The published records of Kirtland's Warblers in spring and autumn migration indicate that they may not pause enroute until at or near their destinations. If this is true of one warbler, it may also be true of other small land birds.

I thank Cameron B. Kepler, Paul W. Sykes Jr., and Elliot J. Tramer for reading a draft of this manuscript.

Literature Cited

Cochran, W. W. 1972. Long-distance tracking of birds. Pp. 39–59 *in* Animal orientation and navigation (Sidney R. Galler, Klaus Schmidt-Koenig, George J. Jacobs, and Richard E. Belleville, Eds.). Natl. Aeronautics and Space Admin., NASA SP-262.

Lowery, G. H., Jr. 1960. Louisiana birds. Baton Rouge, Louisiana State Univ. Press.

Mayfield, H. F. 1960. The Kirtland's Warbler. Bloomfield Hills, Michigan, Cranbrook Inst. Sci.

Nisbet, I. C. T. 1970. Autumn migration of Blackpoll Warblers: evidence for long flight provided by regional survey. Bird-Banding 41: 207–240.

Stone, A. E. 1986. Migration and wintering records of Kirtland's Warbler: an annotated bibliography. Athens, Georgia, U.S. Fish and Wildl. Serv. (unpublished).

Received 2 July 1987, accepted 7 July 1987.

Bird Migration Terminology

Scott B. Terrill[1,2] and Kenneth P. Able[1]

The patterns of migratory behavior in birds span a continuum from obligate long-distance annual migrations to irregular eruptive movements. Current studies reveal ever more variability in avian migration systems. Effective communication requires that established terminology be used precisely and that some new terms be employed to reflect our increased knowledge of migration patterns. We propose standard usage for several common migration terms. We have been as conservative as possible in retaining established terminology, and where possible we suggest simply adding modifiers that more accurately describe the phenomena.

Much of the variability within migration patterns probably is based on underlying differences in the mechanisms that control migratory behavior. We mention some of these possible differences, but for only a fraction of species do we have any information on the mechanisms. Therefore, the terms we propose are intended to be descriptive of the observed phenomena and carry no implication regarding the specific mechanisms involved.

The term *annual migrant* should be applied to populations (species or geographically defined breeding populations of a species) in which all individuals migrate from their breeding sites on an annual basis. This descriptive term is preferable to others, e.g. obligate, true, or regular migrant, that are often used synonymously. A well-known example is the Blackpoll Warbler (*Dendroica striata*). Data from some extensively studied European species indicate that annual migratory disposition expressed in caged birds is often based on endogenous processes (i.e. occurs in the absence of external stimuli; see Gwinner 1986 for a recent review). It is, however, becoming increasingly clear that the migration of at least some annual migrants may not be entirely the result of an endogenous motivation. Rather, late stages of autumn migration can occur only in response to external stimuli (e.g. failure in food supply, unusually high density of conspecifics, extreme weather conditions) and may not occur annually. For example, field evidence indicates that Yellow-rumped Warblers (*Dendroica coronata*; Terrill and Ohmart 1984), American Tree Sparrows (*Spizella arborea*; Niles et al. 1969), Harris' Sparrows (*Zonotrichia querula*; Rohwer 1978), and some species of Palearctic nocturnal migrants (e.g. Lack 1983, Haila et al. 1986) exhibit a delayed or facultative phase of migratory behavior after the initial portion, or obligate phase, of annual migration. In addition, there is experimental evidence for facultative migration in Dark-eyed Juncos (*Junco hyemalis*; Terrill 1987, 1988) and Garden Warblers (*Sylvia borin*; Gwinner pers. comm.). Thus, in terms of regulatory mechanisms, it is misleading to assume that the entire annual migration is under endogenous control simply because a species is an annual migrant. Indeed, an endogenous component need not be involved in annual migration, although we know of no examples where an annual migration is stimulated exclusively by exogenous factors.

We therefore propose the terms *obligate phase* and *facultative phase* as modifiers to describe the behavior of individual annual migrants. The obligate phase is the initial portion of migration from the breeding

[1] Department of Biological Sciences, State University of New York, Albany, New York 12222 USA.

[2] Present address: Vogelwarte Radolfzell, Schloss Möggingen, D-7761 Möggingen, Federal Republic of Germany.

area, performed annually regardless of environmental conditions. In many species the fundamental stimulus for the obligate phase of migration may be endogenous. In some individuals this phase may constitute the entire migration. The facultative phase is a period following the obligate phase in at least some individuals of annual migrant populations in which further migration is induced by deteriorating environmental conditions (see Terrill 1987, 1988 for a detailed discussion; see also Lack 1983).

Partial migrant populations include some individuals that do and some that do not migrate from the same breeding area (Lack 1944, Shüz and Meise 1968, Gauthreaux 1982). The term has also been applied to species that are migratory in part of their breeding range and resident elsewhere (e.g. Bruun 1970, Hayman et al. 1986). To avoid confusion, we recommend that the term be used only to reflect the behavior of individuals within a population, not as a descriptor of species consisting of migratory and resident populations.

Partial migration is sometimes used synonymously with "facultative migration" (e.g. Gauthreaux 1982). Whereas partial migration can certainly be facultative, as in the Blue Tit (*Parus caeruleus*; Smith and Nilsson 1987), it can also be under more rigid, endogenous control (Berthold 1985). We therefore propose the term *obligate partial migration* to refer to the behavior of those individuals of a partial migrant population that migrate each year regardless of annual environmental variation or fluctuations in population density. Presumably, the behavior reflects a genetic polymorphism, and the impetus to migrate is primarily endogenous (e.g. German populations of the European Robin, *Erithacus rubecula*; Biebach 1983). We suggest that the term *facultative partial migration* be used for individuals that may or may not migrate in any given year. Whether an individual migrates appears to depend largely, if not entirely, on environmental conditions (e.g. Blue Tit; Smith and Nilsson 1987).

The term *differential migration* refers to the situation in which migration in some distinguishable classes of individuals (ages, sexes, races) differs with respect to timing, distance, or both (see Gauthreaux 1982). Recently, Ketterson and Nolan (1983) restricted use of the term to populations in which all individuals migrate (annual migrants), and that definition has been adopted by Berthold (1985). Of course, partial migrants can also exhibit differential timing or distance, and we propose that the term be used in its original, broader sense as a modifier of any of the migration categories outlined above.

Literature Cited

Berthold, P. 1985. The control of partial migration: a review. Ring 10: 253–265.

Biebach, H. 1983. Genetic determination of partial migration in the European Robin (*Erithacus rubecula*). Auk 100: 601–606.

Bruun, B. 1970. Birds of Europe. New York, McGraw-Hill.

Gauthreaux, S. A., Jr. 1982. The ecology and evolution of avian migration systems. Pp. 93–168 *in* Avian biology, vol. 6 (D. S. Farner, J. R. King, and K. C. Parkes, Eds.). New York, Academic Press.

Gwinner, E. 1986. Circannual rhythms in the control of avian migrations. Pp. 191–228 *in* Advances in the study of behavior, vol. 16 (J. S. Rosenblatt, C. Beer, M.-C. Busnel, and P. J. B. Slater, Eds.). New York, Academic Press.

Haila, Y., J. Tiainen, & K. Vepsäläinen. 1986. Delayed autumn migration as an adaptive strategy of birds in northern Europe: evidence from Finland. Ornis Fennica 63: 1–9.

Hayman, P., J. Marchant, & T. Prater. 1986. Shorebirds. Boston, Houghton Mifflin.

Ketterson, E. D., & V. Nolan Jr. 1983. The evolution of differential bird migration. Pp. 357–402 *in* Current ornithology, vol. 1 (R. F. Johnston, Ed.). New York, Plenum.

Lack, D. 1944. The problem of partial migration. Brit. Birds 37: 122–130.

Lack, P. 1983. The movements of Palaearctic landbird migrants in Tsavo East National Park, Kenya. J. Anim. Ecol. 52: 513–524.

Niles, D. M., S. A. Rohwer, & R. D. Robbins. 1969. An observation of midwinter nocturnal tower mortality of Tree Sparrows. Bird-Banding 40: 322–323.

Rohwer, S. 1978. Reply to Shields on avian winter plumage variability. Evolution 32: 670–673.

Shüz, E., & W. Meise. 1968. Zum Begriff des Teilziehers. Vogelwarte 24: 213–217.

Smith, H. G., & J.-Å. Nilsson. 1987. Intraspecific variation in migratory pattern of a partial migrant, the Blue Tit (*Parus caeruleus*): an evaluation of different hypotheses. Auk 104: 109–115.

Terrill, S. B. 1987. Social dominance and migratory restlessness in the Dark-eyed Junco (*Junco hyemalis*). Behav. Ecol. Sociobiol. 21: 1–11.

———. 1988. The relative importance of ecological factors in bird migration. Proc. 19th Int. Ornithol. Congr. in press.

———, & R. D. Ohmart. 1984. Facultative extension of fall migration by Yellow-rumped Warblers (*Dendroica coronata*). Auk 101: 427–438.

Received 11 September 1987, accepted 7 October 1987.