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RECENT LITERATURE

Edited by Robert C. Beason

BEHAVIOR

(see also 8, 14, 15)

1. Wingbeat frequency of birds in steady cruising flight: new data and improved predictions. C. J. Pennycuick. 1996. J. Exp. Biol. 199:1613–1618.—In this paper, the author expands his data set from an earlier paper (1990. J. Exp. Biol. 150:171–185) on wingbeat frequencies from 32 to 47 species. The resulting model is that the wingbeat frequency (f) fits the equation $f = m^{3/8}g^{1/2}b^{-23/24}S^{-1/3}\rho^{-3/8}$, where m is the body mass (kg), g is the acceleration of gravity, S is the wing area (m^2) and ρ is the air density. Constant values of 1.23 kg m^{-3} was used for air density and 9.81 m s^{-2} for the acceleration of gravity. When the other factors remain constant, the wingbeat frequency is predicted to vary with the square root of the mass. Whether birds do change their wingbeat frequencies as their mass changes (increases from feeding or decreases from fuel used during a long flight) remains to be seen. [School of Biological Sciences, Univ. of Bristol, Woodland Rd., Bristol BS8 1UG, U.K.]—Robert C. Beason.

2. Proximate control of siblicide in Cattle Egrets: a test of the food-amount hypothesis. J. C. Creighton, and G. D. Schnell. 1996. Behav. Ecol. Sociobiol. 38:371–377.—The food-amount hypothesis predicts that in birds that are facultatively siblicidal, older siblings will become increasingly aggressive toward younger siblings as food level decreases. The data that support this hypothesis have been mixed and, in the avian family Ardeidae, no association has been found between food amount and sibling aggression. The authors in this study reexamined the food-amount hypothesis in Cattle Egrets (*Bubulcus ibis*) in Oklahoma, but corrected for chick ages relative to siblicide to account for changing food requirements of nestlings at different ages. A significant negative correlation was detected in siblicidal nests between the amount of food brought to the nest and the days before siblicide. Compared to nonsiblicidal nests, aggression levels among all ages of chicks in a single nest with asynchronous hatching also increased significantly as the day on which siblicide occurred drew closer. No difference was detected in the amount of food that the oldest chick (A-chick) in siblicidal and nonsiblicidal nests received with the progression of time. As the day of siblicide drew closer, A-chicks in siblicidal nests received a significantly increasing proportion of the available food, while the youngest chick (C-chick) received a significantly smaller proportion. No difference in the proportion of food received by the second-oldest chick (B-chick) in siblicidal versus nonsiblicidal nests was detected. The amount of food brought to siblicidal nests the day before siblicide did not differ from the amount of food brought to such nests the day after. Moreover, A-chicks received about the same percentage of food both immediately before and after siblicide; however, B-chicks received a significantly larger portion of food after siblicide. Unlike previous data associated with herons and egrets, these data support the food-amount hypothesis since increased aggression and food levels in siblicidal nests were significantly negatively correlated. B-chicks seemed to be the major beneficiary of the aggression that resulted in the death of the C-chicks. The authors suggest, and their data support the idea that diminishing food supply, perhaps triggered by increasing hunger, serves as a proximate cue for increased aggression in Cattle Egret chicks. [Dept. of Zoology and Oklahoma Biological Survey, Univ. of Oklahoma, Norman, OK 73019, USA.]—Danny J. Ingold.

3. Anti-predatory vigilance and the limits to collective detection: visual and spatial separation between foragers. S. L. Lima and P. A. Zollner. 1996. Behav. Ecol. Sociobiol. 38:355–363.—A key assumption to collective predator detection in models of anti-predator vigilance behavior is that the burden of vigilance is shared among all group members. The overall aim of this study was to examine the nature of collective detection and its influence on anti-predator vigilance. In particular, the authors were interested in examining the effects of both visual and spatial separation between foragers on collective detection and the vigilance group size effect itself. To this end, emberizid sparrows were studied at feeding

stations in Indiana during the 1993–1994 winter season. Both collective detection and the group size effect (the tendency for decreased vigilance among individuals within large groups) decreased significantly with increasing visual separation between detectors (exposed to predator stimulus) and non-detectors (not exposed to predator stimulus). The information available to non-detectors in departures was primarily visual, although acoustical information was used occasionally by non-detectors that flew, even in the presence of a high wall that fully obscured the view between the two groups. There was a greater but not significant tendency for non-detectors to flush in response to two departures compared to one. When the effects of spatial separation concomitant with visual separation were examined, both collective detection and the effect of group size decreased with increasing distances between feeding platforms for detectors and non-detectors. The authors argue that the influence of visual and spatial separation on the strength of group size effect should be mediated by the strength of collective detection rather than by behavior monitoring of flockmate's vigilance. Indeed their data, including the detection of a positive correlation between pecking times of birds on non-detector platforms and the average proportion of birds flushed from non-detector platforms, support this notion. Finally, the authors discuss a scenario in which the effects of risk dilution in foraging birds, as well as collective detection, are major determinants of the group size effect, and are thus really interdependent. [Dept. of Life Sciences, Indiana State Univ., Terre Haute, IN 47809, USA.]—Danny J. Ingold.

4. Provisioning rules in Tree Swallows. M. Leonard and A. Horn. 1996. Behav. Ecol. Sociobiol. 38:341–347.—The conflict between parents and offspring as proposed by Trivers predicts that in birds, nestlings should intensify their begging behavior toward the latter part of the nestling stage as they become increasingly independent and are fed less by the parents prior to fledging. In order to test this parent-offspring conflict theory and how nestling need, begging intensity and parental feeding might vary with age, the authors studied and videotaped active Tree Swallow (*Tachycineta bicolor*) nests during a single nesting season in Nova Scotia, Canada. The number of swallow nestlings that begged was significantly higher during the middle and latter portions of the nestling cycle compared to the early portion. At all nestling stages, nestlings that gaped sooner, reached higher and were closer to the front of the box, were fed significantly more often. Nestlings at all three stages reached higher when begging after the parents were gone from the nest for longer periods of time; conversely, after individuals were fed, their begging height decreased significantly during the next feeding visit. Both the mean begging height of the brood and the mean number of begging nestlings increased significantly after longer intervals between feeding. Coinciding with this increase in begging intensity when nestlings were fed less, was a significant response by the parents who returned to the nest sooner the higher the nestlings reached during the previous visit. No difference was detected at any nestling stage in gape order, reach or distance to the front of the nest between small and large nestlings, suggesting that older nestlings were not at a significant begging advantage over younger individuals. Moreover, no effect of nestmates on begging intensity, independent of hunger, was detected in any age group of nestlings. Although all nestlings received similar numbers of feedings, males demonstrated a significant preference for feeding larger nestlings while females preferentially fed smaller nestlings. The results of this study clearly demonstrate a definitive link between nestling need, begging intensity and parental feeding in Tree Swallows. This link suggests that begging in nestling Tree Swallows is an honest signal of need in this species. It is not clear why parents differed with regard to the size of nestlings they fed, but these data do suggest that the provision of food in Tree Swallows is not strictly under nestling control. [Dept. of Biology, Dalhousie Univ., Halifax, Nova Scotia, Canada B3H 4J1.]—Danny J. Ingold.

5. Risk taking during parental care: a test of three hypotheses applied to the Pied Flycatcher. S. Dale, R. Gustavsen, and T. Slagsvold. 1996. Behav. Ecol. Sociobiol. 39:31–42.—According to life-history theory there is a tradeoff between investment by parents in current versus future reproductive opportunities. In species with altricial young, such as passerine birds, there is a tradeoff between feeding the young, nest defense, and risk of predation on the adults. In this study the authors attempted a thorough examination of the factors influencing risk taking in parent birds as measured by intensity of nest defense and the amount

of time that elapses before they return to the nest after having been faced with a predation threat. The authors put forth three non-mutually exclusive hypotheses focused on the costs and benefits of risk taking by parents. (1) The "risk to parents" hypothesis focuses directly on the cost of parental risk-taking and predicts that risk-taking behavior should decrease as a predatory threat becomes increasingly dangerous. (2) The "reproductive value of offspring" hypothesis asserts that there should be a positive correlation between parental investment in offspring and the reproductive value inherent in the offspring. The prediction in this case is that parents with larger broods and larger sized or older offspring should take greater risks than parents with smaller broods and small sized, younger offspring. (3) The "harm to offspring" hypothesis focuses on the effect that a period of no parental care (delayed incubation, brooding, or feeding nestlings) could have on offspring. Here the authors predict that parents should take greater risks for younger versus older offspring, offspring in poor versus good physical condition, and that single parents (either secondary females of polygynous males or widowed females) should take greater risks than paired parents. This is because the marginal benefits of slightly increased parental care would be greatest for young nestlings or nestlings in poor condition (which is also frequently the case for nestlings with single parents). These hypotheses were tested during a one year study in southeastern Norway on the Pied Flycatcher (*Ficedula hypoleuca*) by exposing nesting pairs and secondary females to a stuffed specimen of a Sparrowhawk (*Accipiter nisus*), which represents a serious predatory threat to both adults and nestlings. The majority of data supported the "harm to offspring hypothesis" and, although several predictions for the "reproductive value of offspring" hypothesis were tested, no evidence was obtained to support this hypothesis. These findings contradict those of numerous other studies which have demonstrated that measures of parental investment, particularly nest defense, increase with the reproductive value of the offspring. The authors suggest that this difference may be explained at least in part by differences in experimental design between their study and most previous studies. Unlike most previous studies, in which parents were presented with models of nest predators, measures of risk taking in this study were examined while parents were exposed to a predator of adult birds. In addition, risk taking, as measured by the amount of time that elapses until feeding nestlings resumes, is a very direct measure of the amount of stress imposed upon nestlings versus other measures from previous studies such as alarm calling and mobbing. In conclusion, the authors suggest that the costs and benefits associated which each of the three hypotheses influence parental behavior, but that their relative importance ultimately depends on the specific circumstances in each test situation, including the type of predator and the environmental conditions (temperature, rainfall etc.). [Dept. Of Biology and Nature Conservation, Agricultural Univ. of Norway, P.O. Box 5014, N-1432 As, Norway.]—Danny J. Ingold.

FOOD AND FEEDING

(see also 12, 27)

6. Food niche of the Gyrfalcon *Falco rusticolus* nesting in the far north of Finland as compared with other choices of the species. K. Huhtala, E. Pulliainen, P. Jussila and P. S. Tunkkari. 1996. Ornis Fennica 73:78–87.—Prey remains and pellets from six Gyrfalcon eyries were analyzed to determine dietary habits of this species compared to similar data collected from breeding Gyrfalcons in Finnish Lapland. Only 30 pairs of Gyrfalcons are known to breed in Finland, making it a rare bird. The majority (70%) of the study area consisted of lowland forests with Norway spruce (*Picea abies*), Scotch pine (*Pinus sylvestris*) and birch (*Betula* spp.) as the dominate species. Bogs accounted for 13% or the remaining study area habitat, with subalpine birch forests and alpine fell summit accounting for 7% and 1% respectively. Birds were found to be the most dominant prey, constituting 98–100% of the total identified prey biomass. Of this, Willow Grouse (*Lagopus lagopus*) and Rock Ptarmigan (*Lagopus mutus*) were found to be the primary prey items (63–86% to the total biomass). Although the Willow Grouse is the most abundant tetraonid species in one study area, no overall correlation was observed between the proportion of ptarmigan in the diet and the density of *Lagopus* in the study area. Identified waders were primarily Whimbrel (*Numenius phaeopus*) and Golden Plover (*Pluvialis apricaria*). These waders comprised

6–24% of the total prey biomass. Twenty-eight bird species were identified from either prey remains or pellet material. Pellet material provided 7.4% (37 items) of the total 499 prey items identified. Mammals were found to account for 2.9–21.3% of the prey, but only 0.4–4.1% of the total biomass. General patterns observed in the majority of arctic environments reveal that Gyrfalcons specialize on ptarmigans in the early part of the nesting season, and shift later in the breeding season. Gyrfalcons, widely known as ptarmigan specialists were found to respond to high densities of potential new prey, such as waders or microtines. This flexibility in prey relates to both the size of the prey as well as seasonal and regional variations. The authors urge caution when comparing dietary diversity between regions however, noting that biases such as study duration contribute to the observed differences. The authors conclude that the Gyrfalcon is a combination of a prey specialist, whose annual cycle is geared towards that of its predominant prey, and an opportunist that frequently responds to functionally high densities of new prey sources. [Dept. of Zoology, Univ. of Oulu, Linnanmaa, FIN-90570 Oulu, Finland.]—Sue Bennett.

7. The diet of the Oilbird in Venezuela. C. Bosque, R. Ramírez and D. Rodríguez. 1995. Ornithol. Neotropical 6:67–80.—The diet of the Oilbird (*Steatornis caripensis*) was studied in Caripe, Monagas State of northeastern Venezuela. The mostly commonly eaten fruits were from Lauraceae (19 species), followed by Palmae (9 species), Burseraceae (3 species) and Araliaceae (1 species). The greatest amount of fruit pulp was from Lauraceae (47.1%) although it provided the second highest proportion of items eaten (43.9%). More Palmae (46.5%) were eaten, but they provided less pulp (22.1%). Although Burseraceae provided only 9.3% of the items, it composed 30.7% of the pulp in the diet. The breeding season of the Oilbird coincided with the period of maximum Lauraceae fruit availability which peaks from April through July. During the non-breeding season palms are the most important food item. Lauraceae fruit had the highest lipid (49.6% of dry mass) and energy content (31.8 kJ g^{-1}), and palms had lower values for both (12.5% and 23.2 kJ g^{-1}, respectively). [Univ. Simón Bolívar, Dept. Biología de Organismos, Apartado 89.000, Caracas 1080-A, Venezuela.]—Robert C. Beason.

8. Diet and flock size of sympatric parrots in the Atlantic forest of Brazil. M. A. Pizo, I. Simão and M. Galetti. 1995. Ornithol. Neotropical 6:87–95.—Two species of parakeets (*Pyrrhura frontalis, Brotogeris tirica*) and 4 species of parrots (*Forpus xanthopterygius, Pionus maximiliani, Pionopsitta pileata, Triclaria malachitacea*) were studied in southeastern Brazil in the Atlantic forest. The primary foods were fruits of Cercropiaceae, Myrtaceae, and Moraceae, with fleshy fruits preferred over dry ones. *Pyrrhura frontalis* ate more flowers than *B. tirica*. Only the 2 species of parakeets showed seasonal changes in flock size. *Brotogeris tirica* had larger flocks in the wet season than the dry season, but *P. frontalis* showed the opposite pattern. There was a noticeable decrease in parrot abundance during the dry season, probably caused by a change in habitat preferences. [Dept. de Zoologia I.B., Univ. Estadual de Campinas, CP 6109, 13083-970 Campinas, São Paulo, Brazil.]—Robert C. Beason.

9. Resource partitioning between Glossy and White Ibises in a rice field system in southcentral Cuba. M. Acosta, L. Mugica, C. Mancina, and X. Ruiz. 1996. Colon. Waterbirds 19:65–72.—The authors assess the degree of competition for food between White Ibises (*Eudocimus albus*) and Glossy Ibises (*Plegadis falcinellus*) in a 25,000 ha rice field complex. The study, conducted between May and December 1992, included a transect involving 13 microhabitats (10 of which were used by foraging ibises) that represented different stages in the rice cultivation cycle. In addition to censuses, 75 White, and 76 Glossy Ibises were shot and their stomach contents analyzed. In October maximum densities of both ibises occurred with Glossy Ibis densities ten times those of White Ibises, and the separation of the species by microhabiatat was greatest. The results of stomach analysis suggest that the diet of Glossy Ibises varies through the seasons: in spring and early summer they fed largely on invertebrates (their traditionally reported food) but thereafter shifted to a largely graniverous diet (stomachs contained predominately rice and large quantities of grit). White Ibises were more consistent in their use of invertebrates. In October 74% of Glossy and 35% of White Ibises foraged in rice fields with maturing ears while 6% Glossy and 56% White Ibises were in muddy fields, which is consistent with the shift of Glossy Ibises to a graniverous diet. The

authors suggest that the Glossy Ibises may feed largely on invertebrates to meet the demands of breeding season and shift to a graniverous diet in other seasons. [Dept. de Biologic Animal y Humana, Univ. de La Habana, Vedado y L, La Habana, Cuba.]—William E. Davis, Jr.

SONGS AND VOCALIZATIONS

10. Intracellular characterization of song-specific neurons in the Zebra Finch auditory forebrain. M. S. Lewicki. 1996. J. Neuroscience 16:5854–5863.—Auditory neurons in the hyperstriatum verntrale pars caudale (HVc) nucleus of the forebrain in the Zebra Finch (*Taeniopygia guttata*) are highly sensitive to the bird's own song, less so to conspecific song, and not at all to the songs of other species. These neurons responded most strongly to the correct song played forward and weakly to the same song with the sequence of syllables reversed. Song that was played backwards had no effect. These song-specific neurons either responded strongly through the song (tonic cells) or responded with a burst of action potentials at specific points during the song (phasic cells). Although the individual's own song was the strongest stimulus, phasic cells were inhibited during the correct song and less so to song with the syllables in reverse order. This inhibition was followed by phasic bursts of action potentials. The song-specific neurons appear to use long-lasting inhibition to integrate auditory context of syllables as a mechanism to determine their order. These responses are thought to play a role in song learning and production. [Computation and Neural Systems Program, California Inst. of Technology, Pasadena, CA 91125, USA.]—Robert C. Beason.

NESTING AND REPRODUCTION

(see also 2, 4, 5, 31)

11. Caspian Terns (*Sterna caspia*) breed successfully on a nesting raft. K. P. Lampman, M. E. Taylor, and H. Blokpoel. 1996. Colon. Waterbirds 19:135–138.—The site of the fourth largest Caspian Tern colony on Lake Ontario, at Hamilton Harbour, Ontario, is scheduled for development. Hence, in 1993 a 3.6 m × 9.8 m raft was constructed, placed in a pond near Caspian Tern nesting sub-colonies, covered with sand and gravel, Caspian Tern decoys were added, and Caspian Tern vocalizations played. In 1993 a single pair of Caspian Terns nested and produced two chicks. In 1994 six nests were established and six chicks fledged, although all nesting was late and may have consisted of pairs renesting after nest failure on the mainland. In 1995 the raft was colonized early in the season and at least 50 pairs nested and a high count of 97 chicks was made. Heavy fox predation on the mainland sub-colonies may have promoted the high frequency of raft nesting. No vocalizations were played in 1995 and the authors conclude that vocal attractants may not be necessary. This success story should be of interest to anyone working in avian conservation. [12-1280 Maple Crossing Blvd, Burlington, Ontario, L7S 2G2, Canada.]—William E. Davis, Jr.

12. Experimental manipulation of feeding in Red-tailed Tropicbird chicks. E. A. Schreiber. 1996. Colon. Waterbirds 19:45–55.—The author reports on an experimental study designed to test the hypotheses that adult Red-tailed Tropicbirds (*Phaethon rubricauda*) were not foraging at maximum capacity, and that adult behavior was adaptable to shifting chick food demands. Four experimental procedures were used to alter chick food demands at Johnston Atoll and Christmas Island in the central Pacific Ocean from 1991–1993. In the first experiment a second chick was added to 9 nests (Red-tailed Tropicbirds lay a single egg) thereby increasing the demand for food. In a second experiment food demand was increased by forcing single chicks (3 nests) to regurgitate their first meal of the day. Chicks at experimental nests received significantly more food than chicks at control nests, demonstrating that adults were capable of increasing their provisioning for young birds. However, chicks in doubled nests had significantly slower wing growth rates than control chicks. In a third experiment small and large chicks were switched between nests (8 nests) to alter food demands. Large chicks switched with small chicks received immediate increases in food delivery, and small chicks which replaced large one received food at rates comparable to small chicks in control nests on Johnston Atoll (6 nests) but higher amounts than control chicks on Christmas Island (2 nests). In the fourth experiment chicks at six nests were fed one or

two hard-boiled eggs each day to see if parent birds reduced their food delivery and to see if chicks begged less and accepted less food. Chicks that had two eggs took significantly less food from adults, but chicks that had one egg per day received similar amounts of food to control chicks. The author acknowledges that the sample sizes are lower than would be desirable to show conclusively that tropicbirds adults are not energy limited, but concludes that the behavioral response of adults to doubled and different aged chicks demonstrates flexibility (e.g., increased food delivery, and for adults that received a switched small chick extending their nesting season by 4–7 weeks). The author concludes that the results of these experimental procedures, together with previous work on tropicbirds nesting during El Niño-Southern Oscillation events are inconsistent with the hypothesis that seabird adults are energy limited (as suggested by David Lack in 1968) and hence the adaptations of seabirds (e.g., slow growth rate, small clutch size) may not be linked to energy constraints. This paper should be read by anyone interested in avian energetics or seabird evolution. [Ornithological Council, 4109 Komes Ct., Alexandria, VA 22306, USA.]—William E. Davis, Jr.

13. Effects of high-voltage powerlines on birds breeding within the powerlines' electromagnetic fields. P. F. Doherty, Jr. and T. C. Grubb, Jr. 1996. Sialia 18:129–134.—Although numerous studies have been conducted to examine the effects of electromagnetic fields (EMFs) from powerlines on humans and farm animals, relatively little is known about how EMFs effect free-ranging wild animals. In a one-year study in Ohio, the authors studied the potential effects of EMFs on Eastern Bluebirds (*Sialia sialis*), Tree Swallows (*Iridoprocne bicolor*), and House Wrens (*Troglodytes aedon*) nesting in boxes directly beneath powerlines. Transmission lines had no effect on any measure of reproductive measure in bluebirds and House Wrens; however, reductions in Tree Swallow reproductive success occurred on all three study sites. No correlation across the study sites between any reproductive measure and the strength of the EMFs was detected, suggesting that there is no dosage response relationship. The authors posed a few explanations for their findings, including the possibility that Tree Swallows might be a more "environmentally sensitive" species versus bluebirds or wrens. They do concede that their observations are difficult to interpret; nonetheless they suggest that if Tree Swallow fecundity was indeed reduced as a result of exposure to EMFs, then nesting habitats under transmission lines might be acting as a population sink for Tree Swallows and other species. [Dept. Of Zoology, The Ohio State Univ., Columbus, OH 43210, USA.]—Danny J. Ingold.

14. Reproductive success and symmetry in zebra finches. J. P. Swaddle. 1996. Anim. Behav. 51:203–210.—Fluctuating asymmetries are a measure of developmental stability in bilaterally symmetric traits and, hence, are a property of the genome as a whole. Since fluctuating asymmetry may reveal fitness-related information, it is possible that females are able to assess the quality of potential mates on the basis of male ornament asymmetry. Swaddle investigated the effects of ornament asymmetry on mate choice and reproductive success on captive Zebra Finches (*Taeniopygia guttata*). Six aviaries were established with 6 females and 6 males in each. Males were given arrangements of colored leg bands, two orange and two light green, resulting in 3 treatment groups: symmetric, cross-asymmetric and asymmetric. Symmetric males did not begin breeding earlier than cross-asymmetric or asymmetric males. It was suggested that nesting latency may not be a good indicator of female choice in this study because of freely available breeding sites and unlimited resources. The author also suggested that higher quality females may have chosen symmetric males, although female quality was not reported. Symmetrically banded males had greater reproductive success and fledged more young than both asymmetric and cross-asymmetric males. No difference in number of eggs laid or egg viability was detected. It was suggested that females mated to attractive (symmetric) males invested more in parental care and worked harder to rear their offspring than females mated to less attractive individuals (cross-asymmetric and asymmetric). The author was unable to conduct observations of parental activities or to determine if extra-pair copulations (EPCs) existed. I feel these types of data are needed in this study, especially since no data are available on female quality. If females are in fact selecting males based on symmetry, as suggested by Swaddle, then females mated to cross-asymmetric and asymmetric males might be expected to seek out symmetric males for EPCs.

If unable to do so, these females might be expected to reduce their investment in the current breeding attempt in hopes of mating with attractive males in the next attempt. [Inst. of Biomedical and Life Sciences, Div. of Environmental and Evolutionary Biology, Graham Kerr Bldg, Univ. of Glasgow, Glasgow G12 8QQ, U.K.]—Jeffrey P. Duguay.

15. Mate attendance and copulatory behaviour in Western Bluebirds: evidence of mate guarding. J. L. Dickinson and M. L. Leonard. 1996. Anim. Behav. 52:981–992.—The copulatory behavior and association of Western Bluebird (*Sialia mexicana*) pairs was investigated in Monterey County, California to determine if males protect their paternity. The authors observed 77 pairs in 84 different nesting attempts from 1990–1994. One hundred and sixteen copulation attempts were observed. The number of within-pair copulations attempted did not differ between the hour before laying, the first hour after laying and the second hour after laying, suggesting that males do not use frequent copulation as a paternity guard. Most intruding males (61%) were unrelated to the pair on whose territory they intruded. The peak rate of intrusions by extra-pair males coincided with the period when resident females were most receptive to copulation. Males tended to follow their fertile mates more often than the reverse. Additionally, intense mate following by males coincided with the period of maximal receptivity of females to copulation. A negative correlation was found between the distance between mates and the distance to the nearest neighboring nest. Males also tended to follow females more often when near neighbors, suggesting that male Western Bluebirds do indeed guard their paternity. [Hastings Reservation, 38601 E. Carmel Valley Rd, Carmel Valley, CA 93924, USA.]—Jeffrey P. Duguay.

16. Nest desertion by Blue-gray Gnatcatchers in association with Brown-headed Cowbird parasitism. C. B. Gougen and N. E. Mathews. 1996. Anim. Behav. 52:613–619.—Gougen and Mathews investigated parasitism rates of Blue-gray Gnatcatchers (*Polioptila caerulea*) in northeastern New Mexico in an attempt to discern natural rates of parasitism by Brown-headed Cowbirds (*Molothrus ater*) and to determine the effectiveness of nest desertion as an anti-parasite strategy. Eighty-three nests of 60 Blue-gray Gnatcatcher pairs were located from 1992–1995, of which 76% (63 of 83) were parasitized. Parasitism was responsible for the failure of 58% (48 of 83) of the nests. Of 48 parasitized gnatcatcher pairs, 19 (40%) deserted at least one nest and were often successful in fledging gnatcatcher young following renesting. The authors suggested that desertion followed by renesting represents an effective anti-parasite defense in the population studied. No support was found for the adaptiveness of acceptance or for the evolutionary lag hypothesis to explain the inconsistent desertion by gnatcatchers following parasitism. Gougen and Mathews suggest that nest desertion is a generalized response to nest disturbance by cowbirds. However, the cue that elicits this desertion is not understood. [Dept. of Wildlife Ecology, Univ. of Wisconsin, 226 Russell Labs, Madison, WI 53706, USA.]—Jeffrey P. Duguay.

MIGRATION, ORIENTATION, AND HOMING

(see also 23)

17. Migratory orientation of Red-eyed Vireos, *Vireo olivaceus*, in relation to energetic condition and ecological context. R. Sandberg and F. R. Moore. 1996. Behav. Ecol. Sociobiol. 39:1–10.—Migration is an expensive and high-risk event, the success of which is ultimately dictated by the physiological readiness of the migrant and its response to variable ecological conditions in route. The authors in this study examined migratory orientation in Red-eyed Vireos about to cross the Gulf of Mexico in fall and after having just returned across the Gulf on their return flight in the spring. The aim of the investigation was to focus on: (1) how energy stores of migrants influence their decision to initiate migration and their choice of migratory direction, and (2) how the integration of different migratory orientation cues such as the sun and stars is tied to energetic status in relation to migration across a significant ecological barrier. Migratory orientation data for fat and lean vireos were obtained both through cage experiments while manipulating the geomagnetic field and through free-flight release experiments. Energetic status proved to play a significant role in vireo migratory activity and directional orientation. Fat birds in cage tests were more likely

to embark on migration and oriented themselves in a mean southerly direction across the Gulf of Mexico, while lean birds were less active and selected headings in a west-northwest direction, consistent with reorientation migration along the coast or to inland sites. When magnetic north was altered, fat birds showed a statistically significant shift of about 50° to the left of the controls, while lean birds showed a nonsignficant shift of about 44° to the left of controls. Fat and lean birds in free flight release experiments oriented themselves in completely opposite directions (fat to the southwest and lean to the northeast). During the spring migration there were too few fat birds to draw meaningful comparisons with lean birds. Nonetheless, control birds (in the absence of a shift in the geomagnetic field) in both cage and free flight release experiments under clear skies, oriented themselves significantly more often in northwesterly or northeasterly directions respectively. When the geomagnetic field was deflected for caged birds, they responded with a significant 64° shift to the left of the control group. Vireos released in free flight experiments under cloudy skies selected a significantly more westerly course than the controls. The results of this study are the first to demonstrate that Red-eyed Vireos possess a magnetic compass; moreover, the disparity in directions chosen by vireos under clear versus cloudy skies may demonstrate a need for celestial cues to reset their compass. Finally, the data clearly indicated that vireos integrated information from the geomagnetic field into their orientation patterns more effectively when they were in good physiological condition. [Dept. of Biological Sciences, Univ. of Southern Mississippi, Hattiesburg, MS 39406-5018, USA.]—Danny J. Ingold.

18. Bimodal orientation and the occurrence of temporary reverse bird migration during autumn in south Scandinavia. S. Akesson, L. Karlsson, G. Walinder, and T. Alerstam. 1996. Behav. Ecol. Sociobiol. 38:293–302.—In coastal regions when migrating birds encounter the sea they may actually turn around and undertake a reverse migration in order to replenish their fuel reserves before attempting to cross such a large barrier. In this study, the authors examined extensive bird banding recoveries on the southwest coast of Sweden, to determine whether autumn reverse migration behavior is a common phenomenon among different categories of migratory birds when they encounter a significant barrier. Over 700 recoveries representing 20 different passerine bird species were analyzed. Forty-three percent of short-distance or irruptive migrants including Blue Tits (*Parus caeruleus*), Great Tits (*Parus major*), and Jays (*Garrulus glandarius*), and 48% of tropical migrants including Yellow Wagtails (*Motacilla flava*), Sedge Warblers (*Acrocephalus schoenobaenus*) and Reed Warblers (*A. scirpaceus*) were recovered within 10 days of banding. Reoriented migratory movements were observed in 40% (288) of the total sample of recovered birds and in 64% (185) of those birds recovered within 10 days of capture. Reverse migration occurred more often in all categories of migrants (short distance, temperate, and tropical) in the first 10-day period after capture compared to later on. The majority of reverse migratory movements occurred in a direction about opposite the normal southwest migration direction and were headed inland. Within the first 10-day period, no significant difference was detected in the proportion of reverse recoveries of diurnal versus nocturnal migrants. Reverse migration distances ranged from 4–520 km with a median distance from 9–65 km for the majority of species during both time periods (during first 10 days and later). Although the majority of all categories of migrant birds captured had modest fat deposits, a significant correlation was detected between the mean fat scores of birds at capture and the proportion of reverse migration among different species within the first 10 days. In two species (Blue Tits and Reed Warblers), individuals that undertook reverse movements were significantly lighter than forward-moving birds. Taken together, these data clearly demonstrate that when confronted with a major barrier, reverse migration is a common phenomenon among a wide variety of irruptive, temperate zone, and long-distance tropical migratory bird species. The authors discuss the potential adaptive significance of a bimodal orientation mechanism in coastal areas and at peninsulas, and suggest that some individuals (particularly those with low fat reserves) are able to avoid intense competition for food and alleviate the risk of predation by moving inland to more suitable resting and feeding grounds before crossing a major barrier. [Dept. of Animal Ecol., Lund Univ., Ecology Bldg., S-223 62 Lund, Sweden.]—Danny J. Ingold.

19. Orientation cage experiments with Dunlins during autumn migration in Iceland. R. Sandberg and G. A. Gudmundsson. 1996. J. Avian Biol. 27:183–188.—The authors placed more than 20 Dunlins (*Calidris alpina*) in modified "Emlen" funnels to examine whether this technique was feasible for assessing orientation in migrating shorebirds. Test birds were placed in funnels at sunset no more than five hours after capture and were released one hour later. Dunlins exhibited a well-oriented cluster of activity toward the SSE, the same direction in which they should have been migrating (according to band recoveries). These results suggest that small shorebirds can be used in controlled experiments to investigate orientation and navigation. [Dept. of Animal Ecology, Lund Univ., S-223 62 Lund, Sweden.]—Jeff Marks.

20. Magnetic orientation in birds. W. Wiltschko and R. Wiltschko. 1996. J. Exp. Biol. 199:29–38.—This is a review of the role of the Earth's magnetic field on avian orientation and navigation by the researchers most responsible for initiating and stimulating such research. Use of the geomagnetic field for orientation has now been reported for 18 species of birds. In all cases, it is used as an inclination compass that distinguishes poleward from equatorward rather than north from south. Consequently, birds in either hemisphere can use the same mechanism to orient. Species that cross the magnetic equator rely on a complex interaction of information from the magnetic field and celestial cues to cross the equator. The use of the magnetic field for location or map information is unclear. There is some evidence to support to idea, but there is a great deal of variability and apparent discrepancies in the results. At this time there is no hypothesis that has been proposed that accounts for all of the observed behavioral responses to magnetic fields. Clearly, this is an area in which more work, including theoretical work, is needed. [Fachb. Biologie der Univ., Zoologie, Siesmayerstr. 70, D-60054 Frankfurt, Germany.]—Robert C. Beason.

21. Pigeon homing: observations, experiments and confusions. C. Walcott. 1996. J. Exp. Biol. 199:21–27.—Homing pigeons (*Columba livia*) have long been used for research on animal navigation. In this paper, Walcott, a distinguished research on pigeon navigation, reviews what is known about pigeon orientation and what isn't. In a table, he summarizes the various sensory cues that have been proposed as sources of information for pigeons and evaluates their certainty. Sun azimuth (sun-compass), magnetic field, and visual landmarks rated a high degree of certainty, with the first 2 providing compass cues. Odors and magnetic fields rated intermediate degrees of certainty for use as map cues. Pigeons appear to be very flexible in their use of multiple cues. This has resulted in much of the confusion interpreting the results of many experiments. Pigeons raised in different lofts appear to develop different preferences of specific cues over others. This paper should be a starting point for anyone interested in the literature of avian navigation even though its content is limited to pigeon experiments. [Lab. of Ornithology and Sect. of Neurobiology and Behavior, Cornell Univ., Ithaca, NY 14850, USA.]—Robert C. Beason.

22. Magnetic orientation of Snow Buntings (*Plectrophenax nivalis*), a species breeding in the high arctic: passage migration through temperate-zone areas. R. Sandberg and J. Pettersson. 1996. J. Exp. Biol. 199:1899–1905.—These experiments were conducted near the Ottenby Bird Observatory in southeast Sweden during spring migration in 1990 and 1991 and autumn migration in 1991. When the birds had a view of the night sky and when the tops of their cages were covered with translucent plastic, they oriented in a seasonally appropriate direction with respect to the natural or an artificial magnetic field that was rotated 90° CW or CCW. When the artificial magnetic field was vertical, the buntings were bimodal in their orientation when they could see the night sky, but when the cages were covered with a diffusing plastic top, the birds were disoriented. These results are consistent with those from other avian species in that the buntings appear to use an inclination magnetic compass, but they differ from experiments on other emberizids in that the magnetic cues are more important than visual cues at sunset. [Dept. of Animal Ecology, Lund Univ., Ecology Bldg., S-223 62 Lund, Sweden.]—Robert C. Beason.

HABITAT USE AND TERRITORIALITY

(see also 6)

23. Habitat utilization of small birds during autumn migration on the lakeside of Lake Neuchâtel. [Habitatnutzung von Kleinvögeln in der Herbstzugzeit am Neuenburgersee.] L. Jenni and F. Widmer. 1996. Ornithol. Beob. 93:221–248. (German, English summary.)—Mist nets were used to census bird species in various habitats along Lake Neuchâtel during autumnal migrations 1987–1989. The birds divided the habitats into 4 groups: forest, forest edge, inner reedbed and outer reedbed. Species that occupied the reedbeds during the breeding season remained there during the autumn, but species that bred in the forest expended into the reedbed during autumn migration. The forest edges were very important for many species because they provided berries. The forest interior was used by the fewest species and individuals of all the habitats. [Schweizerische Vogelwarte, CH-6204 Sempach, Switzerland.]—Robert C. Beason.

24. Patterns and variation in the structure of forest bird communities in southern Finland. T. Solonen. 1996. Ornis Fennica 73:12–26.—Habitat area and characteristics were examined to determine forest bird species richness and density in 125 census plots of southern Finland. The study areas were located in the hemiboreal and south-boreal zoogeographical zones of southern Finland and included census data collected by the author. To ensure comprehensive coverage of the whole forest bird fauna of the region, including sparse and restricted species, study areas of various size and habitats were investigated. Study areas were classified as small, predominantly homogeneous habitat patches (mean = 1.5 ± 0.3 ha, n = 51); regular mapping plots (mean = 13.8 ± 1.6 ha, n = 68); and six larger study areas that were monitored by the mapping method or by a combination of territory mapping and line transect menthods. No correlation was observed between the number of visits and bird density in the mapping plots, which suggests that the results of different censuses were in this respect comparable. To minimize unrealistically high estimates, single species densities for each sample were calculated only if the species was represented by more than one pair. Forest habitats were characterized by dominant tree species and by edge abundance, productivity as indicated by forest type, number of trees, successional stage (age of trees in yrs.), hole (nest-boxes) density and management intensity with respect to thinning. Samples were standardized by areas to study the variation in species number. As predicted, species numbers increased with increasing study area size. Overall bird density decreased with increasing size and was higher in more productive study sites. Species richness was found to have a significant positive relationship with the amount of edge present. A significant dependence between species number and forest productivity in larger study plots (5.0–55.0 ha) was also observed, but this dependence was not found in the smaller study plots (0.2–10.0 ha). Species numbers were found to exhibit significant positive relationships with both tree age and the numbers of trees present. Those forests with a moderate number of trees appeared to most attractive to birds. Average bird densities of these main forest types ranged from 440–1060 pairs/km^2. Bird densities were found to vary significantly between forest types, with coniferous forests showing significant differences from mixed and deciduous forest types. Community evenness decreased significantly with increasing habitat productivity. The analysis also revealed that the distribution of species abundance approximately fit a lognormal distribution. The author concluded that some general habitat features, i.e., patch size, edge amount and productivity, explained part of the variation in the structure of forest bird communities. However, this proportion was small, especially at larger geographical scales. [Neitsytsaarentie 7 b B, FIN-00960 Helsinki, Finland.]—Sue Bennett.

ECOLOGY

(see 7, 8, 9, 24, 30, 33)

ZOOGEOGRAPHY AND DISTRIBUTION

25. Historical diversification of birds in northwestern South America: a molecular perspective on the role of vicariant events. R. T. Brunfield and A. P. Capparella. 1996. Evolu-

tion 50:1607–1624.—The Chocó area of South American lies between the Western Andean Cordillera and the Pacific Ocean. Its endemism has a high number of restricted taxa including birds. The authors evaluated the derivation of the avifauna in the Chocó area using protein electrophoretic data from 14 taxonomically diverse species-groups. Most (9 of 14) of these groups showed a closer affiliation with Central American taxa than with Amazonia. These results are consistent with those based on phytogeographic data. Within species-groups, the genetic distances between taxa east of the Andes and west of the Andes was about twice that between the Chocó and Central American taxa. These results are consistent with the idea that the taxa east and west of the Andes were separated as a result of the uplifting of the Andes dividing a formerly continuous population and isolating two faunas in refugia on opposites of the mountains, or with the idea that Amazonian taxa dispersed westward across the Andes. [Lab. of Molecular Systematics, National Museum of Natural History, Smithsonian Inst. MRC 534, Washington, DC 20560, USA; email: brumfld@onyx.si.edu.]—Robert C. Beason.

SYSTEMATICS AND PALEONTOLOGY

(see also 25)

26. The skeletal evidence for a sister-group relationship of anseriform and galliform birds—a critical evaluation. P. G. P. Ericson. 1996. J. Avian Biol. 27:195–202.—In the words of the author, "The phylogenetic affinities of the Anseriformes is one of the most intensively discussed higher-level taxonomic problems in ornithology in recent years." The debate typically is divided between either the Ciconiiformes or the Galliformes as containing the closest relative of the Anseriformes. Much of the support for the galliform relationship comes from analyses of cranial characters by Joel Cracraft. In a review of the evidence for an anseriform-galliform connection, Ericson examined skeletal characters in all of the traditionally recognized families and subfamilies of the two orders (i.e., omitting the Opisthocomidae). Of 11 postulated synapomorphies (by Cracraft) of the cranium and mandible that link the two orders, three express variation already covered by the other characters, and six either cannot be verified in most anseriforms and galliforms, or occur widely in other orders. Ericson posits that only two of Cracraft's postulated synapomorphies (i.e., a feature of the basipterygoid process and a character complex describing the design of the quadro-mandibular articulation) are uniquely possessed by anseriforms and galliforms, at least among living birds. Ericson concludes that evidence for the link between the two orders is "very weak" and is ". . .based partly on a biased selection of osteological evidence, and partly on a too superficial analysis of the taxonomic distributions of the selected characters." [Dept. of Vertebrate Zoology, Swedish Museum of Natural History, S-104 05 Stockholm, Sweden.]—Jeff Marks.

EVOLUTION AND GENETICS

(see 4, 5, 25, 26, 30, 31)

PHYSIOLOGY AND DEVELOPMENT

(see also 10, 17, 18, 34)

27. Behavioral control of daily fattening in Great Tits (*Parus major*). K. E. Lilliendahl, A. Carlson, J. Welander, and J. B. Ekman. 1996. Can. J. Zool. 74:1612–1616.—Many temperate-zone passerine species are heavier in winter than in other seasons, but not as heavy as they could be. There is apparently a tradeoff between carrying extra fat for survival, and increasing the risk of predation because of reduced mobility or increased foraging time. Great Tits in winter gain mass throughout the day to build up fat reserves for overnight survival. In this study the authors examined the pattern of daily fattening to evaluate the extent of behavioral control. Captive birds were exposed to a colder than usual night, so that fat reserves were lower by morning, as determined by lower body mass. On the day after cold exposure the birds gained mass, and most returned to pre-experimental mass by evening. On both pre-experimental and experimental days, mass gain was fairly constant

throughout the day, but on the experimental day mass gain was higher in the first hour of light. This difference suggests that the birds adjusted their food intake in response to an assessment of body fat levels. The authors concluded that this species ordinarily does not consume food at a maximal rate, and that the pattern of daily fattening and maximum winter body mass are primarily under behavioral, not physiological, control. [Dept. of Zoology, Stockholm Univ., 106 91 Stockholm, Sweden; e-mail: klill@hafro.is.]—Scott W. Gillihan.

28. Comparison of water consumption between two grassland emberizids. J. L. Zimmerman. 1995. Prairie Nat. 27:215–221.—Dickcissels (*Spiza americana*) and Lark Buntings (*Calamospiza melanocorys*) are ecologically equivalent, midsized omnivores of the tall-grass and short-grass prairies, respectively. But Lark Buntings inhabit more arid environments, and thus might be expected to require less water. Captive birds of both species were exposed to several different temperature/humidity/photoperiod regimes, with water intake measured. Experimental temperatures were above, below, and within the birds' zone of thermal neutrality, and photoperiods approximated winter and summer conditions. Water consumption by both species generally increased with increasing temperature, while humidity had no measurable effect, and photoperiod had only minor effect. As predicted, Lark Buntings consumed less water than Dickcissels. The author speculated that Lark Buntings could meet their daily water requirements through metabolically produced water and from their insect prey, while Dickcissels would also need access to free water. [Div. of Biology, Kansas State Univ., Manhattan, KS 66506-4901, USA.]—Scott W. Gillihan.

29. Energy expenditure during molt in Dippers (*Cinclus cinclus*): no evidence of elevated costs. C. R. Brown and D. M. Bryant. 1996. Physiol. Zool. 69:1036–1056.—Circumstantial evidence points to molt as energetically expensive—it is timed so as not to overlap with other energetically-expensive activities. Molt might be particularly expensive for Dippers, with their relatively small size and regular exposure to chilling water. This study, conducted in central Scotland, included laboratory measurements of energy expenditure with field work on activity budgets and energy expenditures. In the lab, energy expenditures by molting and nonmolting birds were statistically equal. There was a weakly positive relationship between molt intensity and average daily metabolic rate for birds within their thermoneutral zone. In the field, molting birds spent most of the daylight hours resting, and were seldom seen flying or diving, except near the end of molt. Reduced activity is common in molting birds, presumably to conserve energy to offset the costs of molt. Estimates of daily energy expenditure by free-living birds were not correlated with molt intensity. The authors concluded that molt is not energetically expensive for Dippers. They offer several explanations for the timing of the molt, specifically its separation from other energetically costly activities: it hinders flying and diving abilities (breeding birds might need more mobility), it occurs during a period of low prey availability (other activities require an abundance of food), it occurs just before temperatures decline for winter (new feathers may insulate better), it provides fresh plumage just as the birds are competing for territories (plumage characteristics can signal social status), and it coincides with a period of mild weather (the birds can enjoy relative inactivity). [Dept. of Zoology and Entomology, Rhodes Univ., P.O. Box 94, Grahamstown 6140, South Africa; e-mail: zocb@giraffe.ru.ac.za.]—Scott W. Gillihan.

PLUMAGES AND MOLTS

(see also 29)

30. An hypothesis for seasonal color change in the genus *Sterna*. G. Voelker. 1996. J. Avian Biol. 27:257–259.—During the prebasic molt, most adult terns of the genus *Sterna* attain a mottled crown after replacing a limited number of head feathers. This molt typically begins after breeding but before migration. The adaptive significance of this phenomenon has not been examined before now. Voelker points out that the molt probably has nothing to do with crypsis, physiological benefits, nor differential wear of crown feathers. Many species of *Sterna* from the Northern Hemisphere migrate to the Southern Hemisphere, crossing and sometimes wintering in the breeding ranges of other *Sterna* species (which have black crowns). Voelker suggests that the appearance of the nonbreeding species presents an easily recognizable signal that enables them to avoid aggressive interactions with

breeding species that they encounter during migration or on the wintering grounds. Subadults of these same Northern Hemisphere species also have a mottled crown and presumably obtain the same benefits from this appearance as do adults. The phenomenon is not restricted to Northern Hemisphere species. Two resident *Sterna* from South America have mottled crowns during the nonbreeding season, where they occur in sympatry with a black-crowned congener that breeds year-round. Voelker further suggests that most Northern Hemisphere *Sterna* do not attain a completely white crown because they cross the breeding range of two tropical *Sterna* that have white crowns and breed year-round. Indeed, the only northern *Sterna* that molts to a completely white crown (Forster's Tern [*S. forsteri*]) does not cross the breeding range of any species of *Sterna* during migration. The story is a bit more complicated than I have indicated. I urge anyone with a special interest in the functional significance of molt to read this paper. [Burke Museum and Dept. of Zoology, Univ. of Washington, Seattle, WA 98195, USA.]—Jeff Marks.

PARASITES AND DISEASES

31. Ectoparasite transfer during mating in Ring-necked Pheasants *Phasianus colchicus*. N. Hillgarth. 1996. J. Avian Biol. 27:260–262.—According to one model of parasite-mediated sexual selection, females mating with non-parasitized males benefit directly via reduced parasite loads. This appealing and intuitive hypothesis has received little empirical support because so little is known about parasite transfer during mating. Toward filling this gap, Hillgarth dusted 20 male pheasants to remove their ectoparasites (mostly lice). One week later, after periodic examinations proved that the males were parasite-free, Hillgarth attached sticky tape to their tarsi and placed them individually in pens with parasite-infested females. Males were removed within two seconds of mounting the females and the sticky tape examined for lice. A "significant number" of males was infested during the experiments; i.e., at least one louse was found on five of the 20 males. The number of parasitized males may have been higher because lice probably were knocked off the tape as the males were recaptured following mating. The experiment proved that ectoparasites can be transferred rapidly between mating partners. At this point, you may be thinking "Why not dust the females and place them in pens with infected males?" The answer: because it was difficult to come up with a means of getting lice to stick to females without impeding the efforts of the males (i.e., a female's tarsi would not necessarily contact the male during mating, so some sort of device would have to be attached to her dorsum). Hillgarth concludes that females mating with infected males are likely to obtain new lice during copulation. Presumably, the higher the male's parasite load, the greater the number of lice transferred to the female. Hillgarth further notes that the lice in question (*Goniodes colchici* and *Menopon* sp.) tend to congregate on the backs of females and on the flanks of males during the mating season, probably because they are seeking opportunities to transfer to new hosts during copulation. [Burke Museum and Dept. of Zoology, Univ. of Washington, Seattle, WA 98195, USA.]—Jeff Marks.

WILDLIFE MANAGEMENT AND ENVIRONMENTAL QUALITY

(see also 11, 13)

32. Recovering from oil spills: the role of proactive science in mitigating adverse effects. K. C. Parsons. 1996. Colon. Waterbirds 19:149–153.—Catastrophic oil spills affect wildlife populations through direct toxicity and indirectly through the reduction of habitat and food resources. In this commentary, Parsons presents an example of how scientific preparedness (biological monitoring) together with response planning by industry and various regulatory agencies can enhance the chances of reasonable recovery from oil spill disasters. The case history involved the significant wading bird population in the New York Harbor area which includes the Arthur Kill and Kill van Kull shipping waterways that have major storage facilities for fuel oil. New York Harbor is the major port for distribution of fuel oil in the northeastern United States (68 billion liters annually). The Arthur Kill area had recovered substantially from a heavily polluted condition after the passage of the Clean Water Act, and by 1990 8 species of waterbirds had colonized the Kills' wetlands, with about 2500 breed-

ing pairs representing a quarter of the nesting wading birds along the coasts of Connecticut, New York, and New Jersey. In 1990 a series of disastrous spills dumped 5.7 million liters into harbor waterways. An Exxon Bayway pipeline spill alone dumped 2.1 million liters into the Arthur Kill. This latter spill damaged >100 km of shoreline and 80 ha of marsh. From 1986–1990 Parsons had studied the wading bird ecology of the area and hence was able to compare the 1990–1995 wader ecology with prespill data. Tidal foraging species (e.g., Snowy Egrets [*Egretta thula*] were heavily impacted by the spill, and reproductive failure occurred for three breeding seasons (1990–1992). Nontidal species (e.g., Black-crowned Night-Heron [*Nycticorax nycticorax*] were relatively unaffected by the spill. The information which had been acquired prior to the spill was important to the various private organizations and state and federal agencies in demonstrating damages and assessing penalties and remediation funds for polluters. A settlement of $15 million was reached with Exxon. This case study demonstrates the efficacy of acquiring baseline data on sensitive ecological systems where the probabilities of negative environmental impact are high. This is an important commentary that demonstrates how scientific input can be utilized in conservation problems involving industry and the general public. It should be of interest to anyone involved in conservation politics and initiatives. [Manomet Observatory for Conservation Sciences, P.O. Box 1770, Manomet, MA 02345-1770, USA.]—William E. Davis, Jr.

33. The effect of summer cottages on land bird numbers in a Finnish archipelago. K. Lehtilä, K. Ennola and K. Syrjänen. 1996. Ornis Fennica 73:49–59.—The effect of summer cottage settlement on land bird numbers was studied in an archipelago in southwest Finland. These investigators address whether cottages alter bird distributions, which species and species groups are most affected by cottages, and whether cottages were situated in habitat that was originally best or worst for birds, thus biasing present population density comparison. The archipelago is a popular recreational area with increasing developmental pressures. Forty pairs of islands were chosen for this study such that one island in each pair had at least one cottage, while the other was undeveloped. Paired islands were no more than 100–2000 m apart. Island area, topography and exposure to open sea were as similar as possible to one another. Island areas ranged from 0.16–17 ha in the non-cottage group (mean = 3.3 ha), and 0.15–13 ha (mean = 3.5 ha) in the cottage group. Generally, the study islands were small, since the majority of the larger (>20 ha) islands had cottages on them, and therefore non-cottage comparisons with these larger islands was not feasible. All buildings on the cottage group had been completed at least 5 years prior to the study and most had been constructed roughly 10 yrs prior. The number of birds nesting in artificial structures and nest boxes increased with the number of cottages. When the islands were compared pair-wise, mean species richness was found to be significantly greater on cottage islands than non-cottage islands. However, combining the data and treating it as one sample for cottage islands and one for non-cottage islands, the differences between island groups disappeared. Overall, there was little difference in the avifauna on cottage and non-cottage islands, with a few exceptions. The Wagtail (*Motacilla alba*) stood out as favoring islands with cottages ($P < 0.05$). The Wagtail is indigenous to the archipelago and is a common ground nester, preferring to nest in ground and rock hollows. Buildings also provided good nesting sites. Conversely, the Oystercatcher (*Haematopus ostralegus*) and the Willow Tit (*Parus montanus*) were more abundant, but not significantly ($P < 0.10$) so on non-cottage islands. The results of this study indicate that cottage settlement and bird numbers reflected changes in the breeding site selection process. The authors note that human disturbance may also have an effect later in the breeding season, but probably not on passerines. The authors warn however, that rare species may be more sensitive to recreational activities in archipelagos. [Sect. of Evolution and Ecology, Div. of Biology, Storer Hall, Univ. of California, Davis, CA 95616, USA]—Sue Bennett.

34. Environmental contaminant levels in Sharp-shinned Hawks from the eastern United States. P. H. Wood, C. Viverette, L. Goodrich, M. Porkas and C. Tibbott. 1996. J. Raptor Res. 30:136–144.—Tissue samples collected from Sharp-shinned Hawks, *Accipiter striatus,* in the eastern United States from 1991–1993 were tested for contaminants. Twenty-one blood samples were obtained from birds banded along the Kittatinny Ridge, PA, and Cape May, NJ. Ten brain and 31 liver samples were obtained from birds that died in reha-

bilitation centers in the eastern U.S. Of the compounds tested for, DDE, PCBs, and mercury were detected most frequently and in the highest concentrations. DDE was found in 16 of 20 blood samples. All of the brain and liver samples contained DDE. No differences in DDE levels were detected between sexes or among years. However, DDE levels detected in blood samples were significantly higher in adults than juveniles. DDE levels detected from liver samples were not significantly greater in adults than juveniles. The authors suggest that Sharp-shinned Hawks obtain DDE from their wintering grounds. PCBs were detected in 9 of 10 brain samples and 24 of 26 liver samples. No differences were detected in PCB levels among different ages, sexes, or years. Although mercury was detected in 18 of 19 livers, it was present in low concentrations. The level at which contaminants affected reproduction in Sharp-shinned Hawks is unknown. Further research is needed to document the effects of contaminants on reproduction.—Sherry Meyer.