

SPECIAL SECTION

COLONIAL WATERBIRD MOVEMENTS AND POPULATION DYNAMICS: GUIDES FOR THE TEMPORAL AND SPATIAL SCALES OF CONSERVATION

MALCOLM C. COULTER AND PETER C. FREDERICK, CONTRIBUTING EDITORS

Movements and Population Dynamics of Colonial Waterbirds as Guides for the Temporal and Spatial Scales of Conservation

MALCOLM C. COULTER¹ AND PETER C. FREDERICK²

¹Specialist Group on Storks, Ibises and Spoonbills, P.O. Box 48, Chocorua, NH 03817 USA

²Department of Wildlife Ecology and Conservation, P.O. Box 110430, University of Florida,
Gainesville, FL 32611-0430 USA

Colonial Waterbirds 20(2): 295-297, 1997

Avian studies have traditionally been conducted on small spatial scales (territories, but rarely ranges), and over short time periods (2-5 yr). These have served to provide necessary natural history information, and in many cases to elucidate the nature of short-term interactions with resources, habitats, and in rare cases, animal communities. However, this kind of study has not allowed an understanding of longer-term interactions with environmental variables that may be slow to change (predation, weather, disease), or that are rare disturbance events (storms, hurricanes, floods, fires).

Spawned in part by new insights arising from long-term and synthetic studies of populations (Clutton-Brock 1988, Newton 1989), the importance of longer time and spatial scales of study has become a critical issue in the interpretation of research, and the direction and scale of conservation actions (Soulé and Kohm 1989, Wiens *et al.* 1986, Edwards *et al.* 1993). As a tangible result, scientists are realizing that the ability to predict movements and demographic change of animal populations over the long term cannot be obtained by simply projecting the results of short-term studies, or those performed over a small geographic area (Robinson *et al.* 1995).

How do we determine the most appropriate scale for study or conservation? While longer and larger is frequently perceived as better, May (1993) has shown that analyses at very large scales can in some cases serve only to obscure the importance of local patterns. Although it is clear that the question must be matched with answers obtained at an "appropriate" scale, we are still at the stage of defining good matches on a case by case basis. We must also begin to ask what life history strategies, adaptations, or ecological characteristics of birds are likely to demand studies of long duration and large area. At the very early developmental stage of this field, these questions can only be answered through the use of examples.

The importance of choosing the appropriate scale of study or action is made especially dramatic in the case of designing conservation strategies. Though the choice of time and spatial scales of conservation action might be obvious in the case of a highly endemic species that rarely lives more than 2 years, it is not as easy for species that have the ability to range widely, that are long-lived, and that depend on shifting resources. Colonial waterbirds of many types fit this profile, yet conservation of these species remains dominated by information from short-term

studies and small scale studies. Since these long-lived birds also display a variety of life history and movement strategies that are unique to an aquatic existence, the conservation needs of these birds may not be well served by the paradigms resulting from long-term studies of terrestrial birds. There is a need, then, to explore the domains of time and space in which waterbirds should be studied and conserved.

In an attempt to find concrete examples that address these questions, we organized a symposium of studies of colonial waterbirds that had been conducted over large spatial extent and long time periods, held at the fall 1996 meeting of the Colonial Waterbird Society. The papers that follow result from that symposium.

By design, the papers are diverse, and are intended as summaries of bodies of work rather than as primary research articles. They represent examples from very different kinds of birds (flamingos, estuarine and oceanic seabirds, aquatic raptors and long-legged wading birds), each with very different life history constraints and habitat requirements. Each have been studied long enough and/or over a large enough geographic area to allow evaluation of the appropriate scale for study and conservation action.

The papers illustrate a number of points that may be applicable to other waterbirds. First, only very long-term studies may be capable of elucidating the importance of rare events. In the papers on both flamingos (Johnson) and herons (Hafner and Fasola) in the Camargue of France, a minimum of 25 yr of continuous observation are shown to be necessary to observe the powerful and persistent effect of rare winter storm events on demography.

Second, several of the papers offer demonstrations of how choice of time or spatial scale of inquiry can be matched to the question. Begg *et al.* offer statistical methods to determine the best spatial scale for evaluating the effects of oil spills on populations of seabirds. The paper by Sadoul examines change in nesting populations of charadriiform birds in the Camargue of France at 3

different spatial scales, and evaluates how information collected at each scale can be used to detect, and infer mechanisms of, population change. Finally, Friesen shows how studies of genetics in seabird populations have radically different interpretations depending on choice of time period and spatial extent.

Third, life history strategy may be related to the scale of conservation strategies. This is true of Snail Kites (*Rostrhamus sociabilis*), whose extreme sensitivity to drought has resulted in a highly nomadic habit. Both long term and large spatial scale studies have been necessary to demonstrate the extent of movements, and to identify a realistic dispersion of sustaining habitat patches for this bird (Bennetts and Kitchens). Similarly, long-term comparative study of wading birds shows that differences in philopatry between a nomad (White Ibis, *Eudocimus albus*) and a semi-nomadic species (Wood Stork, *Mycteria americana*) living in roughly the same mosaic of wetlands, dictates 2 very different conservation strategies (Frederick and Ogden).

The implications of these studies for the study and conservation of other colonial waterbirds are extensive. It seems clear that the scale of study is important for predicting population change, and for identifying factors that lead to demographically important change. Since many researchers are engaged in the detection of population trends, this conclusion should have widespread impact. These papers also demonstrate that long-term and large spatial scale studies are the only kind that are capable of revealing the appropriate scale of inquiry. The converse is, of course, that the correct choice of spatial scale of analysis will be hidden from researchers and conservationists working over shorter time periods and smaller areas. The fact that several decades may be necessary for work with long-lived birds is sobering indeed.

These papers give substance to the idea that scale of inquiry and analysis is critical to the interpretation of results, the identification of ecological relationships, and consequently, the choice of conservation strategy. They also provide some of the first informa-

LITERATURE CITED

tion on what spatial and temporal scales are appropriate for studying waterbirds. We hope that the concepts and examples embodied in this group of papers may serve to guide future efforts in each of these areas.

ACKNOWLEDGMENTS

We are very grateful to John C. Ogden worked with us in developing the symposium. We are also grateful to each of the authors for accepting our invitation to participate in this symposium and for the considerable time and effort that they made in producing their contributions. We are also thankful to the many reviewers who contributed their thoughtful comments. We thank I. C. T. Nisbett and the local CWS meeting committee (The Charleston Museum and the Savannah River Ecology Laboratory) for coordinating this symposium at the 1996 meeting in Charleston. Finally, we thank our respective organizations—SIS for MCC; University of Florida, Gainesville for PCF. This is Journal Series Number R-05831, Florida Agricultural Experiment Station.

- Clutton-Brock, T. H. 1988. Reproductive success. Chicago University Press, Chicago.
- Edwards, P. J., R. M. May and N. R. Webb (Eds.). 1993. Large-Scale ecology and conservation biology. Blackwell Scientific Publications, London.
- May, R. M. 1993. The effects of spatial scale on ecological questions and answers. Pages 1-17 in Large-scale ecology and conservation biology (P. J. Edwards, R. M. May and N. R. Webb, Eds.). Blackwell Scientific Publications, London.
- Newton, I. (Ed.). 1989. Lifetime reproduction in birds. Academic Press, New York.
- Robinson, S. K., T. M. Donovan, D. P. Whitehead and J. Faaborg. 1995. Regional effects of forest fragmentation on the nesting success of migratory birds. *Science* 267: 1987-1990.
- Soulé, M. E. and K. A. Kohm. 1989. Research priorities for conservation biology. Island Press, Washington, DC.
- Wiens, J. A., J. F. Addicott, T. J. Case and J. Diamond. 1986. Overview: the importance of spatial and temporal scale in ecological investigations. Pages 145-153 in Community ecology (J. Diamond and T. J. Case, Eds.).

l evaluates how in-
ach scale can be
r mechanisms of,
lly, Friesen shows
n seabird popula-
nt interpretations
ne period and spa-

egy may be related
1 strategies. This is
trhamus sociabilis),
to drought has re-
c habit. Both long
cale studies have
trate the extent of
y a realistic disper-
t patches for this
chens). Similarly,
dy of wading birds
hilopatry between
vicinus albus) and a
ood Stork, *Mycteria*
ly the same mosaic
y different conser-
k and Ogden).

ese studies for the
of other colonial
It seems clear that
tant for predicting
or identifying fac-
phically important
chers are engaged
lation trends, this
idespread impact.
nstrate that long-
ale studies are the
e of revealing the
ry. The converse is,
t choice of spatial
hidden from re-
nists working over
smaller areas. The
may be necessary
irds is sobering in-

stance to the idea
nalysis is critical to
ults, the identifica-
aships, and conse-
servation strategy.
f the first informa-