

## RECENT LITERATURE

Edited by John A. Smallwood

## RESEARCH TECHNIQUES

(see 9, 35)

## BEHAVIOR

(see also 16, 27, 36)

1. **Non-random philopatry of sibling Spotted Sandpipers *Actitis macularia*.** J. A. R. Alberico, J. M. Reed, and L. W. Oring. 1992. *Ornis Scand.* 23:504-508.—Past research by Oring and his co-workers has documented that Spotted Sandpipers are sex-role reversed and that they exhibit high breeding-site fidelity with no difference in dispersal between the sexes. Based on nine years of data, the authors determined that sibling Spotted Sandpipers from the same nest returned to the study area at a higher rate than expected. Philopatry was not related to parental identity, fledgling production, fledging success, brood size, or fledging date. Interestingly, siblings did not return to the breeding grounds together. However, the authors speculate that short-term association of siblings could explain the observed nonrandom philopatry “if siblings experience similar migration stresses and predation pressures.” These data have two important implications. First, combined with the high site fidelity exhibited by adults, nonrandom sibling return increases the chances of extreme inbreeding in this species. Second, the results point to the importance of considering assumptions about independent dispersal or philopatry in other species. [Ecology, Evolution, and Conservation Biology Program, Univ. of Nevada, Reno, NV 89512, USA.]—Jeff Marks.

2. **Effects of experimental manipulation of male secondary sex characters on female mate preference in Red Jungle Fowl.** M. Zuk, J. D. Ligon, and R. Thornhill. 1992. *Anim. Behav.* 44:999-1006.—Previous studies by Zuk et al. (1990, *Evolution* 44: 477-485; 1990, *Am. Zool.* 30:235-244; 1990, *Am. Nat.* 136:459-473) showed that female Red Junglefowl (*Gallus gallus*) preferred males with longer, more brilliantly colored combs; redder eyes; redder feathers; and, possibly, longer tail feathers. However, when these characters were manipulated, females showed no significant preferences in choice tests. Analysis of characters that were unaltered in these experiments showed that hens preferred the males with longer wattles, more golden hackle feathers, darker irises, and redder head feathers. Were the previous experiments in error? The authors suggest an intriguing alternative, that hens respond to a suite of physical characters when choosing a mate. When one of these characters is anomalous, hens focus on other characters. More importantly, the results suggest that the many different ornamental features are neither relics of past selection nor pleiotropisms, they are part of a redundant suite of secondary sex characters that ensure truthful communication. Alternatively, the different traits may be additive with the sum dictating the hen's choice. These alternatives await further experimentation. [Dept. of Biology, Univ. of California, Riverside, CA 92521, USA.]—Edward H. Burt, Jr.

3. **Post-nesting movements of female Blue Grouse.** L. G. Sopuck and F. C. Zwickel. 1992. *Northwest. Nat.* 73:46-53.—Previous work by Zwickel and his students has suggested that adult female Blue Grouse (*Dendragapus obscurus*) impede settlement of yearling females until after the adults have started nesting. Thus, some yearlings may be forced to nest in habitats that are suboptimal for brood-rearing. The authors radio-tagged 50 female Blue Grouse to determine the extent to which broods used habitats within the nesting area. Twenty of the radio-tagged hens raised broods (four adults and 16 yearlings) and 30 failed before or soon after the eggs hatched (two adults and 28 yearlings).

Of the hens with broods, all four adults stayed within 0.5 km of their nest during the first week post-hatch; seven of 16 yearling hens moved >0.5 km during this same period. Two yearlings that nested in dense forest (suboptimal brood habitat) moved >1 km to open habitat immediately after their broods hatched. Size of brood ranges increased steadily for the 10 weeks of monitoring, averaging >20 ha by eight weeks post-hatch. There was no apparent difference between age classes in the size of brood ranges.

Eleven of 30 broodless hens moved 1-3.2 km immediately after losing their nests or

hatchlings. All but one of these 11 birds moved to dense forest. Overall, 43% of the broodless hens moved >0.5 km from their nests. Although home range sizes of broodless hens were not statistically different from those of brood hens, brood hens occupied areas with more open vegetative cover. In addition, broodless hens migrated to the winter range an average of one month before brood hens. The authors suggest that (1) saturation of optimal habitats by adults forces some yearling females to nest away from suitable brood habitats, and (2) broods remain on the breeding range longer than broodless hens because of resource requirements of the chicks. [Renewable Resources Consulting Services, 9865 West Saanich Rd., Sidney, BC V8L 3S1, Canada.]—Jeff Marks.

## FOOD AND FEEDING

(see also 10, 31)

### 4. Life-history theory in the nonbreeding period: trade-offs in avian fat reserves?

C. M. Rogers and J. N. M. Smith. 1993. *Ecology* 74:419–426.—This paper is an important paper, but one that must be read carefully; along with clever ideas and interesting test results, it contains a few contradictory statements and unsupported assertions. The main idea being tested is that wintering birds maintain an optimum level of fat reserves, that optimum being a compromise between the costs (e.g., time spent feeding, energetics of flying with the fat load, increased exposure to predators) and the benefits (ability to survive an unpredictable period of reduced food availability). The authors tested this idea by comparing the fat reserves of several species in different environments. Fat reserves should be less valuable to birds with more reliable food supplies. Therefore, ground-feeding birds (whose food can be rendered unavailable by heavy snow) should maintain larger fat reserves than tree-feeding birds. Likewise, birds from areas of heavy snowfall should carry larger fat reserves than birds from locations with milder winters.

The authors tested two predictions. Prediction 1 was “. . . when ground- and tree-feeding guilds are compared between geographic regions of harsh and mild winter climate, only ground-feeders (in the harsh climate) will have high fat reserves . . .” The authors assumed that heavy snows do not impede foraging for tree feeders. Rogers and Smith tested this prediction with three sets of comparisons. In all comparisons, wild birds were mist-netted within a few hours of dawn during the winter months, and visually scored from 0 to 5 for subcutaneous fat reserves. The comparisons were: (1) Dark-eyed Juncos (*Junco hyemalis*, a ground feeder) versus American Goldfinch (*Carduelis tristis*, a ground and tree feeder) in Michigan (heavy snow) versus British Columbia (moderate snow); (2) *Spizella* sparrows (*S. arborea* and *S. pusilla*, ground feeders) versus Northern Cardinals (*Cardinalis cardinalis*, a ground and tree feeder) in Michigan versus Tennessee (light snow); and (3) an unbalanced comparison of Dark-eyed Juncos from Wisconsin (heavy snow) and Seattle, Washington (light snow), versus Black-capped Chickadees (*Parus atricapillus*, a tree feeder) from Wisconsin and British Columbia. In each comparison, the ground feeders' average fat reserves were significantly higher in areas of heavy snow, while there was little or no difference between the fat reserves of tree feeders of the two areas. Although there are serious (partially acknowledged) statistical problems in analyzing their data, the results do coincide with their prediction.

Prediction 2 was that in areas with little snow cover, there would be no significant differences between the fat reserves of ground-feeding and tree-feeding birds. The authors tested this prediction by comparing the fat reserves of 16 different bird species in British Columbia. The results are not at all consistent with their prediction; whether comparing all the species or just the emberizids (for phylogenetic control), the differences in fat reserves between guilds were highly significant ( $P < 0.0001$ ). Nevertheless, in the abstract and the discussion, the authors state that both predictions 1 and 2 were supported!

This paper is worth reading because it provides an interesting way to think about the ecological significance of fat reserves for wintering birds, and some useful protocols for testing hypotheses about fat reserves. However, it must be read cautiously, as its conclusions sometimes exceed or contradict its own data. [Dept. of Ecology and Science Education Center, Univ. of Iowa, Iowa City, IA 52242, USA.]—Peter D. Smallwood.

### 5. Sexual dimorphism and foraging behavior of Emerald Toucanets *Aulacorhyn-*

**chus prasinus in Costa Rica.** C. M. Riley and K. G. Smith. 1992. *Ornis Scand.* 23:459-466.—Feeding on a wide variety of fruits and flowers, Emerald Toucanets are a major fruit disperser in lower montane forests in Central America. Combining measurements of museum skins with observations of wild birds in Costa Rica, this study examines whether sexual dimorphism in bill morphology is related to differences in feeding behavior between the sexes.

Independent of body size, males had significantly longer and more strongly curved bills than did females. These differences allowed the sex of foraging birds to be determined in the wild. Toucanets foraged primarily from twigs in the outer part of the mid-canopy. Foraging data (analyzed as first-order Markov chains) indicated no differences between the sexes in relative height, relative position, or substrate. Both sexes changed their foraging behavior between wet and dry seasons in the same manner. The only difference in foraging behavior between the sexes was that, during the dry season, female bouts were longer than those of males. Moreover, there were no differences between the sexes in the size, color, or types of fruits eaten. On balance, then, the sexes foraged similarly throughout the year, indicating that sexual dimorphism in bill morphology is not related to differences in foraging behavior or diet.

Previous work by Riley indicated no differences in parental roles during breeding (e.g., cavity construction, incubation, provisioning rates) that could be related to bill dimorphism. However, males commonly “duel” one another with their bills, a behavior never observed in females. Riley and Smith suggest that bill size dimorphism in rhamphastids is related to male-male interactions and perhaps to female choice for large-billed males. [Univ. of Texas Marine Science Inst., Port Aransas, TX 78373, USA.]—Jeff Marks.

**6. Autumn diet of Lesser Snow Geese staging in northeastern Alaska.** A. W. Brackney and J. W. Hupp. 1993. *J. Wildl. Manage.* 57:55-61.—Due to the proposed development of portions of the Arctic National Wildlife Refuge, the autumn diet of Lesser Snow Geese (*Chen caerulescens caerulescens*) using staging areas in northeast Alaska was studied to assess energy budgets and gain knowledge on habitat requirements in order to determine if increased human activity on the area would affect the geese. One hundred and fifty-three geese were collected between 26 Aug. and 23 Sept. 1984, 1985, and 1988, and the contents of the esophagus and proventriculus were examined. The diet was classified into three groups: aboveground stems of northern scouring-rush (*Equisetum variegatum*), underground stems of tall cotton-grass (*Eriophorum angustifolium*), and aboveground parts of graminoid species. Diet variations associated with time of day, month of collection, and age of bird were examined.

Underground stems of tall cotton-grass, which are rich in soluble carbohydrates, and aboveground stems of northern scouring-rush, which are rich in crude protein, were the dominant food items. More tall cotton-grass was observed in geese collected in the afternoon and northern scouring-rush was found most often in geese collected in the morning. Freezing and thawing of the substrate likely affected the availability of underground food items and thus resulted in diurnal variation of the diet. Underground parts of cotton-grass comprised more of the diet of birds collected in September than August, most likely due to the plant's translocation of nutrition to underground storage organs at that time.

The primary forage species in this study are confined to specific communities with limited distribution. Thus, increased human activity due to oil development could be detrimental if geese are displaced from these limited foraging sites. The authors suggest minimization of disturbance during staging and determination of availability of all feeding habitats on the coastal plain in case development proceeds. [ANWR, 101 12th St., Box 20, Fairbanks, AK 99701, USA.]—Robin J. Densmore.

## SONGS AND VOCALIZATIONS

**7. Song learning in captive European Starlings, *Sturnus vulgaris*.** M. Eens, R. Pinxten, and R. F. Verheyen. 1992. *Anim. Behav.* 44:1131-1143.—Starlings continue to increase their repertoire of songs throughout their lives, although the number of new songs added decreases with age and the length of song bouts does not increase after the second year. Furthermore, starlings remember and continue to use songs learned early in their lives

even as they incorporate new songs into their repertoire. This is quite unlike the common Canary (*Serinus canaria*), which forgets up to 70% of its syllable types from one year to the next (Nottebohm and Nottebohm, 1978, *Z. Tierpsychol.* 46:298–305). Although their sample sizes are uncomfortably small, Eens et al. show that juvenile males learn songs from other males, but that such tutors are unlikely to be their fathers. Neighbors during the breeding season do not copy songs from each other, although they may share song types. The authors suggest that most learning occurs in the large post-breeding flocks and that each young male has many tutors. Unresolved is the question of whether new songs are memorized each year or whether all types are memorized as a juvenile and additional songs are called up from memory as the bird ages. [Dept. of Biology, Univ. of Antwerp, U.I.A., Universiteitsplein 1, B-2610 Wilrijk, Belgium.]—Edward H. Burt Jr.

## NESTING AND REPRODUCTION

(see also 3, 25, 30, 31, 35)

**8. Do helpers increase reproductive success? An experimental analysis in the Florida Scrub Jay.** R. L. Mumme. 1992. *Behav. Ecol. Sociobiol.* 31:319–328.—Much of the literature that addresses avian cooperative breeding systems makes a strong argument that nonbreeding helpers at the nest are able to enhance their inclusive fitness, and that such behavior is thus an evolved adaptation that has been shaped by natural selection. However, these conclusions have come under some criticisms that suggest that increased reproductive output among cooperative breeders is not necessarily the result of alloparental care per se but perhaps is the result of correlated traits such as territorial quality and breeder quality. Moreover, even if helpers do realize increased fitness, it is not clear whether such benefits can be attributed to the help itself, or to incidental benefits associated with group living. This study was thus designed to test whether the presence of nonbreeders in a cooperatively breeding species has a positive effect on reproductive success, independent of the effects of correlated variables; if an effect does exist, the goal was then to determine if it is the result of the care that nonbreeders provide as helpers. To answer these questions, the author examined a population of Florida Scrub Jays (*Aphelocoma c. coerulescens*), in which nonbreeders from experimental groups were removed, during three breeding seasons in Highlands Co., Florida. Experimental groups and unmanipulated control groups did not differ significantly in nesting phenology, clutch size, number of nesting attempts, or hatching success; however, experimental groups produced significantly fewer 60-day old juveniles than control groups ( $0.56 \pm 0.73$  versus  $1.62 \pm 1.32$ , respectively,  $P < 0.008$ ). Undernourished nestlings and starvation were only a minor cause of nestling mortality; rather, most nestling deaths were attributable to apparent nest predation. Notably though, nestlings were fed more frequently when allofeeders were present, and such nestlings weighed significantly more and survived significantly longer than experimental nestlings. When provided the opportunity, most nonbreeding scrub jays did help provision dependent young, but such helpers were significantly more inclined to feed nestlings or fledglings to which they were closely related ( $P < 0.02$ ). These data suggest a variety of things. First, helpers reduce the incidence of nestling predation, probably through enhanced “sentinel” behavior and group mobbing. In addition, the relationship between nestling size and post-fledgling survival is at least partially causal. Thus, the positive effects of nonbreeding helpers on the fitness of recipients is the result of alloparental care itself and not the by-product of incidental beneficial effects of social living or potentially correlated variables such as territory or parental quality. The indirect fitness benefits of alloparental care in scrub jays are substantial since most help is directed toward close relatives. Whether this behavior has truly been shaped by natural selection won't be completely understood until adaptive and nonadaptive hypotheses can be tested. [Dept. of Biology, Allegheny College, Meadville, PA 16335, USA.]—Danny J. Ingold.

**9. Field tests of several styles of bluebird nest boxes.** K. L. Berner and V. A. Pleines. 1993. *Sialia* 15:3–11.—The authors examined the differential use of nine types of bluebird boxes by Eastern Bluebirds (*Sialia sialis*), Tree Swallows (*Tachycineta bicolor*), House Wrens (*Troglodytes aedon*), and House Sparrows (*Passer domesticus*) from 1989–1992 in New York. When given a choice, pairs of each species chose certain box types over others;

however, although preferences seemed to exist, individuals of each species frequently nested in less desirable box styles when others were unavailable. Bluebirds preferred the Peterson box over all other alternatives (44 nesting attempts for every 100 boxes), including the traditional North American Bluebird Society style box (NABS). Boxes made of PVC pipe and wooden slot boxes were the next most preferred types by bluebirds (29 and 21 nesting attempts for every 100 boxes, respectively). Bluebirds avoided all boxes equipped with a plastic "bird guardian" over the cavity entrance.

Tree Swallows seemed willing to use a variety of box styles, particularly any of the NABS boxes with or without predator guards around the cavity entrance and/or extended roofs. In addition, they showed a strong penchant for Peterson boxes. Swallows avoided PVC boxes and those equipped with the "bird guardian." House Wrens showed no clear preference or avoidance of any of the box types, although they demonstrated a relatively narrow range of use levels. House Sparrows were not a serious competitive threat to the native species, probably since they had been prevented from nesting successfully on the study areas for several years. Sparrows nested most frequently in wooden slot boxes (15 nesting attempts per 100 boxes), which ironically were proposed as being sparrow-resistant. Sparrows also showed a preference for Peterson boxes, and completely avoided PVC boxes. [State Univ. of New York, Cobleskill, NY 12043, USA.]—Danny J. Ingold.

**10. Nesting productivity, food habits, and nest sites of Bald Eagles in Colorado and southeastern Wyoming.** M. L. Kralovec, R. L. Knight, G. R. Craig, and R. G. McLean. 1992. *Southwest. Nat.* 37:356–361.—A geographically isolated population of Bald Eagles (*Haliaeetus leucocephalus*) consisting of approximately 16 pairs was studied from 1981–1989 in 10 counties. The reproductive success rate among these pairs was 63% with 1.32 young fledged/active nest. The most important factor contributing to nest failure was nest destruction by heavy winds. Mammals (53%), birds (22%), and fish (25%) accounted for the 237 prey items identified in and around eagle nests. Gunnison's prairie dog (*Cynomys gunnisoni*) was the single most important prey item in terms of frequency and biomass. Sixteen of 18 nests were located in cottonwood trees (*Populus deltoides*) which were significantly taller ( $P = 0.0006$ ) and had larger dbh ( $P = 0.0002$ ) than random trees. Fifty-eight percent of active nests had an average density and basal area of <100 trees/ha and <10 m/ha, respectively. Most nest sites were on privately-owned land (87%), and 83% of active nests were surrounded by some pasture or rangeland. [Dept. of Fishery and Wildlife Biology, Colorado State Univ., Ft. Collins, CO 80523, USA.]—Danny J. Ingold.

**11. Nest site characteristics in relation to body size in herons in Italy.** M. Fasola and R. Alieri. 1992. *Colon. Waterbirds* 15:185–191.—This study tested the hypothesis that interspecific competition for nest sites in herons is reduced by partitioning nest trees by vertical alignment (stratification) of species by size. The authors censused all 36 colonies in a 5000-km<sup>2</sup> rice cultivation area in NW Italy from 1985–1990. They mapped and recorded vegetation types in 21 colonies located in small patches of vegetated wetlands scattered among the rice fields, and recorded the vegetative structure of 14 colonies. Little Egrets (*Egretta garzetta*), Black-crowned Night-herons (*Nycticorax nycticorax*), and Squacco Herons (*Ardeola ralloides*) were generally found together in the same colonies and sub-colonies, while Grey Herons (*Ardea cinerea*) and Purple Herons (*A. purpurea*) showed significant avoidance patterns for each other but not for the other three species. The authors suggest competitive exclusion of the smaller Purple Heron by the Grey Heron as an explanation. Night-herons and egrets used six of seven vegetation types; Squacco and Purple Herons used low or medium height vegetation, and the latter was the only heron to nest in reed beds. Grey Herons nested higher and in larger trees. Night-herons nested higher and in larger trees than egrets but the difference was not significant. In colonies with both night-herons and Grey Herons, night-herons nested significantly lower and in smaller trees, suggesting competition for space. There was a tendency for herons to align by body size with the largest nesting highest, except for the Purple Heron, which although second largest, nested lowest.

The authors stress the need for preserving wetland patches suitable for heron nesting; 22 reserves have recently been created in the area. They suggest management guidelines for reserves based on the findings of this study. [Dipart. Biologia Animale, Univ. of Pavia, Pz. Botta 9, I-27100 Pavia, Italy.]—William E. Davis, Jr.

## MIGRATION, ORIENTATION, AND HOMING

(see also 31)

**12. Differential timing of autumn migration between sex and age groups in raptors at Falsterbo, Sweden.** N. Kjellén. 1992. *Ornis Scand.* 23:420-434.—From early August to mid-November, 1986 to 1990, Kjellén counted diurnal raptors migrating through southern Sweden. Twenty-eight species were observed, with 14 providing enough data for analyses of sex and age differences in migration. Most species had an even sex ratio, the exceptions being a strong female bias in the polygynous Marsh Harrier (*Circus aeruginosus*) and Hen Harrier (*C. cyaneus*). For species wintering in the tropics, adults migrated ahead of juveniles, whereas for species that typically winter near the breeding grounds, juveniles migrated ahead of adults. Females tended to migrate ahead of males, which agrees with differences in timing of molt that are related to parental duties (females molt earlier whereas males delay molt until after they have finished provisioning young). Unlike most of the other species, male and female Honey Buzzards (*Pernis apivorus*) share parental duties equally. Accordingly, there was no difference in timing of migration between the sexes.

Kjellén's impressive data set points to the importance of social dominance, molting strategies, and the need for early arrival on the wintering grounds as factors explaining the observed differences in migration times between sex and age classes of diurnal raptors. [Dept. of Ecology, Lund Univ., S-223 62 Lund, Sweden.]—Jeff Marks.

**13. Optimal fat loads in migrating birds: a test of the time-minimization hypothesis.** Å. Lindström and T. Alerstam. 1992. *Am. Nat.* 140:477-491.—The authors used data from Bluethroats (*Luscinia svecica*) and Rufous Hummingbirds (*Selasphorus rufus*) to test the idea that birds migrate as fast as possible. Bluethroats showed a constant (linear) increase in body weight with the length of stopover during migration. Migratory Rufous Hummingbirds also showed an increase in body mass with time during their stopovers, but the increase was significantly different than predicted. Physiological and flight mechanical constraints are probably responsible for the upper limit of fat loads accumulated during stopovers. The prediction that birds should migrate faster with small fat loads as they approach their goal is supported by data from the Bluethroat. The results of this paper are in agreement with the hypotheses that migrants are time minimizers; however, they do not match the quantitative predictions. [Dept. of Ecology, Univ. of Lund, S-223 62 Lund, Sweden.]—Robert C. Beason.

**14. Climbing performance of migrating birds as a basis for estimating limits for fuel-carrying capacity and muscle work.** A. Hedenström and T. Alerstam. 1992. *J. Exp. Biol.* 164:19-38.—Radar was used to measure the climb rates and airspeeds of 15 species of migrating birds that weighed between 10 g and 10 kg. Bird flocks were tracked by radar and were identified visually. The mean rates of climb varied from 0.32 m/s (Mute Swan, *Cygnus olor*) to 1.63 m/s in the Dunlin (*Calidris alpina*). The greatest rate of climb for an individual flock was 2.14 m/s by Dunlin. There was a significant negative correlation between body mass and rate of climb ( $r = -0.75$ ) for all species combined. There also was a significant positive correlation between airspeed and body mass ( $r = 0.77$ ). These results agree with the view that birds with larger body mass or carrying larger fat stores for migration have slower climb rates. The calculated work for avian flight muscle at these climb rates was 16-41 J/kg of muscle mass, and was positively correlated with body mass. [Dept. of Theoretical Ecology, Univ. of Lund, S-223 62 Lund, Sweden.]—Robert C. Beason.

**15. Orientation-disturbing magnetic treatment affects the pigeon opioid system.** F. Papi, P. Luschi, and P. Limonta. 1992. *J. Exp. Biol.* 166:169-179.—This paper includes the results of a series of releases testing the effects of naloxone, an opiate antagonist, and magnetic treatment on the performance of homing pigeons (*Columbia livia*). In all nine releases the mean direction of the control group was closer toward home, but these differences were significant in only three of nine treatments with naloxone and one of five with the magnetic treatment. From these results, the authors conclude that treatment with naloxone produces the same results as treatment with an erratic magnetic field during transport to the release site. The data do not clearly support such a conclusion. About the only conclusion that could be drawn from the data is that birds treated with naloxone headed SW in eight

of nine releases regardless of the direction toward home (NNW, S, SE). Magnetically treated birds were sometimes similar in orientation to the naloxone treated birds, but not in all cases. A second aspect of the experiment was to evaluate a connection between magnetic treatment and  $\mu$ -opiate receptors. The brains of magnetically treated and control birds were removed and processed for the amount of  $\mu$ -opiate on the plasma membranes assayed. The number of receptors in the treated birds was significantly lower than the controls in one of the two experiments, but not the other. The rationale for assaying for a change in the number of receptors on the plasma membrane rather than for a change in opioid levels was not given. Changes in receptors on plasma membranes are usually considered to be long-term responses, not immediate responses. The authors extrapolate from their results that the navigational effect of magnetic treatment is a generalized effect mediated through the opioid pathways in the pigeon. Although their results can be considered consistent with such an interpretation, they are not convincing. Clearly, additional replications are needed before drawing such conclusions. [Dipart. di Scienze del Comportamento Animale e dell'Uomo dell'Univ., Via A. Volta 6, I-56126 Pisa, Italy.]—Robert C. Beason.

### HABITAT USE AND TERRITORIALITY

(see 3, 10, 11)

### ECOLOGY

(see also 4, 8, 12, 28, 29, 36)

16. **Anti-predator effect of conspicuous plumage in a male bird.** F. Götmark. 1992. *Anim. Behav.* 44:51–55.—Two explanations have been suggested for the conspicuous plumage of male birds, the sexual selection theory and the unprofitable prey hypothesis. The sexual selection theory states that conspicuous plumage evolved in males because of competition for females which prefer bright males. The theory assumes that brightness is limited by increased predation. Alternatively, the unprofitable prey hypothesis suggests that bright plumage signals a male which is hard to catch. This hypothesis assumes that predation of a male bird is low because predators have learned of the difficulty in catching the male and will thus avoid the bright plumage. Götmark found that Eurasian Sparrowhawks (*Accipiter nisus*) attacked more female than male Pied Flycatchers (*Ficedula hypoleuca*). This supports the unprofitable prey hypothesis and contradicts the sexual selection theory. Furthermore, these results suggest that predation may reinforce sexual selection by reducing predation on the conspicuous male. The importance of Götmark's findings to the unprofitable prey hypothesis is reduced by his failure to control for the time of season and hawk age, which were not determined during a second trial. A question not tested by Götmark is: if conspicuous coloration reduces the risk of predation, why do the males molt to female-like plumage after breeding? [Dept. of Zoology, Univ. of Göteborg, P.O. Box 25059, S-400 31 Göteborg, Sweden.]—Heather C. Dougherty.

17. **Natal dispersal and recruitment of juvenile White-tailed Ptarmigan in Colorado.** K. M. Giesen and C. E. Braun. 1993. *J. Wildl. Manage.* 57:72–77.—Juvenile White-tailed Ptarmigans (*Lagopus leucurus*) were banded and studied over a 25-year period in Colorado in order to estimate survival in two populations and to document dispersal distances. The hypothesis that the differential natal dispersal between males and females accounts for their differing return rates was tested. From 1966 through 1989, 1486 juvenile ptarmigans were banded at the Rocky Mountain National Park (RMNP) and Mt. Evans study areas. The total return rate was 22.7%, and more males (79.1%) were encountered than females (20.9%). Females moved farther than males at both study sites, thus accounting for their lower rate of being resighted. The median dispersal distance was 1.25 km for males and 4.0 km for females. Fifty-one percent of the yearling males were recruited into the RMNP breeding population, while only 12.9% of the yearling females were recruited. The minimum survival rates for males at the RMNP and Mt. Evans sites were 35.0% and 38.7%, respectively. For translocation purposes, the authors suggest that releasing ptarmigans at several locations at least 2 km apart should result in rapid colonization of vacant habitats. [Colorado Div. of Wildlife, Wildlife Research Center, 317 W Prospect Rd., Fort Collins, CO 80526, USA.]—Robin J. Densmore.

## POPULATION DYNAMICS

(see also 17, 31)

**18. Winter abundance, age structure, and distribution of Bald Eagles along the Colorado River, Arizona.** B. T. Brown and L. E. Stevens. 1992. *Southwest. Nat.* 37:404–408.—Numbers of Bald Eagles (*Haliaeetus leucocephalus*) were recorded by age class along the Colorado River in the Grand Canyon from late January through mid-March 1990–1991. Eagle numbers peaked at Nankoweap Creek (a small tributary 108 km downstream from Glen Canyon Dam) in 1990 between 26 Feb. and 4 Mar. when >20 eagles/day were present on five days. Eagle abundance in 1991 exhibited a similar pattern to 1990, although only about half as many eagles/day were present. Immatures and subadults combined were significantly more abundant than adults from early February through early March of both years ( $P < 0.001$ ). Immature and subadult Bald Eagles were present in significantly greater proportions ( $P = 0.029$ ) at Nankoweap Creek than they were along the Colorado River corridor from late January to mid-March 1991. The eagles at Nankoweap represented the largest sustained feeding concentration of this species in Arizona in 1990. Bald Eagles were twice as abundant at Nankoweap in 1990 versus 1991, probably because of the scarcity of spawning trout in 1991. The decline in eagle numbers in early March of both years was possibly due to individuals departing on their northward migration (even though food resources were still abundant), and increasing levels of human disturbance at Nankoweap. [Coop. Park Studies Unit, P.O. Box 5614, Northern Arizona Univ., Flagstaff, AZ 86011, USA.]—Danny J. Ingold.

**19. Population ecology of the [Eurasian] Sparrowhawk (*Accipiter nisus*) L. in Switzerland.** [Populationsökologie des Sperbers *Accipiter nisus* L. in der Schweiz.] U. Bühler. 1991. *Ornithol. Beob.* 88:341–452 (German, English summary).—The effects of chemical residues on Eurasian sparrowhawk populations were assessed by comparing a population in the Swiss lowlands, subjected to human activity, with one in the relatively undisturbed Alps. The sparrowhawk population has declined throughout Switzerland since 1955, with the lowest densities occurring in the early 1970s and increasing since. The Alps population was much less affected by the pollution. The lowland population dropped to 0–6 pairs/100 km<sup>2</sup> (compared to 10–23 pairs in the Alps), below the predicted carrying capacity based on food and nesting sites. Mean clutch sizes, young/brood, and nest failure were similar for both study areas, but slightly poorer in the lowlands. More eggs were broken in the lowlands, perhaps as a result of their 20% thinner shells. Of 200 nestlings banded, significantly more (15%) were recovered in the lowlands than in the Alps (2%). Most of the recoveries were of dead birds that had misencounters with civilization. Chemical pollution was responsible for 20–30% of all the eggs failing to hatch, about 40–60% of all breeding losses. Significantly higher concentrations of PCB, Nonachlor, and mercury were found in lowland eggs than in those in the Alps, but the reverse was reported for Hexachlorocyclohexane, DDT, and DDE. An additional factor that had a detrimental effect on the lowland sparrowhawk population was the elimination of hedgerows and other habitats used by the sparrowhawks' prey. [Abteilung Ethologie und Wildforschungs, Zoologisches Inst., Univ. Zürich-Irchel, Winterthurestras. 190, CH-8057 Zürich, Switzerland.]—Robert C. Beason.

**20. A dynamic analysis of Northern Spotted Owl viability in a fragmented forest landscape.** R. H. Lamberson, R. McKelvey, B. R. Noon, and C. Voss. 1992. *Conserv. Biol.* 6:505–512.—In the first of two papers, the authors model population dynamics of Spotted Owls (*Strix occidentalis*), assuming fixed spatial landscape with some suitable habitat, density dependent search success for nesting sites, and fixed life history parameters. Models that were run with deterministic or stochastic environmental fluctuations revealed qualitative similarities in results: the importance of suitable habitat to long-term population survival. A threshold was identified below which Spotted Owl viability plunged (Allee effect). Deterministic or stochastic landscape variation (e.g., timber harvest) introduced nonequilibrium conditions and resulted in crowding of birds into suitable habitat. These models identified the parameters “habitat occupancy rate” as a poor predictor of long-term population abundance, “juvenile survivorship” as becoming depressed during logging, and “adult survivorship” as the most sensitive element in predicting long-term population survival. The sequel



to these models will introduce two-stage dispersal in density dependent logistic functions. [Dept. of Mathematics, Humboldt State Univ., Arcata, CA 95521, USA.]—Kristin E. Brugger.

### ZOOGEOGRAPHY AND DISTRIBUTION

(see also 31, 32, 33)

**21. New Golden Eagle records from Baja California.** R. Rodriguez-Estrella, J. Llinas-Gutierrez, and J. Cancino. 1991. *J. Raptor Res.* 25:68–71.—New information is provided on the distribution of Golden Eagles (*Aquila chrysaetos*) at the southern end of their range. The authors report many sightings of Golden Eagles in the mid and southern portion of the Baja California peninsula between 1984 and 1989. Although reproductive activity was not observed, two inactive Golden Eagle nests were found on cliffs in Sierra de la Higuera and Sierra San Francisco. The authors suggest the possibility of a breeding population in the area, and that this population is augmented by migrants in the winter. [Centro de Investigaciones Biologica, Apdo. Postal 128, La Paz 23000, B.C.S., Mexico.]—Robin J. Densmore.

**22. First record of the Bristle-thighed Curlew *Numenius tahitiensis* in Easter Island, Chile.** Y. A. Vilina, A. Larrea, and J. E. Gibbons. 1992. *Wader Study Group Bull.* 66:43–44.—The Bristle-thighed Curlew is the only migratory shorebird that winters exclusively on oceanic islands. Individuals appear to be highly faithful to previous wintering islands, and very few extralimital records exist. The authors visited Easter Island (27°09'S, 109°26'W) from 16–23 Sept. 1991 and 20 Apr. to 21 May 1992. During both visits, a single curlew was seen and photographed in the rocky intertidal zone. The cinnamon tinges on the rump, tail, and underparts indicated that it was a Bristle-thighed Curlew. This sighting represents an extension of 2315 km beyond the southeastern edge of the normal wintering range at Ducie Island in the Tuamotu Archipelago. At present, there is no indication that Easter Island is regularly inhabited by Bristle-thighed Curlews. [Unidad de Biología de la Reproducción, Dept. de Biología Celular y Genética, Univ. de Chile, Casilla 70061-7, Santiago, Chile.]—Jeff Marks.

### EVOLUTION AND GENETICS

(see also 31)

**23. Genetic differentiation between populations of Hutton's Vireo (*Aves: Vireonidae*) in disjunct allopatry.** C. Cicero and N. K. Johnson. 1992. *Southwest. Nat.* 37:344–348.—The authors used starch-gel electrophoresis to analyze genetic differences at 33 loci in two subspecies of the Hutton's Vireo (*Vireo huttoni*). Six (18%) of the 33 loci were polymorphic in both *V. h. huttoni* (California) and *V. h. stephensi* (Arizona). The populations were distinguished by a fixed allelic difference at the *Gpi* locus. Nei's genetic distance between the coastal and interior populations was 0.031, suggesting that the Arizona population is genetically more similar to Yellow-winged Vireos (*V. carmioli*) than to *V. h. huttoni* in California. Wright's *F* statistic, which provides estimates of genetic population structure, indicated a strong genetic subdivision between the two forms. Slatkin's rare allele method for estimating gene flow provides evidence that an average of only one migrant exchanged between the southwestern and coastal populations every 11 to 36 generations. These data suggest that the two subspecies of *V. huttoni* have long been isolated (probably prior to the Wisconsin glacial maximum), and are definitely approaching, or have already reached, the species level. [Museum of Vertebrate Zoology, Univ. of California, Berkeley, CA 94720, USA.]—Danny J. Ingold.

### PHYSIOLOGY AND DEVELOPMENT

(see also 13, 14, 15)

**24. Diving heart rates in Adélie Penguins (*Pygoscelis adeliae*).** B. Culik. 1992. *Comp. Biochem. Physiol.* 102A:487–490.—Two freely moving Adélie Penguins in the

Antarctic were implanted with heart rate transmitters. The resting heart rates were 67–77 bpm, which increased to 89 bpm while resting on the surface of the water and to 113–138 bpm during dives of up to 10 s. After surfacing, heart rates increased to the maximum of 218 bpm before dropping to pre-dive levels. There was a good correlation between oxygen consumption and heart rate for the resting birds, suggesting that heart rate may be a good indicator of energy expenditure of the birds. [Inst. für Meereskunde, Düsternbrooker Weg 20, 2300 Kiel 1, Germany.]—Robert C. Beason.

**25. Energy costs of incubation in the [Eurasian] Blackbird *Turdus merula*.** [Die Energiekosten der Bebrütung bei der Amsel *Turdus merula*.] R. Prinzing. 1992. Ornithol. Beob. 89:111–125. (German, English summary.)—Based on measurements of the specific heat and conductivity of eggs and nests, and the embryos' metabolic heat, the author calculated that incubation is not a time of energy loss for the adult. Using the length of incubation, with 12 15-min absences from the nest daily, the blackbird would use less energy (18% at 20 C and 23% at 8 C) sitting on a nest of eggs than roosting in the open. Part of this energy gain is the result of embryonic metabolism in the eggs. Embryonic metabolism increases at an exponential rate beginning three days after laying to almost 100% of the heat needed for incubation. By the end of incubation, the parent needs only to protect the eggs from the environment and provide little heat for normal development. [AK Stoffwechselphysiologie, Univ. Frankfurt, Siesmayerstr. 70, DW-6000 Frankfurt, Germany.]—Robert C. Beason.

### MORPHOLOGY AND ANATOMY

(see also 2, 5)

**26. Brain size in birds: 1. Tinamiformes through Ciconiiformes.** J. Mlíkovský. 1989. Vestn. Cesk. Spol. Zool. 53:33–47. **Brain size in birds: 2. Falconiformes through Gaviiformes.** J. Mlíkovský. 1989. Vestn. Cesk. Spol. Zool. 53:200–213. **Brain size in birds: 3. Columbiformes through Piciformes.** J. Mlíkovský. 1989. Vestn. Cesk. Spol. Zool. 53:252–264. **Brain size in birds: 4. Passeriformes.** J. Mlíkovský. 1990. Acta Soc. Zool. Bohemoslov. [formerly Vestn. Cesk. Spol. Zool.] 54:27–37. (In English.)—These articles examine the relationship between body mass and brain mass in birds. Body masses were compiled from the literature. Brain masses were estimated from brain volumes. The author measured brain volumes of 1675 skulls belonging to 616 extant species, and supplemented his measurements by published data, bringing the total to 4344 brain masses of 766 species. The average brain mass is tabulated for each species, together with body mass, percent brain mass relative to body mass, and the index of relative encephalization. The tables contain the largest data set of brain masses ever assembled, and may be valuable to workers interested in the ecological correlates of brain size.

The allometric relationship between brain mass (Y) and body mass (X) is examined by fitting the equation  $Y = b \cdot X^a$  (a = slope, b = intercept) through the species data points. The equation is fitted separately for 31 families, and the slopes and intercepts are presented. The slopes are compared to the Jerison's (a = 0.667) and Dubois' (a = 0.56) constant. The slopes are significantly higher than the Jerison's constant in nine families, significantly lower in 10 families, and deviate nonsignificantly in 12 families. They are significantly higher than the Dubois' constant in four families, significantly lower in one family (Alcidae), and deviate nonsignificantly in 26 families. [Dept. of Evolutionary Biology, Czechoslovak Acad. of Sciences, Sekaninova 28, 128 00 Praha 2, Czech Republic.]—Stanislav Příbil.

### PLUMAGES AND MOLTS

(see also 2, 16)

**27. Acquisition of breeding coloration depends on badge size in male House Sparrows (*Passer domesticus*).** A. P. Moller and J. Erritzoe. 1992. Behav. Ecol. Sociobiol. 31:271–277.—The black throat badge in male House Sparrows, which serves as a dominance symbol and in sexual signalling, is partially or fully covered by light feather tips during most of the non-breeding season. In order to address the question of whether male House Sparrows are able to determine the timing of acquisition of as well as extent of breeding plumage, the authors measured the badges of over 400 study skins. Additionally, observations

of the preening activity of color-banded sparrows were made during three winters to determine if males preen their badges more frequently than females preen the homologous site, and to detect if a correlation exists between the amount of preening activity and badge size. The degree of feather abrasion showed a similar pattern across the badge with the most intense wear in the middle, resulting in a significant increase in badge area ( $P < 0.0001$ ) as the season progressed. Males with large total badge areas acquired a relatively large visible badge earlier than males with small total badge areas. During late winter, males preened their badge areas more than females preened the areas homologous to the badges, and males with larger badges preened more than males with smaller badges. However, there was no temporal difference in the preening rate of males with large badges versus males with small badges. These data suggest that the light feather tips of the badge of male House Sparrows allows them the flexibility to influence the timing of their full breeding plumage. The relative size of the black badge appears to have been influenced by sexual selection and represents a reliable indicator of quality. [The Galton Lab, Dept. of Genetics and Biometry, Univ. College of London, 4 Stephenson Way, London NW1 2HE, United Kingdom.]—Danny J. Ingold.

### WILDLIFE MANAGEMENT AND ENVIRONMENTAL QUALITY

(see also 6, 9, 19, 20, 31, 34)

**28. Movement corridors: conservation bargains or poor investments?** D. Simberloff, J. A. Farr, J. Cox, and D. W. Mehlman. 1992. *Conserv. Biol.* 6:493–504.—Do the conservation benefits of acquiring land for movement corridors balance their financial and societal costs or should conservation funds be spent to improve and implement other landscape management techniques? The arguments that corridors do not improve dispersal rates, reduce local extinctions, or slow inbreeding are explored. Six definitions of corridors are reviewed, the (weak) empirical evidence for corridor use is presented, and potential biological disadvantages of corridors are listed, including drift-based loss of alleles, stochastic demographic effects, spread of catastrophes, poor habitat quality in corridors, and corridors as population sinks. Proposals for Florida's Conservation and Recreation Lands program that include corridors as justifications may be too abstract. Evaluations of corridors and other landscape management techniques are needed to set conservation priorities. [Dept. of Biological Science, Florida State Univ., Tallahassee, FL 32306, USA.]—Kristin E. Brugger.

**29. Population and conservation status of flamingos in Mar Chiquita, Cordoba, Argentina.** E. H. Bucher. 1992. *Colon. Waterbirds* 15:179–184.—This paper reports on surveys, mostly by fixed-wing airplanes, of flamingo populations at 2000-km<sup>2</sup> Mar Chiquita for most years from 1969–1987, with sporadic observations through 1991. Chilean Flamingo (*Phoenicoparrus chilensis*) breeding populations peaked in 1975 and 1977 with about 30,000 pairs. Beginning in 1974 above-average rainfall produced rising water levels and decreased salinity. By late 1977 mudflat nesting habitat had been flooded and with lowered salinity brine shrimp largely disappeared. Hence no flamingos have bred there since 1977, and the non-breeding population plummeted as well. Birds may have moved to newly flooded salt pans elsewhere in the region. In the winters of 1975 and 1977 about 1000 Andean Flamingo (*P. andinus*) were present, and in 1990 and 1991 a few James Flamingo (*P. jamesi*) were detected. Conservation problems for flamingos in Mar Chiquita include organized poaching of live flamingos for sale to zoos, disturbance by tourists, sewage and industrial pollution, and potential flood control projects. The author emphasizes the erratic nature of flamingo habitat because of changing hydrological conditions, and the resulting need for long-term studies and for conservation planning at the regional level. [Centro de Zoología Aplicada, Univ. de Córdoba, Casilla 122, Córdoba 5000, Argentina.]—William E. Davis, Jr.

**30. Use of fencing to limit terrestrial predator movements into Least Tern colonies.** D. W. Rimmer and R. D. Deblinger. 1992. *Colon. Waterbirds* 15:226–229.—This study tested the efficacy of non-electric fencing in excluding terrestrial predators from Least Tern (*Sterna antillarum*) colonies. The major terrestrial predators were, in decreasing order of abundance as determined by sightings and tracks, foxes, skunks, opossums, and raccoons. In 1990 and 1991 the authors placed woven wire mesh fences with 5 cm × 5 cm openings,

through which chicks and fledglings could move, around two colonies at Crane Beach, Ipswich, Massachusetts. They collected data for either hatched or predated nests in 1987–1989 for 571 unprotected nests, and in 1990–1991 for 60 unprotected and 167 protected nests. For 1987–1989 nests the predation rate was 76%, and for 1990–1991 unprotected nests 54%. Only 1% of fence-protected nests were predated, and as a result protected birds had a significantly higher hatching rate. The authors conclude that non-electric fencing is effective in excluding terrestrial predators from tern colonies, and although initially expensive, fencing can be reused for years at minimal additional cost. [The Trustees of Reservations, 572 Essex Street, Beverly, MA 01915, USA.]—William E. Davis, Jr.

### BOOKS AND MONOGRAPHS

**31. The petrels.** J. Warham. 1990. Academic Press, London. viii + 440 pp. \$59.95, hardcover.—This is the first half of John Warham's masterwork culminating more than four decades devoted to the study of Order Procellariiformes. Warham and other descendants of the 18th-century British diaspora share with the tubenosed swimmers a special affinity for remote oceanic islands and stacks. Thus, the hundreds of citations in the book's magnificent 38-page reference section are dominated by workers from New Zealand, Australia, and South Africa, as well as native Britains. (Apparently, Dee Boersma of the University of Washington is the only woman to have published substantial work on petrels, a condition warranting correction.)

We are told in the Preface that the second volume, now in preparation, will concentrate on such theory-rich subjects as behavior, energetics, population biology, foraging ecology, biogeography, human use, and conservation. The present work, then, serves as a compendium of facts to be plumbed conceptually in the next book, and it certainly is true that we find here a massive encyclopedia about petrels. [Following Warham (p. 16), I use "petrel" for the order as a whole.]

The work is organized into 15 chapters, followed by a useful appendix devoted to a checklist of the 103 species of petrels, and a second, one-page appendix illustrating the results of blood-plasma electrophoresis in a "reference" species. (Why the latter was placed in an appendix rather than in a text figure is puzzling.) Species and subject indices terminate the book.

The order Procellariiformes consists of four families, Diomedidae, Procellariidae, Hydrobatidae, and Pelecanoididae. The first part of the book partitions into nine chapters what is known about the biology of these families. One soon realizes that petrels are truly marine creatures and that if they had somehow "solved" the problem of how to incubate an egg at sea, they would never come to land. Chapter 1 presents an overview of morphology, ecology, global distribution, population dynamics, systematics, and nomenclature. We learn from the fossil record that albatrosses once bred in the North Atlantic, although there are no historical accounts of such cases, and we are immediately impressed by an important and often frustrating characteristic of this volume. Here, and often throughout, Warham marshals intriguing and provocative facts without any subsequent attempt at interpretation. In the present case, we would like to have his ideas on why albatrosses have not survived in the North Atlantic. It seems that in many cases the author's intent has been to leave such discussion to the second volume, a logical approach to be sure, but one often frustrating to the curious reader of this volume.

I found myself continually testing material presented by Warham against my only substantial experience with the order, the biology of Leach's Storm-Petrel (*Oceanodroma leucorhoa*) at the Kent Island, New Brunswick, Canada, breeding colony. Perhaps forming judgments from such a limited base of information is not fair but, for instance, the statement in Chapter 1 that all petrels "... tend to return to breed at their birthplaces ..." (p. 12) clearly does not apply to the Kent Island colony in which less than 5% of the thousands of nestlings banded over the years by C. E. Huntington have ever been found breeding. Similarly, results of recent chick-switch experiments in the Kent Island colony (R. A. Mauck and T. C. Grubb, Jr., unpubl.) dispute the notion that "Nestlings of migratory species may be deserted by their parents before they fledge; ..." (p. 14).

Chapter 2 concentrates on the albatrosses (Family Diomedidae). This chapter is orga-

nized similarly to the remaining eight chapters devoted to specific groups of petrels, with a general introduction followed by sections on the encompassed genera, life styles, distribution, feeding and food, breeding, dispersal and migration, populations and mortality, and conservation. Here, we learn of an interesting adaptation for flight in albatrosses and giant-petrels (*Macronectes*). When the wing is fully extended, the humerus is locked in place at the shoulder by a fan-shaped sheet of tendon from the superficial pectoralis muscle. The result appears to be a substantial reduction in the energetic cost of maintaining the position of the outspread wing against the lift generated during flight. On page 33, Warham presents a clear description of the remarkable process of dynamic soaring which, with the locking wing, goes far to account for the enormous and swift passages so typical of this group. We also learn that Wandering Albatrosses (*Diomedea exulans*) of at least one subspecies take 20 years to attain fully adult plumage.

This volume would have benefitted greatly from inclusion of detailed maps of the world's oceans, perhaps inside the front and back covers or even as a pull-out, with petrel breeding islands labelled. The map on page 38 showing the oceanic breeding sites of albatrosses clearly illustrates the difficulty. Colony islands are shown, which albatross species breed on which islands are marked, but as the islands are unnamed we have no convenient way to determine which island is which. This problem recurs throughout the book, with impossibly remote specks of rock (e.g., Alexander Selkirk Island, Ducie Island, Possession Island) mentioned as if we all know where they are. Of course, I suppose we could go look them up in an atlas.

The recent satellite tracking records of Weimerskirch and colleagues confirm the truly Homeric voyages taken by these birds as part of their normal routine. During one 33-day feeding trip, a male Wandering Albatross covered 15,200 km. During the breeding season, the sexes of this species apparently divide foraging habitat on the grandest of scales, males feeding in the Antarctic and females in the tropics.

The albatrosses range in their nest-building from mollymawks sitting on truncated cones to the Galapagos Albatross (*Diomedea irrorata*) that has dispensed altogether with a nest and shuffles about on the lava substrate while taking its egg along with it. In albatrosses, such nest-building does not occur for a very long time. For example, male Sooty Albatrosses (*Phoebastria fusca*) do not breed until age 12.

Albatross populations seem rather stable on this man-dominated globe, though declines of Wandering Albatrosses at several colonies, apparently due to entanglements in fishing nets, are worrisome.

The remarkably low annual productivity of petrels, all of which lay only one egg per year, is surely a co-adaptation with, or perhaps even a consequence of, their remarkably high annual survivorship. Warham cites the estimate of Lancelot Richdale, another grand master of petrel biology, that Wandering Albatrosses breeding in New Zealand had an annual survivorship of 97%. We are frustrated by not having in this volume a theoretical treatment linking low annual productivity, high survivorship, and such issues as age-specific reproductive effort and age-specific experience.

Chapters 3 to 8 are devoted to the Family Procellariidae, the fulmars, gadfly petrels, prions, and shearwaters. These are medium-to-large robust birds found in all the world's oceans. The smaller species are nocturnal at the colony. Among the fulmars described in Chapter 3, the Snow Petrel (*Pagodroma nivea*) is noteworthy for very large intracolony variability in body size in the apparent absence of assortative mating. Essentially nothing is known about the genetic causes or fitness consequences of such variation.

Among the gadfly petrels (*Lugensa*, *Pterodroma*) reviewed in Chapter 4, one small New Zealand population of the Mottled Petrel (*P. inexpectata*) nests on an island in a freshwater lake, an apparently unique circumstance among petrels.

In the presumed interests of readability, Warham has dispensed with the more ponderous baggage of science. Thus, in the Chapter 5 treatment of the Blue Petrel (*Halobaena caerulea*) and the prions (*Pachyptila*), one finds the only *P* value in the volume. Later in the chapter, we are given an interesting account of "convergent evolution." After rejecting Robert C. Murphy's suggestion that their vessels should be painted to match the cryptic plumage patterns of the Dove Prion (*P. desolata*), the U.S. Navy during World War I conducted independent tests for crypticity and arrived at "omega gray" as the best color for their ships, a color with precisely the same reflective properties as the bird!

Warham's account of their feeding and foods clearly shows that the prions (and the diving petrels described in a later chapter) function as miniature baleen whales. The birds share with the mammals an enormously expandable throat pouch, a straining device mounted on the lateral margins of the mouth, and a large tongue for propelling water back out through the strainer. Both groups specialize in planktonic prey.

Also in this chapter, Warham almost offhandedly corrects a published claim concerning nest-site segregation between two prion species. This example illustrates the author's great familiarity with the biology of the order, an attribute with noticeable consequences throughout the book.

Chapter 6, on *Bulweria*, implicitly challenges the intrepid to find the nesting place of Jouanin's Petrel (*B. fallax*). The species has been censused at sea in large numbers near the southeast coast of Arabia, but has not been found ashore. (Funds for the expedition might be sought from The Explorers Club of New York.)

The general impression that petrels in their remote island strongholds have managed to retreat completely from adversity is not quite true. Many are subject to predation by powerful avian predators (*Macronectes*, *Larus*) and some to other unpleasantness. Chicks of Bulwer's Petrel (*Bulweria bulwerii*) are dragged from their burrows by land crabs, and while they incubate, some petrels are gnawed by introduced rats.

In Chapter 7, devoted to the genera *Procellaria* and *Calonectris*, we find that in one breeding colony of the Westland Black Petrel (*P. westlandica*) the sex ratio favors males two to one, presumably at least in part because males have a considerably higher annual survivorship. Why? It's tough having to wait for Volume Two. As just one example of Warham's scholarship, he gives us an account in this chapter of the state of knowledge possessed by the classical Greeks and St. Augustine concerning the biology of Cory's Shearwater (*Calonectris diomedea*).

We next come to the issue of chick desertion by the parents before the chick has left for the sea. One of the problems encountered with testing this notion, a problem apparently not fully appreciated by Warham, is that it is quite possible that during the end of the nestling phase while the chick is losing body mass, it refuses food brought by its parents. Thus, to ascribe the loss of chick mass to parental desertion may be fallacious.

The shearwaters (*Puffinus*) of Chapter 8 comprise some of the most numerous and well-studied petrels. One flock of the Slender-billed Shearwater (*P. tenuirostris*) was estimated at 132 million birds. Thanks to the early work of Robert Lockley and the studies that continue on islands off the coast of Wales, the breeding biology of the Manx Shearwater (*P. puffinus*) is perhaps the best known in the order.

In Chapter 9, on the storm-petrels (Hydrobatidae), Warham claims we have only circumstantial evidence that this group feeds at night. Apparently, he is not aware of my own work showing experimentally that storm-petrels fly upwind at night to a food-odor source. We also find here another species with an unknown breeding site, Markham's Storm-Petrel (*Oceanodroma markhami*), although somewhere in northern Peru is the likely location.

Warham closes the chapter by noting the efforts of Steve Kress and colleagues to entice, with sound and odor, Leach's Storm-Petrels to begin new breeding colonies on islands along the Maine coast.

The diving petrels (Pelecanoididae) of Chapter 10 are the most divergent morphologically of the petrels. In reducing the size of their wings for efficient "flying" underwater, natural selection appears to have traded off wing-loading and maneuverability in the air. Diving petrels have so converged with the alcid in these attributes that as late as 1958 they were considered to belong to that very different family.

The Common Diving Petrel (*Pelecanoides urinatrix*) has an annual survivorship of 82% and first breeds at age 2. The contrast between these and the analogous figures for the albatrosses, 97% and 12, begs for discussion.

The second part of the book (Chapters 11 to 15) presents the breeding biology of the petrels, partitioned phenologically. Chapter 11 is introductory and details the costs, benefits, and methods of studying this group. With colonies often numbering in the millions, petrels present seldom-rivalled opportunities to collect sample sizes that will keep any statistician happy. Petrels are often unwary and many breed in burrows, attributes encouraging to the practitioner of manipulative experiments. A cost of working with the group is the difficulty

of living long enough to collect such important demographic data as lifetime reproductive success. Warham relates the case of a Royal Albatross (*Diomedea epomophora*) banded by Richdale that, in 1988, was at least 58 years old and had by then outlived its bander by five years! In this chapter Warham brings into play the related field of wildlife photography. Throughout the book, the fruits of his expertise are on exhibit in a series of excellent photographs depicting the details of these birds' lives, even details of their lives underground in breeding burrows.

In the section concerning breeding dispersion, we are informed that the burrows in one colony of Galapagos Storm-Petrels (*Oceanodroma tethys*) reach the astounding density of 15/m<sup>2</sup>. By my calculation, if the burrows consisted only of nest chambers and if the nest chambers were square in horizontal section, then cramming 15 into a square meter would require each to measure about 25 cm × 25 cm, with walls between adjacent burrows of 0 cm thickness and with no entrance tunnels! Clearly, this colony must be stratified vertically into a multistoried tenement.

While there is great variety in the season of the year during which various species breed, there are apparently at least two cases of subpopulations of the same species breeding at different seasons of the year on the same island. In the storm-petrel (*O. tethys*) on the Galapagos, even failed breeders remain faithful to their temporal subpopulation. Fertile ground for genetic analysis, this.

We learn of the importance of long-term pair bonds for the breeding success of the group. Of Laysan Albatrosses (*Diomedea immutabilis*) losing a breeding partner, 99% did not even attempt to nest the following season.

Notwithstanding my reference earlier to Leach's Storm-Petrel, the order is replete with examples of natal philopatry. The examples of intense natal philopatry found in Laysan Albatrosses by Harvey Fisher were, in fact, the inspiration for William Shields' influential theoretical excursion into the adaptiveness of inbreeding. The attachment seems to be overwhelmingly to the nest site. Laysan Albatross chicks displaced only short distances were ignored by their parents which returned with food to the precise nest location. Similarly, records from many species of petrels suggest that fidelity to the nest site, and not to a particular bird of the opposite sex, is responsible for the many examples of long-term pair bonds.

Chapter 12 concerns the "pre-egg" stage, the period between first return to the breeding site and egg laying. As might be expected, there is much more known about this stage for surface nesters than for burrowers. The assertion that surface-nesting petrels are too big to burrow is puzzling. Grizzly bears aren't.

I found in this chapter an attribute of petrels apparently being argued from a group-selectionist perspective, "Burrowing also helps make the most use of land available, as this may be in short supply . . ." (p. 244). Such a minority view of natural selection also appears to surface several chapters later when the author states that in the storm-petrels, *Oceanodroma furcata* and *O. homochroa*, ". . . a wide spread of egg dates may ensure better survival" (p. 274).

In considering the levels of activity at colonies during the pre-egg stage, Warham presents evidence that lunar and other cycles may be involved. In my own studies of growth bars on feathers as indicators of nutritional condition (ptilochronology), Leach's Storm-Petrel is the only species examined so far in which growth bars are not regularly spaced. I wonder whether this inconstancy is a function of overlapping activity cycles in the species, and whether the same result will be found in other petrels, particularly those which are nocturnal at the colony.

The account of Laysan Albatrosses attempting to copulate in stacks four high leads to the question of extra-pair fertilizations among petrels. To my knowledge, so far, EPFs have been searched for genetically only in the Northern Fulmar (*Fulmarus galacialis*) and Leach's Storm-Petrel, unsuccessfully in both species.

The volume's most important contribution is its massive compilation of facts. For example, Table 12.1 is the first of five major summary tables concerning what is known about the breeding biology of the order. Along with numerous tables of lesser scope, these are fertile ground for those prospecting for testable hypotheses.

The section of Chapter 12 concerning sperm storage provokes the following question. If

spermatozoa sequestered in the sperm-storage gland of the female all have their heads directed toward the blind end of the tubule, how are they released to fertilize the egg in the infundibulum?

Warham states that courtship feeding does not exist in tubenoses. This is quite a blanket statement, especially as there are species with undiscovered breeding sites.

Chapter 13 focuses on characteristics of the petrel egg. Whether any female ever lays a second egg in a season following loss of her first egg can now be answered definitively using DNA fingerprinting techniques. The burden of proof seems to be on those advocating the affirmative. This chapter contained a term new to me. "Starring" refers to the first small complex of cracks made by the egg tooth.

On page 281 is a remarkable x-ray photograph of a Bonin Petrel (*Pterodroma hypoleuca*) bearing an apparently fully-formed egg, the volume of which seems to exceed a third of the bird's total. We then proceed into a mind-numbing account of egg-size calculations. In the midst of all these equations devoid of driving hypotheses is a figure showing that diving petrels lay a disproportionally small egg. This fact was considered surprising, but the very high wing-loading of this group was apparently not considered an explanatory constraint. In reading this section, I wondered whether the differences in shell thickness between surface and burrow nesters are consequences of trade-offs between breakage resistance and efficiency of gas exchange. One might predict the shell thickness of eggs in deep burrows to be below expectation.

In Chapter 14, on incubation, we learn of a male Laysan Albatross that sat for 58 straight days during its first turn on the egg. On page 311, we again see evidence of Warham's familiarity with the group, as he corrects published claims of other workers in the field. However, he reports uncritically the conclusion of G. V. T. Matthews that Manx Shearwaters may have been more prone to incubate older eggs because of their greater investment in the breeding episode. Matthews' conclusion is an example of the Concorde Fallacy, of failing to make decisions about further investment based only on present value.

The analysis of the lengths of incubation periods points up the general problem of drawing conclusions from univariate analyses. Piecemeal correlations are presented with such independent variables as egg size, yolk mass, birth weight, and adult body mass. Far preferable would have been the statistically controlled output of multivariate analyses with such variables employed as factors or covariates, but such analyses are absent from the book.

I was surprised to learn that no petrel, not even those nesting on the surface, is known to remove egg shells from the vicinity of the nest. Apparently, this is a behavioral mutation waiting to happen.

The last chapter, 15, concerns the chick stage of reproductive life. Early on, we are told of a Laysan Albatross nestling that apparently fledged after being "tended" by no less than six strange adults. It is not clear whether any of the tenders were pre-breeders or failed breeders. The book's level of detail is nicely illustrated by an entire paragraph with six references devoted to the time taken for the egg tooth to drop off.

I believe that in the following paragraph on the attainment of homeothermy Warham reaches the wrong conclusion because he starts with the wrong question:

That chicks in burrowing petrels can be left untended when but a few days old, whereas those of fulmars and albatrosses need guarding for weeks rather than days, is not a consequence of the former's protection from predators as compared with an unguarded chick above ground: chicks of burrowing species simply become homeothermic much sooner than the others (p. 340).

The correct question seems to me to be: Why do underground chicks become homeothermic sooner? Homeothermy requires energy expenditure that otherwise could go into growth. Above-ground nesters must guard their chick against such aerial predators as gulls. Since they must be at the nest anyway, natural selection should favor protracted brooding which confers the benefits of high body temperature to chick growth rates without the energetic costs of homeothermy.

Overall, I found the quality of the production not up to the standard I have come to expect from this publisher. Particularly in the latter parts of the book, there were unsettling numbers of disfiguring contextual, grammatical, and typographical errors.

In concluding this review, I wish to dispel any misconception that my overall impression



is negative. On the contrary, it is thumpingly positive. When a bright and energetic person spends most of his life pursuing a single line of endeavor, the result is often exemplary. Such is the case here. This volume and its eagerly-awaited companion focusing on proximate and ultimate causation will certainly stand well into the next century as the definitive treatment of Order Procellariiformes. John Warham has set high standards of methodology and erudition to be strived for in the future by those who succumb to the mysteries of the petrels and their ocean homes.—Thomas C. Grubb, Jr.

**32. Birds of the Smokies.** F. J. Alsop, III. 1991. Great Smoky Mountains Natural History Association, Gatlinburg, Tennessee. 167 pp. \$9.95, softcover.—This pocket-sized book indicates when and where to find the 100 most conspicuous species of birds in the Great Smoky Mountains National Park. The introduction briefly describes the park's habitats along with their characteristic species of birds. Also described are seasonal changes in the plants and birds of the park. A section entitled "Birding in the park" cautions visitors about sudden changes in the weather, poisonous plants and snakes, biting insects, and bears. This section also provides information on bird guides, optical equipment, strategies for finding birds, and explains how to use the chart provided with each species described in the book. These charts are the most creative and useful aspect of the book since they show at a glance the season in which each species occurs and the elevation where the species can be found. Photographs accompany each species account, but their quality varies and many do not show the field marks. However, scant attention is given to identification, which is in keeping with the author's stated intention "to further your enjoyment by illustrating many of the more conspicuous species and to provide general information on when and where you are most likely to observe them." General information is provided in the 100 species accounts. The book concludes with specific information on where to observe the most sought after species and directions to good birding spots within the park.

This is a useful book for the occasional or beginning bird watcher who also carries a field guide. Alsop writes enthusiastically about the park and its birds and that along with the modest price should encourage many park visitors to take a careful look at the avian riches of the Great Smoky Mountains.—Edward H. Burt, Jr.

**33. Finding birds in the National Capital area (revised edition).** C. Wilds. 1992. Smithsonian Institution Press, Washington, D.C. 263 pp., 11 halftone illustrations, 29 maps. \$14.95, softcover.—In 1983, Claudia Wilds published the first edition of this guide to the best (and most convenient) birding areas within a half-day's drive of Washington, D.C. During the nine years that this first edition was available more than 10,000 copies were sold. I bought a copy, and my wife and I used it regularly to locate pleasant places to bike and bird-watch on our weekend getaways in the spring, summer, and fall. This book guided me to what are now some of my very favorite patches of countryside—places where in late May one can easily forget that the great gray, bureaucrat-filled buildings of downtown D.C. are within an hour's drive.

I was thus excited to hear last year that a new edition of this birding guide was near completion. My tattered copy of the first edition was ready for upgrading, and I was eager for new weekend birding ideas.

Birding guides, even the best ones, quickly become dated because of the inexorable pressures of urban and suburban development and from concomitant changes in bird populations and distributions. Thus housing developments have encroached on some of the open field birding sites in Frederick County, Maryland. The entrance to Huntley Meadows Park (Virginia) was moved to the opposite side of the park even before the first edition of Wilds's book had been released, and by the time I began hunting for Bewick's Wrens (*Thryomanes bewickii*) as instructed in the tangles of vegetation near old abandoned barns west of Hagerstown, Maryland, the species had disappeared from this area altogether—part of a general population decline in the East.

Wilds's new edition has now arrived, and what a splendid update it is! It is fifty pages longer, and the much revamped text is augmented by all-new and vastly improved (and more handsome) maps to guide the traveling birder. The series of wash illustrations of familiar regional birds remains the same, but they are nothing more than a pleasant garnish to the necessary meat of the work, the text and maps.

The layout and list of chapters are nearly identical to that of the first edition. Two excellent introductory chapters are followed by a very useful annotated list of the ca. 350 species of birds to be expected in the area. The main body of the book comprises twenty-nine chapters treating the various birding areas. Finally, the final three chapters focus on pelagic trips, the hawk migration, and finding owls.

This is an excellent book for anyone interested in finding birds and their favorite haunts in northern Virginia, eastern West Virginia, the Delmarva Peninsula, and Maryland west of the Chesapeake Bay. It is reasonably priced, well produced, and worth having in the car as a companion to your favorite field guide.—Bruce M. Beehler.

**34. Management of habitat for breeding and migrating shorebirds in the Midwest.** J. Eldridge. 1992. Fish and Wildlife Leaflet 13.2.14, U.S. Fish and Wildlife Service, Washington D.C. 6 pp. No price given, unbound.—This leaflet constitutes an additional chapter to the U.S. Fish and Wildlife Service's *Waterfowl management handbook*. The objective of this publication is to provide practical guidelines for attracting migrating and breeding shorebirds in 12 mid-continent states, including North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio. A table is provided that indicates the breeding, migrating, and wintering status of the 40 shorebird species of the region, from the ubiquitous Killdeer (*Charadrius vociferus*) to the nearly extinct Eskimo Curlew (*Numenius borealis*).

In a section titled "Management of breeding shorebirds" the author provides information on the vegetation structure preferred by various shorebird species. Also discussed are the juxtaposition of various habitats; the role of grazing, mowing, and prescribed burning; and the importance of ephemeral wetlands.

The author discusses in some detail the food preferences and foraging behavior of shorebirds. During migration, shorebirds rely heavily on midge (Chironomidae) larvae; several paragraphs are devoted to midge life history and managing habitat for midge larvae. Finally, specific management regimes are recommended for various types of wetlands, including the timing of floodings and drawdowns.

Although specific pieces of information are not cited within the text, a "suggested reading" list is provided. The recommended management regimes are sufficiently specific to be valuable to land stewards and wildlife managers. Copies may be obtained from the Publications Unit, U.S. Fish and Wildlife Service, 1849 C St., N.W., Mail Stop 130-ARLSQ, Washington, DC 20240, USA.—John A. Smallwood.

**35. Golden-crowned Kinglets: treetop nesters of the north woods.** R. Galati. 1991. Iowa University Press, Ames, Iowa. xi + 142 pp., foreword by J. J. Hickey, numerous black-and-white photographs, and line drawings by C. H. Nelson. \$18.95, hardcover.—This volume is a personal account of the author's summer-long study of the breeding biology of the Golden-crowned Kinglet (*Regulus satrapa*). Most of the scientific data presented in the book has been published elsewhere (Galati and Galati, 1985, J. Field Ornithol. 56:28–40), therefore the main interest in this book is in learning the trials and tribulations of studying a treetop nester. The thirteen chapters cover all of the stages in nesting behavior as well as the study area and various experiments with eggs and nestlings. Both the line drawings and the black-and-white photographs are well executed and add to the charm of the book.—James L. Ingold.

**36. The Black-capped Chickadee: behavioral ecology and natural history.** S. M. Smith. 1991. Cornell University Press, Ithaca, New York. ix + 362 pp., illustrated. \$46.50, hardcover; \$17.95, softcover.—The Paridae may well be the best studied group of passerine birds and the Black-capped Chickadee (*Parus atricapillus*) the most studied North American species. In this book, Smith has presented all that is known and more importantly what is not known about the biology of the Black-capped Chickadee.

The book begins with a general chapter on natural history, including a discussion of systematics and subspecies, which is followed by a chapter on study techniques, such as color banding and pilochronology. Other chapters deal with various aspects of the bird's biology: food and feeding, communication, early breeding season, later part of the breeding season, nonbreeding season, surviving winter, and survivorship and population dynamics.

The last chapter, my favorite, lists ideas for future research. Most of the ideas had been

presented in the previous chapters, but reiterating them at the end brings into focus what we still need to learn about this species.

Overall, the writing is clear and concise. The outstanding feature of this work is the comparative flavor. At all stages, Smith compares various aspects of the biology of the Black-capped Chickadee with the biology of other parids such as the Willow Tit (*P. montanus*) and the Great Tit (*P. major*). The book is well illustrated with original figures and tables from primary sources. These illustrations are large, well reproduced, and easy to read. The black-and-white photographs vary in quality, however, with some being very grainy and/or out of focus.

This book will be a valuable addition to one's personal library, for both the professional and the casual birder. It will be an important resource for information on all parids as well as for research projects at all levels of investigation.—James L. Ingold.