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DEMOGRAPHIC LANDBIRD MONITORING: A PRECISION TOOL FOR LAND STEWARDS

Phil Nott, Ph.D.,
Research Scientist,
The Institute for Bird Populations,
Point Reyes Station CA 94956

DEMOGRAPHIC MONITORING AND MANAGEMENT

Global warming will increasingly challenge land stewards attempting to manage climate-related disturbance ecosystems and provide suitable habitat for shifting avian communities. In the monitoring, modeling, and management cycle of an adaptive ecosystem management approach to bird conservation we must choose appropriate monitoring techniques. The techniques must capture the critical ecological information that will allow management to appropriately address population declines, monitor the effectiveness of their management actions, and account for non-breeding conditions (Sherry and Holmes 2000). Demographic monitoring, using techniques such as mist-netting and banding, quantifies a suite of demographic variables that are useful to management, and indeed, provide precision tools for managers to a) assess whether management is appropriate, b) predict whether the management will be effective, and c) assess the efficacy of the management after it has been applied.

Non-demographic bird monitoring techniques including inventory, point counts, census, and area search techniques, although useful, are limited in the amount of ecological information that they can reveal to management. They are generally used to monitor species presence/absence and population abundance. At the avian community-level they allow the calculation of species richness, and various diversity indices which can be tracked over time as avian communities shift. At the species-level it is possible to plot the abundance (or territory density) over time and detect high population variability (or stability), increasing (or declining) population trends, and periodic behavior (e.g. cycling).

To increase the efficacy of management it is essential to be able to identify the proximal demographic causes of population change (i.e. which portion of the life cycle is being affected and by how much). For instance, if a breeding population dropped significantly between any two years there are several possible demographic causes, including a) low numbers of young were produced the previous year, b) breeding adults returned but abandoned their territories, c) the population experienced high mortality during the winter, or d) a combination of one or more factors. A proposed management solution for the breeding habitat may increase reproductive output or create more breeding habitat. Such actions cannot reduce stressors on the wintering grounds (or during migration) that might be affecting population performance by causing high mortality or reducing the reproductive potential of returning migrants.

EFFECTIVENESS MONITORING

More importantly, if the effectiveness monitoring of management success is based on non-demographic monitoring in order to detect a change in the abundance or density of birds then that measure might be counter to avian conservation goals of creating "source habitat" such that the breeding population produces more than enough young to replace its own numbers (Van Horne 1983). Although it is possible to manage habitat to attract more adult birds, without knowledge of their reproductive output you may have created "sink habitat" in which the adults are abundant but unable to produce enough young to replace their own numbers (Brawn and Robinson 1996, Vickery et al. 1992). Quantifying the age structure of a local population relative to reproductive success can reveal "despotic distributions". In despotic distributions, the most productive territories are large (i.e. low density of singing males), well established in primary breeding habitat and vigorously defended year after year by older, more experienced and physically dominant (despotic) males, whereas reproductive success is low where higher densities of less experienced males defend smaller territories in secondary habitat (e.g. Krebs 1971, Zanette 2001). Here management actions should be designed to reduce adult density and increase productivity towards maintaining a source population.

Demographic monitoring using mark-recapture techniques, such as the Monitoring Avian Productivity and Survivorship protocol (DeSante et al 2007), allows quantification of the demographic components of survival, reproductive success, and recruitment, among others. Thus, if a population change is observed it is possible to identify which demographic component is responsible. Population changes may be caused by variation in annual survival rates which suggests that the stressors are operating during the non-breeding season (Sillett *et al*. 2000). Such poor non-breeding conditions may also have a carry over effect on subsequent reproductive success through poor physiological status of returning adults leading to low reproductive potential (Nott et al. 2002, Nott *et al in prep.*). Alternatively, if the proximal cause of population change is annual variation in reproductive success then one might examine annual variation in environmental conditions on the breeding grounds, the health of breeding individuals in the population, and important habitat characteristics that could be improved through appropriate management (Nott et al. 2005).

DEMOGRAPHIC PARAMETERS

Here we provide a suite of demographic variables and the ecological information that mark-recapture monitoring techniques can convey:

Population Size – demographic monitoring expresses the population size as the number of adult and hatch-year individuals captured per net hour.

Breeding Condition - the breeding status (and gender) of individuals is assessed by examining the presence of a cloacal protuberance in males or a brood patch in females.

Apparent Survival Rates and Recruitment – state-of-the-art mark-recapture models developed in collaboration with Patuxent Wildlife Research Center provide estimates of the apparent annual survival rate and the probability of recruitment.

Reproductive Success – the ratio of young to adults provides a within-species only index of reproductive success.

Age – examination of plumage molt limits allows individuals to be reliably aged. Age structure may determine the distribution of breeding individuals, their reproductive potential, and overwintering habitat type.

Wing Chord Length – many species exhibit geographic structure in morphometrics including wing length (measured as the wing chord length). The range-wide distribution of wing chord lengths may, for instance, be consistent with leap-frog migration strategy whereby populations breeding in the most northerly portion of a breeding range migrate to the southern limits of the winter range. Typically, the longer distance migrant populations have a longer wing chord length.

Physiological Condition – individuals can be scored for fatty tissue or muscle mass, and the body mass can be directly measured. Although the mean wing chord length of distant populations may differ a robust within-species measure of body condition relates body mass to wing chord length. Banding data (unpublished) show considerable annual covariation in adult body condition during the early portion of the breeding season, subsequent reproductive success, and the body condition of fledglings. Clearly, the early season physiological condition of a population needs to be monitored to accurately assess the efficacy of management designed to increase reproductive success.

Physical Disposition – careful examination of birds in the hand can reveal injury, disease, parasitism levels, and allow for feather, blood, fecal, and respiratory sampling. This kind of sampling can reveal very important information concerning, for example, distribution and detection rates of avian pathogens including West Nile Virus and Avian Influenza, or corticosteroid levels of returning migrants (a measure of reproductive potential), or migratory connectivity and conservation genetics (isotope analysis and molecular genetics).

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