

The Outlook for Migratory Songbirds: “Future Shock” for Birders

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Tennessee Warbler being “warpainted” with red pollen as it sips nectar from Combretum.



IN ALVIN TOFFLER’S 1970 NOVEL *Future Shock*, the personal, psychological, and sociological consequences of accelerated change in everyday life were outlined. He predicted a “massive adaptational breakdown” unless man quickly learned to control the rate of change. “Almost invariably, research into the effects of change concentrate on the destinations toward which change carries us, rather than the speed of the journey. . . the *rate* of change has implications quite apart from, and sometimes more important than, the *directions* of change. No attempt to understand adaptivity can succeed until this fact is grasped. Any attempt to define the ‘content’ of change must include the consequences of pace itself as part of that content.”

When we think of ecological phenomena that are occurring at rates that stagger the imagination, tropical deforestation in the latter part of the twentieth century should come immediately to mind. It is difficult to come to grips with the implications of having a land mass almost entirely covered with one kind of forest or another converted to field, pasture and plantation within a few decades (Fig. 1). It seems unreal, like a game we can play at dinner parties—question: “When it is all over, what will be the effects of this enormous global experiment on the billions of birds of hundreds of species that make the annual trek between North America and the Neotropics?”

But it is not a game—it is really happening

For birds, as well as people, the ability to adapt to change depends largely on the rate and magnitude of the change. The rate of forest conversion in the Neotropics, ranging from one to four percent per year for the most conservative estimates (Gradwohl and Greenberg 1988), is almost undoubtedly too great to allow for genetic adaptations of its avifauna through natural selection. So, the degree to which migratory birds will persist in the new Latin American landscape may depend upon how readily these birds are able to adapt behaviorally and use the newly altered landscape as home. Those individuals that cannot adapt to the new landscape or cannot find habitat elsewhere will die. Populations and species composed of these individuals may also disappear.

The tropical adaptations of migrant birds

Important to the question of the future of migrant birds is consideration of their tropical adaptations. If migrant songbirds were generally the same wherever they are, using the same habitats and feeding in the same way in both breeding and wintering areas, this would be a short piece of their story. If they moved about freely, exploiting transient but abundant foods, shying away from

tropical avian residents, we would suspect that tropical deforestation might devastate the residents but not migrants. We might even predict that deforestation would favor the migrants by eliminating competition from resident birds. This is known as the migrant birds "fit in" concept, the view that migrants are forever the "new kids on the block."

This idea of the adaptable migrant, forever skimming off the cream and moving on, was a notion that comforted avian ecologists in the 1960s and 1970s. It implies that migratory birds are immune to the future shock of deforestation. Unfortunately, field studies of migrants in the tropics show that the idea is incorrect.

The current view might best be called the homogenized view of migrants and residents, and was extensively documented in a symposium held in 1977 (Keast and Morton 1980). It appears that on a broad biogeographical scale, migratory birds are most common and diverse in the Northern Neotropics (Mexico, Greater Antilles) and resident tropical birds are the most diverse nearer the equator. This probably relates more to the proximity of these areas to northern breeding grounds, rather than to competitive interactions between migrants and residents. This sort of broad geographic pattern, based on lumping all migrant birds, obscures the fact that each species has a discrete winter distribution. Often, these distributions are quite localized so that each region of the Neotropics has its particular migrant fauna. For example, even though many migrants winter in the northern Neotropics, many common species winter almost wholly within South America (e.g., Scarlet Tanager [*Piranga olivacea*], Red-eyed Vireo [*Vireo olivaceus*], Canada Warbler [*Wilsonia canadensis*], and Blackburnian Warbler [*Dendroica fusca*]). On a regional and local level, migrants and residents are both often most common in the same habitats. Furthermore, except at occasional squabbles over specific food plants, it has proven almost impossible to show that migrants avoid residents. In fact, given the degree to which migrants join in mixed species foraging flocks with residents, the opposite seems true (e.g., Morton 1980).

Migrants are adapted to both tropical and temperate zone sojourns. Some examples of their seasonally different adaptations have to do with foods eaten, some with habitats used. Worm-eating

Warblers (*Helmitheros vermivorus*) and Blue-winged and Golden-winged warblers (*Vermivora pinus* and *V. chrysoptera*) tend to be ordinary foliage gleaners on their breeding territories (Greenberg 1987a). But in winter, they specialize in where they look for invertebrate food. Worm-eating Warblers rummage in dead leaves caught in tangles above ground, the other two probe with needle bills in dead small leaves or damaged parts of living leaves. The dead leafing life style they employ in the tropics is one they share with a number of highly specialized tropical forest birds in the Furnariidae and Formicariidae (ovenbirds and antbirds). In what is possibly a tantalizing testimonial to the importance of tropical adaptations, young hand-raised fledgling Worm-eating Warblers spend most of their time playing with dead leaves (as in their future tropical employment) as opposed to live foliage and other objects offered to them in their nursery (Greenberg 1987b).

A number of migrants that are insectivorous in the breeding season consume plant products in the tropics. This leads to some interesting morphological adaptations and complex behavioral interactions. In winter, Orchard Orioles (*Icterus spurius*) take nectar for which they have a long, split tongue with brushy edges. In a typically bizarre tropical interaction, Orchard Oriole males are manipulated by the nectar-giving plants into carrying their pollen to other plants. *Erythrina fusca* flowers, after being fed from, suddenly show a burnt-orange

color like that coloring the plumage of dominant aggressive male orioles. This would seem to move orioles to greener pastures and with the move comes pollen from the tree whose flowers said "keep away, already occupied" (Morton 1979). The Tennessee Warbler (*Vermivora peregrina*) is "war painted" by one of its favorite forest plants, the *Combretum* vine. Like the orioles, Tennessees defend nectar so that all individuals are not successful in gaining access to it (Tramer and Kemp 1979). The plant responds by "face painting" successful warblers with bright red pollen to give them a badge of dominance. In this way, pollen is more likely to reach another plant for fertilization (Morton 1980). Eastern Kingbirds are known as the "Cedar Waxwings of the tropics" owing to their proclivity for swooping into a tree crown *en masse* for a fruit meal. In fact, they eat little but fruit, and time migration for the ripening of favorite species (Morton 1971). That migrant birds depend more on plant products for tropical sustenance than they do for temperate sustenance is not surprising. Both resident tropical and migratory birds are more dependent on fruit and nectar than are resident temperate zone species (Karr 1971a, Morton 1973). Further, migration of birds *within* the tropics is based more upon the seasonality and availability of fruit than of invertebrate foods (Morton 1977).

Worm-eating Warbler inspecting inside a dead leaf for spiders and insects.



Beyond the interesting foraging adaptations that all migratory birds have for surviving in the tropics, migratory birds show a tremendous variation in their habitat preferences as well. Along with the demise of the theory of the "infinitely adaptable migrant," recent research has challenged the idea that migratory birds have a universal preference for "disturbed" habitat. As with resident tropical birds, the many species of landbird migrants vary in the degree to which they depend upon forest habitat and the maturity of the forest they require. Identification of those species most closely associated with threatened habitats, such as forest, and determination of what factors allow these species to persist after forest clearing remain the highest priorities for survey work in the tropics.

The degree to which migrants depend upon more mature forest vegetation is easy to underestimate because some individuals of many species can be found in virtually every habitat. In part, this is owing to the concentration of migrants from huge breeding ranges into small wintering ranges (Terborgh 1980). When quantitative surveys are conducted it has been repeatedly shown that a number of migratory birds are substantially more common in forests (Rappole and Morton 1985, Hutto 1988a, Lynch *in press*, Greenberg *ms*).

At this point a slight digression into methodology is necessary, because reliance on certain techniques and statistical analyses has slowed our understanding of the habitat use of Neotropical migrants considerably. Many workers have relied on mist net use for data on the distribution and abundance of tropical birds (Karr 1976, Waide 1980, Martin 1985, Rappole and Morton 1985). The employment of mist nets has a superficial appeal of objectivity and repeatability since it depends less obviously on the skill of the observer than do the results of other direct censusing techniques. However, mist nets are subject to more insidious bias including the fact that a smaller portion of the birds will be captured in a forest than a field. This bias can be more significant because most studies have shown that migratory birds occur disproportionately in the forest canopy at a level not sampled by mist nets. For example, Karr concluded that migrants constitute only one to three percent of the avifauna of a lowland tropical forest in Panama. However, the most common migratory

species in this forest, Bay-breasted Warbler (*Dendroica castanea*), was never mist-netted. Based on a visual census from a canopy tower on nearby Barro Colorado Island, Greenberg (1981) found that the Bay-breasted Warbler was the most common single species in the outer canopy. Lynch (*in press*) found that mist net captures often were lowest for migrants in forested habitats when point censuses, using visual and auditory cues, showed they were most common in forests.

Migrant species that remain nonvegetarian in winter often show the most dependence upon forests for tropical survival. Indeed, individuals defend, and return to, winter feeding territories with the regularity of those famous swallows in Capistrano (*e.g.*, Karr 1971b). This highlights an important concern for conservation. Territoriality can limit bird density and, therefore, the numbers of individuals that survive in winter as well as summer. On top of this, one sex might outcompete the other for territories, skewing the sex ratio of breeders the following summer. Males are often larger than females and, consequently, take over territories readily. Female choice of mate is partly based on what's left over after the males have competed for breeding territories, automatically selecting for larger males. When this happens, it behooves females to shift out of competition with males. This seems to be the case with Hooded Warblers (*Wilsonia citrina*). This species shows a clear segregation between the sexes in the winter: Hooded Warbler males live in forest, females live in shrubby fields (Lynch *et al.* 1985). It is a remarkable result of territorial competition that females and males in this one species now differ more in habitat than is often the case among separate *species* (Morton *et al.* 1987). This phenomenon of intersexual habitat segregation is best documented for the Hooded Warbler, but is also found in the American Redstart (*pers. ob.*).

What is behavioral adaptability?

Each year the young of various species of migratory birds arrive in the tropics and adopt a patch of habitat and a suite of foraging preferences characteristic of their species. Migratory birds do not appear to be infinitely adaptable, but it does leave open the interesting and important question: what determines how

adaptable migratory birds are? Clearly, migratory birds are not hard-wired for particular food plants the way many insects are. Yet, some seem relatively stereotyped in their foraging behavior and habitat choice (*e.g.*, Kentucky Warblers [*Oporornis formosus*]) whereas others seem very able to change their preferences (*e.g.*, Yellow-rumped Warbler [*Dendroica coronata*]). Although the "psychological" factors that might influence a bird's adaptability seem like a critical point for our understanding future shock in migrants' behavior, this branch of study is in its infancy. One intriguing possibility exists: that adaptability is controlled by an underlying fear response towards new, unfamiliar stimuli. The Greeks called this form of fear "neophobia." Greenberg (1983) defines neophobia in migrants according to how ecologically specialized or "plastic" they are: specialized species are more neophobic than are more generalized species. Since young migrant songbirds are totally independent, and separated, from their parents long before they reach tropical wintering areas, how do they develop species-typical tropical behavior? Species-typical levels of neophobia, probably inherited, seem a likely answer. He found that the more ecologically plastic Bay-breasted Warbler was less fearful of new objects than the more specialized Chestnut-sided Warbler (*Dendroica pensylvanica*).

How many songbirds are there?

Like many of you, we were drawn to birding at an early age by the large numbers of magnificent warblers, thrushes, tanagers, and flycatchers that passed through our region on spring migration. The adventure of seeing new species, elegantly exotic travellers, and the challenge of learning to know their songs (and remembering them) made our early teen years memorable. The abundance of the migrant chorus was a stark contrast to the extinctions we read about—Passenger Pigeon, Labrador Duck, and Carolina Parakeet. Extinction was something in the past that could not happen in today's enlightened world, or so we thought.

Today, we are worried about the prospect that the migrant chorus may soon be a ghost of its past glory—perhaps it already is. People who have birded during spring migration in the same area(s)

for two or three decades or more, have valuable insight into the migrant songbird issue. Unfortunately, they are not often queried by academics interested in the migrant bird question. In our experience, not one birder with three or four decades of experience finds the migration today like it used to be. Why is it that science has not documented this, confirming our impressions?

One reason may be that academic ornithologists may be overly concerned with looking for population trends in Breeding Bird Censuses and surveys. There is reason to think that such surveys are inherently conservative, and therefore serve as poor "early warning systems." By the time breeding bird numbers decline, we may already have a pessimistic answer to how adaptable migrants are to changes in their world. Serious declines may have already taken place.

The reason we say this is that these census techniques (*e.g.*, Breeding Bird Census and Breeding Bird Surveys) are based almost entirely on the number of singing males, birds that are advertising a territory, and some detailed studies have shown that mated singing males constitute only a small portion of the entire male population. It requires detailed studies, often involving removing singing males from their territories, to determine the degree to which a population of floating, non-territorial males exists. Few such studies have been conducted, but those that have suggest that nonbreeding "floaters" may be an important component of bird populations in spring and summer. One famous removal experiment (Stewart and Aldrich 1951, Hensley and Cope 1951) was conducted on warblers in spruce forests of Maine in the 1940s. The removal of singing birds resulted in immediate replacement by individuals that might have remained floaters. The population pressure was so high that removals of territorial birds did not bring about a noticeable decline. It might be said that high spruce budworm numbers was abnormally attractive to floaters so that the pressure was not normal. Other studies indicate that insect outbreaks at high latitudes are not necessary for floaters to occur. Under different ecological circumstances in Panama, migratory Yellow-green Vireos (*Vireo flavoviridis*) (Morton 1977) replaced removed conspecifics almost immediately and continuously from mid-January to the end of April, when removal ended. We feel



Eastern Kingbirds feeding on fruit of Cecropia.

that real decreases in numbers might not be noticeable in typical breeding bird censuses or the breeding bird survey until worrisome declines have already taken place (Wilcove and Terborgh 1984). Healthy populations contain a "surplus" population of floaters that dampens fluctuations of breeding birds but whose loss *would* be noticeable to migration-watchers.

The fact that breeding bird surveys may not show a decrease when one is really occurring makes the recent results of the Breeding Bird Survey even more dramatic. After initial stable or increasing populations for many eastern forest migrants (Hutto 1988b, based on Robbins *et al.* 1986), the last 11 years have shown consistent declines in several species of neotropical migrants (Robbins *et al.* 1988).

Beware of false dichotomies

When faced with evidence of declines (usually on local census plots), some scientists have argued that local breeding effects are more important than tropical deforestation (*e.g.*, Whitcomb *et al.* 1981, Hutto 1988b) or vice versa (Briggs and Criswell 1979, Johnston and Winings 1987, Marshall 1988). The simultaneous "testing" of alternative hypotheses is presented as the way to ascribe cause to declines. We argue that a dichotomous presentation of hypotheses

favoring local breeding season effects (insularization or forest fragmentation and associated predation or cowbird parasitism) (Hutto 1988b, p. 377), versus tropical deforestation is unrealistic. Negative effects taking place in both breeding and wintering seasons are cumulative.

Dichotomous thinking can cause assumptions to be adopted that narrow the possibilities entertained. For example, Hutto (1988b, p. 378) repeats an assumption common among researchers that favor the breeding season side of the coin: "But for tropical deforestation to have caused the reported breeding season declines, the deforestation would somehow have to affect local breeding pockets, while leaving regional breeding season totals unaffected—an unlikely situation." Whitcomb *et al.* (1981) stated the assumption as follows: "... high mortality of neotropical migrants on wintering grounds or migratory routes would be expected to affect populations of large forest areas as well as smaller ones, so winter mortality *per se* is not the explanation for selective deterioration of bird communities on small forest islands. The latter point is crucial, for if the observed trend toward depletion of numbers and disappearance of species were characteristic of large continuous areas of forest habitat as well as small islands, we must look for explanations that possibly are unrelated to island biogeography." The ap-

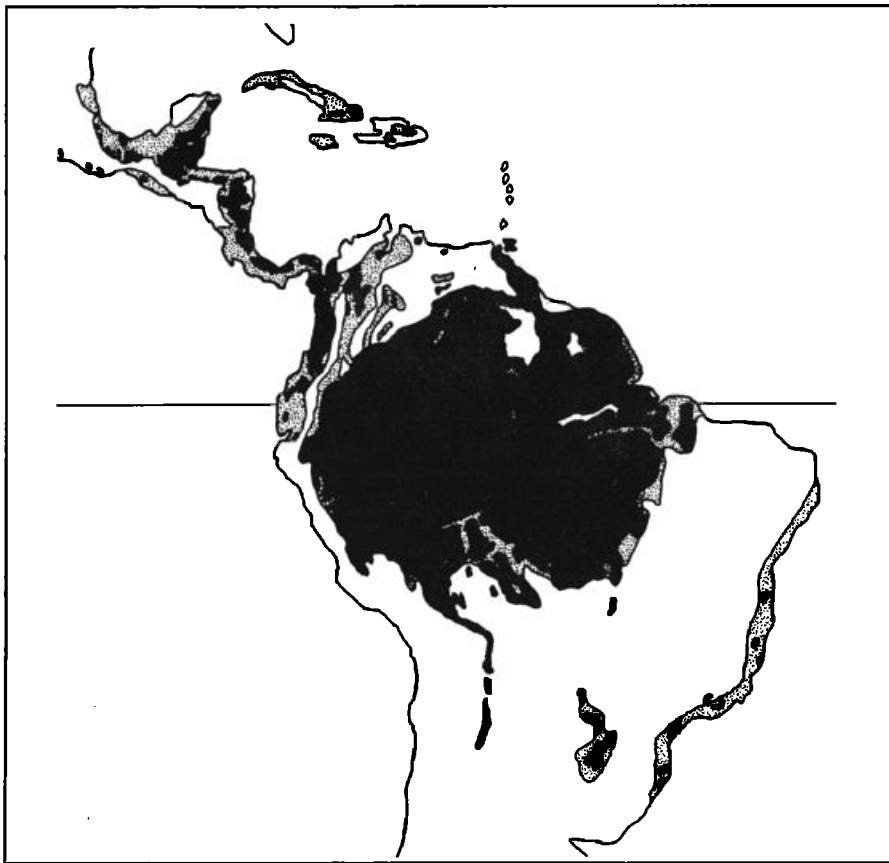


Figure 1. The estimated extent of moist Neotropical forest prior to human settlement (gray areas) and current (black areas). The massive black area has, in fact, today a checkered look, especially around its periphery as the annual rate of deforestation there is 5%. Last year 80,000 square kilometers of virgin forest were burned for permanent clearance in Brazil alone. Huge swaths are degraded daily by dams and flooding, unintentional fires, agriculture, and timber exports. Source: *Tropical Rainforests: a disappearing treasure*. Smithsonian Inst., Traveling Exhibition Service, 1988. Prepared by John Anderton.

plication of island biogeographic theory (MacArthur and Wilson 1967) to avifaunal preserves was the focus of this study, not migrant birds *per se*. However, since neotropical migrants are the species that decline in forest fragments, to have "outside" influences such as winter survival impinge on the theory would destroy the entire island biogeographic application and make for much complexity.

There is actually no reason to suppose that reduction in the global population in the winter will not have a very complex effect on the distribution pattern of the birds when they settle out to breed in the spring. Avoidance of small forest patches could result *both* from the immediate response the bird has to fragmented forest combined with the overall reduction in populations. If the floating population still existed, it is our guess that we might still see spectacular spring waves of migrant songbirds *and* still find them in fragments of forest.

Beware of dichotomous management policy

It is sound wildlife management practice to determine and protect high quality habitat for species throughout their annual cycle. The practice of purchasing and managing wetlands for wintering waterfowl was begun decades before waterfowl surveys could begin to estimate population sizes. We may never have adequate breeding censuses for shorebirds, yet few ornithologists would question the wisdom of the Western Hemisphere Shorebird Reserve Network and other habitat conservation efforts by J.P. Myers of The National Audubon Society.

Probably because of the myths regarding the adaptable migrants in the tropics, the concept that habitat should be assumed to be important at all times of year has been abandoned by some people empowered with worrying about

bird conservation policy. For example, a recent listing of Birds of Management Concern by the United States Fish and Wildlife Service noted that Breeding Bird Survey trends have Cerulean Warblers (*Dendroica cerulea*) decreasing by over 3% per year since the beginning of the Survey. Since relatively little research had been done on this species, no one knows what might be causing this decline. The report concludes that fragmentation of old growth forest on the breeding grounds is the most likely factor. But the possibility that intensive forest clearing on the Cerulean Warblers' Andean wintering grounds might also be a contributing factor is not even mentioned. This report has apparently chosen to view the breeding season-wintering season habitat condition as a dichotomy and has uncritically endorsed one side.

The job ahead of us

If the high rate of change in our migrant songbirds' world brings about a chronic deterioration of their numbers, we should expect more than a deterioration of our experience of them. Migrants have always been a major component of breeding bird communities. More than 50 percent of the breeding birds, often 85 percent, are migrants (MacArthur 1959). In many long term Breeding Bird Census plots, migrants dropped below 50 percent of breeding birds in the late 1960s (David Johnston *pers. comm.*). Unfortunately, resident birds such as chickadees did not increase in population to make up for the loss of migrants. So, the bottom line is that the insects these birds fed upon are going to be under less selection pressure to escape from them. Most of these escape methods reduce the rate at which insects turn green leaves into insect biomass. Without avian predators, insects might have more generations per year, feed during daylight hours instead of just at night, put more energy into growth rate rather than poisons or behavioral mechanisms to deter predation, etc. We have a tremendous economic stake in preserving normally large numbers of migrant birds in our forests and fields. We cannot afford to wait until one species after another becomes "threatened" or "endangered." Our need is to preserve them as unendangered, as they still are. We do not want to wait until the situation is hopeless.

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LITERATURE CITED

- BRIGGS, S. A., and J. H. CRISSWELL. 1979. Gradual silencing of spring in Washington. *Atlantic Naturalist* 32:19-26.
- GRADWOHL, J., and R. GREENBERG. 1988. Saving the tropical forests. Earthscan Publications, London.
- GREENBERG, R. 1981. The abundance and seasonality of forest canopy birds on Barro Colorado Island, Panama. *Biotropica* 13:241-252.
- . 1983. The role of neophobia in determining the degree of foraging specialization in some migrant warblers. *Am. Nat.* 122:444-453.
- . 1987a. Seasonal foraging specialization in the Worm-eating Warbler. *Condor* 89:158-168.
- . 1987b. Development of dead leaf foraging in a tropical migrant warbler. *Ecology* 68:130-141.
- HENSLEY, M. M., and J. B. COPE. 1951. Further data on removal and repopulation of breeding birds in a spruce-fir forest community. *Auk* 68:483-493.
- HUTTO, R. L. 1988a. The effect of habitat alteration on the migratory land-birds of western Mexico: a conservation perspective. *Conservation Biology* in press.
- . 1988b. Is tropical deforestation responsible for the reported decline in neotropical migrant populations? *Am. Birds* 42:375-379.
- JOHNSTON, D. W., and D. I. WININGS. 1987. Natural history of Plummers Island, Maryland. XXVII. The decline of forest breeding birds on Plummers Island, Maryland, and vicinity. *Proc. Biol. Soc. Wash.* 100:762-768.
- KARR, J. R. 1971a. Structure of avian communities in selected Panama and Illinois habitats. *Ecol. Monogr.* 41:207-233.
- . 1971b. Wintering Kentucky Warblers (*Oporornis formosus*) and a warning to banders. *Bird-Banding* 42:299.
- . 1976. On the relative abundance of migrants from the North Temperate Zone in tropical habitats. *Wilson Bull.* 88:433-458.
- KEAST, ALLAN, and E. S. MORTON (Eds.) 1980. Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation. Smithsonian Inst. Press, Washington, D. C.
- LYNCH, J. *in press*. Distribution and abundance of overwintering Nearctic migrants in the Yucatan Peninsula, I: general patterns of occurrence. *Condor*.
- , E. S. MORTON, and M. VAN DER VOORT. 1985. Habitat segregation between the sexes of wintering Hooded Warblers. *Auk* 102:714-721.
- MACARTHUR, R. H. 1959. On the breeding distribution pattern of North American migrant birds. *Auk* 76:318-325.
- , and E. O. WILSON. 1967. The theory of island biogeography. Princeton University Press, Princeton.
- MARSHALL, J. T. 1988. Birds lost from a Giant Sequoia Forest during fifty years. *Condor* 90:359-372.
- MARTIN, T. E. 1985. Selection of second growth woodland by frugivorous migrating birds in Panama: an effect of fruit size and density? *J. Trop. Ecol.* 1:157-170.
- MORTON, E. S. 1971. Food and migration habits of the Eastern Kingbird in Panama. *Auk* 88:925-926.
- . 1973. On the evolutionary advantages and disadvantages of fruit eating in tropical birds. *Am. Nat.* 107:8-22.
- . 1977. Intratropical migration in the Yellow-green Vireo and Piratic Flycatcher. *Auk* 94:97-106.
- . 1979. Effective pollination of *Erythrina fusca* by the Orchard Oriole (*Icterus spurius*): coevolved behavioral manipulation? *Ann. Missouri Bot. Gard.* 66:482-489.
- . 1980. Adaptations to seasonal changes by migrant land birds in the Panama Canal Zone. Pp. 437-453 in Keast, A., and E. S. Morton (Eds.). Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation. Smithsonian Inst. Press, Washington.
- ROBBINS, C. S., D. BYSTRAK, and P. H. GEISSLER. 1986. The Breeding Bird Survey: its first fifteen years, 1965-1979. U. S. Fish and Wildlife Serv. Resour. Publ. 157, Washington.
- , J. R. SAUER, and S. DROEGE. 1988. Population trends of North American forest birds wintering in the tropics. Abstract, 106th A. O. U. Meeting, Fayetteville, Arkansas.
- STEWART, R. E., and J. W. ALDRICH. 1951. Removal and repopulation of breeding birds in a spruce-fir forest community. *Auk* 68:471-482.
- TERBORGH, J. W. 1980. The conservation status of neotropical migrants. Pp. 21-30 in Keast, A., and E. S. Morton (Eds.). Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation. Smithsonian Inst. Press, Washington.
- TRAMER, E. J., and T. R. KEMP. 1979. Diet-correlated variations in social behavior of wintering Tennessee Warblers. *Auk* 96:186-187.
- WAIDE, R. B. 1980. Resource partitioning between migrant and resident birds. Pp. 337-352 in Keast, A., and E. S. Morton (Eds.). Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation. Smithsonian Inst. Press, Washington.
- WHITCOMB, R. F., C. S. ROBBINS, J. F. LYNCH, B. L. WHITCOMB, M. K. KLIMKIEWICZ, and D. BYSTRAK. 1981. Effects of forest fragmentation on avifauna of eastern deciduous forest. Pp. 125-205 in Burgess, R. L., and D. M. Sharpe (Eds.). Forest island dynamics in man-dominated landscapes. Springer-Verlag, New York.
- WILCOVE, D. S., and J. W. TERBORGH. 1984. Patterns of population decline in birds. *Am. Birds* 38:10-13.

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Adult male Orchard Oriole opening flowers of *Erythrina fusca*, exposing burnt-orange colored petals matching his color.