The importance of ringing for management of South Africa's seabird populations

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Fifteen species of seabird breed in South Africa. Of these, nine are endemic to South Africa and Namibia at the specific or subspecific level: African Penguin *Spheniscus demersus*, Cape Gannet *Morus capensis*, Cape Cormorant *Phalacrocorax capensis*, Bank Cormorant *P. neglectus*, Crowned Cormorant *P. coronatus*, Kelp Gull *Larus dominicanus vetula*, Hartlaub's Gull *L. hartlaubii*, Swift Tern *Sterna bergii bergii* and Damara Tern *S. balaenarum*.

The populations of two others, Leach's Storm Petrel *Oceanodroma leucorhoa* (Whittington *et al.* 1999) and Roseate Tern *S. dougallii* (Randall *et al.* 1988), are small, restricted to South Africa and seemingly separated from breeding populations elsewhere. Four species, White Pelican *Pelecanus onocrotalus*, Whitebreasted Cormorant *P. carbo*, Greyheaded Gull *L. cirrocephalus* and Caspian Tern *Hydroprogne caspia*, breed and feed at inland water sites in southern Africa as well as around the coast. However, at least some of these populations appear relatively isolated from populations north of southern Africa (Underhill *et al.* 1999b).

The endemic and isolated nature of southern Africa's seabird populations means that the region is responsible for their conservation. In South Africa nine of the 15 species are classified as Threatened or Near-threatened, using criteria of the World Conservation Union (Barnes 2000). This makes seabirds one of the groups of marine animals of greatest conservation concern in South Africa.

Whereas the conservation status of seabirds deteriorated rapidly in southern Africa in the 20th century, especially in the latter part of the century, their value for tourism has expanded remarkably in recent years. In 1999, for example, 359 035 people visited Boulders on the Cape Peninsula to view the penguins (South African National Parks unpubl. records). Seabirds have again become a resource with potential for economic development.

In South Africa, indices derived from seabirds have been shown to be reliable indicators of the status of some fish populations on which they feed (Crawford & Dyer 1995; Crawford 1999). It is thought that summary indices of the extent to which objectives for marine ecosystem management are attained could be developed from seabirds (Underhill & Crawford 1999). For example, South Africa's *Marine Living Resources Act* of 1998, has as objectives optimum utilisation and ecologically sustainable development of marine living resources, conservation of marine living resources, protection of the marine ecosystem, preservation of biodiversity and minimisation of pollution. Seabirds are themselves of conservation concern. Being near the top of the trophic chain, they reflect the state of resources on which they prey, i.e. the health of the ecosystem beneath them. They are susceptible to marine pollution and reliably indicate its extent.

Therefore, the main objectives of research in South Africa conducted on seabirds by Marine and Coastal Management are:

- to evaluate the conservation status of populations and, where this is unsatisfactory, to advise on measures to improve it;
- to advise how colonies may be developed for tourism in a sustainable manner;
- to develop indices of the health of prey resources and marine ecosystems that are based on measurements of seabird parameters.

Ringing is essential or useful for each of these objectives, as we discuss below.

CONSERVATION OF SOUTH AFRICA'S SEABIRDS

Definition of a population

Effective management of any population requires a definition of that population. Seabirds breed at a number of localities around the southern African coast, but it is important to understand the degree of interchange, if any, between colonies. To some extent it is possible to infer this from changes in the sizes of colonies (e.g. Shelton *et al.* 1984). For example, the formation of new colonies, such as those of African Penguins at Stony Point, Robben Island and Boulders from 1982–1985, necessitates immigration of birds to those colonies. Similarly, intermittent occupation of islands by species such as Swift Tern indicates movement between breeding localities (Crawford *et al.* 1994). However, the degree of interchange between colonies and the range of populations can best be gauged by noting movements of marked individuals. As immigration to or emigration from colonies can operate in one direction over a time scale of one to several decades (Crawford 1998), it is necessary to undertake ringing over prolonged periods. Already ringing has shown substantial movement of most seabirds around southern Africa (Underhill *et al.* 1999b), but for some species (e.g. Cape Cormorant) there is a need to investigate further the extent to which breeders move between breeding localities.

Classification of the conservation status of a population

The conservation status of South Africa's seabirds is based on criteria adopted by the IUCN, which use the extent of a species' range, the number of mature individuals in the population, and the rate of decrease of the population (IUCN 1996).

Estimates of population sizes of seabirds are often calculated by establishing the number of breeding pairs, and then using estimates of the proportion breeding and survival to calculate the number of individuals (Crawford *et al.* 1991). Both survival and proportion breeding are best obtained from marked individuals.

The populations of several of South Africa's seabirds have undergone massive decreases. IUCN criteria measure these as rates per year or per generation. The period of a generation is taken to be the average life expectancy of breeders. This is the sum of the mean age at first breeding and the average life expectancy once breeding. Estimating both these parameters necessitates ringing.

Identifying life stages of conservation concern

If the conservation status of a species is unsatisfactory, it is useful to identify those stages in the life cycle of the species that are the cause of this. For example, decreases in a breeding population may result from inadequate recruitment to the breeding population, from excessive mortality of breeders, or from both these factors.

Understanding which parameter is responsible for the decrease of a colony is of considerable help in establishing the cause of the decrease. For example, if adult mortality is too high, one may wish to investigate factors such as disease (e.g. Cape Cormorants at Dassen Island – Crawford *et al.* 1992), oiling (e.g. African Penguins at Robben Island – Crawford *et al.* 1999), predation (e.g. African Penguins at Betty's Bay – Whittington *et al.* 1996), etc. On the other hand, if it can be established that recruitment to the colony is inadequate (e.g. African Penguins at Possession Island – Cordes *et al.* 1999), it is likely that either breeding success (e.g. African Penguins at Robben Island – Crawford *et al.* 1999) or immature survival is too low or that young birds are emigrating to other colonies (e.g. African Penguins at Dyer Island – Crawford 1998, 1999). Factors causing this may include disturbance of breeders and an inadequate supply of food.

Modelling seabird populations

Identifying the stage(s) in the life cycle of a particular species where its conservation status is poor, and where remedial action will prove beneficial, will usually require the development of a population model that will enable the effect of changes in parameters to be examined (e.g. Crawford *et al.* 1999). For managers to rely on their intuition in this regard can prove misleading. Development of a population model requires estimating the parameters to be used in the model, including breeding success, immature and adult survival, age at first breeding and breeding frequency. The latter four all require the marking of individuals, and estimation of breeding success is also often facilitated by ringing.

Advising on appropriate remedial action

Once the cause of the decrease of a population has been established, remedial measures to counter it need to be implemented. This sometimes requires further analysis. For example, if a scarcity of food is shown to be the cause of inadequate breeding success, it is necessary to know to what extent the availability of food must be increased to offset the population decrease. This may involve establishing relationships between seabird performance (e.g. breeding success) and prey abundance that can be used to define an acceptable level of escapement of prey from fishers. Again estimation of seabird parameters will usually involve ringing.

Establishing the efficacy of remedial measures

After remedial measures have been introduced, it is necessary to monitor their efficacy. For example, the conservation value of cleaning oiled seabirds has been questioned (Sharp 1996), but this action has been shown to have great benefit for colonies of African Penguins (Underhill *et al.* 1999a). Marking individual birds and compiling the resighting data is used to prove that cleaning oiled penguins is effective, thus showing that conservation management is producing the required outcome and that limited financial resources have been used wisely.

DEVELOPMENT OF TOURISM TO SOUTH AFRICA'S SEABIRDS

It is necessary to ensure that tourism at seabird colonies will be sustainable in the long term. The impact of tourists on colonies can be investigated by measuring and comparing the success of breeders near to and distant from tourist routes, and examining movements of individuals into and away from tourist and remote areas. Levels of impact that will cause long-term decreases in colonies can be established through population models (Shannon & Crawford 1998). Monitoring can be implemented to ensure that impacts do not attain these levels or, if they do, that the tourism operation is scaled down to the extent that the impact reduces to an acceptable level. Again population parameters are needed to construct the models. Both their derivation and monitoring the performance of individual birds, to assess the impact of tourism, require ringing.

DEVELOPMENT OF INDICES OF RESOURCE AND ECOSYSTEM HEALTH

Seabird diet has been shown to be a reliable index of the abundance of some forage fish off South Africa (Crawford & Dyer 1995, Crawford 1999). Ringing is not necessary for this. However, in developing an index of marine ecosystem health, it is anticipated that ringing will be required.

Establishing desirable levels of populations

Species may range between low and high levels of abundance. At the former they become of conservation concern. At the latter they may assume the status of pests, where they adversely interact with species of conservation concern and with fishing operations. It is

desirable to hold populations at intermediate levels of abundance (Underhill & Crawford 1999). A means of establishing minimum viable populations (MVPs) is to undertake Monte Carlo simulations of populations that will establish the probability of extinction over a specified time frame for different starting populations (Shannon & Crawford 1999). This requires knowledge of population parameters and variability about them, and hence the marking of individuals. The minimum desirable population will be some multiple of MVP. Other approaches, e.g. ecosystem models, may be used to define maximum desirable populations.

Measurement of performance

Once parameters that will contribute to a summary index of ecosystem health have been selected, it will be necessary to measure their performance. This may be just the size of the breeding population, or numbers of birds oiled. However, if the index is to have some future outlook, it is likely that parameters such as survival or reproductive success will also be incorporated. In this event the marking of individuals would once again be a requisite.

CONCLUSIONS

To conclude, it is quite clear that ringing studies are essential for the effective conservation and management of southern Africa's seabirds, and are likely to be used in development of indices of ecosystem health. Although progress has been made towards establishing population parameters, which are required for modelling populations, much still needs to be done, and further objective-driven ringing is needed.

Many of southern Africa's seabirds are long lived (Underhill *et al.* 1999b). Therefore, it can be expected that their population dynamics will be better understood as time-series of information lengthen. It is anticipated that ringing will continue to be an important aspect of management-oriented research on seabirds for many years yet.

REFERENCES

Barnes, K.N. (Ed.). 2000. The Eskom Red Data Book of birds for South Africa, Lesotho and Swaziland. Johannesburg: BirdLife South Africa.

Best, P.B., Crawford, R.J.M. & Van der Elst, R.P. 1997. Top predators in southern Africa's marine ecosystems. Trans. Roy. Soc. S. Afr. 52(1): 177–225.

Cordes, I., Crawford, R.J.M., Williams, A.J. & Dyer, B.M. 1999. Decrease of African Penguins at the Possession Island group, 1956–1995 – contrasting trends for colonial and solitary breeders. Mar. Orn. 27: 129–138.

Crawford, R.J.M. 1998. Responses of African Penguins to regime changes of sardine and anchovy in the Benguela system. S. Afr. J. mar. Sci. 19: 355–364.

Crawford, R.J.M. 1999. Seabird responses to long-term changes of prey resources off southern Africa. In: Adams, N.J. & Slotow, R.H. (Eds). Proceedings of 22nd International Ornithological Congress, Durban, 1998. Johannesburg: BirdLife South Africa. pp. 688–705.

Crawford, R.J.M. & Dyer, B.M. 1995. Responses by four seabirds to a fluctuating availability of Cape Anchovy *Engraulis capensis* off South Africa. Ibis 137: 329–339.

Crawford, R.J.M., Ryan, P.G. & Williams, A.J. 1991. Seabird consumption and production in the Benguela and western Agulhas ecosystems. S. Afr. J. mar. Sci. 11: 357–375.

Crawford, R.J.M., Allwright, D.M. & Heyl, C.W. 1992. High mortality of Cape Cormorants (*Phalacrocorax capensis*) off western South Africa in 1991 caused by *Pasteurella multocida*. Col. Waterbirds 15(2): 236–238.

Crawford, R.J.M., Dyer, B.M. & Brooke, R.K. 1994. Breeding nomadism in southern African seabirds – constraints, causes and conservation. Ostrich 65(2): 231–246.

Crawford, R.J.M., Shannon, L.J. & Whittington, P.A. 1999. Population dynamics of the African Penguin at Robben Island.

Mar. Orn. 27: 135–143.

IUCN. 1996. 1996 IUCN list of threatened animals. Gland, Switzerland: IUCN.

Randall, R.M., Randall, B.M. & Ralfe, M. 1988. Roseate terns in South Africa: population size, revision of previous estimate and conservation. Bontebok 7: 1–6.

Shannon, L.J. & Crawford, R.J.M. 1998. The impact of disturbance by tourists to the Jackass Penguin colony at Robben Island. Ostrich 69: 212.

Shannon, L.J. & Crawford, R.J.M. 1999. Management of the African Penguin *Spheniscus demersus* – insights from modelling. Mar. Orn. 27: 119–128.

Sharp, B.E. 1996. Post-release survival of oiled, cleaned seabirds in North America. Ibis 138: 222–228.

Shelton, P.A., Crawford, R.J.M., Cooper, J. & Brooke, R.K. 1984. Distribution, population size and conservation of the Jackass Penguin *Spheniscus demersus*. S. Afr. J. mar. Sci. 2: 217–257.

Underhill, L.G. & Crawford, R.J.M. 1999. An index of health of the southern Benguela system from monitoring seabirds. In: 10th Southern African Marine Science Symposium: Land, Sea and People in the New Millennium. Port Elizabeth: SANCCOR. p. 143.

Underhill, L.G., Bartlett, P.A., Baumann, L., Crawford, R.J.M., Dyer, B.M., Gildenhuys, A., Nel, D.C., Oatley, T.B., Thornton, M., Upfold, L., Williams, A.J., Whittington, P.A. & Wolfaardt, A.C. 1999a. Mortality and survival of African Penguins *Spheniscus demersus* involved in the *Apollo Sea* oil spill: an evaluation of rehabilitation efforts. Ibis 141: 29–37.

Underhill, L.G., Tree, A.J., Oschadleus, H.D. & Parker, V. 1999b. Review of ring recoveries of waterbirds in southern Africa. Cape Town: Avian Demography Unit. 119 pp.

Whittington, P.A., Hofmeyr, J.H. & Cooper, J. 1996. Establishment, growth and conservation of a mainland colony of Jackass Penguins *Spheniscus demersus* at Stony Point, Betty's Bay, South Africa. Ostrich 67: 144–150.

Whittington, P.A., Dyer, B.M., Crawford, R.J.M. & Williams, A.J. 1999. First recorded breeding of Leach's Storm Petrel *Oceanodroma leucorhoa* in the Southern Hemisphere, at Dyer Island, South Africa. Ibis 141: 327–330.

Terns

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This is a brief introduction to the tern group outlining the number of species breeding (6) and the number of regular non-breeders (8) in southern Africa. Terns are a neglected group for which much data on occurrence around both coastlines and inland still needs to be collected. Terns are difficult birds to catch for ringing purposes as nocturnal roosts are hard to find, but once found terns are easy to mistnet. The large numbers of recoveries for a few species (Common, Arctic and Sandwich) indicate only that these populations are heavily ringed in Europe. Ringing in southern Africa can help fill in the knowledge gaps about the breeding grounds and the staging posts along the migration routes. Of southern African species only the Swift Tern has been ringed in large numbers.

A series of colour slides was shown of birds handled in southern Africa and in Aus-