MEMOIRS OFTHE NUTTALL ORNITHOLOGICAL CLUB,
NO. 15

William E. Davis, Jr. and Jerome A. Jackson, Memoir Series Editors

BIRD BANDING IN NORTH AMERICA: THE FIRST HUNDRED YEARS

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CAMBRIDGE, MASSACHUSETTS
Published by the Club
2008

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Contributions of Bird Banding to International Waterbird Conservation

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Abstract.—Achieving effective bird conservation requires integration and cooperation across geographic scales, cultural experiences, and shared avian ecologies. Banding and color marking of migratory birds have greatly enhanced their conservation at the international level by expanding geographic scale and stakeholder participation in conservation efforts. Over the last century, bird banding and color marking have continually contributed to our knowledge of migration routes, breeding locations, and winter destinations of North America's migratory birds. Development of collaborative networks has allowed researchers to answer broad-scale questions about how birds function within their environments. With this knowledge came a greater appreciation not only of the birds' annual cycles but also a greater understanding of the critical need to consider bird conservation in a more holistic way—one that includes the full range of human experiences that affect birds and their habitats. Bird banding and color marking have set a strong foundation to pose questions that modern techniques, such as satellite tracking, genetics, and stable isotopes, may help answer. Banding certainly has a future in monitoring the response of migratory birds to our conservation and management actions.

Every continent is visited by migrant birds that breed in North America and migrant birds from every continent visit North America. Achieving effective conservation and management of such wide-ranging organisms is necessarily complex and challenging and can only be effective if efforts are coordinated and integrated across geographic scales, cultural experiences, and shared avian ecologies (Andrew and Andres 2002). Over the last century, banding and color marking of migratory birds have provided a biological foundation that has helped define the geographic scale of migratory bird conservation issues and catalyzed the formation of international networks of bird conservationists. European banders (ringers), in cooperation with their African and Asian

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colleagues, used their collective bird-banding information as a basis to devise bio-political networks for the conservation of migratory birds (Davidson et al. 1999). In North America, early twentieth-century efforts directed toward game-bird management have evolved into the general acknowledgment of the need for a flyway perspective to manage and conserve all migratory bird species (Schmidt et al. 1999, Harrington et al. 2002). In this paper I use waterbird examples to illustrate how bird banding has contributed to international conservation efforts for migratory birds.

GEOGRAPHIC SCALE

Only scant information on the recovery of banded waterfowl was available when Great Britain (for Canada) signed the migratory bird convention with the U.S. in 1916. Shortly after the convention was signed, the two countries agreed to develop a single, bilateral bird-banding system (Crissey 1984)—an arrangement that has persisted for almost 90 years. The accumulation of banding data over the next two decades allowed Lincoln (1935) to delineate waterfowl migration flyways. Additional information on migratory bird movements catalyzed a bilateral migratory bird treaty with Mexico in 1936 and led to the first trilateral North American Wildlife Conference on migratory wildlife (Special Committee on Conservation of Natural Resources 1936). Although the term "flyway" is often used to portray an overly simplistic view of bird migration, the basic concept of a source breeding population moving across latitudes (or longitudes) to wintering destinations remains a useful principle for migratory bird management and conservation. Indeed, realization of the need to manage populations at a flyway scale persists in the current approach to waterfowl-harvest management. Likewise, initial waterfowl banding efforts have now transformed into a coordinated, statistically-rigorous program that provides information that is incorporated into the hunting regulation-setting process (e.g., Johnson et al. 2002).

Along with metal leg-bands, other marking methods (e.g., neck bands, wing streamers, leg flags) have been used to study movements of migratory birds and to establish links among breeding, stopover, and wintering locations. Neck bands allow relatively easy re-sighting of known individuals and have provided much information on migration

patterns of geese and swans in North America. Connections between contiguous U.S. wintering areas of Tundra Swans (*Cygnus columbianus*) and breeding sites in Alaska and Canada were discovered by using neck-banded individuals (Sladen 1973). Observations of neck-banded individuals also portrayed differences in fall and spring migration patterns in small subspecies of Canada and Cackling geese (*Branta canadensis*, *B. hutchinsii*; Hines et al. 2000). Migration chronology data gained from these studies are used to establish hunting seasons that minimize the harvest of northerly migrant populations (U.S. Fish and Wildlife Service 1995), although recent information suggests that reporting rates for neck-banded birds are higher than those for other band types (Sheaffer et al. 2004). Neck banding has been used to link Alaska breeding sites of Greater White-fronted Geese (*Anser albifrons*) to an important stopover in northwestern Texas and to wintering sites in the highlands of north-central Mexico (Anderson and Haukos 2003). Beyond establishment of migration corridors, uniquely marked individuals are valuable to investigations of a variety of ecological and behavioral questions.

The capturing and color banding of shorebirds (waders) have contributed greatly to the understanding of their range-wide distribution and to the identification of specific geographic linkages of populations across the globe (Fox 2003). In the Pacific Basin, observations of color-flagged individuals have illustrated the elliptical migration route of Bar-tailed Godwits (*Limosa lapponica*) from western Alaska to New Zealand and northward through the Yellow Sea (Gill et al. 2005). With knowledge of the migration pathway, biologists realized that godwits are subjected to a subsistence harvest, either underway or planned, at all points of their annual cycle (B. McCaffery, U.S. Fish and Wildlife Service, pers. comm.). Thus, a management strategy for Alaska-breeding godwits clearly needs to consider effects of harvest throughout their range. Also in the Pacific Basin, observations of color-marked Bristle-thighed Curlews (*Numenius tahitiensis*) were used as a basis for developing more detailed genetic studies that addressed linkage of segregated breeding populations to specific wintering locations (L. Tibbitts, U.S. Geological Survey, pers. comm.). Knowledge of population linkage is needed to development of management strategies that can address spatially explicit threats of subsistence hunting, habitat alteration, and invasive species predation (Sherley 2001). Beyond shorebirds, recoveries of American White Pelicans (*Pelecanus erythrorhynchos*) taken by

hunters in the Alvarado Wetlands of Veracruz, Mexico, indicate that pelicans wintering there originate from virtually all breeding sites in the U.S. and Canada (B. Andres, unpubl. data). Thus, any conservation strategy for American White Pelicans breeding in North America should consider the exposure to threats in the Alvarado Wetlands (Andres and Cruz-Carretero 2003).

Handling shorebirds during the capturing and banding process allows biologists to obtain morphometric data that are also useful in distinguishing population origins of birds captured at a specific site. In addition to being used for study of age and sex composition of populations, measurements of captured birds can be used to investigate functional relationships between birds and their environments. In Delaware Bay, for example, measurements of weight gain in stopover shorebirds have been used to assess the ability of the bay to provide adequate energetic requirements, via horseshoe crab (*Limulus polyphemus*) eggs (U.S. Fish and Wildlife Service 2003). Range-wide re-sightings of Red Knots (*Calidris canutus*) color-flagged during the banding process, usually applied as a batch mark, have been used to estimate adult survival and to relate it to body condition of knots in Delaware Bay (Baker et al. 2004). The technological development of individually coded color-flags will likely improve estimation of survival rates, over use of batch marks, of Red Knots that migrate through Delaware Bay (Atkinson et al. 2003). Using banded individuals, Pfister et al. (1998) suggested that the chance of Semipalmated Sandpipers (*Calidris pusilla*) surviving the over-water flight from Massachusetts to the coast of Suriname, and hence returning to the stopover the next year, was related to their fat levels at departure. Because maintenance of high quality stopovers has direct survival consequences, assessment of site health at all stopovers along a migration corridor would represent a true flyway approach to migratory shorebird conservation.

CULTURAL EXPERIENCES

The biological connectivity established through banding programs is often the foundation for developing international networks of people who are interested in the conservation of shared migratory birds. The hands-on result of banding birds offers a unique opportunity to bring together conservation stakeholders from a variety of societal perspec-

tives—not only biologists, but also policy-makers, educators, landowners, and industry representatives. Besides the melding of perspectives at a given site, cultural values and experiences need to be integrated across geographic scales to achieve effective flyway conservation. Beyond the biological information that international banding teams supply, they can also expand the outlook of participants and broaden the context of a local banding effort. For example, the cooperative color flagging of a small number of Dunlin (*Calidris alpina*) on Alaska's North Slope may be statistically insignificant to estimate survival, yet the outreach generated from the bilateral effort has significant, beneficial conservation implications in Japan (Andres et al. 2001). Cooperative, multilateral conservation networks leverage not only financial and biological resources, but also societal importance. Societal commitment for migratory bird conservation manifests itself in the development and implementation of multilateral flyway treaties and conventions (Boere and Rubec 2002).

Banding has played a central role in the development of a collaborative approach for investigating questions about the migration system of the Western Sandpiper (*Calidris mauri*). Cooperation across the entire migration and wintering range of the sandpiper has allowed researchers to address questions at a hemispheric scale (Nebel et al. 2002). Organized networks can provide training and capacity-building opportunities at numerous levels. University researchers involved in the network have supported and advised Latin American and Mexican students who, after completing their graduate work, have gone on to develop their own scientific training programs. Research projects undertaken by network participants also educate younger students about shorebird migration biology (e.g., Warnock 2003). Designed to connect students across flyways, the Shorebird Sister Schools Program has repeatedly used banded birds to pique biological interest and as a focus for shorebird and habitat conservation messages (Chapman and Andres 2003). A central tenet of the program is to link students, educators, biologists, and communities in shorebird and habitat conservation. Parallel flyway-scale educational efforts directed toward shorebird and environmental conservation are also underway in Australia and Japan (see Andres et al. 2005).

The "Western Hemisphere Shorebird Reserve Network" (WHSRN) was formed on the concept that conservation of long-distance migrant shorebirds requires a network of sites that collectively is

only as strong as the weakest link in the chain (Myers et al. 1987). Since its initial conception in the early 1980s, the WHSRN has endeavored to build linkages among network sites. Re-captures of color-flagged Semipalmated Sandpipers provide a direct link between stopovers in Canada and the U.S. and wintering sites on the coast of northern South America (Gratto-Trevor and Dickson 1994). The direct connectivity established by re-sighting or re-capturing a bird from a known origin provides tangible evidence useful for persuading conservation administrators and donors to expend funds outside of their immediate jurisdiction, and the sensational description of bird migration can catalyze broad conservation actions. Involvement of a variety of stakeholders was a fundamental step in building the Linking Communities Project among residents of Chaplin Lake, Saskatchewan (Canada), Great Salt Lake, Utah (U.S.), and Marismas Nacionales, Nayarit (Mexico). Connecting the breeding, stopover, and wintering sites of migratory shorebirds, the coalition has sponsored teacher exchanges, held site visits at each of the links, and developed cooperative conservation strategies for shared migratory bird species (Padilla et al. 2000).

CONCLUSION

Banding and re-capturing of migrant birds have played a significant role in the development of the concept of flyway conservation. Champions in the development of the African-Eurasian Migratory Waterbird Agreement and the Asia-Pacific Migratory Waterbird Conservation Strategy were bird banders who realized the importance of connecting places and people across migratory birds' ranges (Beintema and van Vessem 1999, Asia-Pacific Migratory Waterbird Conservation Committee 2001). Although newer genetic, telemetric, and stable isotope techniques will likely become more efficient at answering certain migration questions, bird banding will continue to play a role in monitoring the state and performance of migratory bird populations. In many instances, the utility of banding efforts could be enhanced by developing more open, collaborative, and hypothesis-driven projects (Nebel and Lank 2003). Transparent, collaborative networks, that cover all aspects of the conservation or management system, are really the only models for comprehensively addressing questions about the biology of long-distance migrant birds. Direct integration of

bird banding, and other scientific pursuits, into the conservation and management decision-making process should become standard operating procedures for conservation designers, practitioners, and administrators in the twenty-first century. Bird banding has helped make us aware of the necessity of broadening our geographic and cultural perspectives — in the next century, bird banding can help us find solutions to the pressing conservation challenges faced by migratory birds.

ACKNOWLEDGMENTS

Thanks to John Tautin for asking me to participate in the symposium. Octavio Cruz-Carretero's friendship and commitment inspired me to work harder on conservation issues. Special thanks to Chan Robbins and Barbara Dowell for introducing me to international bird research. The energy and ideas of Gerard Boere have greatly infiltrated my perspective on broad-scale conservation. Lastly, I thank the bird conservation community for providing interesting thoughts and inspirational actions.

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