coast and at Oamaru and Taiaroa Head on the southeast coast are underway. (New Zealand Department of Conservation). Fraser and Ardern studied seasonal variation of diet at Oamaru over one year (1994-1995). Renner began a study on chick survival, parental investment and paternity on Motuara Island, Marlborough Sounds (1995).

Threats: Introduced mammalian predators appear to be the most significant threat to penguins on land with foxes and dogs in Australia (Dann 1992) and ferrets (Challies, pers. comm.) and possibly dogs in New Zealand being implicated in a number of colony extinctions and declines. The role of cats in determining the distribution and abundance of penguins varies, being relatively unimportant on Phillip Island (Dann 1992) but possibly significant on Wedge Island in Tasmania (Stahel and Gales 1987) and the west coast and Stewart Island in New Zealand. There is no evidence yet that introduced rats kill adult or young penguins or reduce breeding success. Penguins are killed by cars at a number of places where they cross coastal roads at night to reach their burrows; notably Phillip Island and Portland in Victoria, Bruny Island and Lillico Beach in Tasmania, and Oamaru and Wellington in New Zealand. The effects on the population sizes at each site vary and in some cases road mortality has clearly contributed to declines in breeding numbers. Deliberately lit fires are believed to have caused declines in numbers of penguins breeding on De Witt Island in south west Tasmania between 1975 and 1977 (White 1980). Fortunately the deliberate burning of Bass Strait islands seems to be becoming less common but it is likely to have contributed to declines in numbers at some sites in the past. In addition, fire is an important factor at some sites through habitat modification (Fortescue 1995).

Penguins being taken for crayfish bait are thought to have reduced 'alarmingly' the population of De Witt Island during the 1950s and 60s (White 1980). Although this practice may have once been widespread, it now appears rare. Inshore fishing nets have been the source of some mortality for penguins in New Zealand (Tennyson, pers. comm.), at Victor Harbour and Nepean Bay in South Australia and in Corner Inlet and Corio Bay in Victoria. How commonly this type of mortality occurs is not known because reporting rates are likely to be low. This netting practice is more widespread in New Zealand than Australia.

The immunological penalty of malnutrition is poorly understood, but is reflected in severe internal helminth parasitic disease in starved birds (Harrigan 1988, 1992, Mason *et al.* 1991). Similar burdens of helminth parasites may not be as pathogenic in adult birds in good condition, suggesting helminths must be regarded as opportunist pathogens (Norman, pers. comm.). Ectoparasites, protozoa, bacteria and fungi have been identified as the primary causes of death, or as agents contributory to multi-factorial deaths in individuals (Harrigan 1988, Norman, pers. comm.). The role of known bacterial and viral pathogens of birds in the epidemiology of mortality of blue penguins, or the costs of morbidity or reproductive wastage have not been investigated or have been only superficially and unsystematically examined.

Little Penguins are the most likely seabirds in southern Australia to come into contact with oil spills at sea (Dann 1994b) and several thousand birds were affected in the Iron Baron oil spill in northern Tasmania in 1995(Giese and Goldsworthy, pers. comm.). Organochlorine and heavy metal accumulations at levels typical for temperate latitude seabirds have been found in Little Penguins from near Sydney and at Phillip Island (Gibbs 1995) but it is not known whether these levels interfere with the penguin's health or breeding success.

Clupeoids (Pilchards *Sardinops sagax*, Australian Anchovy *Engraulis australis* and Sandy Sprat *Hyperlophus vittatus*) are major foods of Little Penguins in Victoria (Cullen *et al.* 1992), in NSW (Fortescue 1995), in Western Australia (Klomp and Wooller 1988b), and in Tasmania (Gales and Pemberton 1990). Both pilchards and anchovies are taken commercially in Australia and New Zealand but the impacts of these fisheries on penguin breeding success and survival are unknown.

Direct threats, such as habitat loss through weed invasion, erosion, fire regimes, grazing and housing developments (Harris and Bode 1981, Fortescue 1991, 1995), have had an impact on the distribution and abundance of penguins in some areas. Habitat loss is particularly a problem at mainland sites or on islands that are intensively settled. Trampling of burrows by humans and stock is a contributor to habitat loss, particularly where erosion develops as a consequence. Fire and rabbits can be a danger by destroying the above ground vegetation among which the nests are situated or which provides the soil support to stop burrows collapsing. Some introduced weeds cause severe loss of breeding area, e. g., Kikuyu Grass (*Pennisetum clandestinum),* which forms dense patches which penguins find difficult to penetrate. On Bowen and Montagu Islands, kikuyu is recognized as a serious pest and measures are in place to eliminate it (Fortescue 1995, Klomp, pers. comm.). Cape Ivy (*Senecio mikanioides)* also reduces available space for burrowing seabirds.

Population trends: Most Little Penguins breed on offshore islands. There is rarely any evidence (with some exceptions referred to below) of any extinction or population fluctuations at these colonies but the difficulties of access to many of these colonies and the large errors in estimating breeding numbers have resulted in scant data with which to assess any trends.

While there seems to be no evidence of decreasing numbers in colonies on offshore islands, with the exception of some which have been intensively settled and/or are now connected to mainlands by bridges (Bruny Island, Tasmania, Hodgson 1975; Phillip Island, Victoria [decreasing until mid-1980s] Dann 1992; Griffiths Island, Bowker 1980) or subjected to significant levels of illegal poaching and burning (De Witt Island, Tasmania, White 1980). There have been decreases of colonies on the mainland of Australia, Tasmania and New Zealand. In the Otago region of New Zealand, Little Penguins no longer breed at seven previously occupied breeding sites (Dann 1994a). In Australia, there have been reductions in numbers of breeding birds at Eden, New South Wales (Barton 1978); Portland, Victoria (Department of Conservation and Natural Resources, Victoria, unpublished data); Penguin, Tasmania (N. Showell, pers. comm.) and, in New Zealand, at Green Island and Allans Beach, Otago (Dann 1994a).

The size of some breeding colonies has been diminished since European settlement in both Australia and New Zealand (Dann 1992, 1994a). Conversely, several new colonies have become established in the recent past, for example at St. Kilda in Victoria, where approximately 200 birds now breed on a breakwater constructed for the 1956 Olympic Games (Cullen *et al.* 1996). Alternatively, numbers of breeding birds are thought to have increased at St. Kilda, Victoria (Cullen 1996); at Phillip Island, Victoria since late 1980s and in New Zealand at Oamaru and Taiaroa Head (Dann 1994a).

In summary, most populations of Little Penguins appear to be relatively secure throughout most of their range although some colonies on the Australian mainland (relatively few), in Tasmania and the on North and South Islands of New Zealand have declined. Most breed on offshore islands throughout their range and are not immediately threatened.

RECOMMENDATIONS:
Research management:

1. The taxonomic status of the members of the blue penguin complex should be elucidated, with particular reference to the five forms described for New Zealand.

2. Population estimates for the New Zealand forms are required.

3. Studies of the impact of mammalian predators, particularly in New Zealand, are needed.

4. Interactions with fisheries should be examined both in Australia and New Zealand.

5. Management programs should include allocation of logistic and financial resources for a rapid diagnostic response to unusual mortality events. A hematological and serological screening program, with provision for archiving frozen sera for retrospective serological studies, should be incorporated in population ecology programs.

6. Consideration should be given to minimizing the possibility of transferring pathogens to naive populations by traffic of agents in fomites, vectors or birds carrying infection during research, rehabilitation and captive management activities.

7. The management of habitat in relation to fire and weeds should be studied further.

PHVA: No

Captive Program Recommendation: No

Level of Difficulty: Level 3

Existing Captive Population (ISIS):
World total population 27.35.40 = 102

Sources:

Barton, D. 1978. Breeding Fairy Penguins at Twofold Bay, NSW. *Corella* 2: 71-72.

Blakers, M., Davies, S. J. J. F. and Reilly, P. 1984. *The Atlas of Australian Birds*. RAOU and Melbourne University Press, Melbourne.

Bowker, G. 1980. Griffiths Island. Seabird Islands No. 99. *Corella* 4: 104-6.

Copley, P. 1996. A review of the status of seabirds in South Australia. *Proceedings of Seabird Workshop., November 1992.* Australian Nature Conservation Agency, Canberra.

Cullen, J.M., Montague, T.L. and Hull, C. 1992. Food of Little Penguins Eudyptula minor in Victoria: Comparison of three localities between 1985 and 1988. *Emu* 91; 318-341.

Cullen, J.M., Blake,, N. and Bickham, M. 1996. Urban Penguins. Nature Australia 1996: 23-25.

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Species Editor/Coordinator for CAMP: P. Dann

Contributors: A. Chiaradia, M. Cullen, P. Dann, M. Fortescue, R. Jessop, R. Norman, M. Renner, C. Challies, E. J. Woehler.

Eudyptula minor albosignata

STATUS: New IUCN Category: Endangered
Criterion based on: B1, B2a, B2b, B2e
CITES: Not listed

Taxonomic status: Subspecies (Kinsky and Falla 1976); it is clearly a distinctive form but actual taxonomic status needs to be confirmed.

Current distribution (breeding and non-breeding):
Breeding distribution – nest only on Motunau Island and the Banks Peninsula on the east coast of the South Island, New Zealand. Adults appear to be sedentary throughout the year; more than 80% of banded adults found dead away from their colonies are recovered with 100 km of where they nest.

Non-breeding distribution- First- and second-year birds range along the east coast of the South Island from Otago to Cook Straight. Band recoveries show a pronounced southward movement of young birds soon after fledging followed by a northward movement in autumn and early winter. Both one- and two-year-olds come ashore at their natal colonies in substantial numbers during the breeding season.

Concentrated Migration Regions: It is assumed that the seasonal movements of young birds are made within a few km of the coast.

Historical Distribution: Overall distribution probably is unchanged.

Extent of Occurrence: Land area used for nesting and moulting totals c. 1 km^2. The area of sea frequented by breeding birds totals c. 7,000 km^2 and by non-breeding birds c. 18,000 km^2. These figures assume breeding birds remain within 100 km of where they nest, that non-breeding birds range the length of the east coast of the South Island, and that both groups stay within 25 km of the coast.

Number of Locations: Two apparently discrete subpopulations, Motunau Island and Banks Peninsula. Despite their close proximity there are no records of birds banded as chicks in one subpopulation breeding in the other. The Banks Peninsula subpopulation comprises a scattering of small colonies only three of which are likely to comprise more than 100 pairs.

Population Trends- % change in years or generations: There were between 800 and 1,100 penguin burrows on Motunau Island when the first surveys were made in 1958-62 (Cox *et al.* 1967). During the last 20 years there appears to have been a modest increase in numbers.

Numbers on the Banks Peninsula have probably been declining since mammalian predators were introduced in the late 1800s. As a result, colonies have been progressively lost from accessible areas particularly around the heads of the bays. There was a significant increase in predation in the early 1980s and it is continuing at a high level: the main predator now is the ferret *(Mustela furo).* Monitoring of seven accessible colonies showed an overall decline in the number of breeding pairs of 60-70% between 1980 and 1993 (Challies 1993). The two colonies least affected during this period have since halved in size. There is growing evidence that the "safe" colonies also are being affected as a proportion of young birds attempt to breed in adjacent areas prone to predation.

Generation Time; c. 8 years (8.1 estimated from long-term banding study on Motunau Island).

World Population: approximately 2,200 breeding pairs of which $\geq$1,650 are on Motunau Island and $\geq$550 are on the Banks Peninsula.

Data Quality: 1 for Motunau Island (estimate based on continuous long-term monitoring of size and composition of subpopulation); 2 for Banks Peninsula (based on mix of annual surveys and general field observations).

Recent Field Studies: A substantial amount of data have been collected over the last 20 years on aspects of the birds demography, population biology and conservation (including long-term monitoring of colonies, nature and impact of predators and their populations and a 10-year translocation experiment). These data have been stored until funds are available to have them analyzed and written up.

Ongoing field programs include maintaining the all-age banded sample on Motunau Island and associated demographic study and long-term monitoring, continuation of detailed study at Godley Head as a basis for interpreting changes occurring on the Banks Peninsula, continuation of translocation study, further predator trapping and study of impacts, annual counts of selected colonies on the Banks Peninsula, and others.

Threats: On Banks Peninsula, predation poses by far the greatest threat (there are no introduced mammals on Motunau Island). Ferrets have the most impact with stoats *(Mustela erminea)* and feral cats *(Felis catus)* probably contributing. Domestic dogs *(Canis familaris)* cannot reach most of th surviving colonies and now are only a threat locally.

The recent increase in predation by ferrets occurred as the control of rabbits *(Oryctolagus cuniculus*) on pastoral land was relaxed. Rabbits are the ferrets' preferred food especially during the breeding season; penguins and other wildlife are taken mainly at other times of the year. Unless rabbit numbers are again reduced to the low levels existing before 1980, which seems unlikely, the ferret problem will probably continue. In that case, the penguins' medium-term prospects on Banks Peninsula are poor without direct human intervention.

At sea, the main threat appears to be entanglement in fishing nets set close inshore. The numbers of birds caught in nets is not known, but there is a history of multiple net catches of penguins around Motunau Island. A ban on leaving nets set inshore overnight has been in place around the Banks Peninsula and Motunau Island since October 1993. This ban appears to have been widely disregarded.

Comments: The deteriorating conservation status of this penguin appears not to be a high priority for the New Zealand Department of Conservation which has the legislative responsibility for protected wildlife. This is mainly the result of budgetary constraints; the fauna conservation problems in New Zealand far exceed allocated funds. All of the field studies undertaken have not been government-funded; they either have been personally funded by investigators or supplemented by small grants from non-governmental organizations. The penguins have benefited locally from predator trapping undertaken privately by farmers and other interested in the conservation of native wildlife. Two small, predator-proof fences have been built recently to protect vulnerable colonies; both presently contain about 20 pairs of birds.

RECOMMENDATIONS:
Research management:

1. The taxonomic status of the *Eudyptula minor* complex should be investigated in detail to determine the significance of the described forms with particular reference to *E.m. albosignata*. Only then will it be possible to determine which geographic populations should be treated separately for conservation purposes.

2. An effort should be made to put the ongoing research program on a more formal basis with the first objective being to get the results of those parts critical to understanding the nature and impact of the predation made public. This will assist in judging the severity of the problem and identifying suitable strategies.

PHVA: Yes

Captive Program Recommendation: No

Level of Difficulty: Level 3

Existing Captive Population (ISIS): 0
World total population: 0

Sources:

Challies, C.N. 1993. Penguin predation on Banks Peninsula. Unpublished report to the Royal Forest and Bird Protection Society, New Zealand. 4 pp.

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Species Editor/Coordinator for CAMP: C. N. Challies

Contributor: C.N. Challies

Megadyptes antipodes

STATUS: New IUCN Category: Vulnerable
Based On: A1a, A1b, A1c, B1, B3

CITES: Not listed

Other: In New Zealand this species is considered to be rare on Campbell, Auckland and Stewart Island groups and vulnerable on the mainland of the South Island. Identified as a Category B species in (Molloy and Davis 1994). (Note: Molloy and Davis is the key document in setting priorities for Department of Conservation programs in New Zealand)

Taxonomic Status: Species, no subspecies recorded. The species is segregated into three discrete populations: South Island, Auckland Islands, Campbell Island (Triggs and Darby 1989). The only record of a subantarctic bird further north is one banded Campbell Island bird recovered dead on Stewart Island.

Current Distribution (Breeding and Wintering):
Breeding: East coast of South Island, New Zealand; at Banks Peninsula and from Oamaru to Slope Point
- Islands in Foveaux Strait
- Stewart Island and off lyers including Codfish Island
- Auckland Islands
- Campbell Island

Wintering: Includes all of the above and vagrant adults and juveniles present further up the coast of South Island as far as Cook Straight. One bird present on Chatham Island but not breeding.

Concentrated Migration Routes: Breeding adults are sedentary. Large inter-annual differences in juvenile dispersal. The normal pattern is for juveniles to "disappear" after fledging when they are assumed to move northward. In some years of high food availability juveniles remain at their natal grounds throughout the year.

Historical Distribution: Records of breeding at Banks Peninsula are relatively recent. Remains in pre-European Polynesian midden sites at Chatham Islands indicating potential breeding outside the present distribution.

Extent Of Occurrence: D: calculated as 86,154 km^2. It should be noted that this includes the marine range of this species as defined in the methods. This probably does not contribute much to the conservation understanding for this species except to say it is not short of marine habitat.

Area Of Occupancy: South Island A: This is calculated as the terrestrial habitat, encompassing 282 ha (Seddon *et al.* 1989). Not calculated for the rest of the distribution.

Number Of Locations: Population is fragmented. Definitions of breeding locations are inconsistent, e.g. for South Island Seddon *et al.* (1989) give 42 locations whereas Marchant and Higgins (1990) give 32 locations. Moore (1992) presents equivalent values for Auckland

and Campbell Islands as numbers of landing sites. No values are available for others parts of the distribution.

Population Trends:
South Island
Annual nest counts began in 1981. Since that time two significant mortality events have taken place, each accounting for about half of the breeding population. The first one was in 1986 (Marchant and Higgins 1990) and the second in 1990. Following the latter event the number of breeding pairs had recovered within 4 years. Large-scale fluctuations appear to be a feature of the population dynamics of the species. It is important to note that rapid recovery following the 1990 crash can attributed to a number of factors including high food availability and intensive control of introduced predators.

Campbell Island
Insufficient long-term data collected at comparable times of the year in order to estimate population trends. 1992 census (unpublished data) was 36% lower than 1988 census (Moore and Moffat 1992, Moore 1992).

Not documented:
Auckland Islands, Stewart Island and outlyers, Codfish Island, and Foveaux Strait Islands

Generation Time: 5 to 7 years

World Population: Only three published estimates of world population exist.
4,000-5,000 individuals (Marchant and Higgins 1990)
6,000-7,000 individuals (Moore 1992)
5,100-6,200 individuals (del Hoyo *et al.* 1993)

Regional Populations:
The one published record for South Island was 300-320 breeding pairs in 1990 before the population crash (Marchant and Higgins 1990). The most recent estimate for South Island is 507 breeding pairs for 1995 (unpublished data).

Population estimates for other regions are inconsistent e.g. Stewart Island and outlyers including Codfish and Foveaux Strait 300-400 breeding pairs (Marchant and Higgins 1990); 170- 210 breeding pairs for 1989-92 (Southland DOC files); J.T. Darby believes there to be fewer than 150 breeding pairs.

Data Quality: South Island 1; Stewart Island 2; Codfish Island 1; Foveaux Strait 3; Auckland Islands 2; Campbell Island 1-2.

Recent Field Studies: Long-term monitoring was initiated in 1981 and has been coordinated by J.T. Darby. Staff and researchers from New Zealand Department of Conservation, University of Otago, Landcare Research Ltd., private landowners, non-governmental organizations and independent researchers have since been involved. Specific field studies are as follows:

Alterio, N. 1994. Habitat use of introduced mammalian predators in Yellow-eyed Penguin breeding areas.
Ardern, R. 1994-96. Population dynamics of pelagic prey fish.

Charteris, M. 1994-95. The influence of nest boxes on breeding success.
Darby, J.T. 1981-95. Long term population studies.
Edge, K.-A. 1992-95. Assessing the viability of artificial brood reduction as a management tool.
Efford, M., Darby, J.T., Spencer, N. 1995. Analysis of long term data sets.
Lalas, C., Jones, J., Jones, P.R. 1984-96. Nest and nest habitat manipulations.
Lalas,C., Jones, J., Jones, P.R. 1990-96. Breeding group created from relocated, rehabilitated penguins at Katiki Point.
Moore, P. *et al*. 1991-94. Foraging range in diet.
Peacock, L. 1995. Time series analysis of long term ecological and environmental data.
Ratz, H. 1991-94. Population dynamics and effects of introduced mammalian predators of Yellow-eyed Penguins.
Ratz, H. 1996. Checks for tourist impacts.
Seddon, P.J. 1985-88. Nest site selection.
Shaw, A. 1993-96. Long-term oceanographic variables.
van Heezik, Y. 1985-88. Relationship between food availability and breeding success.
Wright, M. 1996. Visitor impacts.
[Diploma Thesis 1993. Parasite prevalence in Yellow-eyed Penguins.]

Threats: Wide-spread: Predation by exotics, marine perturbations, habitat loss
Localized: Disease, fishing, human interference, fire

Note: The 1990 population crash has been attributed to avian malaria (Graczyk *et al*. 1995). It may have been complicated by a food shortage, which exacerbated the impact of the malaria outbreak. The two were probably unrelated but were sequential.

Loss of habitat is only an issue on South Island. Twenty breeding locations have statutory protection. Predation continues to be a management concern on South Island; the impact of predation is unknown on Stewart, Auckland and Campbell Island.

Trade: Not currently found in trade.

Comments: On South Island, predation of chicks and loss of breeding habitat have caused population declines. The impact of predation of chicks on Stewart Island and Campbell Island (cats) has yet to be documented. The species is sensitive to marine perturbations but has shown remarkable ability to recover (e.g., South Island following two population crashes in the last 10 years).

RECOMMENDATIONS:

Background Information

The Department of Conservation (DOC) (1991) produced a species recovery plan that envisaged the consolidation of Yellow-eyed Penguins on South Island by the implementation of two techniques: (1) creation of nesting habitat through re-vegetation programs; (2) the elimination of introduced mammalian predators by zones of rank grass bordering breeding locations. Fencing of DOC reserves with Yellow-eyed Penguins on South Island began in 1986 with all fenced by 1996. Annual predator trapping programs have been implemented.

The Yellow-eyed Penguin Trust was formed in 1987 to raise public awareness and funds for ongoing conservation including reserve acquisition, land purchase and creation of breeding habitat.

There are a number of private land owners taking measures to protect Yellow-eyed Penguins (e.g., trapping predators, habitat protection, maintaining remnant vegetation, and independent research).

RESEARCH RECOMMENDATIONS:

Top three priorities:

1. Publication of existing results is crucial. The existing data set for South Island now extends over 16 years. It needs to be investigated for long term trends and the subsequent development of a research strategy. Researchers should be encouraged to publish results in peer-reviewed journals.

2. Evaluation of management techniques to assess the effectiveness of implemented management strategies.

3. Formal PHVA to evaluate the tolerance of the species to predation by introduced mammals.

Other research:

1. Ongoing mitochondrial DNA studies need to be finalized.

2. Quantify the impact of heat stress on breeding success.

3. Investigate juvenile migration and dispersal patterns.

4. Investigate factors influencing territory size and affecting recruitment.

5. Analyze remains from the Chatham Islands to see if they include Yellow-eyed Penguin chick bones.

6. Assess impacts of supervised and unsupervised tourism.

7. The species recovery plan included the creation of a consultative group for cooperation and liaison with interested parties.

MANAGEMENT:

1. Continued efforts to protect habitat are required.

2. Management of predators and the development of more efficient techniques are priority tasks.

3. There is a significant visitor industry based around Yellow-eyed Penguins and this requires continual liaison between management agencies and operators. Advocacy with a large sector of the community about the issues that yelloweyed penguins face is ongoing. There are adequate opportunities to view this species in the wild.

4. New Zealand is one of the few industrialized countries that allow recreational gill netting near breeding areas. Progress is being made in the banning of gill netting near breeding areas on Otago Peninsula.
5. Complete inventory on South Island every 5 years with publication of results.

6. Complete survey of the Auckland Islands with publication of results.

7. Continue to promote statutory protection to habitats.

8. Investigate levels and impact of predation on Stewart, Auckland and Campbell Islands.

PHVA: Draft Completed 1992. M. Efford and K.-A. Edge (see Edge 1996) have investigated the effects of egg removal and poor food years through a specific population model.

Captive Program Recommendations: No.
Level Of Difficulty: NA
Existing Captive Population: One bird at Marine land Napier

Sources:

Edge, K.-A. 1996. *Parental investment in penguins; a phylogenetic and experimental approach.* Unpublished Ph.D. thesis, University of Otago, Dunedin, New Zealand.

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Seddon, P.J., van Heezik, Y.M., and Darby, J.T. 1989. *Inventory of Yelloweyed Penguin (Megadyptes antipodes) mainland breeding areas on the South Island NZ.* Yelloweyed Penguin Trust and Otago Branch Royal Forest and Bird Protection Society of New Zealand, Dunedin.

Triggs, S. and Darby, J.T. 1989. Genetics and Conservation of Yellow eyed Penguin: An interim Report. Science and Research Internal Report No. 43 DOC Wellington Wildlife Service. 1986 Yellow eyed Penguin Draft species Recovery Plan. Department of Internal Affairs. Dunedin, 115pp.

Species Editor/Coordinator for CAMP: B. McKinlay

Contributors: K.-A. Edge, C. Lalas, , B. McKinlay, P. Moore, H. Ratz

Spheniscus humboldti

STATUS: New IUCN Category: Vulnerable
Based on: C1, C2, E

CITES: Appendix I

Other: In Peru, governmental authorities consider that the Humboldt Penguin is in danger of extinction (Pulido 1991). In Chile the Humboldt Penguin is considered Vulnerable (CONAF 1988, Rottmann and López 1992, Araya and Bernal 1995). In the *Red List of Chilean Vertebrates* (CONAF 1988), surveys and studies for the protection of breeding islands are strongly recommended. Listed as Near Threatened in *Birds to Watch 2*, (Collar *et al.* 1994).

Taxonomic status: Species

Current Distribution:

Breeding: On the mainland coast and offshore islands of Chile and Peru mainly between Isla Foca (5°S) and Algarrobo (33°S). Araya and Todd (1987) reported a breeding site at Punihuil Islet, Chiloe Island (41°55'S), extending the known breeding range to the south by ca. 900 kilometers.

For Peru, the most northerly breeding sites reported in 1996 were Punta Aguya (5°41'S) and Isla Lobos de Tierra (6°25'S). In total, there are more than 12 breeding sites in Perú.

According to Araya (1983) and Araya and Todd (1987) the northernmost known breeding site of Humboldt Penguins in Chile is located at a sea cave (Cueva del Caballo) a few kilometers north of Iquique (20°21'S). There is information concerning a colony that existed until 1960 on Alacran island (18°29'S), which is now connected to the mainland. There are also data suggesting 5 breeding sites between the Loa river (c. 21°S) and Caldera (c. 27°S), of which Algodonales Islet, Abtao Islet and Pan de Azúcar Island are the most important. Between Grande Island and Punihuil, a total of 12 colonies has been reported. There are no data on breeding colonies between Pupuya Islet and Punihuil islet. See Regional Populations, below, for more details.

Wintering: Humboldt Penguins occur in Chile from the Peruvian border in Arica (18°20'S) to Punihuil. No updated information is available for Peru.

Concentrated Migration Regions: Humboldt Penguins are generally considered to be sedentary but there are recent data to refute this (Culik and Luna-Jorquera 1997a). These authors equipped non-breeding penguins from Pan de Azúcar Island with satellite transmitters and determined an extended migration route of about 700 km to northern Chile. Banding studies conducted by CONAF in 1995 indicated that juveniles from Pan de Azúcar yielded recoveries from Arica, about 750 km to the north, on the Peruvian border. Banding studies being done at Algarrobo indicate that adult birds are dispersing to the north (50 km) and south (170 km).

Historical Distribution: The Humboldt Penguin is a "perfect example of endemism and ecological fitness. Its range is substantially the length of the coastline along which the Current (Humboldt) is in contact with the continent" (Murphy 1936). The northern limit of this species was Punta Aguja and Sechura Bay, with penguins migrating during certain seasons northward to the latitude of the Gulf of Guayaquil (ca. 3°S) (Murphy 1936). In Chile, Hellmayr (1932) and Murphy (1936) state that the breeding range of this species was from the Peruvian boundary south to Algarrobo (33°21'S), Valparaiso, spreading in winter south to Corral (39°50'S). Hellmayr (1932) reported a small island in Algarrobo (at present known as Isla Pájaros Niños) as the most southerly colony of this species. Johnson (1965) reported that this species occurs along the coast of Chile from Arica to Corral and nests from Pupuya islet northwards.

Extent of Occurrence: Recent studies using satellite transmitters (Culik and Luna-Jorquera 1997b) demonstrate that 90% of locations occurred within 35 km of their breeding islands (n =5 birds). The area utilized at sea is larger than 3,800 km^2 = D

Area Occupied: Assuming that around every breeding location a 35 km radius (see Extent of Occurrence, above) may be exploited, each breeding island allows birds to exploit an area of 3800 km2 = D.

Number of Locations: For Peru, the data summarized by Duffy *et al.* (1984), indicate that in 1981 there were 17 breeding sites. Today only two important breeding colonies are reported: Punta San Juan and Pachacamac. In Chile, there are at least 14 breeding sites (see table 1). Of these, 13 are islands and islets and only one is a breeding site on the mainland (a sea cave). Note that for four of these sites, there are no recent observations. For northern Chile there are about 21 non-breeding sites.

Population Trends - % Change in Years or Generations: In Peru, the population was estimated to be 9,000 birds in 1981 (Duffy *et al.* 1984). The latest estimate (1996) is of 5,500 birds (Riveros Salcedo).

In Chile, in 1982 there were 10,000-12,000 birds. After the 1982-83 El Niño, the population decreased to 3080 birds. In the last census done by Araya (unpubl. data) in 1995-96, the population was conservatively estimated to be about 7500 birds.

In general, it seems that the population is continuing to decline. Between 1980-81 (pre 1982-1983 ENSO event) and the present, there has been an overall drop of 35% in 15 years. There is some discrepancy in the information provided by the Contributors; this is probably due to different time of the years in which the surveys were made. An extensive data base collected by CONAF for Pan de Azúcar Islands and observations made by several researchers (B. Culik, C. Guerra, G. Luna-Jorquera), has shown that great fluctuations occurred in the numbers of birds on the colony, decreasing to c. 50% in winter with respect to the summer.

Trend over past 100 years: Murphy (1936) reported that at one time, presumably pre-twentieth century, islands off the West coast of South America had their "crusts (presumably referring to the guano cap) as full of penguins as a Cheddar is of skippers". Raimondi (1856) (cited in Murphy 1936) described how, in the middle of the nineteenth century, Humboldt Penguins abounded on the south island of the Chincha group. While neither report was able to give figures, it is clear that Humboldt Penguins once were extremely numerous in the Humboldt upwelling region. It is thus not unreasonable to assume that the Humboldt

Penguin world population in the middle of the nineteenth century could have been in excess of a million birds.

By the time Murphy published his work in 1936, the population decline of penguins was already very evident. Murphy reported that the hundred or more Peruvian islets are "periodically allowed to become merely ankle-deep in new guano before they are again swept clean. The breeding penguins must resort, therefore, to precarious nesting sites." Murphy stated that by 1936 the penguin population had undergone a vast decline.

Generation Time: Humboldt Penguins need 3-4 years to reach sexual maturity (Guerra and Oyarzo 1992). The mean life span of Humboldt Penguins in the wild is unknown.

For Humboldt Penguins in captivity in North America, males breed as early as 2 years of age and 3 years of age for females. The oldest documented breeding is 30 for males and 25 for females. The average age of adults in the population in captivity is 12 years.

World Population: Consideration of the data from most recent censuses (Chile - Table 1 and Peru - Table 2), would indicate a world population of ca. 13,000 birds. NOTE: In some cases surveyors have based their numbers upon nests, and others on counts of individual birds.

Recent Field Studies:
Peru:
Carlos Zavalaga and Rosana Paredes (1997) are conducting work on the breeding biology and foraging ecology of birds from Punta San Juan.

J.C. Riveros Salcedo is conducting a long term survey on different colonies along the Peruvian coast evaluating the status of the seabirds, including the Humboldt Penguin.

Chile:
Since 1980, Braulio Araya and Mariano Bernal (1995) have been conducting a yearly census on the main Humboldt Penguin colonies along the Chilean coast.

Between 1988 and 1991 the Chilean Forest Service (CONAF, Corporaci6n Nacional Forestal) conducted a survey on the conservation of the Humboldt Penguin at Pan de Azucar National Park (Hector Oyarzo). Final results are available (in Spanish) in the CONAF III Region (*Copiaeo*).

During August and March 1992, Yerko Vilina conducted a study on the reproductive biology of the Humboldt Penguin at Chanaral Island (Vilina 1993). Arturo Mann studied the parasite fauna of the Humboldt Penguin at Cachagua Islet. Ecto- and endoparasites were described (Mann 1992).

Since January 1995 Mariano Bernal and Alejandro Simeone (Valdivia, Chile) have been conducting a survey on dynamics and resource partitioning among Humboldt Penguins, Chilean Brown Pelicans and Kelp Gulls during the breeding season at Pájaro Niño Islet, Algarrobo.

Table 1. Regional populations of Humboldt Penguin in Chile (breeding individuals)

Locality	1980-82	1983	1984	1985	1986	1987	1988	1988-89	1990	1995-96	1996	Source
Cueva del Caballo (20°12'S)	-	-	-	-	-	-	16§	-	-	-	-	-
Isla Pan de Azucar (26°09'S)	6000	-	131	2500	2570	-	4000*	600	1000	1750	-	1
Isla Grande (27°15'S)	58	-	-	-	-	34§	-	-	-	40	-	1
Isla Cima Cuadrada (27°41'S)	-	180	-	-	-	-	-	-	-	-	-	1
Isla de Chañaral (29°01'S)	750	-	146	6000	1000	-	-	788	1500	2500	-	1
Isla Choros (29°15'S)	96	-	32	-	-	14§	-	-	-	50	-	1
Isla Pájaros (29°35'S)	624	-	-	-	-	54§	-	880	-	1000	-	1
Isla de los Huevos (31°55'S)	60	-	64	274	-	34§	-	-	-	120	-	1
Islote Papudo (32°30'S)	-	100	-	-	-	-	-	-	-	-	-	-
Islote Cachagua (32°35'S)	1000	-	1055	-	-	-	-	-	2030	2000	-	1
Islote Concón (32°52'S)	250-500	-	12	-	100	46§	-	12	10	20	-	1
Ex Isla Pájaro Niño (33í21'S)	-	-	530	1000	2000	-	-	-	-	200	1600	1
Islote Pupuya (34°00'S)	-	14$	-	-	-	-	-	-	-	-	-	-
Islote Puñihuil (41°55'S)	-	-	-	12	-	-	-	-	-	50	-	1
Total	9088	294	1970	9786	5670	182	4016	2280	4540	7730	1600	
Est. Total	10-12000	300	3080	10000	5-6000	200	400	3000	4500	7500	1600	

1 B. Araya and M. Bernal compiled from their data for this CAMP. Data quality 1 and 2. * Oyarzo and Correa 1988. Data quality 2. # A. Simeone (unpublished data) Data quality 1
§ Araya and Todd 1987. Data quality 1. $ Araya 1983. Data quality 3.

Table 2. Regional populations of Humboldt Penguin in Peru (breeding individuals)

Localities	1981*	Mar 1981*	Jul 1996	Source
Punta Aguja (05°41'S)	-	-	10	1
Isla Lobos de Tierra (06°25'S)	900	-	100	1
Isla Macabi (07°47'S)	-	-	15	1
Isla Mazorca (11°22'S)	120	8	100	1
Isla Pachacamac (12°17'S)	750	320	800	1
Isla Chincha Centro (13°39'S)	-	-	50	1
Isla Ballestas (13°44'S)	8	9	60	1
Isla San Gallan (13°50'S)	-	111	60	1
Punta Arquillo (13°52'S)	-	-	50	1
La Vieja (14°17'S)	-	8	-	-
Pta. San Fernando (15°08'S)	-	-	500	1
Punta San Juan (15°21'S)	2220	2000	3400	2
Punta Pampa Redonda (15°50'S)	300	0	-	-
Punta La Chira (16°29'S)	-	-	300	1
Isla Hornillos (16°52'S)	-	-	60	1
Santa Rosa (19°19'S)	-	0	-	-
21 Islands and headlands	4770 -	-	-	-
11 Islands and Headlands	-	2608	-	-
Total	9068	5064	5505	
Estimated Total	9000		5500	

1 J.C. Riveros Salcedo compiled for this CAMP. Data quality 1 and 2.
2 C. Zavalaga and R. Paredes for this CAMP. Data quality 1. * Data from Duffy *et al.* 1984

Recent Field Studies (continued):
Since 1990, Javiera Meza, CONAF V Regiốn, Valparaiso, has been censusing the colony at Cachagua Islet. During 1990 and 1991, Carlos Guerra conducted a study on the effects of summer and winter nesting on selected life history parameters of Humboldt Penguins from Pan de Azucar Island (Guerra and Oyarzo 1992). Since 1993, Roberto Aguilar (Univerisdad de Antofagasta, Chile) has been conducting a post-doctoral study on the physiology of embryos and their growth rate in captivity.

Since 1993, Boris Culik (Kiel, Germany) and Guillermo Luna-Jorquera have been conducting ecophysiological, bioenergetic and behavioral studies of penguins at sea on birds from Pan de Azucar Island. Since 1994, E. Diebold *et al.* (1994) of the Milwaukee County Zoo together with Chilean researchers (B. Araya, A Simeone and M. Bernal) have been conducting a long term survey on the colony of penguins at Pájaros Niños Islet. The main goal is to enhance the conservation of Humboldt Penguin in the wild and in captivity (see Diebold *et al.* 1994).

Threats:

1. Climate. Heavy rain in some regions where it is not common, causes nest desertion with total loss of eggs and/or chicks (this is independent of rains due to El Niño).

2. Decline in prey species. over-fishing resulting in a drop in prey availability (last year in Chile the total catch was 8,000,000 metric tons).

3. Drowning. A number of Humboldt Penguin are being caught by fishermen in gill nets in some localities such as Punta San Juan, Peru (Boersma and Stokes 1995), central Chile (Simeone *et al.* 1996), and northern Chile.

4. Hunting for human consumption. Adults have been hunted and eggs collected for human consumption and baiting purposes (Schlatter 1984, Vilina *et al.* 1995). Egg collection by fishermen and tourist activities also provoke nest desertion (Araya and Todd 1987, Vilina 1993).

5. Human interference due to tourism and disruptive effects derived from scientific work and ringing activities (see Luna-Jorquera *et al.* 1996).

6. Loss of habitat due to guano exploitation.

7. Marine perturbations because of El Niño.

The following <u>secondary</u> threats were also detected: Interspecific competition with pelicans.

1. Predation. Araya (1983) and Schlatter (1984) have reported predation by rats. There is also an historical record from Araya and Duffy (1987) on predation by foxes introduced to Chañaral Island. At Pájaros Niños Islet, which has been linked to the mainland for about 20 years, there are some feral cats that probably prey on chicks and juveniles (Simeone, pers. obs.).

2. Pollution attributable to increasing mining, industrial activities and problems derived from urbanization and inadequate planning of growing human activities (recreation, tourism, etc.).

Trade: No current trade. Araya (1983) reported information given by local fishermen and sailors that accounts for the capture of about 40 birds from North of Chile for export (probably illegal trade). In addition, Hays (1985) estimated that 9264 Humboldt Penguins have been exported to several zoos in the world within a period of 32 years. This does not include birds that died during capture and transport. Exportation is now prohibited from Perú and Chile (Williams 1995, Simeone 1996).

Comments: El Niño must be considered a main marine perturbation for the Humboldt Penguin (Araya and Todd 1987, Arntz and Valdivia 1985). Although El Niño causes breeding failure and high mortality among the seabirds (Tovar and Cabrera 1985), there is evidence to suggest that this phenomenon exerts a selection pressure on the seabird population, favoring the ability to increase rapidly in numbers after each event (Schreiber and Schreiber 1984). Nevertheless, since the sixties, the commercial fishery for anchovies has been in competition with the guano birds and, through overexploitation, has reduced the anchovy population and its availability to the seabirds (Tovar and Cabrera 1985). Recent research suggests that Humboldt Penguins have to work hard in order to obtain food, even during non-El Niño years (Culik and Luna-Jorquera 1997b).

Recommendations:

1. Convene a PHVA Workshop in Chile in 1998 (note: planned for November 1998 in Olmue). Strive for maximum participation from key agencies associated with wildlife management in Perú and Chile.*

2. A complete population assessment as soon as possible and the timing and methodology used for this assessment must be standardized (e.g., count molting birds).

3. Protection of breeding locations and enforcement of existing legislation where these penguins breed should be given high priority, including improved funding and support of wardens charged with enforcing regulations. In Peru, the harvest of guano must be regulated in order to preserve nesting habitat and reduce disturbance during the nesting seasons. Improved predator control at mainland sites, including maintenance of predator enclosure systems.

4. Support conservation-oriented research including patterns of reproductive success, recruitment into the breeding population, studies of foraging ecology, and studies of migratory behavior.

5. Genetic studies to determine whether Humboldt Penguins from the distributional area have the same genetic background and whether there is continuous mixing of the population.

6. Marine reserves should be created around the major breeding colonies.

7. Establish conservation education programs oriented at reducing hunting pressure and by-catch.

8. Husbandry research in order to stabilize captive populations and preclude the need to remove birds from the wild. The long term intention of captive propagation should be to reintroduce juveniles into secure sites in the wild, particularly where local extinction

might occur (pending results of PHVA).

9. Investigate incidence of potential hybridization with Magellanic Penguins where the species' ranges overlap.

10. Reduce fish harvests during ENSO events.

11. Recommend enhanced industrial and mining waste treatment efforts in coastal regions where the species occurs.

*A symposium and round table discussion on the ecology and conservation of penguins in Chile was held on 13 November 1997 in Santiago, Chile, concentrating on the Humboldt penguin (Simeone 1998).

PHVA: Yes

Captive Program Recommendation - Pending. A decision regarding a captive program will depend upon further data from a PHVA. Captive programs for Humboldt Penguins already exist at several zoos and aquaria in the USA, Europe and Japan. The aim of this program must be to manage a population sufficient so as to preserve 90% or more of the genetic diversity of the overall population for a minimum of 100 years. Consequently, it is not necessary to remove new birds from the wild in the future but a complete estimation of the numbers of birds existing in captivity is highly recommended.

Level of Difficulty: There are data on aspergillosis in Humboldt Penguins maintained in captivity and problems with temperature and humidity inside the nests. Nutritional factors may affect mortality of parent-reared chicks. Consequently a moderate difficulty (level 2) is appropriate for Humboldt Penguin.

Existing Captive Population: According to Simeone (1996) there were at least 2,202 captive birds in 1994: 226 in North America, 947 in Europe, and 1029 in Japan. The members of genus *Spheniscus* have shown propensity to hybridize in captivity (del Hoyo 1992). Genetics studies should be conducted.

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Spheniscus mendiculus

STATUS: New IUCN Category: Endangered
Based on: A1a; B1; B2e; C2a; E
CITES: Not listed
Other: Listed as Endangered on the US Endangered Species list. Listed as Near Threatened in *Birds to Watch 2* (Collar et *al.* 1994).

Taxonomic Status: Species

Current Distribution (breeding and wintering):
Breeding Distribution - Galapagos Islands; distribution is mainly restricted to Fernandina and Isabela Island. They are absent from most of the eastern side of Isabela Island. A few individuals are regularly seen at Santiago and Bartolome, Islands (and on Floreana) and there are a few pairs that breed there (Mills 1993, Soria *et al.* 1994, Vargas 1995). Also seen regularly at Rabida, north Santa Cruz, and Sombrero Chino. A survey in 1996 (Miller and Miller) did not reveal birds on Sombrero Chino and north Santa Cruz. Display and mating has been seen on these islands (Harris 1982), although breeding has not been recorded.

Concentrated Migration Regions: Does not migrate but does disperse during the non-breeding period and in El Niño years. Sighted on islands throughout the year where they do not breed. No telemetry tracking studies to date.

Historical Distribution: This species has never been recorded breeding outside the Galapagos Islands.

Extent of Occurrence: Restricted = B
They seem to be shallow water feeders (near shore). Varies with where they are (i.e., how far off shore they forage). But, generally thought to forage less than 10 km off shore.

Area Occupied: Breeding range is restricted to approximately 290 km of coastline.
B = 11 km^2 to 500 km^2

Number of Locations: Approximately 100 km from one end of range of occurrence to the other. 3 locations. 1 = Fernandina and Isabela (western islands). 2 = Santiago and Santa Cruz (central islands). 3 = Floreana (southern island).

Population Trends - % Change in Years or Generations: Boersma (1977) counted approximately 2,000 individuals and estimated that the population was between 6,000 - 15,000 individuals in the early 1970s. The population was reduced during the large ENSO event in 1982-83 by approximately 77%, when fewer than 500 individuals were counted (Valle 1983). As of 1995, the population had still not recovered to pre 1982-1983 ENSO levels, but over 800 individuals were counted in the latest census (Vargas 1995). Therefore, the present population is about 40% of that before the 1982-83 ENSO event.

Trend over past 100 years: Population size is variable and at its lowest after severe ENSO events.

Generation Time: Unknown, but three individuals of known age were 11 years old and still breeding (Boersma 1974).

World Population: Estimated to be between 1,500 and 4,000 pairs, based on the methods for estimating Galapagos Penguin numbers established by Boersma (1974). This may be an overestimation of the population (Mills and Vargas, in press).

Regional Population(s): In the most recent census (1995), 32% of the population was counted on Fernandina Island, 64% on Isabela, and 4% on the other islands combined (Floreana, Santiago, and Bartolome,).

Data Quality: 1

Recent Field Studies: The Charles Darwin Station and the National Park conduct yearly censuses for penguins and Flightless Cormorants (*Compsohaelius [Nannopterum] harrisi*), control introduced predators, and support conservation and management of the Islands' marine and terrestrial wildlife. K. L. Mills conducted field studies of the Galapagos Penguin in 1993 and 1994 on Cape Douglas, Fernandina and Bartolome (see also Vargas 1995). G. D. Miller and R. D. Miller surveyed all islands in 1996.

Threats: Increased human exploitation of the Islands and increased numbers of people living and visiting the Islands are the most serious threats. Natural marine perturbations (e.g., ENSO events), pollution, and fishing also pose serious threats to the already small population. Introduced predators such as rats, cats and dogs continue to take young and adults on Isabela, Floreana, and Santiago Islands. Predators such as the black or Norway rats are likely to be introduced to Fernandina Island in the near future, if not already. Potentially, climate change could be a threat.

Trade: Not currently found in trade.

Comments: The potential for the development of a bait fishery could increase mortality of penguins from entanglement in fishing nets and reduce prey. Oil pollution from the release of petroleum products from boats is likely to be an increasing problem as boat traffic increases. Sinking of boats (accidents) also poses a threat. It would be useful to try to predict the effect of another severe El Niño cycle on the Galapagos Penguin. More recent El Niño events have been mild compared to the 1982-1983 event which reduced the population by 70%.
Usually molts just prior to breeding. Boersma feels that they are most effected by food supply therefore, they molt prior to breeding.

Recommendations:

1. Discourage use of fishing nets within the foraging range; and prevent development of coastal fishing activities around Fernandina and Isabela.

2. Minimize effects of human disturbance in the breeding areas from both tourists and residents.

3. Control predators and promulgate stronger regulation to prevent further introductions, e.g., continued periodic inspections of vessels to ensure that they are rat, cat and dog-free, use of rat guards, elimination of cats and dogs from vessels.

4. Continued monitoring of the population (currently carried out in August; there are plans to continue monitoring). We suggest that survey techniques be standardized (i.e., by doing a count of molting birds).

5. Provide nest boxes in predator-free areas to help monitor reproductive success.

PHVA: Yes

Captive Program Recommendation: No
Level of Difficulty: 1
Existing Captive Population (ISIS): None listed in ISIS

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Spheniscus magellanicus

STATUS: New IUCN Category: Lower Risk
Because of the population reduction trends at Punta Tombo and in the Falklands, the species is listed as Lower Risk. Certain populations may qualify for "Near Threatened" status.

CITES: not listed

Taxonomic Status: Species

Current Distribution: Argentina: Peninsula de Valdes (42°04'S 63°21'W) to Isla Martillo in the Beagle Channel (54°54'S 67°23'W), including Isla de los Estados and Islas Malvinas (Falklands Islands). Chile: From islands in the Fuegian Region (Cape Horn) to Chiloe Island and occasionally up to Is. Pan de Azucar.

Wintering Distribution:
In winter they migrate offshore and to north. On the Atlantic Ocean side (east coast of South America), some individuals reaching up to Rio de Janeiro (Brazil).

Concentrated Migration Regions:
In the Atlantic Ocean, Magellanic Penguins migrate from south to north along the coast of Argentina, Uruguay and Brazil. During austral winter big concentrations of penguins are seen in the waters of Santa Catalina State (South of Brazil).

Historical Distribution: Colonies at Isla Leones and Cabo Vírgenes are known from the XIX century and Puerto Deseado Islands from the XV century. Historical records mention that a Magellanic Penguin colony existed in the southwest of the Ushuaia Peninsula. This colony disappeared, for unknown reasons, during the mid 1950s (Schiavini and Yorio 1995).

Extent of occurrence: More than 20,000 km^2 (D).

Area of occupancy: D = larger than 20,000 km^2

Locations in Argentina:
CHUBUT PROVINCE
Latitude and Longitude

1. Estancia San Lorenzo
   Estancia San Lorenzo 42°05'S 63°51'W
   Asentamiento Oeste 42°06'S 63°56'W
2. Islote Notable 42°25'S 64°31'W
3. Caleta Valdes Externa 42°16'S 63°38'W
4. Islas de la Caleta Valdes
   Isla Primera 42°21'S 63°37'W
   Isla Segunda 42°21'S 63°37'W
5. Caleta Valdis Interna 42° 27'S 63°36'W
6. Punta Clara 43°58'S 65°16'W
7. Punta Tombo 44°02'S 65°11'W
8. Punta Loberia

Punta Loberia 44°35'S 65°22'W
Isla Cumbre 44°35'S 65°22'W
9. Isla Blanca Mayor 44°46'S 65°38'W
10. Cabo Dos Bahias
Cabo Dos Bahias 44°54'S 65°32'W
Isla Moreno 44°54'S 65°32'W
11. Isla Arce 45°00'S 65°29'W
12. Islas Leones
Isla Leones 45°03'S 65°37'W
Peninsula Lanaud 45°03'S 65°37'W
Isla Buque 45°03'S 65°37'W
Isla Sudoeste 45°03'S 65°37'W
13. Complejo Tova Tovita
Isla Tova 45°06'S 66°00'W
Isla Gaviota 45°06'S 65°58'W
Isla Este 45°07'S 65°56'W
Isla Tovita 45°07'S 65°57'W
14. Islas Vernacci
Isla Vernacci este 45°11'S 66°29'W
Isla Vernacci norte1 45°11'S 66°30'W
Isla Vernacci norte2 45°11'S 66°30'W
Isla Vernacci suroeste 45°11'S 66°31W
Isla Vernacci noroeste 45°10'S 66°31'W)
Isla Viana Mayor 45°12'S 66°24'W

SANTA CRUZ PROVINCE
16. Punta Pajaros 46°57'S 66°50'W
17. Ria Deseado Isla Quiroga 47°45'S 65°56'W
Isla Chaffers 47°46'S 65°52'W
Isla Larga 47°45'S 65°56'W
Islote Burlotti 47°46'S 65°57'W
18. Ria Deseado Interior
Isla de los Pajaros 47°45'S 65°58'W
Canadon del Puerto 47°45'S 66°00'W
Isla del Rey 47°46'S 66°03'W
19. Bahia Oso Marino
Isla Pinguino 47°53'S 65°49'W
Isla Chata 47°53'S 65°50'W
20. Punta Buque
Punta Buque 48°06'S 65°55'W
Isla Liebres 48°06'S 65°54'W
Isla Burgos 48°05'S 65°54'W
Isla Schwarz 48°04'S 65°54'W
Estancia 8 de Julio 48°07'S 66°08'W
21. Bahia Laura
Bahma Laura 48°21'S 66°21'W
Isla Rasa Chica 48°22'S 66°20'W
Islote del Bajio 48°22'S 66°20'W
Islote Sin Nombre 48°22'S 66°21'W

22. San Julian
    Banco Cormoran 49°16'S 67°40'W
    Banco Justicia 49°16'S 67°41'W
23. Ria Santa Cruz
    Isla Leones 50°04'S 68°27'W
    Punta Entrada 50°08'S 68°22'W
24. Monte Leon 50°17'S 68°51'W
25. Isla Deseada 51°35'S 69°02'W
26. Cabo Virgenes 52°20'S 68°21'W

TIERRA DEL FUEGO PROVINCE
27. Isla Martillo 54°54'S 67°23'W
    Bahia Franklin 54°52'S 64°39'W
    Isla Observatorio 54°39'S 64°08'W
    Isla Gofre 54°40'S 64°11'W

Locations in Chile:
Most of the colonies are located in the southern regions (Isla Diego Ramirez, Isla Hornos, Islas of the Canal de Beagle, Punta Arenas and Islas Magdalena, Marta and Contramaestre in the Estrecho de Magallanes and Seno Otway). At the north-central regions there are fewer and smaller colonies than in the south (Islas Cachagua, Juan Fernandez and Island in front of Chiloe (Punihuil), with an unknown number of breeding pairs.

Locations in the Falklands Islands:
On both large islands and larger offshore islands.

Population Trends:
Argentina: Magellanic Penguins are found in colonies scattered along the coast of Patagonia. Little information exists on the size of colonies over time (Capurro *et al.* 1988, Boersma *et al.* 1990, Frere 1993, Carribero *et al.* 1995, Gandini *et al.* 1996). Existing information suggests no clear trends for the entire population. Several colonies at Peninsula Valdes have expanded in recent years. For example, the colony at Caleta Valdes was apparently new in the early 1960s when two pairs were found. It continued to grow through the 1970s and 1980s (Perkins 1983, Carribero *et al.* 1995). Now, approximately 26,000 pairs nest at Caleta Valdes (Carribero *et al.* 1995). Isla Deseada colony in the south of Santa Cruz province, increased from 5,000 pairs in 1986/87 to more than 12,000 pairs in 1995/96 (Frere and Gandini unpubl. data). In contrast, Punta Tombo has declined in numbers since 1987 by nearly 30% (Boersma unpubl. data). The decline is not because of low reproductive success but probably to changes in survival of juveniles and young adults. Cabo Virgenes colony has been stable for at least the last ten years (Frere *et al.* 1996a). Annual monitoring of selected colonies (Bingham 1994 1995a 1995b) shows that the Magellanic Penguin population in the Falkland Islands has declined to about half its 1980s level. Woods and Woods (1997) record Magellanic Penguins in 107 (46%) of the 10 km^2 squares in the Falklands with breeding confirmed in 91%. They estimated the total breeding population as 108,883 (range 76,000-142,000) pairs based on estimates for 76 (71%) of the 107 squares.

Generation Time: On average, the species begins to reproduces at around 4-5 years of age for females and 7-8 years of age for males. Varies from colony to colony. Oldest breeder at Punta Tombo was older than 17 years of age.

World Population: Approximately 1,300,000 pairs (Bingham 1998).

Regional Populations:
Argentina: The current population along the coast of mainland Argentina is estimated to be 650,000 breeding pairs (Gandini *et al.* 1996). (assuming 100,000 pairs at Isla de los Estados (Schiavini and Frere unpubl. data). See Bingham (1998) for a current review of regional populations.)

Malvinas/Falklands Islands: >100,000 pairs (Croxall *et al.* 1984).

Chile: >200,000 pairs (Schlatter 1984)

Data Quality: Argentina: 1; Malvinas/Falklands Is.: 2; Chile: 3

Recent field studies:
Argentina:
Since 1982 research has been carried out at Punta Tombo, directed by Boersma in association with Yorio and Stokes. Several colonies have been monitored through time: Caleta Valdes and Estancia San Lorenzo (Pablo Yorio, Alejandro Carribero and Daniel Perez), Punta Tombo (Dee Boersma and Pablo Yorio), and Puerto Deseado colonies and Cabo Virgenes (P. Gandini and Esteban Frere). These studies covered almost all the key colonies for the species in Argentina. The projects include population studies, breeding ecology, habitat selection, diet and interactions with human activities, e.g., petroleum contamination until 1990. Gandini, Frere and Boersma also looked at the number of penguins found dead on beaches in the Province of Chubut. This work has been continued by Fundaci6n Patagonia Natural (located in Puerto Madryn), an Argentine NGO which has been actively involved in conservation issues with penguins. Also CONICET has funded Argentine researchers to study Magellanic Penguins along the coast (A. Scolaro).

Malvinas/Falklands Islands:
Falkland Islands Seabird Monitoring Program. Studies have been carried out on aspects of breeding biology, physiology, conservation, habitat use, oil pollution, migration, mate selection, diet, and behavior.

Chile:
Claudio Venegas is working together with P. Becker on heavy metal contamination in Magellanic Penguins in the area of Punta Arenas. B. Culik is working in two colonies in the Punta Arenas area, which use the straight of Magellan and the Seno Olway for foraging. The differences he and Arne Radl found with respect to diving behavior and reproductive success cannot be attributed to the type of prey used, as both colonies feed on sprat. However, both colonies experience different levels of stress from tourism and fishery activities and the extent of these influences will be further investigated.

Threats: Oil transport, Pollution, Fishing, Marine perturbations, Habitat loss, Hunting and Predation by exotics.

In Argentina, Gandini *et al.* (1994) estimated that more than 20,000 adults and 22,000 juveniles are killed by oil contamination along of 3000 km of Argentine coast each year. Although legislation exists to prevent oil dumping and discharge, penguins are regularly found contaminated with oil. Oil-contaminated ballast water continues to be discharged by tankers as they approach the ports. Oil pollution along the Argentine coast could be reduced by proper treatment of ballast water and enforcement of MARPOL (Gandini *et al.* 1996).

Hunting of penguins for use as bait in Punta Arenas is a threat as well.

Preliminary information suggests that incidental mortality in fishing nets is occurring. In addition, penguins may be captured in nets but some preliminary data indicate that this is not an important source of mortality. Furthermore, fisheries may have an indirect effect on the population because of the by-catch of the shrimp and hake fisheries. Most of the by-catch includes juveniles of hake (*Merlucius hubsii*) and anchovy (*Engraulis anchoita*), important penguin prey along the north coast of Patagonia (Frere *et al.* 1996b, Gandini *et al.* 1996).

In the Malvinas/Falkland Islands, loss of tussock habitat that the penguins use for nesting may be restricting their population. Predation from introduced foxes is a problem on at least two offshore islands. Egg collection is continued under a license agreement and is very heavy at some sites. Egging may be having a local impact on colonies but probably is not affecting the population. Exploitation of petroleum resources is likely to occur around Malvinas/Falkland Islands, which may cause an increase in pollution, and other effects associated with an increasing human population.

In general (i.e., in all areas), during some years almost all birds fail to rear chicks because of rains and lack of food for young associated with ENSO events. Reduction of habitat and changes in land use reduce the quality and abundance of good breeding areas. Predation from introduced foxes, cats and rats is a problem on some islands.

Trade: Chile is currently issuing permits for export.

Comments: Magellanic Penguins are relatively common which may mean it is important for zoos to assess the numbers of spaces that have been allotted to each species and to make sure that the more abundant species do not usurp spaces from species that are in very low numbers in the wild. Zoo-based Species Survival-type programs should determine how many individuals and how many species should be maintained in captivity with higher priority given to breeding programs of species in low numbers in the wild.

RECOMMENDATIONS:

1. National and international pressure is needed to stop petroleum discharge.

2. Continue evaluating the rate of mortality in fishing nets and in bait hunting; continue evaluating the overlap between Magellanic Penguin diet and fisheries harvests including both target species and by-catch; determine major foraging areas and potential competition with fisheries.

3. Continued monitoring is needed and should be initiated in Chile and continued in the Falkland/Malvinas.

4. Establish marine reserves around key colonies.

5. Delineate and protect migration and dispersal routes of Magellanic Penguins, using telemetry, in order to quantify the overlap with shipping routes.

6. CONAF and the German School in Punta Arenas should be supported in their efforts to stop the hunting of Magellanic Penguins for bait.

7. Develop joint conservation strategies between Argentina, Uruguay, Brazil, Chile and the Falkland Islands.

PHVA: No

Captive Program recommendation: No

Level of difficulty: 1

Existing Captive population:
Argentina: Mundo Marino sea aquarium: 100 individuals. Mar del Plata Aquarium may also have a few birds.

Institutions reporting to ISIS: 168 (31 December 1995). Japan: 300. There has been a moratorium on breeding in North America since 1993.

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Spheniscus demersus

STATUS: New IUCN Category: Vulnerable
Based on: A1a, A2b, E
CITES: Appendix II
Other: In South Africa, endangered in terms of the Nature and Environmental Conservation Ordinance, No. 19 of 1974 of the Province of the Cape of Good Hope. This now applies to the Northern Cape, Western Cape and Eastern Cape Provinces. In Namibia, there is no official legal status. Listed as Near Threatened in *Birds to Watch 2* (Collar et *al.* 1994)

Taxonomic status: Species.

Current distribution (breeding and wintering):
Breeding distribution: Between Hollams Bird Island, Namibia and Bird Island, Algoa Bay, South Africa.

Number of locations: 27 extant breeding colonies - eight islands and one mainland site along the coast of southern Namibia; 10 islands and two mainland sites along the coast of Western Cape Province, South Africa; six islands in Algoa Bay, Eastern Cape Province, South Africa (Crawford et *al.* 1995a). There is no breeding along the coast of South Africa's Northern Cape Province, which lies between Namibia and Western Cape Province.

Concentrated Migration Regions: None. Juveniles tend to disperse along the coastline to the west and north (Randall et *al.* 1987).

Historical Distribution: Breeding no longer occurs at nine localities where it formerly occurred or has been suspected to occur (Crawford et *al.* 1995b) - Neglectus, Seal, Penguin, North Long, North Reef and Albatross Islands in Namibia; Jacobs Reef, Quoin and Seal (Mossel Bay) Islands in South Africa. In the 1980s, breeding started at two mainland sites in South Africa (Boulders, Stony Point) for which no earlier records of breeding exist.

Area occupied: Throughout breeding range and farther to the north and east. Rare off Kwazulu/Natal (Cyrus and Robson 1980). Vagrants have occurred north to Sette Cama (2 32 S), Gabon, on Africa's west coast and to Inhaca Island (26 58 S), Mozambique, on the east coast (Shelton et *al.* 1984). In coastal waters, usually within 12 km of the shore. Birds feeding chicks forage within 20-46 km of the colony (Wilson 1985; Randall 1989), mostly within 3 km of the coast (Berruti et *al.* 1989). Adults generally remain within 400 km of their breeding locality, but juveniles regularly move in excess of 1000 km from their natal island (Randall 1989).

Extent of occurrence: About 25,000 km^2, category D (> 20000 km^2).

Population Trends: % Change in Years: There were an estimated 222 000 adults (birds in adult plumage) in the late 1970s 194 000 in the late 1980s and 179 000 in the early 1990s (Crawford et *al.* 1995a). This gives a mean annual rate of decrease between the late 1970s and the early 1990s of 1.3 %, and between the late 1980s and the early 1990s of 1.5 %.

% Change in Generations: Adult survival is estimated to be about 0.90 p.a. (Randall 1983, Crawford *et al.* submitted). Therefore, average life expectancy of breeders is 6.6 years. Mean age at breeding is about four years (Randall 1983, Crawford *et al.* submitted). This gives an average age of breeders of 10-11 years. Birds have been known to live to more than 24 years in the wild (Whittington *et al.* submitted). The overall decrease in breeders between the late 1970s and early 1990s, i.e. about 15 years or 1.5 generations, was 19.4 % (Crawford *et al.* 1995a). Therefore, the mean recent decrease per generation is 12.9 %.

Trend over past 100 years: In 1910, there were probably 1.4 million adult birds at Dassen Island (Shannon and Crawford submitted). In the mid 1950s, the overall African Penguin population was estimated to be about 300 000 adults (Rand 1963a, b). This included 145 000 at Dassen Island, which may have underestimated the population there by as much as 70 000 (Shannon and Crawford submitted). By the early 1990s, the World's wild population had decreased to about 180 000 adults.

World population: In 1991-1994, the World's wild population was estimated to be 56 000 breeding pairs representing 179 000 adults (Crawford *et al.* 1995a). The number of adults was estimated from the ratio between birds in adult plumage and breeding pairs at Robben Island.

Regional populations: There has been regional variation in trends in the abundance of African Penguins (Crawford *et al.* 1990 1995a). In Namibia, there has been a 30 % reduction since the late 1970s, the most severe declines being south of Lüderitz, where colonies continue to decrease. Populations at Mercury, Ichaboe and Halifax Islands now appear to be stable. In South Africa, numbers fell by 17 % between the late 1970s and early 1990s, with especially severe decreases near Saldanha Bay and at Dassen and Dyer Islands. These decreases have been arrested, except at Dyer Island. Three new colonies were established in the Western Cape Province in the early 1980s, and now support about 10 000 adult birds. At islands in Algoa Bay, the estimated number of adults increased by nearly 30 000 between the late 1970s and the early 1990s, with large increases at St Croix and Bird Islands.

Data Quality: 1

The estimated numbers of breeding pairs and adults at localities in 1991-1994 are listed in the following table (Crawford *et al.* 1995a):

Locality	Pairs	Adults
Hollams Bird Island	1	3
Sylvia Hill	26	83
Mercury Island	3659	11709
Ichaboe Island	2858	9146
Halifax Island	981	3139
Possession Island	751	2403
Pomona Island	8	26
Plumpudding Island	26	83
Sinclair Island	63	202
Namibia	8373	26794
Bird Island, Lambert's Bay	25	80
Malgas Island	99	317
Marcus Island	207	662
Jutten Island	1349	4317
Vondeling Island	229	733
Dassen Island	9389	30045
Robben Island	2799	8957
Boulders	359	1149
Seal Island, False Bay	95	304
Stony Point	77	246
Dyer Island	8349	26717
Geyser Island	328	1050
Western Cape Province, South Africa	23305	74577
Jahleel Island	549	1757
Brenton Island	31	99
St Croix Island	19478	62330
Seal Island, Algoa Bay	375	1200
Stag Island	24	77
Bird Island, Algoa Bay	3784	12019
Eastern Cape Province, South Africa	24241	77572
South Africa	47546	152149
WORLD	**55919**	**178943**

Recent Field Studies:
Breeding cycle: Off southern South Africa the main breeding season is January to September; most birds moult between October and January (Randall 1989; Crawford *et al.* 1995c). The annual cycle farther north lags this by a few months (Crawford *et al.* 1995a).

Population surveys: Namibia's Ministry of Fisheries and Marine Resources (MFMR) counts annually the number of breeding pairs at Mercury, Ichaboe and Possession Islands. South Africa's Sea Fisheries Research Institute (SFRI) monitors the number of breeding pairs at 11 localities (all except Stony Point) in South Africa's Western Cape Province. Breeding pairs at Stony Point are counted by a committee of the local municipality. Port Elizabeth Museum (PEM) counts breeding pairs at Bird Island, Algoa Bay. Other breeding localities are surveyed less frequently by MFMR, SFRI and PEM.

Counts of moulting birds are undertaken at two-weekly intervals by MFMR at Mercury, Ichaboe, Halifax and Possession Islands, Cape Nature Conservation (CNC) at Dassen Island, SFRI at Robben Island, and nature conservation authorities of Eastern Cape Province at Bird Island, Algoa Bay. Counts during the peak moult are also made at Boulders by SFRI and at St Croix Island by PEM.

The relationship between counts of breeding birds and counts of moulting birds, that will enable the adult population to be estimated from counts of breeding birds, is being investigated for Algoa Bay by PEM.

Population parameters: Demographic parameters of African Penguins have been measured at Robben Island (Crawford *et al.* submitted). Adult survival was between 0.82 and 0.90 in 1993/94, but fell to 0.75 in 1994/95 when many birds at the island were oiled following the sinking of the *Apollo Sea* in June 1994. Some penguins initiated breeding when two years old, and all probably bred at age five. The proportion of mature birds that bred in a year varied between about 0.70 and 1.00. During the breeding season, pairs laid their first clutch between January and August, mostly in February and March. The average clutch was 1.86 eggs. Of lost clutches 32 % were replaced, whereas 23 % of pairs losing broods relayed and 21 % of pairs that successfully fledged chicks relayed. On only one occasion was the laying of a third clutch during a breeding season recorded, and this was unsuccessful. The mean number of chicks fledged per breeding pair varied between 0.32 and 0.59 per annum.

Success of rehabilitation efforts: The return to islands and breeding success of penguins rehabilitated after being oiled following sinking of the Apollo Sea has been monitored by ADU and CNC (Underhill *et al.* in press). Of penguins flipper banded after rehabilitation, 65 % had been seen at islands within two years of their release. At Dassen Island, there were some seasonal differences in the breeding success of rehabilitated birds and birds not affected by oil (Nel and Williams submitted). Moulting and breeding cycles were affected.

Diet: The diet of African Penguins is monitored by SFRI at three islands - Dassen, Robben and Dyer (Crawford and Dyer 1995, Adams *et al.* submitted). Anchovy *Engraulis capensis* is the main prey item at Robben Island (Crawford *et al.* 1995c). At Dyer Island there has been a trend to replacement of Anchovy by Sardine, *Sardinops sagax* (Adams *et al.* submitted).

Foraging range: The foraging range of breeding penguins at different localities is being investigated using transmitters to satellites. An adult rearing chicks at Dassen Island moved as far as Boulders and Marcus Island, but normally foraged closer to Dassen Island.

Threats:

CLIMATE:

Heat: African Penguins are subject to heat stress (Randall 1983). In hot, humid, cloudless and windless conditions, parents abandon clutches and broods for the sea to cool and prevent further dehydration. Losses to Kelp Gulls (*Larus dominicanus)* and other predators of eggs and chicks then frequently occur. African Penguins apparently reduce heat stress by breeding in shade, e.g. under bushes and in burrows. However, as a consequence of removal of accumulated deposits of guano, in which burrows can be excavated, penguins have been forced to nest on the surface at many localities, increasing their susceptibility to heat stress.

Rain: Heavy rain may result in flooding of nests, drowning of small chicks and losses of older chicks to hypothermia (Randall *et al.* 1986).

There has been a change in the center of distribution of the breeding population of African Penguins. Much of the breeding population is now in Algoa Bay, where conditions are warmer than elsewhere, both on land and at sea.

Should ambient temperatures increase as a result of global warming, increased desertions of nests and decreased reproductive success can be anticipated. Should rainfall increase, greater flooding of nests will occur.

PARASITES AND DISEASE:

This section deals with parasites and disease in the wild and in captivity. Most of the information arises from studies of captive populations and birds in rehabilitation centers. The possibility exists that diseases contracted by rehabilitated birds can be passed to wild populations.

Endoparasites: Various worms occur in the gastro-intestinal (GI) tract, and some in the kidneys and lungs. Most can be treated with standard anti-worm medication. Cerebral symptoms may be seen with GI worms, whose eggs may be encysted in any part of the body, or endoparasites that lodge in liver, spleen, brain, lungs etc.

Strigeid digenian trematodes *Cardiocephaloides physalis* were responsible for large numbers of chick mortalities at St Croix Island in July 1981 (Randall and Bray 1983).

Ectoparasites: Lice, ticks and fleas are common, but not usually a problem.

Aspergillosis: A fungus that affects the lungs, particularly if penguins are stressed or overcrowded. Treatment is expensive and labor-intensive, involving nebulization (prophylaxis) and injections of Amphotericin-B. Oral itroconazole is favored by many as an effective and simple treatment (R. Norman, pers comm.).

Bumblefoot: May be caused by *Staphylococcus* bacteria, but always associated with damp floors. Treatment difficult, but a dry environment will avoid it.

Haematozoa: The most important is avian malaria *Plasmodium relictum*. Mortality is high, but, if diagnosed, birds can be treated with Chloroquin plus Doxyxycline or Proguanil. The latter can be suspended in Keltrod, a mix of Hydroxy-benzoates, which makes it easier to administer. All penguins should be given prophylaxis during their stay in rescue stations, especially in summer, but controlled scientific assessment of the best drug and dose has not been done in South Africa.

Leucocytozoon (commonly present in many flying birds) occasionally affects penguins. Possibly responds to Chloroquine.

Babesiosis is endemic in African Penguins and has been reported elsewhere. Probably causes no symptoms, except under stress conditions.

Newcastle Disease: A virus with very high mortality and very contagious. A vaccine can be prepared, but its efficacy is unknown.

Avian cholera: Avian cholera *Pasturella multocida* has killed penguins at Dassen Island (Crawford *et al.* 1992a).

Infections: Pneumonia (viral or coccal) is common. Usually treated with amoxycillin.

Steps need to be implemented to minimize the risk of rehabilitated penguins returning disease to wild colonies.

FISHING: Commercial purse-seine fisheries off South Africa and Namibia catch large quantities of Sardine and Anchovy, which are important prey items for African Penguins (Frost *et al.* 1976). Sardine stocks off South Africa and Namibia collapsed in the 1960s, respectively contracting to the southeast and north as they did so. A consequent reduced availability of prey was probably the main reason for the large decrease in numbers of penguins between Lüderitz and Dassen Island (Crawford *et al.* 1990). The decrease in number of penguins at Possession Island, southern Namibia, from 23 000 pairs in 1956 to fewer than 500 pairs in 1987 was exponential, with decay equivalent to the natural mortality rate of adults. Recruitment to the colony in this period appears to have been minimal (Cordes *et al.* submitted).

At Robben Island between 1989 and 1995, African Penguins fed mainly on Anchovy. The number of chicks fledged per breeding pair was significantly related to estimates of spawner biomass for the South African Anchovy resource (Crawford and Dyer 1995, Crawford *et al.* submitted). Numbers of immature birds immigrating to the colony were also significantly related to Anchovy biomass. The proportion of adults breeding in any year at Robben Island was related to the biomass of the South African stock of Sardine.

Development of a purse-seine fishery in Algoa Bay may decrease availability of prey fish to the large African Penguin population there.

Limited mortality results from entanglement of penguins in fishing nets (Cooper 1974, R.M. Randall, D.C. Nel unpublished). There is potential for this to increase if gill nets are set in proximity to breeding colonies. In South Africa, gill nets are only used in small fisheries for mullets and sharks.

COMPETITION WITH OTHER PREDATORS FOR FOOD: In addition to fishing, greatly expanded herds of Cape Fur Seals (*Arctocephalus pusillus)* have decreased availability of food to African Penguins (Crawford *et al.* 1992b).

HUNTING FOR FOOD OR OTHER PURPOSES: Collection of penguin eggs was primarily responsible for the very large decrease in numbers of African Penguins at Dassen Island between 1910 and 1956. It is estimated that in the first half of the 20th century 48% of eggs produced at Dassen Island were harvested (Shannon and Crawford submitted). The last sanctioned egg collections were in 1967.

There are unconfirmed reports of penguins being killed as use for bait in rock-lobster traps. Apparently they are attractive as bait because their flesh and skin is relatively tough compared to that of fish and other baits. The extent of this practice is unknown. Most reports emanate from the Namibian islands.

HUMAN INTERFERENCE OR DISTURBANCE: Exploitation and disturbance by humans is the probable reason for penguins stopping breeding at four colonies, one of which has since been recolonized (Crawford *et al.* 1995b). At other localities, egg collecting caused large decreases, especially at Dassen Island and in Algoa Bay. Historically, guano collection has been a major cause of disturbance at many colonies. Disturbance may also arise from tourism, mining, management and research actions, and other activities at breeding localities, such as maintenance, angling and swimming.

Disturbance is most damaging during breeding, at times causing panic and desertions of nest sites with losses of eggs and small chicks to Kelp Gulls. Young birds may also be deterred from breeding (Hockey and Hallinan 1981). Where there are burrows, humans moving about may cause burrows to collapse, thereby destroying breeding habitat and sometimes causing mortality.

Modeling has shown that regular searches for oiled birds have potential to severely depress populations if not properly controlled (Shannon and Crawford submitted). At some localities (e.g. Boulders) African Penguins show remarkable tolerance of humans, whereas at others (e.g. Seal in Algoa Bay) they are readily disturbed. Some of the human residents adjoining the colony at Boulders do not show the same tolerance to penguins. They seek a reduction in the number of penguins at the colony.

LOSS OF HABITAT: Competition for breeding space: Competition with Cape Fur Seals for breeding space is the probable reason for cessation of breeding at five former breeding colonies (Crawford *et al.* 1995b). Expanding seal herds have displaced large numbers of penguins at other breeding localities, including Hollams Bird, Mercury and Sinclair Islands (Rand 1952, Shaughnessy 1980, Crawford *et al.* 1989). Displacement of penguins by seals has recently been countered to some extent by a policy of seal-scaring and placement of artificial shelters at breeding colonies (Crawford *et al.* 1994). African Penguins compete with other seabirds for breeding space. At Bird Island in Algoa Bay, they were displaced from a portion of prime breeding habitat by Cape Gannets *Morus capensis* (R.M. Randall unpublished). The projected rise in sea level may further reduce breeding habitat of African Penguins.

MARINE PERTURBATIONS, INCLUDING ENSO AND OTHER SHIFTS: In addition to fishing, environmental change is thought to have influenced alternating regimes of high and low abundance of Sardine and Anchovy worldwide, including the Benguela system (Lluch-Belda *et al.* 1989, 1992). Long-term trends of African Penguin populations in the Benguela system may to some extent be linked to regimes of Sardine and Anchovy. For example, the decreasing numbers of penguins at Dyer Island since the mid 1980s have matched a decreasing trend in the biomass of the South African Anchovy stock (Adams *et al.* submitted). In the same period, the stabilization or increase of colonies between Stony Point and Lambert's Bay has corresponded with an increasing trend in the South African Sardine stock.

These trends are the opposite of trends that followed the collapse of Sardine and rise of Anchovy off South Africa in the 1960s (Crawford *et al.* 1990).

PREDATION:
Sharks: Detailed examination of injuries sustained by penguins at St Croix Island indicated they were inflicted by Great White Sharks (*Carcharadon carcharias)* (Randall *et al.* 1988). At St Croix Island, these injuries were second only to oil pollution as a cause of mortality of penguins (Randall *et al.* 1988, R.M. Randall unpublished). Cooper (1974) attributed injuries observed at Dassen Island to sharks.

Seals: There are many accounts of Cape Fur Seals killing penguins (Cooper 1974, Broni 1984, Rebello 1984). This phenomenon has been recorded at Ichaboe, Halifax, Possession, Malgas, Dassen and Dyer Islands. The phenomenon is thought to be regional and periodic in occurrence. Mortality may be high - at least 25 penguins were killed on one day at Dassen Island (Cooper 1974).

Killer Whales: There are isolated records of Killer Whales (*Orcinus orca)* preying on African Penguins (Rice and Saayman 1987, Williams *et al.* 1990). Their influence is likely to be minor, because they are uncommon in southern African inshore areas (Ross 1989).

Kelp Gulls and Sacred Ibis: Kelp Gulls prey on eggs and chicks (Cooper 1974). Most of their takings constitute scavenging, such as deserted clutches, infertile eggs and dying chicks. They have learnt to capitalize on disturbance, preying on eggs and chicks that are temporarily exposed when parent birds take fright at human activities. The desirability of controlling Kelp Gulls at particular localities needs investigation. Sacred Ibis (*Threskiornis aethiopicus)* also have potential to scavenge eggs and small chicks.

Mole Snakes: At Robben Island, Mole Snakes (*Pseudapsis cana)* eat penguin eggs (Crawford *et al.* 1995c). If this predator attains high levels of abundance, the desirability of control should be researched.

Feral Cats: Feral Cats (*Felis catus)* prey on eggs or chicks of penguins at Dassen and Robben Islands (Berruti 1986, Crawford *et al.* 1995c) and probably also at Bird Island, Lambert's Bay, Boulders and Stony Point. Control programs are underway at Dassen and Robben Islands and are successful in maintaining cat populations at moderately low levels. Ideally cats should be eliminated at these islands.

Other mainland terrestrial predators: Various small predators prey on young stages of penguins at mainland localities and at the two islands (Bird at Lambert's Bay and Marcus) now joined to the mainland. Leopards (*Panthera pardus)* have eaten adult penguins at Stony Point (Crawford *et al.* 1995a). At this locality, predation is thought to have caused a decreasing trend. Some small predators have been trapped and released elsewhere. Black rats (*Rattus rattus)* occur at Marcus Island (R.M. Randall unpublished) and probably other localities linked to the mainland. They are potential predators of eggs.

POLLUTION:

Oil: Oil spills have major impact on African Penguins, especially when the oil washes ashore at breeding localities (Morant *et al.* 1981, Adams 1994, Underhill *et al.* in press). Oil kills penguins by impairing the insulative capacity of their feathers, so that they die of hypothermia in water (Erasmus *et al.* 1981) or of starvation on land because hypothermia makes it impossible for them to feed at sea. Ingested oil may produce a range of physiological abnormalities and is associated with a greater diversity of potentially pathogenic bacteria (Kerley and Erasmus 1987).

Catastrophic oil spills occur irregularly, but there is persistent chronic oiling. Of 689 dead penguins found at St Croix Island over a 10-year period, oil pollution accounted for more deaths (44 %) than any other factor (R.M. Randall unpublished). Cleaning oiled penguins has been undertaken with considerable success, notably by the Southern African National Foundation for the Conservation of Coastal Birds (SANCCOB) - (Underhill *et al.* in press, Nel and Williams submitted). Development of a proposed harbor near to St Croix Island, will place this large colony at increased risk of pollution.

Chemicals: Residues of polychlorinated biphenyls (PCBs) and the organochlorine pesticides DDE and Dieldrin have been found in penguin eggs (Van Dyk *et al.* 1982, De Kock and Randall 1984). In all cases the residue levels were low and unlikely to cause reproductive impairment.

CATASTROPHIC EVENTS:

Fire: At Robben Island and Boulders, the two new colonies where African Penguins breed under wooded vegetation, fire could cause extensive loss of breeding habitat and mortality of birds, eggs and chicks. The risk of fire should be minimized by clearing old wood.

Comments: Classification of the African Penguin as "Vulnerable" according to IUCN Red List Categories (A1a, A2b, E) is straightforward. "Endangered" status is approached, based on a probable decrease of 40 % in the last three generations, and a possible decrease of 40% in the next three generations, extrapolated from the present rate of decrease.

There is little evidence that the annual loss of birds has slowed as the population has decreased (Crawford *et al.* 1995a). If the present loss (40,000 adults in the last 15 years) continues, extinction in the wild will occur within 70 years.

Future trends in the overall population of African Penguins are difficult to predict. The recent decrease has been driven by large losses at Dyer Island and at colonies in the south of Namibia. It could be argued that as these colonies become smaller, further decreases will have less impact on the world population, and may indeed be offset by increases at expanding colonies. Similar reasoning in the early 1980s would have held that increases at then expanding colonies, including Dyer Island, would sooner or later have offset losses elsewhere.

It can be expected that trends at the two large colonies in Algoa Bay (St Croix and Bird Islands), which between them support 42 % of all African Penguins (Crawford *et al.* 1995a), will have a large influence on the future world population. For example, a catastrophic oil spill in Algoa Bay could almost halve the world population. The proposal to create a port and heavy industrial complex near the St Croix group of islands will place the colonies there at high risk.

Trends in Western Cape Province will mainly be influenced by events at Dassen, Dyer and Robben Islands, which support 37% of the World population. The proposal to develop Saldanha as a major port for oil and bulk carriers, with a predicted frequency of major oil spills (equivalent to or larger than the *Apollo Sea* spill) of once in 20 years, threatens the penguin populations within and adjacent to the area.

Mercury and Ichaboe Islands support 78% of the Namibian and 12% of the world populations. Penguins at these localities will be at risk, e.g. from displacement by seals (Crawford *et al.* 1989), if island staff is withdrawn. Additional threats in this region are prospecting for and exploitation of diamonds on or immediately adjacent to breeding localities, oil exploration along the Namib coast, and the present extreme shortage of food for penguins.

The total area available for nesting by African Penguins is less than 1,000 ha (about 16 km^2). There are only 14 colonies with more than 1,000 adults. The establishment of two new breeding localities in the 1980s, and recolonization of a third, must be offset against the loss of one colony off southern Namibia. Breeding may also soon stop at Pomona and Hollams Bird Islands.

RECOMMENDATIONS:

1. Population monitoring

   Trends in populations should continue to be monitored at all extant colonies. At selected localities, demographic parameters should be monitored. Of particular concern is the present paucity of recruitment of young adults to the breeding population at several localities, e.g. Possession Island.

2. Legal protection

   All breeding localities of this vulnerable species should be legislated as nature reserves.

3. Security of food base

   Food is probably the main limiting factor at most colonies west of Cape Agulhas. Means of improving the forage base should be investigated, e.g., ensuring adequate escapement of prey fish from fisheries.

4. Management of oiling

   A reduction in oil contamination should be targeted. Rescue of oiled birds should be supported. A coordinated contingency plan for the rescue of oiled penguins should be devised. A rehabilitation facility in Algoa Bay is necessary given the high proportion of the World population found in that region. The likely impact for the colony at St Croix Island of development of the proposed port nearby needs investigation. The impact on breeding colonies of searches for, and capture of, oiled birds requires research. Procedures to minimize disturbance during rescue operations should be devised. The likelihood of rehabilitated birds returning disease to wild colonies must be minimized. It is necessary to have a data base of hematological values in all captive populations in southern Africa.

5. Management of breeding habitat

   Breeding habitat of African Penguins must be secured, e.g., through continued exclusion of seals, and improved, e.g. through shading and drainage. No guano scraping should be allowed in and around colonies of African Penguins. Risks of fire at Robben Island and Boulders should be minimized.

6. Management of predation
   The impact of seal predation at selected colonies, e.g. Dyer Island, needs fuller investigation through field observations and modeling. There is potential for remedial action through the culling of "problem" seals. Populations of Feral Cats at Bird Island (Lambert's Bay), Dassen Island and Robben Island should be eliminated. The desirability of controlling Kelp Gulls at particular localities needs investigation. Measures must be implemented to preclude introduction of rats to islands.

7. Management of mortality arising from humans
   There should be no exploitation of African Penguins or their eggs. The effect of net fishing in the immediate vicinity of penguin colonies must be investigated, and no netting that causes mortality of penguins leaving or returning to colonies should be allowed.

8. Management of tourism
   Tourism to selected penguin colonies should be carefully implemented, and its effects monitored. Appropriate national tourism strategies need to be developed. Management of the Boulders colony to minimize conflict with man needs attention.

9. Augmentation and establishment of colonies
   Means of establishing new colonies, or of manipulating colonies to expand in a certain direction (to minimize conflict with man), should be investigated. There is a likelihood that studies of behavior of captive populations can help in this. The possibility of returning birds bred in captivity to the wild should be investigated. The purpose of this would be to augment populations at colonies that are presently depressed of decreasing, and to establish techniques for reintroductions before the overall population has decreased to a critical level. This is a complex procedure and will require the assistance of specialist groups outside southern Africa. The technique, if established, will have value for other *Spheniscus* penguins.

10. Management of captive populations
   African Penguins in captivity (except for rehabilitation) should be kept in such a manner as to be individually recognizable, so that accurate information on ancestry can be maintained in stud books. Export of African Penguins from southern Africa should only be allowed from institutions that keep accurate records of stock, including provenance information, when available, and to institutions that keep similar records.

PHVA: Yes.

Captive Program Recommendation: Level 3.
Level of Difficulty: 1.
Existing Captive Population (ISIS): 873 (121 in Japanese collections may be hybridized and their lineages and genetics need to be examined before inclusion in co-operative programs). In recent years South Africa's East London Aquarium (ELA) has sold captive-born juveniles from excess stock to reputable zoos in other countries. The total number of birds traded by

ELA is probably less than 30. In each instance, provincial nature conservation authorities issued the appropriate permits. The Port Elizabeth Oceanarium has sold no birds as yet, but is actively seeking buyers for its excess stock. There seems to be no trade of genuinely wild African Penguins, not even rumors of such activity.

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Appendix III. IUCN Red List Categories

Prepared by the

IUCN Species Survival Commission

As approved by the
40th Meeting of the IUCN Council
Gland, Switzerland

30 November 1994

IUCN RED LIST CATEGORIES

I) Introduction

1. The threatened species categories now used in Red Data Books and Red Lists have been in place, with some modification, for almost 30 years. Since their introduction these categories have become widely recognised internationally, and they are now used in a whole range of publications and listings, produced by IUCN as well as by numerous governmental and non-governmental organisations. The Red Data Book categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them.

2. The need to revise the categories has been recognised for some time. In 1984, the SSC held a symposium, 'The Road to Extinction' (Fitter & Fitter 1987), which examined the issues in some detail, and at which a number of options were considered for the revised system. However, no single proposal resulted. The current phase of development began in 1989 with a request from the SSC Steering Committee to develop a new approach that would provide the conservation community with useful information for action planning.

In this document, proposals for new definitions for Red List categories are presented. The general aim of the new system is to provide an explicit, objective framework for the classification of species according to their extinction risk.

The revision has several specific aims:

- to provide a system that can be applied consistently by different people;
- to improve the objectivity by providing those using the criteria with clear guidance on how to evaluate different factors which affect risk of extinction;
- to provide a system which will facilitate comparisons across widely different taxa;
- to give people using threatened species lists a better understanding of how individual species were classified.

3. The proposals presented in this document result from a continuing process of drafting, consultation and validation. It was clear that the production of a large number of draft proposals led to some confusion, especially as each draft has been used for classifying some set of species for conservation purposes. To clarify matters, and to open the way for modifications as and when they became necessary, a system for version numbering was applied as follows:

Version 1.0: Mace & Lande (1991)
The first paper discussing a new basis for the categories, and presenting numerical criteria especially relevant for large vertebrates.

Version 2.0: Mace *et al.* (1992)

A major revision of Version 1.0, including numerical criteria appropriate to all organisms and introducing the non-threatened categories.

Version 2.1: IUCN (1993)

Following an extensive consultation process within SSC, a number of changes were made to the details of the criteria, and fuller explanation of basic principles was included. A more explicit structure clarified the significance of the non-threatened categories.

Version 2.2: Mace & Stuart (1994)

Following further comments received and additional validation exercises, some minor changes to the criteria were made. In addition, the Susceptible category present in Versions 2.0 and 2.1 was subsumed into the Vulnerable category. A precautionary application of the system was emphasised.

Final Version

This final document, which incorporates changes as a result of comments from IUCN members, was adopted by the IUCN Council in December 1994.

All future taxon lists including categorisations should be based on this version, and not the previous ones.

4. In the rest of this document the proposed system is outlined in several sections. The Preamble presents some basic information about the context and structure of the proposal, and the procedures that are to be followed in applying the definitions to species. This is followed by a section giving definitions of terms used. Finally the definitions are presented, followed by the quantitative criteria used for classification within the threatened categories. It is important for the effective functioning of the new system that all sections are read and understood, and the guidelines followed.

References:

Fitter, R., and M. Fitter, ed. (1987) The Road to Extinction. Gland, Switzerland: IUCN.

IUCN. (1993) Draft IUCN Red List Categories. Gland, Switzerland: IUCN.

Mace, G. M. *et al.* (1992) "The development of new criteria for listing species on the IUCN Red List." Species 19: 16-22.

Mace, G. M., and R. Lande. (1991) "Assessing extinction threats: toward a reevaluation of IUCN threatened species categories." Conserv. Biol. 5.2: 148-157.

Mace, G. M. & S. N. Stuart. (1994) "Draft IUCN Red List Categories, Version 2.2". Species 21-22: 13-24.

II) Preamble

The following points present important information on the use and interpretation of the categories (= Critically Endangered, Endangered, etc.), criteria (= A to E), and sub-criteria (= a,b etc., i,ii etc.):

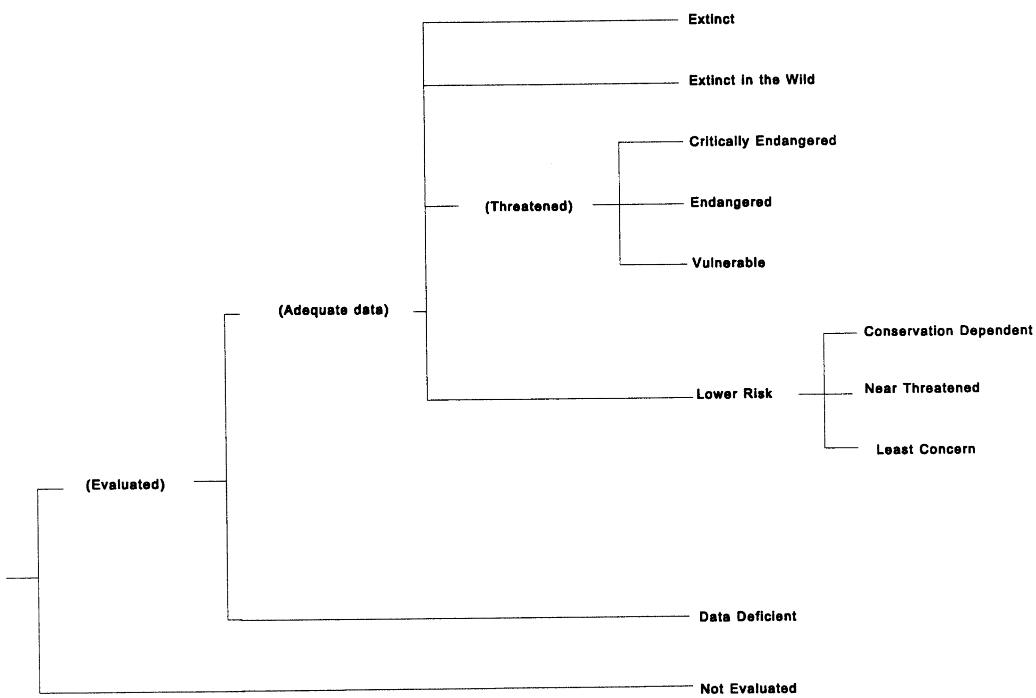
1. **Taxonomic level and scope of the categorisation process**
The criteria can be applied to any taxonomic unit at or below the species level. The term 'taxon' in the following notes, definitions and criteria is used for convenience, and may represent species or lower taxonomic levels, including forms that are not yet formally described. There is a sufficient range among the different criteria to enable the appropriate listing of taxa from the complete taxonomic spectrum, with the exception of micro-organisms. The criteria may also be applied within any specified geographical or political area although in such cases special notice should be taken of point 11 below. In presenting the results of applying the criteria, the taxonomic unit and area under consideration should be made explicit. The categorisation process should only be applied to wild populations inside their natural range, and to populations resulting from benign introductions (defined in the draft IUCN Guidelines for Re-introductions as "..an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area").

2. **Nature of the categories**
All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories (see Figure 1).

3. **Role of the different criteria**
For listing as Critically Endangered, Endangered or Vulnerable there is a range of quantitative criteria; meeting any one of these criteria qualifies a taxon for listing at that level of threat. Each species should be evaluated against all the criteria. The different criteria (A-E) are derived from a wide review aimed at detecting risk factors across the broad range of organisms and the diverse life histories they exhibit. Even though some criteria will be inappropriate for certain taxa(some taxa will never qualify under these however close to extinction they come), there should be criteria appropriate for assessing threat levels for any taxon (other than micro-organisms). The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met. Because it will never be clear which criteria are appropriate for a particular species in advance, each species should be evaluated against all the criteria, and any criterion met should be listed.

4. **Derivation of quantitative criteria**
The quantitative values presented in the various criteria associated with threatened categories were developed through wide consultation and they are set at what are generally judged to be appropriate levels, even if no formal justification for these values exists. The levels for different criteria within categories were set independently but against a common standard. Some broad consistency between them was sought. However, a given taxon should not be expected to meet all criteria (A-E) in a category; meeting any one criterion is sufficient for listing.

Figure 1: Structure of the Categories



5. **Implications of listing**

Listing in the categories of Not Evaluated and Data Deficient indicates that no assessment of extinction risk has been made, though for different reasons. Until such time as an assessment is made, species listed in these categories should not be treated as if they were non-threatened, and it may be appropriate (especially for Data Deficient forms) to give them the same degree of protection as threatened taxa, at least until their status can be evaluated.

Extinction is assumed here to be a chance process. Thus, a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than in a lower one (without effective conservation action). However, the persistence of some taxa in high risk categories does not necessarily mean their initial assessment was inaccurate.

6. **Data quality and the importance of inference and projection**

The criteria are clearly quantitative in nature. However, the absence of high quality data should not deter attempts at applying the criteria, as methods involving estimation, inference and projection are emphasised to be acceptable throughout. Inference and projection may be based on extrapolation of current or potential threats into the future (including their rate of change), or of factors related to population abundance or distribution (including dependence on other taxa), so long as these can reasonably be supported. Suspected or inferred patterns in either the recent past, present or near future can be based on any of a series of related factors, and these factors should be specified.

Taxa at risk from threats posed by future events of low probability but with severe consequences (catastrophes) should be identified by the criteria (e.g. small distributions, few locations). Some threats need to be identified particularly early, and appropriate actions taken, because their effects are irreversible, or nearly so (pathogens, invasive organisms, hybridization).

7. **Uncertainty**
The criteria should be applied on the basis of the available evidence on taxon numbers, trend and distribution, making due allowance for statistical and other uncertainties. Given that data are rarely available for the whole range or population of a taxon, it may often be appropriate to use the information that is available to make intelligent inferences about the overall status of the taxon in question. In cases where a wide variation in estimates is found, it is legitimate to apply the precautionary principle and use the estimate (providing it is credible) that leads to listing in the category of highest risk.

Where data are insufficient to assign a category (including Lower Risk), the category of 'Data Deficient' may be assigned. However, it is important to recognise that this category indicates that data are inadequate to determine the degree of threat faced by a taxon, not necessarily that the taxon is poorly known. In cases where there are evident threats to a taxon through, for example, deterioration of its only known habitat, it is important to attempt threatened listing, even though there may be little direct information on the biological status of the taxon itself. The category 'Data Deficient' is not a threatened category, although it indicates a need to obtain more information on a taxon to determine the appropriate listing.

8. **Conservation actions in the listing process**
The criteria for the threatened categories are to be applied to a taxon whatever the level of conservation action affecting it. In cases where it is only conservation action that prevents the taxon from meeting the threatened criteria, the designation of 'Conservation Dependent' is appropriate. It is important to emphasise here that a taxon require conservation action even if it is not listed as threatened.

9. **Documentation**
All taxon lists including categorisation resulting from these criteria should state the criteria and sub-criteria that were met. No listing can be accepted as valid unless at least one criterion is given. If more than one criterion or sub-criterion was met, then each should be listed. However, failure to mention a criterion should not necessarily imply that it was not met. Therefore, if a re-evaluation indicates that the documented criterion is no longer met, this should not result in automatic down-listing. Instead, the taxon should be re-evaluated with respect to all criteria to indicate its status. The factors responsible for triggering the criteria, especially where inference and projection are used, should at least be logged by the evaluator, even if they cannot be included in published lists.

10. **Threats and priorities**
The category of threat is not necessarily sufficient to determine priorities for conservation action. The category of threat simply provides an assessment of the likelihood of extinction

under current circumstances, whereas a system for assessing priorities for action will include numerous other factors concerning conservation action such as costs, logistics, chances of success, and even perhaps the taxonomic distinctiveness of the subject.

11. **Use at regional level**

The criteria are most appropriately applied to whole taxa at a global scale, rather than to those units defined by regional or national boundaries. Regionally or nationally based threat categories, which are aimed at including taxa that are threatened at regional or national levels (but not necessarily throughout their global ranges), are best used with two key pieces of information: the global status category for the taxon, and the proportion of the global population or range that occurs within the region or nation. However, if applied at regional or national level it must be recognised that a global category of threat may not be the same as a regional or national category for a particular taxon. For example, taxa classified as Vulnerable on the basis of their global declines in numbers or range might be Lower Risk within a particular region where their populations are stable. Conversely, taxa classified as Lower Risk globally might be Critically Endangered within a particular region where numbers are very small or declining, perhaps only because they are at the margins of their global range. IUCN is still in the process of developing guidelines for the use of national red list categories.

12. **Re-evaluation**

Evaluation of taxa against the criteria should be carried out at appropriate intervals. This is especially important for taxa listed under Near Threatened, or Conservation Dependent, and for threatened species whose status is known or suspected to be deteriorating.

13. **Transfer between categories**

There are rules to govern the movement of taxa between categories. These are as follows: (A) A taxon may be moved from a category of higher threat to a category of lower threat if none of the criteria of the higher category has been met for 5 years or more. (B) If the original classification is found to have been erroneous, the taxon may be transferred to the appropriate category or removed from the threatened categories altogether, without delay (but see Section 9). (C) Transfer from categories of lower to higher risk should be made without delay.

14. **Problems of scale**

Classification based on the sizes of geographic ranges or the patterns of habitat occupancy is complicated by problems of spatial scale. The finer the scale at which the distributions or habitats of taxa are mapped, the smaller will be the area that they are found to occupy. Mapping at finer scales reveals more areas in which the taxon is unrecorded. It is impossible to provide any strict but general rules for mapping taxa or habitats; the most appropriate scale will depend on the taxa in question, and the origin and comprehensiveness of the distributional data. However, the thresholds for some criteria (e.g. Critically Endangered) necessitate mapping at a fine scale.

III) Definitions

1. **Population**
Population is defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life-forms, population numbers are expressed as numbers of mature individuals only. In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

2. **Subpopulations**
Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little exchange (typically one successful migrant individual or gamete per year or less).

3. **Mature individuals**
The number of mature individuals is defined as the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity the following points should be borne in mind:

- Where the population is characterised by natural fluctuations the minimum number should be used.

- This measure is intended to count individuals capable of reproduction and should therefore exclude individuals that are environmentally, behaviourally or otherwise reproductively suppressed in the wild.

- In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals which take this into account (e.g. the estimated effective population size).

- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals).

- In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.

4. **Generation**
Generation may be measured as the average age of parents in the population. This is greater than the age at first breeding, except in taxa where individuals breed only once.

5. **Continuing decline**
A continuing decline is a recent, current or projected future decline whose causes are not known or not adequately controlled and so is liable to continue unless remedial measures are taken. Natural fluctuations will not normally count as a continuing decline, but an observed decline should not be considered to be part of a natural fluctuation unless there is evidence for this.

6. **Reduction**

A reduction (criterion A) is a decline in the number of mature individuals of at least the amount (%) stated over the time period (years) specified, although the decline need not still be continuing. A reduction should not be interpreted as part of a natural fluctuation unless there is good evidence for this. Downward trends that are part of natural fluctuations will not normally count as a reduction.

7. **Extreme fluctuations**

Extreme fluctuations occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e., a tenfold increase or decrease).

8. **Severely fragmented**

Severely fragmented is refers to the situation where increased extinction risks to the taxon result from the fact that most individuals within a taxon are found in small and relatively isolated subpopulations. These small subpopulations may go extinct, with a reduced probability of recolonisation.

9. **Extent of occurrence**

Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g., large areas of obviously unsuitable habitat) (but see 'area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

10. **Area of occupancy**

Area of occupancy is defined as the area within its 'extent of occurrence' (see definition) which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon (e.g. colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon. The criteria include values in km^2, and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small (see Figure 2).

11. **Location**

Location defines a geographically or ecologically distinct area in which a single event (e.g. pollution) will soon affect all individuals of the taxon present. A location usually, but not always, contains all or part of a subpopulation of the taxon, and is typically a small proportion of the taxon's total distribution.

12. **Quantitative analysis**

A quantitative analysis is defined here as the technique of population viability analysis (PVA), or any other quantitative form of analysis, which estimates the extinction probability of a taxon or population based on the known life history and specified management or non-management options. In presenting the results of quantitative analyses the structural equations and the data should be explicit.

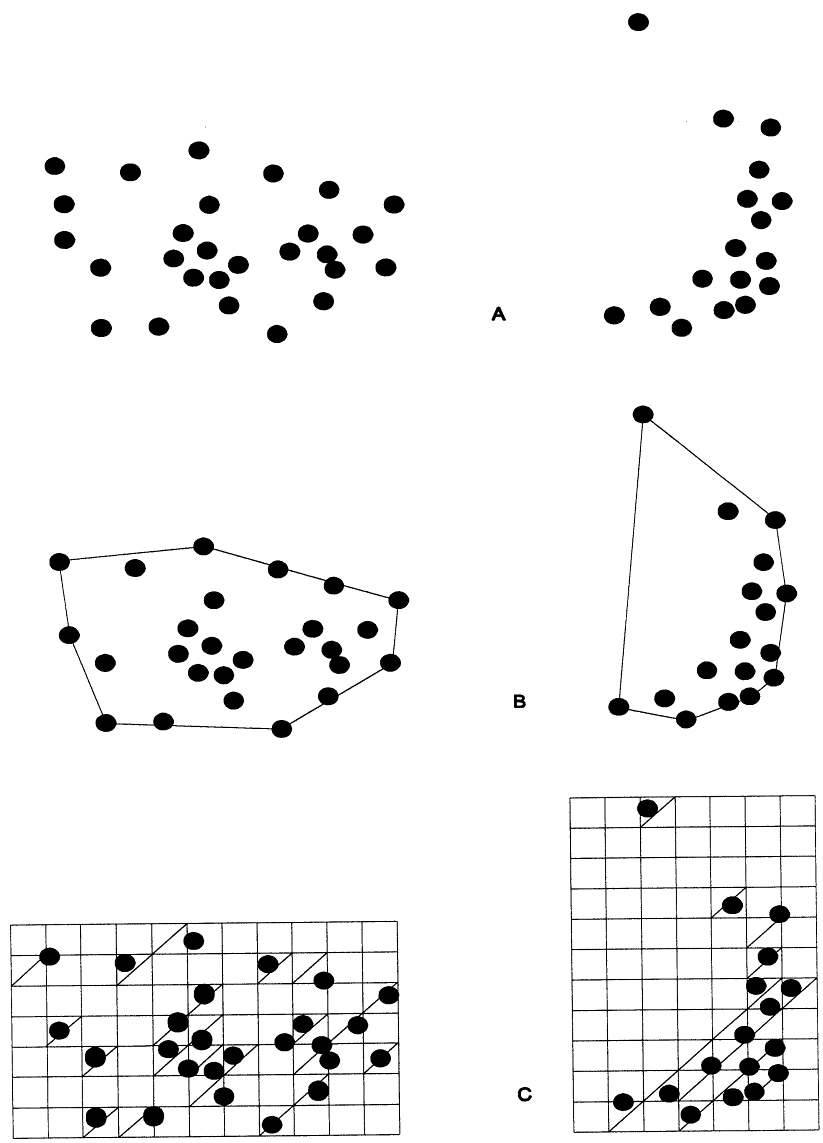


Figure 2:
Two examples of the distinction between extent of occurrence and area of occupancy. (a) is the spatial distribution of known, inferred or projected sites of occurrence. (b) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (c) shows one measure of area of occupancy which can be measured by the sum of the occupied grid squares.

IV) The categories [1]

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) on pages 12 and 13.

ENDANGERED (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) on pages 14 and 15.

VULNERABLE (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to D) on pages 16 and 17.

LOWER RISK (LR)
A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

2. **Near Threatened (nt).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

3. **Least Concern (lc).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

Note: As in previous IUCN categories, the abbreviation of each category (in parenthesis) follows the English denominations when translated into other languages.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

V) The Criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation
b) an index of abundance appropriate for the taxon
c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
d) actual or potential levels of exploitation
e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2 or area of occupancy estimated to be less than 10 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:

a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals.

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals.

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within 3 years or one generation, whichever is longer or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals)
b) all individuals are in a single subpopulation.

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or 3 generations, whichever is the longer.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation
b) an index of abundance appropriate for the taxon
c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
d) actual or potential levels of exploitation
e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 50%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than five locations.

2) Continuing decline, inferred, observed or projected, in any of the following:

a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals.

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals.

C) Population estimated to number less than 2500 mature individuals and either:

1) An estimated continuing decline of at least 20% within 5 years or 2 generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals)
b) all individuals are in a single subpopulation.

D) Population estimated to number less than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or 5 generations, whichever is the longer.

VULNERABLE (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer,, based on (and specifying) any of the following:

   a) direct observation
   b) an index of abundance appropriate for the taxon
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000 km^2 or area of occupancy estimated to be less than 2000 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than ten locations.

2) Continuing decline, inferred, observed or projected, in any of the following:

   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:

   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations
   d) number of mature individuals.

C) Population estimated to number less than 10,000 mature individuals and either:

1) An estimated continuing decline of at least 10% within 10 years or 3 generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
   a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals)
   b) all individuals are in a single subpopulation.

D) Population very small or restricted in the form of either of the following:

1) Population estimated to number less than 1000 mature individuals.

2) Population is characterised by an acute restriction in its area of occupancy (typically less than 100 km^2) or in the number of locations (typically less than 5). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.