

## RECENT LITERATURE

Edited by Jerome A. Jackson

### MIGRATION, ORIENTATION, AND HOMING

(see also 23, 70)

1. **Sex and age biased mobility in Hawk Owls *Surnia ulula*.** I. Byrkjedal and G. Langhelle. 1986. *Ornis Scand.* 17:306-308.—Using 79 Hawk Owls recovered in Norway between September and January, the authors tested 3 hypotheses for differential "migration" among age and sex classes of birds: the body-size, social-dominance, and arrival-time hypotheses (see Kerlinger and Lein, *Ornis Scand.* 17:1-7, 1986; Marks, *J. Field Ornithol.* 57:328, 1986). Most of the adult males were recovered inside the breeding range, whereas most of the adult females were found outside the breeding range and below 100 m elevation (where the availability of prey in winter was highest). No strong trends emerged for juveniles of either sex. Thus, mobility of Hawk Owls during the nonbreeding season did not seem to be governed by any single-factor hypothesis. The pattern for adult males was best explained by the arrival-time hypothesis, and that for adult females by the social-dominance hypothesis.—Jeffrey S. Marks.

### POPULATION DYNAMICS

(see also 47)

2. **Seasonal variations in feeding range and flock structure of the Rook *Corvus frugilegus* in eastern Ireland.** R. A. MacDonald and J. Whelan. 1986. *Ibis* 128:540-557.—Traditionally, tremendous interest has been focused upon avian flocking, with much of it concerned with the adaptive significance of flocking. This paper contributes to the field by examining seasonal patterns in feeding range and flocking in a common European corvid, the Rook (*Corvus frugilegus*). Marked birds were followed throughout the year and the researchers observed that the feeding range and flock structure of Rooks showed temporal variations caused mainly by the dispersion of food and reproductive behavior.

When food availability was high and Rooks were reproductively active, their feeding range was restricted, particularly in spring, autumn, and early winter. However, a large feeding range occurred in late summer and late winter, when food availability was generally low or locally distributed and when Rooks were reproductively inactive. The occurrence of flocks common to several rookeries reflected variations in feeding range.

The structure of flocks showed similar seasonal variations; small widely spaced flocks were most common in summer, autumn, early winter, and spring, while large dense flocks occurred in late winter. Daily variations in flock structure occurred within any one season. Both the daily and seasonal fluctuations in flock composition may be attributed to the dispersion of prey and feeding strategy used to obtain it, reproductive behavior, and the risk of predation. Future experimental work will be required to substantiate these hypotheses.—J. M. Wunderle, Jr.

3. **Birth area fidelity and age at first breeding in a northern population of Pied Flycatcher *Ficedula hypoleuca*.** N. E. I. Nyholm. 1986. *Ornis Scand.* 17:249-252.—From 1965 to 1982, 6459 banded young fledged from nest boxes in northern Sweden. This report is based on 68 of these birds (38 males and 30 females) that were trapped as breeders between 1966 and 1985. Overall, Nyholm estimated that 10-13% of the males and 4-5% of the females returned to their natal area to breed; 3.3% of the males and 1.3% of the females did so as yearlings. Breeding sites of birds banded as nestlings seemed to be randomly distributed within the study area, and there was no difference between the sexes in mean distance from birth site to breeding site. Although sample sizes were too small for analysis, returning females that first bred as 1-yr-olds had grown faster as nestlings than those that first bred as 2-yr-olds. For males, there was no indication that age at first breeding was influenced by nestling growth rate.—Jeffrey S. Marks.

4. **Mass mortality of Short-tailed Shearwaters along the Japanese coast.** N. Oka and N. Maruyama. 1986. *Tori* 34:97-104.—Mass mortality of juvenile Short-tailed Shear-

waters (*Puffinus tenuirostris*) occurred along the Pacific coast of central and northern Honshu, Japan, from May to mid-June 1983–1985. Of 2258 carcasses collected, more than 99% were considered young of the year, and the main cause of mortality was “emaciation.” The authors review past cases of mass mortality in this species and suggest a rough 10-yr periodicity: past mass mortality was documented in 1934, 1942, 1954, 1964, and 1973–1975, although some such events were in Australia, others in Japan. No attempt was made to relate the mortality with El Niño occurrences.—Jerome A. Jackson.

## NESTING AND REPRODUCTION

(see also 2, 3, 24, 50)

**5. Comparative biology of the burrowing petrels of the Crozet Islands.** P. Jouventin, J.-L. Mougin, J.-C. Stahl, and H. Weimerskirch. 1985. *Notornis* 32:157–220.—Located in the proximity of the Antarctic and Subantarctic convergences, the cold and windy Crozet Islands (46°S) have a remarkably diverse seabird fauna comprising 34 species, 32 of which nest on a single island. In this paper, based on field work conducted September 1981–March 1982, Jouventin et al. detail the breeding biology of the 16 burrow-nesting species: *Pterodroma macroptera*, *P. lessonii*, *P. brevirostris*, *P. mollis*, *Halobaena caerulea*, *Pachyptila saluini*, *P. desolata*, *P. belcheri*, *P. turtur*, *Procellaria aequinoctialis*, *P. cinerea*, *Oceanites oceanicus*, *Fregata tropica*, *Garrodia nereis*, *Pelecanoides georgicus*, and *P. urinator* (= *urinatrix*). Included are data on reoccupation of burrows and pairing, activity of non-breeders, laying, incubation, growth rate of chicks, size of feeds, fledging, egg size and weights, and much more. The data are well synthesized in a large number of tables and graphs, and provide nearly all of what is known about the breeding activities for some species.

This wealth of data provides the basis for thoughtful comparisons among similar species that nest in a common habitat. Ecological isolation seems to be maintained by differences in foraging range, feeding behavior, and breeding season. The long period of egg neglect in petrels (here recorded to 11 days in *Pterodroma brevirostris*, the longest known) is shown to vary with size and flying ability. The authors view this behavior as a “safety device useful when the foraging birds are unsuccessful or prevented from coming back to land by bad weather, and when the incubating birds, unable to fast any longer, are obliged to leave the nest.” They also document synchrony in the patterns of birds returning to land in the pre-laying period. These synchronized visits may enhance the chance of meeting and pairing, which would be useful in species that mate for life. How the synchrony might be achieved is not known; it is not correlated with weather or lunar cycles.

This is a remarkable and important paper that will be a standard reference in the seabird literature.—J. R. Jehl, Jr.

**6. Breeding in three species of fairy-wrens (*Malurus*): do helpers really help?** S. C. Tidemann. 1986. *Emu* 86:131–138.—Breeder-helper associations in Superb (*M. cyaneus*), Variegated (*M. lamberti*), and White-winged (*M. leucopterus*) fairy-wrens are described and compared. Feeding rates are not significantly raised by the presence of helpers, but females feed less in their presence, thereby conserving energy; rates increase according to the number of fledglings, but less than proportionately. Feeding rate also increases according to the age of nestlings. Parent and helper contributions are complementary so that feeding rate is stable while any individual's contribution is not. Variegated Fairy-Wrens share feeding between sexes, but in the other two species females feed more. Superb Fairy-Wren helpers are young of the year, feeding more when nestlings are older, whereas White-winged Fairy-Wren helpers are all adult males, feeding more at early stages.—Malcolm F. Hodges, Jr.

**7. Biology of the Bank Cormorant, part 4: nest construction and characteristics.** J. Cooper. 1986. *Ostrich* 57:170–179.—Bank Cormorants (*Phalacrocorax neglectus*) collect primarily seaweed as nesting material by diving for it. Nests are built in colonies on offshore rocks or on cliffs of islands. Bulky nests (weight: up to 6 kg; volume: up to 54 l) are built almost exclusively by the male in about 34 days, during which an average of 238 dives are made of a total duration of 18 h). Some robbing of nesting material occurs, mostly early in nest-building. The birds occasionally defecate on the nests, hardening the exterior. Birds with larger nests tend to be more successful at hatching young than those with smaller nests.

The author postulates that by losing its dependence on land-based nesting materials, Bank Cormorants can use more remote offshore nesting habitats; also, their nests are large and strong to withstand the harsh coastal environment.—Malcolm F. Hodges, Jr.

**8. The breeding biology of the South African Cliff Swallow.** R. A. Earle. 1986. *Ostrich* 57:138–156.—The South African Cliff Swallow (*Hirundo spilodera*) nests in colonies usually under concrete bridges. Clutches range from 1–4 eggs, with most 4-egg clutches probably the result of intraspecific brood parasitism. Both sexes incubated despite the lack of an incubation patch on males. Incubation averaged 14.6 days, and young fledged 24.1 days on average after hatching. Weight of young peaked at approximately 31 g on the 19th to the 22nd day after hatching, which is about 10 g above mean adult weight; most of the surplus was water. Nesting success was 56%, with recruitment of 0.9 young:adult.—Malcolm F. Hodges, Jr.

**9. Asynchronous and synchronous hatching: effect on early growth and survivorship of Herring Gull, *Larus argentatus*, chicks.** P. N. Hébert and R. M. R. Barclay. 1986. *Can. J. Zool.* 64:2357–2362.—Hébert and Barclay shuffled eggs in a Herring Gull colony on Kent Island, New Brunswick, to test some predictions related to Lack's hypothesis that asynchronous hatching facilitates brood reduction. The authors established a series of 3-egg experimental nests by placing together three eggs of similar size and weight and the same position in laying interval (i.e., all A or all B or all C eggs, where A indicates first-laid eggs, B indicates second-laid eggs, etc.). All eggs hatched within 24 h of each other in the 28 experimental nests used, whereas eggs hatched over >2 days in the 15 three-egg control nests. The consequences of this difference in hatching synchrony were profound, especially for the last-hatched chicks (= C chicks).

Control C chicks hatched lighter, obtained food less frequently, had lower growth rates, and had lower survivorship probabilities and mean life expectancies than A and B chicks. They also disappeared first more often than A and B chicks. None of these differences was found among chicks in the experimental nests: hatching weights, feeding frequency, growth rates, survivorships, and mean life expectancies were similar for all three chicks in experimental nests, and which chick disappeared first was random.

The authors interpret their results to mean that asynchronous hatching provides a competitive advantage to the A chicks, and to a lesser extent the B chicks, relative to C chicks. Their data fully support this position and, furthermore, the experimental nests document the effects of the absence of such a competitive advantage. Curiously, however, the anticipated overall consequences did not materialize. The thought would be that in times of food shortage, early brood reduction would be advantageous. Early loss of C chicks would enhance survival of A and B chicks and make control nests overall more successful than experimental nests in which all three chicks share the limited food for a longer period of time. However, the 15 control nests yielded only five fledglings (11.1%) while the 28 experimental nests yielded 11 fledglings (13.0%). Overall in this one study, then, all the differences seen along the way made no difference in fledging success.—A. John Gatz, Jr.

**10. Costs and benefits to Red-breasted Mergansers nesting in tern and gull colonies.** A. D. Young and R. D. Titman. 1986. *Can. J. Zool.* 64:2339–2343.—On two small islands off New Brunswick, most Red-breasted Mergansers (*Mergus serrator*) nest in colonies of Common Terns (*Sterna hirundo*) rather than either solitary or in mixed colonies of Herring (*Larus argentatus*) and Great Black-backed (*L. marinus*) gulls. Young and Titman obtained data that corroborated a hypothesis that this nesting pattern arose from predator avoidance. Only 1 of 160 merganser nests (0.6%) in the tern colony suffered predation, whereas 10% (1 of 10) of the nests in the gull colony and 33% (4 of 12) of the solitary nests suffered predation. The authors observed tern flocks mobbing predaceous birds ten times during 26 h of specific observation and incidentally on seven other occasions. Solitary gulls dove at predaceous birds with an even higher frequency—three times in 4 h of observation.

As is so often the case, the benefit does not come without an associated cost. The terns were also seen to mob female mergansers returning to their nests on eight occasions and a full 30% (48 of 160) of the merganser nests in the tern colony were abandoned. The abandonment rate was only 10% (1 of 10) for merganser nests in the gull colony and 17%

(2 of 12) for solitary merganser nests. Furthermore, intraspecific nest parasitism was highest among the closely-spaced merganser nests in the tern colony.

More data are needed to understand the costs and benefits of mergansers nesting among gulls versus solitarily. The small sample sizes for these two categories in the present study do not permit one confidence in assessing the relative rates of abandonment and predation nor the possibility of predation by the gulls themselves.—A. John Gatz, Jr.

**11. Reproductive performance in Lesser Snow Geese: are two parents essential?** K. Martin, F. G. Cooch, R. F. Rockwell, and F. Cooke. 1985. *Behav. Ecol. Sociobiol.* 17: 257-263.—This paper describes a removal experiment designed to evaluate if bi-parental care is essential or helpful in increasing reproductive success of breeding Lesser Snow Geese (*Anser caerulescens*). In this experiment most removals were of males, though some female removals were also done. Experimental nests were created by removing mates during early laying, late laying, and incubation. As one might expect there was a dramatic (76%) nest loss when removals occurred during early egg laying; what seems surprising is that 20% of these nests were successful (at least one fledgling). Furthermore, there were no significant differences in the success of lone parents when removals occurred during late laying or during incubation. These results are all the more interesting given that the controls were the two nearest neighbors to an experimental nest, raising the likelihood that the disruption of the experimental nest might have positively affected the success of neighbors (due to competition for resources, etc.). This study joins the growing ranks of parent-removal studies that have shown little or no effect of uni-parental care on reproduction (especially females), and with those earlier studies, raises the question of the selective value of bi-parental care.—Patricia Adair Gowaty.

**12. Incubation feeding in Snow Buntings: female manipulation or indirect male parental care?** B. E. Lyon and R. D. Montgomerie. 1985. *Behav. Ecol. Sociobiol.* 17:279-284.—In order to evaluate evolutionary explanations for the feeding of females by males during incubation in Snow Buntings (*Plectrophenax nivalis*) nesting in the Canadian high Arctic, mates of females were removed at the end of laying and at hatching. The reproductive performance of these lone females was then compared to each other and to control females whose mates were not removed. (The method of male removal was not noted in the paper, an oversight that calls into question the robustness of the controls.) Females whose mates were removed at the end of laying spent significantly more time off their eggs than females whose mates were removed at hatching and control females. As a result the incubation period for females without males during incubation was significantly longer than those with males. In addition females without males during incubation hatched significantly fewer eggs than females with males. The loss of incubation feeding had no apparent effect on the number of chicks fledged, but it did seem to affect the timing of starvation of chicks from those nests in which two chicks died: the chicks of those females without incubation feeding died significantly earlier than those of females who had been fed during incubation. Thus the study supports the idea that incubation feeding is an adaptive male behavior that enhances the reproductive success of both parents.—Patricia Adair Gowaty.

**13. Food delivery and sibling competition in experimentally even-aged broods of the Cattle Egret.** M. Fujioka. 1985. *Behav. Ecol. Sociobiol.* 17:67-74.—Creation of even-aged broods of normally asynchronously hatching Cattle Egrets (*Bubulcus ibis*) allowed comparison of reproductive success of asynchronous and synchronous broods, clarification of the mechanisms of brood reduction (passive starvation or siblicide), and clarification of the debate over whether parents deliver maximum amounts of food to their chicks. Overall survivorship of chicks from synchronously hatched broods (SHB) was higher than for chicks from asynchronously hatched broods (AHB), but there were no significant differences in growth rates of chicks from either ASB or SHB. In addition no chicks died of starvation in the SHB, but four did from ASB. The most subordinate sibling lost serious fights and was excluded from food contests in both types of broods. Thus, the author concluded that brood reduction occurs through siblicide. The data support the conclusion that brood reduction in Cattle Egrets occurs through both passive starvation and siblicide. Parents deliver food in response to begging rate, thus the overall food delivery rate to SHB was higher during the periods when begging rate was greatest in these even-aged broods, suggesting that parents

of SHBs may raise lighter chicks than those of AHBs in years when food is scarce. The overall conclusion, that asynchronous hatching is adaptive for birds that exploit unpredictable, yearly changeable food resources, is consistent with the data presented, and leads to the prediction that in years when food is scarce, parents of SHBs may experience lower reproductive success.—Patricia Adair Gowaty.

**14. Shared paternity in the Acorn Woodpecker (*Melanerpes formicivorus*).** N. Joste, J. D. Ligon, and P. Stacey. 1985. *Behav. Ecol. Sociobiol.* 17:39–41.—This is an electrophoretic study in which parentage was determined more rigorously than by assumption based on “parental” behavior. The claim of these authors is that this is the first time that Acorn Woodpeckers can be classified as cooperatively polyandrous; however, due to the assumptions of their study, particularly the one that states that the male(s) and female(s) parent(s) of the brood were represented in the sampling effort, this study provides only a more sophisticated source for the assumption of parentage. This is an important point, so I will belabor it: other, unexamined sources of the inconsistent genes they document are egg dumping and copulations by non-group males. Given that two females have been known to lay in the same Acorn Woodpecker nest, one of these alternative explanations for the inconsistencies must be addressed. On the up side, I applaud these authors for making the difficult attempt to describe the mating system on the basis of data that more nearly approximate the genetically effective mating pattern.—Patricia Adair Gowaty.

**15. Parental investment in clutch size and egg size in the Ural Owl *Strix uralensis*.** H. Pietiäinen, P. Saurola, and R. A. Väisänen. 1986. *Ornis Scand.* 17:309–325.—The authors measured 331 clutches of 145 female Ural Owls in southern Finland from 1977–1984. All owls bred in nest boxes and nearly all were banded. Not unexpectedly, the vole cycle had a profound influence on the reproductive performance of the owls. Only 24% of the females laid eggs during poor vole years vs. 76% during peak years. Average clutch size declined from 3.48 in good years to 3.01 in intermediate years to 2.25 in poor years. Clutch initiation was delayed nearly a month in poor years. Egg size peaked in good vole years, during which variation in egg size among females was lowest. Interestingly, individual females laid eggs of fairly constant size from year to year, suggesting that egg size has high heritability. There is a wealth of good information in this paper.—Jeffrey S. Marks.

**16. Nest site settlement by the Pied Flycatcher: does the female choose her mate for the quality of his house or himself?** T. Slagsvold. 1986. *Ornis Scand.* 17:210–220.—Pied Flycatchers (*Ficedula hypoleuca*) in this central Norway study area are single-brooded and nest almost exclusively in nest boxes. Males arrive in spring about 1 wk before females and usually return to former breeding areas. Males remain on territory even after their nest boxes have been altered. By tilting nest boxes after males arrive but before females settle, Slagsvold was able to assess the influences of nest-site quality and male quality on female choice.

In 5 of 7 experiments, females laid eggs (i.e., chose males) earliest in territories with upright boxes. Slagsvold concludes that females chose mates primarily on the basis of nest-box quality rather than male quality, speculating that differences in quality among males were small. Other components of male quality, e.g., their ability to provide food or nest defense, were not tested. Slagsvold’s study is one of the first to present experimental evidence that female choice is based on a resource held by the male.—Jeffrey S. Marks.

**17. Diurnal feeding cycle at an inland Great Blue Heron colony.** E. G. Horvath and R. K. Moholt. 1986. *Murrelet* 67:27–28.—Studies of Great Blue Herons (*Ardea herodias*) nesting in coastal areas have shown that feeding rates peak during low tides regardless of time of day. Few studies have been conducted at inland heronries that are unaffected by tidal cycles. In this study, 16 heron nests were observed from 0400–2200 for 8 consecutive days at Sycan Marsh in interior Oregon. Although herons fed young throughout the day, most of the 197 feedings observed occurred around sunrise or sunset. Differences in the daily feeding schedules of coastal vs. inland Great Blue Herons suggest that herons adjust their feeding behavior to exploit local peaks in prey availability.—Jeffrey S. Marks.

**18. The process of asynchronous hatching and sibling competition in the Little Egret *Egretta garzetta*.** Y. Inoue. 1985. *Colonial Waterbirds* 8:1–12.—This paper is a

translation and condensation of two papers originally published in Japanese. The study was conducted on 59 nests in two Japanese heronries, with 13 nests studied in detail. The paper focuses on the process of asynchronous hatching, the asymmetric growth and survival of chicks as a function of hatching order, parental feeding behavior at the nest, and the competitive abilities of siblings. The mean hatching interval was 37 h, and in the four pairs observed on the day the first egg was laid, intermittent incubation began on that day. Ninety-eight percent of the eggs hatched in the order in which they were laid. Hatching intervals between first, second, and third eggs were significantly shorter than between third, fourth, fifth, and sixth eggs. In general, first, second, and third chicks grew at almost equal rates, fourth chicks grew more slowly, while fifth and sixth chicks had very low growth rates. The survival rate of chicks followed a similar pattern, with low survival rates for the youngest chicks. Most mortality was caused by starvation.

Feeding methods changed with time: boluses were deposited on the nest floor initially, and at a later stage were passed directly to individual chicks. Chick begging frequencies increased through the direct feeding stage. The author suggests that there are two critical periods for junior (fourth-sixth) chicks. The first occurs when the principal feeding method changed from indirect (bolus on nest floor) to direct (bolus to chick), since senior chicks receive food by the latter, more efficient method, and the junior chicks are particularly disadvantaged if parental food delivery was insufficient. The second critical period occurs during the direct feeding stage, when food intake is increasingly influenced by the competitive ability of the chicks. Older chicks generally prevail over younger ones in direct competition for boluses. The results support the hypothesis that asynchronous hatching may be an adaptation for brood-size adjustment to unpredictable food availability.—William E. Davis, Jr.

**19. Nesting habits and habitats of Ancient Murrelets and Cassin's Auklets in the Queen Charlotte Islands, British Columbia.** K. Vermeer and M. Lemon. 1986. *Murrelet* 67:33-44.—The Queen Charlotte Islands are home to about 254,000 pairs of Ancient Murrelets (*Synthliboramphus antiquus*) and 236,000 pairs of Cassin's Auklets (*Ptychoramphus aleuticus*). In this study, nesting habitat selection by the 2 species was assessed on Frederick Island, which has the largest numbers of murrelets and auklets in the Queen Charlottes.

Both species excavated burrows in forest habitat with sparse or no undergrowth. Ancient Murrelets nested primarily in moss-covered ground 40-450 m inland. They avoided grass tussocks and dense colonies of Cassin's Auklets. Cassin's Auklets nested in grass- and moss-covered ground within 100 m of shore. Differences in nesting habitat were probably related to different chick-rearing strategies. Accompanied by their parents, Ancient Murrelet chicks went to sea at 2 d old. Their well-developed tarsi enable them to cover long distances over mossy ground as their parents coaxed them to the water. By contrast, Cassin's Auklet chicks were fed at the nest for 6 weeks. Fledglings flew from grass hummocks and other rougher terrain, and received no help from their parents. Some fledglings crashed into trees and other objects, and nesting near shore may have helped reduce such casualties.—Jeffrey S. Marks.

**20. Heavy brood parasitism by the Common Cuckoo *Cuculus canorus* on the Azure-winged Magpie *Cyanopica cyana*.** S. Yamagishi and M. Fujioka. 1986. *Tori* 34: 91-96.—The authors found that 31 of 41 (75.6%) of Azure-winged Magpie nests studied at Azumino, Japan, were parasitized by the Common Cuckoo. Later nests were more often parasitized than early nests. The high incidence of parasitism is attributed to the recent expansion of the ranges of both species and the resultant recent development of a host-parasite relationship between them.—Jerome A. Jackson.

## BEHAVIOR

(see also 6, 7, 12, 18, 41, 50, 52, 54, 58, 59, 65, 67, 71)

**21. Retrieval of stored seeds by Marsh Tits *Parus palustris* in the field.** T. A. Stevens and J. R. Krebs. 1986. *Ibis* 128:513-525.—A number of recent studies have focused on the role of memory in food storing and retrieval by a variety of parid and corvid species. Much of this previous work was done in the laboratory, where experimental conditions

could be conveniently controlled. Tackling the problem of food retrieval behavior in the field is understandably more difficult, but the authors have approached the problem with Marsh Tits (*Parus palustris*) by using some imaginative techniques.

Marsh Tits with tiny magnets attached to their legs were permitted to store radioactively labeled half-peanuts. The stored peanuts were subsequently located by use of portable scintillation counters. At the site of the stored peanuts, the investigators placed a small Hall-plate to detect the magnets on the returning bird. Each Hall plate was attached to a control box and clock which recorded the time of retrieval by the tit. Stored peanuts and the control box were checked at sunrise and sunset of each day of the study.

The results indicate that Marsh Tits attempted to recover approximately 24% of their stored food and over 65% of these recoveries were successful, other peanuts having been removed by cache robbers prior to attempted recovery. Most of the retrieval occurred within one or two days and the proportion of recorded retrieval fell to zero after about three days. Stored peanuts were commonly "robbed" by cache robbers (primarily rodents feeding at night) who emptied cache sites within three days. Although sample sizes were low, there was a tendency for retrieval to occur in the afternoon. As with previous studies by researchers associated with the Edward Grey Institute of Field Ornithology, this study employs an imaginative technique to solve a difficult field problem.—J. M. Wunderle, Jr.

**22. Mixed reproductive strategy and mate guarding in a semi-colonial passerine, the swallow *Hirundo rustica*.** A. P. Moller. 1985. Behav. Ecol. Sociobiol. 17:401-408.—Mate guarding is inferred in this study on the basis of heterogeneity in the behavior of males: during fertile periods males follow females more than during pre-fertile and post-fertile periods. However, the validity of this inference is questionable, because males spent the most time daily with female mates when copulation rates were high, suggesting that the tendency for males to follow females might just as readily be attributed to copulatory access as to "guarding." Several lines of evidence militate against my alternative interpretation: male following is stronger in colonial pairs than in solitary pairs as are copulations, copulation attempts, extra-pair copulations, and chases of females by males that are not their mates. The author also argues that females in colonially nesting situations, as well as males, benefit from being closely followed by their mates, because attendance by their mates reduces the frequency with which they are chased by and harassed by non-mate males. When extra-pair copulations occurred, females were neither forced to copulate with their mates nor did male mates desert, even when male mates witnessed extra-pair copulation. The author concludes from this well-designed and balanced (but unfortunately edited) study that mixed reproductive strategies of both males and females is a regular event among paired breeding swallows.—Patricia Adair Gowaty.

**23. Dominance behaviour, body weight and fat variations, and partial migration in European Blackbirds, *Turdus merula*.** P. Lundberg. 1985. Behav. Ecol. Sociobiol. 17: 185-189.—Does intraspecific competition mediated through social dominance account for the movement out of an area by certain age-sex classes of individuals? This is the question that motivated the analyses in this paper. During the non-breeding season adult males, adult females, and juvenile males and females show pronounced variation in weight, with juvenile and adult males increasing in weight in the early winter months. However, when it snowed both juveniles and females lost weight. The weight of adult females reached high levels in winter generally, while juvenile females lost weight. An analysis of variance suggested that "time of year" and "sex" explain the variation in body weight in the winter. When the data were examined by month, "age," "sex," and "time of year," each had significant effects during January, the month in this study in which it snowed. There were two peaks in aggressive encounters over food, indicating male-female and adult-juvenile dominance relationships. The two peaks in aggression correlated with the autumn "migration," when a fraction of the population left the area, and during winter, the least favorable time of year for blackbirds. These patterns of weight variation and aggression are consistent with the social dominance hypothesis that explains movements as a result of differential access to resources.—Patricia Adair Gowaty.

**24. Replacement of breeders and within-group conflict in the cooperatively breeding Acorn Woodpecker.** S. J. Hannon, R. L. Mumme, W. D. Koenig, and F. A.

Pitelka. 1985. *Behav. Ecol. Sociobiol.* 17:303-312.—Breeding Acorn Woodpeckers (*Melanerpes formicivorus*) were removed from six groups in order to (1) evaluate the intensity of competition among helpers from different groups to fill breeding vacancies, (2) determine whether helpers bred when their parent of the opposite sex was removed, (3) examine potential breeding competition between parents and helpers, and (4) examine conflicts within groups over breeding status. After removals, the researchers watched groups until "power struggles," which had no operational definition in the paper, or replacements occurred. Vocalization counts were used to determine if group members advertised for new members. Males were assumed to be breeders if they engaged in mate-guarding of females or incubated more than 1% of the time; females were assigned to breeding status if they laid eggs. Intrusions by non-group members occurred after removal of breeders. Successful intrusions were by sibling units, made up of two of more related birds usually of the same sex. These intrusions lasted from 1-5 d and involved as many as 30 individuals; 85% of intruders were helpers from other groups. The length of interactions was positively correlated with the number of intruders involved. Both duration and number of intrusions were positively and significantly correlated with the number of storage holes in granaries. Replacements were most rapid in groups containing only helpers of the opposite sex as the removed bird. In groups containing helpers of the same sex as the bird that had died, replacement was either delayed substantially or did not occur at all. Incest occurred in one group. Calls increased after removals and the increased calling rate was attributed to the remaining breeder who typically sat in a prominent position in the granary and gave loud and long bouts of *karrit-cut* calls. Nests were produced on all experimental territories. One to four females replaced the removed females from each group; two or more males replaced the removed males. Helpers of the same sex as that of the replacing bird were driven from the territory by the new birds at two of three groups. In groups with more than two potential breeders of the same sex, dominance interactions apparently prevented helpers from breeding. Obviously, competition, even among close kin, is high in cooperative species where breeding opportunities are rare.—Patricia Adair Gowaty.

**25. Competition for food between the Snowy Owl (*Nyctea scandiaca*) and the Arctic fox (*Alopex lagopus*).** (Konkurentsia iz-za korma mezhdu belymi sovami (*Nyctea scandiaca*) i pestsami (*Alopex lagopus*). N. G. Ovsianikov and I. E. Meniushina. 1986. *Zool. Zh.* 55:901-910. (Russian, English summary.)—On Wrangel Island in the Arctic Ocean, when lemmings are abundant but stay under the snow, inaccessible to owls, the owls systematically attack Arctic foxes and feed exclusively on prey stolen from them. Being able to take advantage of the foxes' hunting success seems to be the major factor allowing the owls to winter so very far north. When lemming numbers are low, owls may attack foxes also in summer. Sometimes the foxes exploit the owls' prey. These interrelationships can be interpreted as a mechanism broadening the prey-catching capabilities of the predator through the hunting strategy of the other.

A "hunting" Snowy Owl alights on some prominence near a mousing fox, and watches it. When the fox catches a lemming, the owl flies quickly to the fox and tries to snatch the prey. This entails some risk, of course, because the fox tries to defend its prey and drive the owl away, although more often than not the fox loses. With a lemming in its mouth the fox is defenseless; otherwise it may charge the owl.

One spring day the male of a fox pair, whom the authors were observing daily, was attacked by an owl as he was taking a lemming to his mate. The fox dropped the lemming and lunged at the owl. The owl swooped down and made off with the prey just as the vixen dashed up. The next day when her mate brought her another lemming she hid in the snow while eating it, in contrast to her usual habit of eating prey off the snow surface.

A week later the same pair lost a lemming to an owl when the vixen was about to accept it from the fox. About 2 h afterward, the fox was returning to the den with a lemming, looking around all the while. An owl stooped on him. He dodged, retaining the lemming, and started scrabbling in the snow. The owl came down again; the fox jumped aside and continued digging quickly. On the owl's third pass the lemming was in the hole and the fox, teeth snapping, jumped up at the bird. The fox buried the lemming yet deeper and chased the owl, who ceased attacking. The fox returned to his cache and lay down by it for 44 min. Then he retrieved the lemming and continued to the den. The female was not there.



After a brief search for her, the fox himself ate the lemming, hunkering down in the snow. These observations point up not only the fox's strong drive to bring food to a pregnant female but also the use of caches to guard prey from avian competitors, and how calculatingly the fox can behave in complex competitive situations.

In a summertime incident, a fox and a young, unconfident-acting owl disputed possession of a large Snow Goose (*Anser caerulescens*) gosling, the fox trying to hide pieces of the carcass under a bush, while the owl tried to make off with the remains.

Sometimes the relationship is to the advantage of the fox. If lemmings are few in the summer at the time when the Snow Geese take their goslings to lakes, the foxes have poor hunting, but owls and gulls can still attack the geese on the water. At times like this foxes try to steal prey from owls.

Both owl and fox attentively follow the other's movements, note and remember details of their interactions, and draw conclusions about the competitor's moves which allow them to evaluate possible results. The authors feel that such complex and calculated interactions cannot be logically explained without assuming that these animals are using elementary rational capability.

Hence, the fox and owl share not only main but also alternate food sources. At some point a prey species becomes inaccessible to one of the predators, which would either starve or have to leave the area in search of food. These critical periods can be endured by exploiting the other predator's hunting success. This competitive symbiosis augments prey-catching ability and allows these species to survive in extremes of their range. One can expect that their populations will be stabler where they are found together.—Elizabeth C. Anderson.

## ECOLOGY

(see also 2, 5, 37, 59, 63, 64)

**26. Habitats of the Little Owl, *Athene noctua*, in Mediterranean regions.** (A propos des habitats de la Chouette chevêche, *Athene noctua*, dans les régions méditerranéennes.) M. Juillard. 1985. Nos Oiseaux 38:121-132 (French, English summary.)—In the Mediterranean part of their range (i.e., in south France, northeast Greece, Spain, and Portugal), Little Owls were found in different habitats from those in central Europe. Here, they nested in natural cavities in green and cork oak forests, olive groves, and mulberry orchards, cracks in the walls of stone quarries or sandpits, rabbit burrows in sand dunes, and crevices in abandoned buildings or piles of stones on pastureland.

Biotores suitable for Little Owls must be open and must have low vegetation, lookouts for hunting, and several potential nest sites. In central Europe, most pairs of Little Owls whose biotores are destroyed leave the area rather than colonize seemingly suitable areas nearby. In contrast, displaced pairs in Mediterranean countries commonly move to neighboring sites. This difference in behavior is understandable if one examines European and Mediterranean parts of the raptor's range. In central Europe, the weather can be severe, the owls are disturbed by humans year-round, and food, particularly the large insects on which the birds depend, is scarce. In contrast, the climate of the Mediterranean region is mild, there is little human disturbance, and food is abundant. Add to this the fact that there is also less farming and more pastoral (sheep) activity here than in central Europe.

The most important of these regional differences appears to be food scarcity. If there is enough food for the adults and their young, Little Owls will tolerate substantial changes in their biotope, but if not, they disappear. Exploitive agricultural practices, use of chemical pesticides, and automobile traffic are becoming increasingly incompatible with the habitat requirements of this species. Consequently, this small raptor, which seems assured of a future in Mediterranean countries, may soon disappear entirely from the large orchards in central Europe where it has traditionally nested.—Michael D. Kern.

**27. Determinants of feeding territory size in New Holland Honeyeater *Phylidonyris novaehollandiae*.** D. C. McFarland. 1986. Emu 86:180-185.—This is an examination of the relations between territory size, intrusion, and resource density. New Holland Honeyeater territories decrease in size both as the number of intruders and the density of *Banksia* flower inflorescences increase. The latter is the statistically significant determinant of territory size. Territories are usually held a number of weeks.—Malcolm F. Hodges, Jr.

**28. Shrub-steppe bird assemblages revisited: implications for community theory.**

J. B. Dunning, Jr. 1986. *Am. Nat.* 128:82-98.—The importance of competition to the structure of avian communities has been the central paradigm of a whole generation of field ornithologists. Wiens and Rotenberry's studies of shrub-steppe bird communities over the past 10 yr have played a considerable role in casting doubt on the widespread significance of competition in determining community patterns. In this paper, Dunning argued that shrub-steppe bird communities may not be good "models" for investigating the role of competition. The shrub-steppe avifaunas have (1) low species number, (2) high variability of total breeding population density, and (3) dominance by one or a few species that accounts for much of the variance in total breeding population density. Dunning compiled breeding bird census data, published in *American Birds*, and showed that the last two of these characteristics are not typical of other North American communities that have been censused for several years.

The shrub-steppe avifaunas were interpreted by Wiens as existing in a non-equilibrium state maintained by irregular climatic extremes. Dunning found these community characteristics in one census area in Connecticut that was subjected to periodic flooding, but he showed that this situation was not typical within the published census data.

Dunning argued that a correlation between trophic morphology and diet is not expected in the breeding shrub-steppe avifauna, since the dominant species are sparrows that feed on insects during the breeding season and seeds during the winter. Evolutionary effects of competition on trophic morphology is expected during the winter at times of resource limitation, but not necessarily during the breeding season.

It appears that the controversy over interspecific competition is far from being settled. Dunning's analysis suggests a number of testable hypotheses that will interest field ornithologists, and emphasizes the importance of looking for competitive effects in winter bird communities.—George Kulesza.

**29. A lesson in the limitations of field experiments: shrubsteppe birds and habitat alteration.**

J. A. Wiens, J. T. Rotenberry, and B. Van Horne. 1986. *Ecology* 67:365-376.—Habitat structure was manipulated in a 4.5 ha area of cold desert shrubsteppe in Oregon by systematically removing either 0, 25, 50, or 75% of the shrubs from 25 × 25 m blocks. Breeding territories of three passerine species were plotted in the experimental area, and also in an adjacent control area, for the year preceding the manipulation, and for 7 yr following the manipulation. The territory placement and population densities of Brewer's Sparrows (*Spizella breweri*) and Horned Larks (*Eremophila alpestris*) were affected by the manipulations in some years, but the effects were not consistent. There was no consistent change in territory size among these species. Sage Sparrows (*Amphispiza belli*) and Brewer's Sparrows modified their activity budgets in the experimental area, but not their use of substrate types.

The authors concluded that a habitat manipulation of this size scale may be suitable to observe individual responses of activity budgets and use of space. However, the manipulated area was apparently much too small to produce any substantial population response. Time lags in the response to the manipulation, and site tenacity by breeding birds, are additional factors that may obscure the results of this work.

This study is consistent with previous conclusions that shrubsteppe breeding bird communities are not fully saturated with species, and that the communities are not strongly shaped by competitive effects among species. Species occupancy appears to be largely independent of the details of habitat structure.—George Kulesza.

**30. Relationships among weather, habitat structure, and ponderosa pine forest birds.**

R. C. Szaro and R. P. Balda. 1986. *J. Wildl. Manage.* 50:253-260.—Breeding bird community structure was studied in a northern Arizona ponderosa pine (*Pinus ponderosa*) forest that had been subjected to various timber harvest treatments. Treatments were related to harvest intensity: clearcut, heavy, medium, light, and untreated (60 yr since last cut). Birds were censused for 3 yr in 93 study plots distributed over the 5 harvest regimes. Vegetation and weather data were also collected at each site.

Thirty breeding bird species were detected over 3 yr. Breeding densities and weather conditions varied widely among years. Bird densities were significantly greater on light-

and medium-cut stands than on the untreated stand. A nice application of cluster analysis grouped treatments by their similarities in bird species composition and indicated, by the pattern of treatment versus year clustering, that "Treatments were more important than weather in influencing community composition." There was, however, an interaction of treatment and weather that influenced bird density and species diversity: "[Treatment impact] clearly was more pronounced after the mildest winter and tended to be minimized after the severest winter." Because of these results, the authors stress the importance of multi-year data collection in studies of effects of habitat alteration on avian community organization.—Richard A. Lent.

**31. River dynamics and the diversity of Amazon lowland forest.** J. Salo et al. 1986. *Nature* 322:254–258.—Tropical rain forests are old and stable and have served as habitat refugia through environmental thick and thin; hence their high species diversities . . . or so we have been told. In the words of human historian Samuel Eliot Morison, "some speculations have been repeated so often as to acquire the force of fact."

Here, as elsewhere (see Kerr, *Science* 233:940, 1986), new techniques of space-based imagery analysis provide a refreshing new model for the historical ecology of a major biome. Salo and his 6 coauthors argue that Amazonian rain forests are subject to frequent and widespread disturbance caused by lateral erosion and channel changes of meandering white-water rivers. Evidence of recent erosion of this type was shown by 26.6% of the large region analyzed. In contrast, only 3–5% of the forest was in the first 5 years of regeneration following tree fall, traditionally considered the dominant Amazonian disturbance mode. Forest regeneration associated with each disturbance type is qualitatively distinct, spatially and ecologically, with river erosion producing a greater variety of habitats (see Remsen and Parker, *Biotropica* 15:223–231, 1983). The authors argue that a history of disturbance, not stability, has produced high species diversity in Amazonia, and that conservation programs should attempt to maintain underlying mechanisms.

In 1985, Campbell (*Nat. Hist. Mus. L. A. Co., Contr. Sci.* 364:1–18) reported Holocene sediments underlying broad areas of Amazonia, including high species diversity areas postulated as refuges! Also in 1985, Sanford et al. (*Science* 227:53–56) proposed fire as a significant disturbance to Amazonian rain forests. Now this. It emerges that this region may be neither old nor stable.—Peter F. Cannell.

**32. Bird/habitat relationships along a successional gradient in the Maryland Coastal Plain.** P. Mehlhop and J. F. Lynch. 1986. *Am. Midl. Nat.* 116:225–239.—Bird occurrences were examined over four breeding seasons along a successional gradient from recently abandoned pasture to mature hardwood forest. Thirty-eight bird species were captured using mist-nets at 59 locations. Correlations between numbers of individuals per species netted per site, and the number of singing males within 25 m of the site were generally significant, but at low magnitudes. This suggests that requirements for a suitable singing perch or nest site may be partially independent of other habitat requirements such as foraging or roosting sites. Principle component analyses (PCA) of vegetation characteristics at all mist-net sites defined a habitat gradient that reflected a successional continuum. Capture rates of most breeding bird species were single functions of vegetational scores at the various netting locations on the dominant PCA axis. Species that preferred mature forest, such as Northern Cardinal (*Cardinalis cardinalis*) and Carolina Wren (*Thryothorus ludovicianus*) were fairly common along the entire successional gradient, whereas species that showed a proclivity for the immature end of the gradient, such as Yellow-breasted Chat (*Icteria virens*) and White-eyed Vireo (*Vireo griseus*), showed a sharp decline in abundance between open, brushy vs. closed canopy habitats. Bird capture rates increased along a gradient from early successional stages to mature forests. After adjustment of data by rarefaction to accommodate for unequal sample sizes, species richness per standardized sample was highest in young forest. Three dominance indices all revealed that bird dominance increased with successional age of the vegetation. This was likely due to an abundance of a few very common species, such as Wood Thrush (*Hylocichla mustelina*) and Northern Cardinal, and the presence of a disproportionate number of "rare" species in mature forest sites.—Danny J. Ingold.

**33. Predicting habitat quality for grassland birds using density-habitat correlations.** B. A. Maurer. 1986. *J. Wildl. Manage.* 50:556–566.—As more field data accumulate

on density-habitat relationships in birds, the stronger is the suggestion that these relationships are not as close or simple as originally supposed (cf. Van Horne, *J. Wildl. Manage.* 47: 893, 1983). Maurer's carefully validated study shows that data-intensive, empirical habitat models can perform poorly when tested with data independent from that used to generate the model.

Bird population and habitat data were collected at two mesquite (*Prosopis*) grassland sites in southeastern Arizona. Densities of five bird species (Cassin's Sparrow, *Aimophila cassinii*; Botteri's Sparrow, *A. botterii*; Black-throated Sparrow, *Amphispiza bilineata*; Brown Towhee, *Pipilo fuscus*; Blue Grosbeak, *Guiraca caerulea*) were measured using six line transects per site. Variation of species densities among transects were related to variation in habitat variables using stepwise multiple regression and principle components regression. Regression models derived using data from one site were used to predict bird densities at the second site.

The models performed poorly when predicting densities using independent data. Even the best models "showed a relatively poor capability to predict densities . . . whereas the worst models showed substantial prediction bias . . ." As reasons for the prediction failures, Maurer suggests extrapolation of models beyond the range of the original data, and possible differences in limiting factors (such as interspecific competition) between the sites. Also, regional ecological processes may influence local bird populations, decoupling local densities from site-specific habitat features (see Ricklefs, *Science* 235:167, 1987). "Thus, the ultimate cause for prediction failure of habitat models may be due to the possibility that species are not tightly adapted to specific features of the habitat." The scale of observation and unit of analysis (i.e., study site versus bird nest) is also very important.

Maurer stresses the importance of proper validation of empirical habitat models before they are applied to wildlife management. Because of the poor predictive ability of his quantitative models, Maurer is critical of qualitative procedures, such as the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (commonly known as "HEP"), as being too cursory to be of value in monitoring avian response to habitat change.—Richard A. Lent.

## WILDLIFE MANAGEMENT AND ECONOMIC ORNITHOLOGY

(see also 30, 37, 38, 40)

**34. Traditions of sea bird fowling in the Faroes: an ecological basis for sustained fowling.** A. Nørrevang. 1986. *Ornis Scand.* 17:275-281.—The Faroe Islands are in the North Atlantic between Great Britain and Iceland. Many seabirds—mostly Common Murres (*Uria aalge*) and Atlantic Puffins (*Fratercula arctica*)—nest on the cliffs and grassy slopes surrounding the islands, and humans have been harvesting them there since about the 9th century with no apparent effect on the populations. Here, Nørrevang outlines the history of fowling on the Faroe Islands, pointing out that knowledge of seabird biology accumulated by Faroe Islanders over the centuries allowed them to manage the seabirds for maximum sustained yield.

Puffin and murre colonies were identified by name such that small portions of a colony or cliff ledge were distinguishable. In some puffinries, names served as registry of ownership. Each owner was responsible for maintaining his part of the puffinry while obtaining a maximum catch. Other puffinries were jointly owned by a community, which held meetings each spring to set bag limits based on the number of puffins observed in each colony. Puffin fowling was banned in years when marked declines in numbers were observed. Most murre colonies were accessible only by rope, and up to 20 people were required for fowling expeditions. Murre cliffs were owned by villages or by groups of fowlers, and each subcolony had an upper limit of harvest allowed. During winter, nest holes in dense colonies were trampled by foot and by livestock to prevent the turf from sliding into the sea. At the other extreme, holes were cut into turf that was too hard for puffins to excavate nest sites. Some colonies expanded by 20% or more owing to these artificial burrow starts.

Faroe Islanders knew that birds arriving late in the season were nonbreeders that could be harvested in greater numbers without harming the population. They also knew that eggs would be replaced if taken early in the season. Strict time periods were established during

which eggs could be collected, and adult birds were not taken from parts of the colony where eggs had been harvested. This is a very interesting account of what must have been one of the world's earliest conservation efforts.—Jeffrey S. Marks.

### CONSERVATION AND ENVIRONMENTAL QUALITY

(see also 26, 30, 34, 47, 66)

**35. Metals in liver and kidney tissues of autumn-migrating Dunlin *Calidris alpina* and Curlew Sandpiper *Calidris ferruginea* staging at the Baltic Sea.** S. Blomqvist, A. Frank, and L. R. Petersson. 1987. Mar. Ecol. Prog. Ser. 35:1-13.—Levels of 10 metals (Ca, Cd, Co, Cu, Fe, Mg, Mn, Pb, V, Zn) were measured in liver and kidney tissues of fall-migrant Dunlins and Curlew Sandpipers collected at Ottenby Bird Observatory on the Swedish island of Oland in the Baltic Sea. Collected birds were assigned to one of three age categories: hatching year, one-yr-old, or older on the basis of plumage characteristics. Probable breeding area of the birds was determined from banding records as northern Siberia. Levels of all metals were considered normal and similar to those reported in other studies of birds and mammals. Cadmium levels showed an increase with age and copper levels showed a decrease with age in both species. The authors express concern that continued contamination of the environment with cadmium could have an ultimate negative effect on birds in marine environments.—Jerome A. Jackson.

**36. Organochlorine concentrations in pre fledging Common Terns at three Rhode Island colonies.** T. W. Custer, C. M. Bunck, and C. J. Stafford. 1985. Colonial Waterbirds 8:150-154.—In an attempt to confirm that organochlorine residues in eggs of Atlantic Coast waterbirds reflect local contamination, the authors analyzed carcasses of pre fledging Common Tern (*Sterna hirundo*) chicks and samples of their diet from Providence, Wickford, and Price Neck colonies, and tern eggs from Wickford. Significantly higher concentrations of DDE were found in the tern carcasses from the Providence colony in the most highly industrialized of the three sites, than from the rural coastal Price Neck colony. PCBs (polychlorinated biphenyls) were significantly higher at Providence than at Wickford or Price Neck. Dieldrin and two PCDDPE (polychlorinated diphenyl ether) isomers were found only in Providence birds. DDE and PCB concentrations were higher in the carcasses than in the eggs from the Wickford site. DDE and PCBs were found in killifish from Providence but not in fish from Price Neck. Thus between-colony differences in contaminants from terns and killifish samples were similar to trends of contaminants in eggs reported in a previous study.

Contaminants in young terns seem to result more from diet than from egg residues. Among site differences in contaminants may reflect, in part, prey selection differences. The authors conclude that the concentrations of organochlorine and PCDDPE contaminants were not high enough to adversely affect survival or reproductive success of terns, even in the Providence colony.—William E. Davis, Jr.

**37. Effects of loblolly pine plantations on songbird dynamics in the Virginia Piedmont.** E. L. Childers, T. L. Sharik, and C. S. Adkisson. 1986. J. Wildl. Manage. 50: 406-413.—The objective of this study "was to determine the effects of establishment and development of loblolly pine [*Pinus taeda*] plantations" on the avian community. Birds were sampled (strip transects) in 8 plantation seral stages, plus second growth pine-hardwood and hardwood forests, in summer, winter, and spring 1979-1980. There was good replication: 3 stands per seral stage or forest type, for a total of 30 sample stands, matched for area, shape, slope, aspect, elevation, soil, and surrounding vegetation.

Thirty bird species were detected across all plots in spring, 22 during summer, and 10 in winter. Number of summer birds was highest in 2- and 5-yr-old plantation stands and declined significantly in older stands. Indices of species diversity showed a similar trend. Abundance and diversity of summer birds were significantly lower in the 2 second growth forest types than in young plantations. The general pattern of significantly more birds and more species in young plantations was repeated in the spring, but not the winter data; the winter avifauna was "extremely variable from site to site." There were major shifts in species composition across the "plantation chronology," i.e., a successional effect.

The authors conclude that "conversion to loblolly pine in small, scattered stands does

not appear to affect adversely the regional avifauna." However, pine conversion continuing at the present rate (40% pine plantations, 60% second growth forest on state lands) "can be expected" to cause increases in early successional species such as Yellow-breasted Chat (*Icteria virens*) and Prairie Warbler (*Dendroica discolor*), and decreases in late successional species such as Red-eyed and Yellow-throated vireos (*Vireo olivaceus*, *V. flavifrons*) and Scarlet Tanager (*Piranga olivacea*).—Richard A. Lent.

**38. Implications of marsh size and isolation for marsh bird management.** M. Brown and J. J. Dinsmore. 1986. *J. Wildl. Manage.* 50:392–397.—Island biogeography theory was applied to bird community data from 30 Iowa prairie marshes ranging in size from 0.2–182.0 ha: "habitat islands in intensively-farmed cropland." An attempt was made to choose marshes that were similar in physical and habitat characteristics, and which differed primarily in their size and isolation from other marshes.

Twenty-five breeding bird species were observed in the study marshes over 2 yr and were classed into "area-dependent," "possibly area-dependent," and "area-independent" groups. A species-area relationship was evident. Much (75%) of the variation in species richness among marshes was explained by marsh size and isolation, using multiple regression analysis.

Entering the debate on whether a single large wildlife preserve will support more species than several smaller ones (cf., Simberloff and Abele, *Science* 191:285, 1976; May, *Nature* 254:177, 1975), Brown and Dinsmore note that one large site may not always be best for preserving marsh bird species diversity. On the other hand, "small sites may exclude area-dependent species." In their study, 10 of 25 species were not present in marshes <5 ha in area, and each species generally occurred more often in larger marshes. The authors suggest that species richness should not always be the most important objective for management. In addition to marsh size and isolation, important factors to consider include preservation of rare species and unique sites, habitat heterogeneity, disease and disturbance potential, and management costs. To manage for bird species richness, "the best strategy seems to be to acquire additions to existing marsh complexes."—Richard A. Lent.

**39. Reproduction and organochlorine contaminants in terns at San Diego Bay.** H. M. Ohlendorf, F. C. Schaffner, and C. J. Stafford. 1985. *Colonial Waterbirds* 8:42–53.—As a follow-up to observations in 1980 of severe reproductive problems in Caspian Terns (*Sterna caspia*) in contrast to successful breeding by Elegant Terns (*S. elegans*), the authors in 1981 conducted a study to determine if organochlorine contaminants were involved. They compared organochlorine concentrations in Caspian and Elegant tern eggs from the same colony, concentrations in fish brought to Caspian Tern chicks, and in dead adult terns. The second egg laid was collected from 25 Caspian Tern, and 10 Elegant Tern nests. Each egg was analyzed for a dozen organochlorine contaminants.

More than one-third of the Caspian Tern eggs in 168 nests were lost, with failure to hatch the greatest cause of loss. All Caspian Tern eggs contained DDE concentrations from 2.1 to 56 ppm. Randomly collected eggs did not have significantly thinner shells than pre-1947 comparison eggs, but eggs found broken in the nest, or that were pipped but not hatched, were significantly thinner than normal. Caspian Tern eggs had significantly higher mean concentrations of DDE than those of Elegant Terns (9.30 to 3.79 ppm). DDE concentrations were not significantly correlated with eggshell thickness, but were with lowered eggshell density, and the authors suspect that higher DDE concentrations were in part responsible for lowered hatching success in some nests. Fish brought to Caspian Tern chicks contained up to 3 ppm DDE. The Caspian Terns fed in fresh and brackish water, while the Elegant Terns fed predominately in salt water, and the authors suggest that these differences account for much of the difference in DDE concentrations in the eggs of the two species. DDE concentrations found in dead adult terns were not high enough to suggest that DDE caused the deaths.—William E. Davis, Jr.

**40. Response of breeding Great Blue Herons to human disturbance in north-central Colorado.** D. K. Vos, R. A. Ryder, and W. D. Graul. 1985. *Colonial Waterbirds* 8:13–22.—The effects of human disturbance on breeding Great Blue Herons (*Ardea herodias*) have not been well documented. Hence, the authors studied these effects at two colonies, Fossil Creek and Lonetree Reservoirs in 1981 and 1982, and preliminary data from 1980

were included in the analysis. The purpose of the study was to measure heron responses to different human activities and to compare these responses between sites and at different times during the breeding season. Twice weekly observations of 6 h each were made at the colonies from March through July. The response to each human disturbance was ranked as: (1) none or minimal, if no herons flushed from nests (67% of all human disturbances), (2) local, if herons flushed from the immediate area of disturbance (27%), or (3) general, if temporary nest abandonment was widespread (6%). To increase the sample size, experimental intrusions, including people on foot, on motorcycles, or in boats, were conducted in 1982. Counts of heron chicks were used to estimate fledging success.

Land-related intrusions produced the greatest and most intense disturbance, with motorcycles causing the greatest proportion of general disturbances. Boat intrusions produced the fewest responses, most of which were local. There were significant differences in the response patterns between the colonies. These may reflect differences in vegetation structure or intensity of human disturbance. Herons were most sensitive to human incursions during the early part of the breeding season, less so during egg-laying and incubation, and least responsive when chicks were present.

Although the number of young fledged was enough to produce population stability, the authors suggest that human disturbance may limit the number of nesting pairs. The authors conclude with management recommendations for Great Blue Heron nesting sites. These include the establishment of buffer zones free from human activity of 150 m in water and 250 m on land.—William E. Davis, Jr.

## PHYSIOLOGY

(see 42, 56, 61)

## MORPHOLOGY AND ANATOMY

(see also 23, 49, 62, 69)

**41. Reversed size dimorphism in birds of prey, especially in Tengmalm's Owl *Aegolius funereus*: a test of the "starvation hypothesis."** E. Korpimäki. 1986. *Ornis Scand.* 17:326–332.—Lundberg's starvation hypothesis (*Ornis Scand.* 17:133–140, 1986) predicts that sexual size dimorphism in owls increases with unpredictability of food deliveries during the nesting season. Both among and within species, females should be larger, and weight dimorphism greater, in owls nesting farthest north and earliest in the season (when conditions for obtaining food are harshest). The meat of Korpimäki's paper is a test of this hypothesis using data from Tengmalm's (Boreal) Owl, the most weight-dimorphic of all European owls.

Considering pooled samples, neither female size nor degree of dimorphism in weight or wing length increased with latitude in European Tengmalm's Owls. However, among 20 pairs of Tengmalm's from Finland, females were significantly heavier, and males significantly lighter, in early-nesting than in late-nesting pairs. Also, male wing length increased significantly with the laying date of his mate. Consequently, degree of weight dimorphism decreased with laying date, and early-nesting females chose the smallest males as mates. Evidence from individual pairs thus supported the starvation hypothesis. Korpimäki reasons that females preferred smaller males because of the males' aerial agility, which should have improved territorial defense and hunting efficiency. Future studies attempting to unravel the mysteries of reversed size dimorphism in raptors would do well to follow Korpimäki's lead in studying size differences between members of breeding pairs.—Jeffrey S. Marks.

**42. Treecreeper climbing; [sic] mechanics, energetics, and structural adaptations.** R. Å. Norberg. 1986. *Ornis Scand.* 17:191–209.—The behavioral and morphological adaptations of creepers (*Certhia* spp.) are remarkably convergent with those of woodpeckers. Creepers use their tails for support during climbing, foraging up the trunk and then flying down to the base of the next tree. They may climb several km during a day's foraging. Using a 16 mm movie camera and a 35 mm SLR camera, Norberg photographed wild Treecreepers (*C. familiaris*) in Sweden to address questions on the mechanics and energetics of tail-supported climbing.

One complete stride (about 66 mm long and lasting 0.1375 s) consists of the power stroke and the floating phase. During the power stroke (about 0.0625 s), the bird moves with its claws attached to the trunk. The tail is lifted off the trunk after 0.0375 s. During the floating phase, the feet and tail are off the trunk while the bird continues to move upwards. The tail tip contacts the trunk slightly before the feet do at the end of the phase, when upward movement has ceased. Foraging Treecreepers climb at a rate of about 0.1 m/s with a stride frequency of 1.5/s. Maximum velocity is about 1 m/s vertically and 0.24 m/s horizontally. The energy cost of 1 stride is 0.028 J, 84% of which is for vertical movement, 6% for horizontal movement, 5.6% for leg movement, and 4.4% for rotation of head and body. The climbing efficiency of Treecreepers is enhanced by their long tails, strongly-curved claws, long hind claws, and the graded lengths of the front toes.—Jeffrey S. Marks.

**43. Identification of Cormorant, *Phalacrocorax carbo*, and Shag, *Ph. aristotelis*.** (Artbestämning av storskarv *Phalacrocorax carbo* och toppskarv *Ph. aristotelis*). P. Alstrom. 1985. Var Fagelvarld 44:325–350. (Swedish, English summary and figure captions).—This thorough review and excellently illustrated guide to the identification of Great Cormorants and Shags should be of use to anyone interested in field work on these or other cormorant species. The 49 (!) figures are black-and-white photographs and line drawings which illustrate plumage characteristics of these species at different ages, and differences in the ways the species hold their bodies while in flight or swimming. The 4-page English summary provides a review of molt and ageing, and details plumage and flesh color differences between the species. With the increasing number of reports of Great Cormorants from the southeastern United States, a similar comparison of this and North American species would be most useful.—Jerome A. Jackson.

#### PLUMAGES AND MOLTS

(see also 48, 50)

**44. Apparent dichromatism in juvenile Common Nighthawks (*Chordeiles minor*).** J. P. Goossen. 1986. Murrelet 67:62–63.—Two apparent sibling juvenile Common Nighthawks were photographed near Creston, British Columbia on 2 August 1980. The plumage colors were distinctly different for the 2 young, one being gray (2.5 YN 6/8) and the other light red (2.5 YR 6/8). Color morphs of juvenile *C. minor* have not been well described and warrant additional attention from researchers.—Jeffrey S. Marks.

#### ZOOGEOGRAPHY AND DISTRIBUTION

(see also 20, 25, 31, 38, 48, 63, 74, 75)

**45. Appearances of Iceland Gulls *Larus glaucooides* in France in 1984.** (Sur les apparitions en France du Goéland à ailes blanches *Larus glaucooides* en 1984.) G. Burneleau. 1986. Alauda 54:15–24. (French).—Iceland Gulls are accidental and irregular winter visitors in France under normal circumstances. However, large numbers invaded France in 1984 after a series of violent North Atlantic storms. Although they were reported along the entire west coast of France (as nicely shown, by department, on a map of France), almost half of them were sighted in the departments of Charente-Maritime and Finistère. Immatures (86% of the gulls observed; 42 individuals) were seen regularly between January and June. But adults (14% or 7 individuals) were observed only in January and February.

The fact that the earliest reports of Iceland Gulls in the British Isles and France coincided in 1984 and that three-fourths of the reports for France were from sites along the Atlantic coast (rather than the English Channel) suggest that some birds came directly to France, rather than by way of Great Britain.—Michael D. Kern.

**46. The populations of Peregrines (*Falco peregrinus* Gmelin) in north Africa: a zoogeographical puzzle.** (Les populations du Faucon pèlerin *Falco peregrinus* Gmelin en Afrique du Nord: un puzzle zoogéographique.) A. Brosset. 1986. Alauda 54:1–14. (French, English summary).—Four and perhaps five well-defined subspecies of *Falco peregrinus* occur in north Africa: *brookei*, *pegrinoides*, *minor*, *calidus*, and a previously undescribed race with



features of both *pelegrinoides* and *brookei*. Diagnostic characteristics of the five are presented and illustrated in the text.

The sedentary race *brookei* populates the Mediterranean coast of north Africa. It is restricted to the region between Tangier and Cap Bon. The distribution of *pelegrinoides* is similar, but inland, and does not overlap that of *brookei*: it includes Tunisia, Algeria, and Morocco north and west of the Atlas Mountains. The undescribed, dark-headed race with characteristics of both *pelegrinoides* and *brookei* is found on the Atlantic seaboard of north Africa, as is the tropical African race *minor* farther south in the province of Tarfaya (formerly Rio de Oro). The latter may also occur inland south of the Atlas Mountains. Races in the Atlas Mountains themselves or inland south of them have yet to be determined.

The nordic migrant race *calidus* overwinters in north Africa between December and April, and is also seen during migrations (August–October and March–May), at the mouths of rivers and in lagoons along the Mediterranean and north Atlantic (Moroccan) coast. Consequently, it is sympatric with *brookei*. However, the two races have different foraging niches, *brookei* relying for food on terrestrial birds such as doves and starlings, while *calidus* preys on shorebirds such as ducks and gulls.

Evidence to-date suggests that *pelegrinoides* is a geographic race of *F. peregrinus* rather than a distinct species.—Michael D. Kern.

**47. South Polar Skua breeding colonies in the Ross Sea region, Antarctica.** D. G. Ainley, S. H. Morrell, and R. C. Wood. 1986. *Notornis* 33:155–163.—Continuing their extensive and long-term studies of Antarctic birds, Ainley and colleagues used ground and aerial surveys to study South Polar Skuas (*Catharacta maccormicki*) in the Ross Sea. They increased the number of known breeding sites from 21 to 55 and suggested that perhaps 20 more may exist. They estimated the Ross Sea population at 15,000 skuas, of which 20% nest independently of penguin colonies. Their total is very similar to that (13,500) proposed earlier (Ainley et al. 1984, *Ornithol. Monogr.* 32) from ship-based studies. At some well-studied colonies, populations have varied considerably over the past 30 years, partly owing to increased food, increased disturbance, and other effects of humans.—J. R. Jehl, Jr.

## SYSTEMATICS AND PALEONTOLOGY

(see also 73)

**48. Variation within the Redpolls of Canterbury.** J. F. Fennell, P. M. Sagar, and J. S. Fennell. *Nortonis* 32:245–253. **Variation between Redpolls in four southern New Zealand localities.** J. Fennell and P. Sagar. 1985. *Notornis* 32:254–256.—The Redpolls (*Carduelis flammea*) of New Zealand are highly variable in color. A morphological study based on over 800 banded birds from the Canterbury area, and comparison with museum material, failed to reveal whether the original introduced stock might have been *C. f. flammea* or *C. f. cabaret*. The application of trinomial names based on European races for New Zealand birds is discouraged. Redpolls on Campbell Island and the Snares Islands did not differ from mainland birds in size, but those from Campbell, especially males, tended to have orange breasts.—J. R. Jehl, Jr.

## EVOLUTION AND GENETICS

(see also 11, 13, 41, 65)

**49. Predation risk and unpredictable feeding conditions: determinants of body mass in birds.** S. L. Lima. 1986. *Ecology* 67:377–385.—A simulation computer model was developed to investigate the effects of unpredictable food supply versus predation risks on the evolution of avian body mass. It was reasoned that larger body mass would convey greater fitness in winter if it involves the maintenance of fat reserves that were used to survive the most energetically stressful situations. On the other hand, larger-sized individuals may experience a cost in fitness if they are less likely to escape the attacks of predators, or risk greater exposure to predators when feeding for longer periods of time.

Lima's model uses parameters to describe a "good day" when feeding is possible at a

specified rate of energy intake, and there exists a temperature-dependent cost of feeding. On such days, parameters are specified to indicate the probability of predator attack, and the probability of escape which is considered to be mass-dependent. On "bad days" no feeding is possible, but there is also no risk of predation since the bird remains under protective cover. Parameters were assigned for the probability that the next day is "bad" given that the present day is "good," and also for the probability that the next day is "bad" given that the present day is "bad."

For a given set of parameters, the model predicts optimal body mass, at the start of a day, which minimizes the probability of death during the winter. Optimal body mass increases with a greater probability of "bad days" and lower ambient temperature, while optimal body mass decreases with greater predation risk or lower food supply.

This model represents a more balanced theoretical treatment of the evolution of body size than previous models that have not considered the possibilities of mass-dependent predation risks.—George Kulesza.

**50. Sexual selection and variation in reproductive strategy in male Yellow Warblers (*Dendroica petechia*).** M. V. Studd and R. J. Robertson. 1985. *Behav. Ecol. Sociobiol.* 17:101-109.—Many evolutionary arguments to explain variation in reproductive options invoke ideas about trade-offs in the allocation of energy between parental investment and competition for mates. This trade-off idea was tested explicitly, perhaps for the first time, in this study, using Yellow Warblers, a species in which the males exhibit variation in the amount and conspicuousness of the sexually distinctive plumage of the breast. The amount of brown on the breasts of males was used to rank males by their degree of conspicuousness. Visits to the nest to feed nestlings and to feed females decreased with increasing plumage rank of males. In addition duller males responded more to their mates distress calls in the presence of a moving rubber snake than did brighter males. These data demonstrate a negative correlation between parental care and plumage brightness, consistent with the idea that individuals trade-off allocation in parental strategy and sexual competitiveness. In addition the mates of bright males have higher reproductive output than the mates of dull males, despite the comparative reduction in male parental care, a finding consistent with the idea that plumage bright males obtain and hold higher quality territories. Collection of data that are capable of rejecting the idea that bright males have higher reproductive success (actual parentage assignments based on biochemical markers) could elevate this study to the classic category.—Patricia Adair Gowaty.

**51. The relationship between presumed gamete contribution and parental investment in a communally breeding bird.** J. L. Craig and I. G. Jamieson. 1985. *Behav. Ecol. Sociobiol.* 17:207-211.—Using data for the communally breeding Pukeko (*Porphyrio porphyrio*) these authors investigated whether there are possible costs associated with parental investment, which cues males and females may use to assess genetic parentage, and whether there is an association between parentage and investment. It is argued that presumed genetic contributions must be related to cues the birds might use to assess their genetic parentage and guide their investment decisions. The researchers evaluated two cues to "genetic paternity": all mountings of a female by each male, and full copulations. Participation in full copulations and the number of eggs remaining in a nest at hatching were the possible cues they considered for genetic maternity. For males, the relationship between both presumed cues of genetic paternity and investment in incubation were negative and significant. The association between chick care and the number of mounts was positive and significant, but between chick care and full copulations nonsignificant. Incubation by females was positively correlated with egg number, but there was no significant correlation between incubation and copulation; there was no significant association between chick care and either cue of genetic maternity. This study suggests that the simple model relating amount of parental investment to likelihood of genetic parentage may be too simple or altogether incorrect. On the other hand it may indicate that the presumed cues to genetic parentage used by the researchers are not the cues used by the birds themselves. The advantage of this study is that it focuses some much needed attention on the proximate causes of variation in parental care.—Patricia Adair Gowaty.

## FOOD AND FEEDING

(see also 2, 5, 17, 21, 25, 26, 27)

**52. Feeding behavior of Bramblings, *Fringilla montifringilla*, in winter.** (Comportements alimentaires chez les Pinsons du Nord, *Fringilla montifringilla*, en hiver.) C. Nardin and G. Nardin. 1985. Nos Oiseaux 38:113-120. (French, English summary).—Bramblings overwintering near Belfort, France, formed large bands and searched widely for mast on the floor of beech woods when no snow was present. When it snowed, they either left the area or concentrated their foraging activities around trees that had dropped large amounts of mast. Such foraging behavior has been reported already in the literature. However, during an ice storm, Bramblings did not feed throughout the woods, but kept some areas of the forest floor free of snow and ice by continuously scratching the soil; in doing so, they dug tunnels (up to 40 cm in length) under the frozen surface to reach beech mast. Such tunneling behavior has not been reported previously.—Michael D. Kern.

**53. Eastern Curlews *Numenius madagascariensis* feeding on *Macrophthalmus* and other ocyppid crabs in the Nakdong Estuary, South Korea.** T. Piersma. 1986. Emu 86:155-160.—Eastern Curlews feed mostly on *M. japonicus* during migration stopovers in Nakdong Estuary. Crabs are taken by deep bill-probes into burrows on mudflats. During low tide, the curlews spend 75-90% of their time foraging, taking only crabs which are 0.6-4 cm wide. Average intake is 1.95 mg ash-free dry weight per second foraging. Profitability increases more than 3 times from the smallest to the largest taken; this is given as the reason why Eastern Curlews don't bother with smaller, but much more abundant species of crabs.—Malcolm F. Hodges, Jr.

**54. Foraging of birds in eucalypt woodland in north-eastern New South Wales.** H. A. Ford, S. Noske, and L. Bridges. 1986. Emu 86:168-179.—Forty species of birds were assigned to 6 feeding guilds: ground feeders, bark feeders, leaf feeders, frugivores, aerial feeders, and nectarivores. Foraging behavior of each species is described. Observations included foraging method, substrate, height, and plant, noted for each foraging event.—Malcolm F. Hodges, Jr.

**55. Diet of the Barn Owl at a riverine roost in the central Orange Free State.** J. J. Herholdt. 1986. Ostrich 57:185-187.—Contents of 195 pellets, collected from beneath a Common Barn-Owl (*Tyto alba*) roost, were examined. A total of 248 prey items from 11 or 12 species of birds and mammals (2 bird skulls could not be identified) were found. Birds made up 50% of the diet by occurrence, the highest percentage of birds yet recorded in any study of barn-owl diets.—Malcolm F. Hodges, Jr.

**56. Grit ingestion by nestling Tree Swallows and House Wrens.** K. R. Mayoh and R. Zach. 1986. Can. J. Zool. 64:2090-2093.—Mayoh and Zach quantified the ingestion of grit by 1- to 21-day-old Tree Swallows (*Tachycineta bicolor*) and 1- to 15-day-old House Wrens (*Troglodytes aedon*). Their data show that >50% of nestling wrens had grit by day 5 and that the average amount of grit present peaked on day 10. Similarly, more than 50% of the nestling swallows had grit by day 6, but there was no clear peak in the amount of grit present. Both species showed low but significant correlations between the average mass of grit particles and nestling age; these correlations seemed primarily due to the lack of grit in the diet the first few days after hatching. Older nestlings, like adults, had lower levels of grit. The grit in swallow nestlings was predominately small (<0.5 mm) mollusk shell fragments, although similarly-sized sand was also common. Nestling wrens had almost exclusively small (<0.5 mm) sand particles as grit.

Several questions need to be addressed to gain an understanding of the ecological significance of these results. First, does the initiation of grit ingestion coincide with a dietary shift from small, soft food to large, chitinous food as the authors suggest? Gut analyses in conjunction with grit analyses would answer this question. Second, does the ingestion of mollusk shells provide calcium needed for bone growth in rapidly growing chicks? This suggestion fits with the fact that adults have much lower levels of grit, but evidence of calcium use from the grit is lacking and wrens did not use high-calcium grit. A laboratory study using radioactively-labeled grit would help address this question. A related question

is why older nestlings and adults show decreased grit ingestion. The authors note that peaks in grit ingestion correspond to peaks in feather eruption, but do not suggest reasons for this. Perhaps the answers to the first two of these questions would help in addressing the third.—A. John Gatz, Jr.

**57. Diet studies of seabirds: a review of methods.** D. C. Duffy and S. Jackson. 1986. Colonial Waterbirds 9:1-17.—This review, which includes almost 200 references, concentrates on the methods of collecting, analyzing, and presenting diet data on seabirds. Consideration is given to such important factors as sample sizes required, and the types of statistical procedures used in diet comparisons between species, food consumption, and energetic studies. Most dietary information from birds at sea is collected by killing, but the development of stomach pumps has now made killing unnecessary for diet data collection at breeding colony sites. The authors review methods for capturing birds at colonies and the procedures for retrieving samples from captured birds using various pumps and emetics. In their discussion of types of dietary samples, they stress the significance of problems associated with differential digestion.

Considered in the methods of analyzing samples are problems with preserving specimens, measurements of diet data including species identification, frequency of occurrence, numerical abundance, state of digestion, life history characteristics of prey, and derived diet data. To facilitate presenting and comparing data, indices of abundance are considered, including the Index of Relative Importance (IRI), Absolute Index (AI), and Relative Importance Index (RII). The discussion of comparing data includes a variety of diversity indices, including the Shannon-Weiner Information Index, and evaluations of diversity such as the coefficient of variation (CV) and analysis of variance (ANOVA). Measurements of dietary overlap are also considered.

The authors suggest that the two main problems of seabird diet studies are digestion and nutrition, about which little is known. They conclude by emphasizing that killing seabirds can be minimized by using other methods at colony and roosting sites, that methods of dietary analysis should be clearly reported, and that methods such as frequency of occurrence and numerical abundance should be used regularly to facilitate comparisons between studies.—William E. Davis, Jr.

**58. Foraging efficiency of sympatric egrets.** D. M. Kent. 1986. Colonial Waterbirds 9:81-85.—Here Kent compares the foraging efficiency of the Little Blue Heron (*Egretta caerulea*), Snowy Egret (*E. thula*), and Tricolored Heron (*E. tricolor*), in an attempt to ascertain the mechanisms by which their resource partitioning is maintained. He explores the possibilities that partitioning could be maintained by aggression or its avoidance, or that morphological or physiological factors could produce optimal resource differences and hence different habitat or prey selection. The study was conducted in the Tampa Bay region of Florida, where observations totaling 57 h were conducted on 103 days from October 1981 through August 1982. For each bird, the number of strikes and captures, prey type and size were recorded. Foraging behaviors were also recorded. Four indicators of foraging efficiency were calculated from the data: (1) striking efficiency, (2) grams of prey per min, (3) calories per min, and (4) foraging time necessary to satisfy daily energy requirements.

There was an inverse relationship between striking efficiency and the degree of activity while foraging, with the very active Tricolored Heron having the lowest efficiency. The energy intake of Tricolored Herons, however, was more than twice that of Snowy Egrets, with Little Blue Herons intermediate. Differences in the caloric value of prey, reflecting size and type, accounted for the differences in energy intake. When energy expenditure while foraging was included in the analysis, the results indicated that Snowy Egrets must forage twice as long each day as either of the other two herons. Kent suggests that in his study area, competition or its avoidance with Little Blue and Tricolored herons produces the relatively low foraging efficiency of Snowy Egrets, but that Tricolored and Little Blue herons use different resources primarily because of morphological differences.—William E. Davis, Jr.

**59. Behavior, habitat use, and food of three egrets in a marine habitat.** D. M. Kent. 1986. Colonial Waterbirds 9:25-30.—Kent attempts to determine the extent of resource overlap and potential resource partitioning mechanisms among three similar-sized

herons: the Snowy Egret (*Egretta thula*), the Little Blue Heron (*E. caerulea*), and the Tricolored Heron (*E. tricolor*). The study was conducted in the Tampa Bay area of Florida, with observations totaling 65 h from October 1981 through August 1982.

The foraging habitat was divided into: (1) shore, (2) shoreline (in water), (3) pools, (4) open water, and (5) canals. Foraging behavior and prey size were each divided into five categories and the field data tape recorded. A comparison was made for use frequency of each foraging behavior, habitat, and prey type, within and among species. All three heron species were significantly associated with some type of foraging behavior, and Snowy Egrets and Tricolored Herons with both foraging behavior and prey type. Little Blue and Tricolored herons were also significantly associated with habitat type. Furthermore, a significant association was found in all three species with frequency of prey type. There was considerable overlap for habitat use among the three species, and moderate overlap in foraging behavior; but partitioning is reflected between Snowy Egrets and Tricolored Herons, and Tricolored and Little Blue herons in differences of diet. Further, Snowy Egrets and Little Blue Herons partitioned by eating different size fish. Intraspecific aggression, although rarely observed, or species specific differences in foraging efficiency, reflecting morphological differences, could account for the different combinations of prey and habitat choice, and foraging behavior, which produce resource partitioning.—William E. Davis, Jr.

**60. Food habits of the Long-eared Owl in south-central British Columbia.** T. D. Hooper and M. Nyhof. 1986. *Murrelet* 67:28–30.—Pellets collected at 29 Long-eared Owl (*Asio otus*) nests from 1981–1984 yielded 331 prey items. Three genera of small mammals (*Microtus*, *Perognathus*, *Peromyscus*) constituted 85% of the diet. The remains of a red squirrel (*Tamiasciurus hudsonicus*) and a bushytail woodrat (*Neotoma cinerea*) were found in pellets from the only nest located in coniferous forest. Neither of these species has been reported previously in the diet of Long-eared Owls.—Jeffrey S. Marks.

**61. Methods of seed processing by birds and seed deposition patterns.** D. J. Levey. 1986. Pp. 147–158, in A. Estrada and T. H. Fleming, eds. *Frugivores and Seed Dispersal*. Dr. W. Junk Publ., Dordrecht, W. Germany. 392 pp.—How birds handle seeds after selecting a fruit has important consequences for the seed dispersal patterns they produce. Levey has presented some of the most detailed data yet on seed processing, seed retention times, and viability of defecated seeds, based on his comparative experimental study of nine species of tropical fruit-eating birds and seven bird-dispersed plant species. Tanagers and finches generally masticate fruits, separating the seeds and dropping them; manakins swallow fruits whole. (Note that these behavioral patterns correspond neatly to morphological features discussed by Moermond et al. 1986.) Most birds ingest small seeds. Tanagers and manakins take similar amounts of time before defecating seeds (about 10–30 min), but finches retain seeds for longer periods (30–45 min, and up to 5 h). Relatively large seeds are usually regurgitated rather than defecated. Levey demonstrates that regurgitation takes less time (sometimes as little as 7 min from fruit ingestion) than defecation. It should be noted, however, that even though *per-fruit* processing times may be faster if seeds are regurgitated rather than defecated, *daily* consumption of fruits may actually be slower because a bird cannot feed continuously if its gizzard and esophagus are occupied by fruits whose seeds must be regurgitated. Besides seed size, seed retention time depends on a bird's mass and the texture of the pulp. Differential treatment of seeds and fruit pulp turns out not to be restricted to such specialized birds as *Phainopepla nitens*—manakins pass seeds much faster than pulp. Levey ends his paper with a useful discussion of the design of feeding experiments and the evolutionary consequences of different methods of seed handling.—Nathaniel T. Wheelwright.

**62. The influence of morphology on fruit choice in neotropical birds.** T. C. Moermond, J. S. Denslow, D. J. Levey, and E. Santana C. 1986. Pp. 137–146, in A. Estrada and T. H. Fleming, eds. *Frugivores and Seed Dispersal*. Dr. W. Junk Publ., Dordrecht. 392 pp.—This is one of three papers included in the proceedings of a symposium-workshop held at the Los Tuxtlas Biological Station, Veracruz, Mexico in June 1985 that focuses on the ecology of fruit-eating birds. It summarizes a series of experiments (many published elsewhere) on fruit choice in captive birds in Costa Rican lowland rain forest. The results suggest a general correspondence between morphology and foraging mode: birds

with short, broad wings, wide gapes, and weak legs tend to snatch fruits on the wing, whereas birds with longer, deeper bills and strong legs preferentially pluck fruits from a perch. Birds in the former group (trogons, cotingas, manakins, flycatchers) are apparently more selective in their diets, presumably because flying for fruits requires more energy than reaching. Potential textbook-writers in ornithology or animal behavior should consider including some of the expertly drawn figures in this paper. Its chief contributions, though, are to link morphology, behavior, and diet breadth in fruit-eating birds and to highlight the implications of this research for the evolution of plant reproductive traits.—Nathaniel T. Wheelwright.

**63. Avian frugivory and seed dispersal in eastern North America.** M. F. Willson. 1986. *Current Ornithol.* 3:223–279.—According to Willson, the study of plant-animal interactions has been monopolized by “tropicists,” a bias she attempts to correct by highlighting the importance of avian frugivory and seed dispersal in the temperate zone. Drawing from the diverse literature on bird-plant interactions in eastern North America, including U.S. Biological Survey stomach sample records and amateur bird censuses published in *American Birds*, her review begins with a preliminary description of the ecological characteristics and species richness of bird-dispersed plants and fruit-eating birds. Plants that rely chiefly on birds for seed dispersal represent a diversity of taxa (90 genera, 40 families), regions, habitats, and growth forms in eastern North America; most North American plant families with small fleshy fruits eaten by birds apparently originated in the temperate zone. As in other parts of the world, black and red predominate among fruit colors. The dependence on birds for seed dispersal is more common among species of vines and shrubs than trees or herbs. Other characteristics, such as seasonal trends in fruit traits, show few consistent patterns between studies. Fruit-eating birds are also diverse (39 genera, 15 families) and numerous in the temperate zone, but their involvement in plant-animal mutualisms has not, in most cases, resulted in the evolution of obvious morphological or behavioral specializations. One confounding problem is that bird species are categorized according to degree of frugivory, even though the importance of fruits in birds’ diets may vary strikingly between seasons and habitats.

Willson repeatedly makes the point that we know relatively little about the behavior of fruit-eating birds, the seed dispersal patterns they produce, the importance of individual and temporal variation in plants and birds, competition for fruits or dispersers, and regional or habitat differences. In an effort to synthesize what is known and to address a host of important questions, the paper presents numerous comparisons and several lengthy tables and appendices. The studies from which Willson’s data are taken are so varied in methods and focus, as she notes, that it is difficult to arrive with confidence at many broad generalizations. Few readers will be convinced on this basis that we should abandon the tropics for the fascination of the temperate zone, but all of them will appreciate the complexity of avian frugivory and seed dispersal in eastern North America. Despite much research on avian frugivory, most of it during the last decade and much of it by Willson and her colleagues, the field is wide open—in fact, wider open now than ever. One of the contributions of this review is that it suggests many promising directions for future research.—Nathaniel T. Wheelwright.

**64. Some aspects of avian frugivory in a north temperate area relevant to tropical forest.** D. W. Snow and B. K. Snow. 1986. Pp. 159–164, in A. Estrada and T. H. Fleming, eds. *Frugivores and seed dispersal*. Dr. W. Junk Publ., Dordrecht. 392 pp.—This book is dedicated to David and Barbara Snow, whose papers, published over two and a half decades, continue to steer the course for research on the evolutionary ecology of fruit-eating birds. It is fitting that they contributed a thought-provoking article contrasting frugivory in the tropics with the temperate zone, where they have spent over 2000 h observing birds visiting fruiting plants. Three features seem to distinguish the two regions. First, the risk of predation while visiting fruiting plants is much higher for birds in the temperate zone. The authors noted hunting hawks at an average rate of one during every 3 h of observation. Second, temperate zone birds apparently defend fruiting plants over long periods, especially during the winter, in contrast to tropical birds. Third, avian seed predators abound in the temperate zone but not, according to the Snows, in the tropics. Their proposition that pigeons and parrots rarely feed on fruits adapted for dispersal by legitimate avian frugivores is not

true in the lower montane forests of Costa Rica, at least, but they are certainly correct in noting the relative paucity of tropical seed-eating birds. Once again the Snows have drawn attention to key questions that need to be addressed in the study of tropical fruit-eating birds.—Nathaniel T. Wheelwright.

**65. Three-speed foraging during the breeding cycle of Yellow-rumped Caciques (Icterinae: *Cacicus cela*).** S. K. Robinson. 1986. *Ecology* 67:394–405.—The foraging behavior of a color-banded population of Yellow-rumped Caciques was studied in Peru. The caciques are polygynous colonial-nesters, and only females feed the young. Non-nesting females foraged at a relatively slow rate, high in the forest canopy, and captured many small arthropods. Females in the egg-laying, incubating, and fledgling-feeding stages foraged at a faster rate, but captured similar prey at the same heights as non-nesting females. Females building nests and feeding nestlings foraged at a significantly faster rate in the understory, and captured many large orthopteran insects.

These changes in feeding behavior were not directly dependent on varying prey availability, but instead seemed to reflect adaptive compromises between energetic demands and survivorship risks of the females. Robinson reasoned that the forest canopy, frequented by non-nesters, is a safer place to feed, but yields only a low, but constant, rate of prey intake. Alternatively, females feeding nestlings assume higher survivorship risks by spending less time per feeding patch, but are able to take larger prey.

This study provides circumstantial support for at least two major themes in evolutionary ecology. First, it argues that the optimal foraging theory may be insufficient if restricted to short-term considerations of maximum energy obtained per unit time. Instead optimal foraging is viewed in the context of a life history strategy involving trade-offs between feeding benefits and survivorship costs. A problem with this type of theory is that the survivorship risk of any behavior is difficult to measure, and we are left with interesting speculations but largely untestable hypotheses.

A second major theme involves Lack's hypothesis that the clutch size of nidicolous birds is limited primarily by the ability of parents to provide food for their young. Robinson's data are consistent with Lack's hypothesis, since the loss of female body mass at the end of the nestling period may indicate stress, and females are seldom able to fledge more than one young from a typical clutch of two eggs.—George Kulesza.

**66. Human influence on bird diets.** (Kormyatsya ptitsy). A. G. Rezanov. 1986. *Priroda* 6:44–49. (Russian).—The remarkable adaptability of many bird species to anthropogenic conditions has led to them developing "city habits" and "technological habits," particularly regarding food, a bird's primary concern. Perhaps the oldest such habit is following agricultural machinery in hopes of catching an insect or rodent that has been disturbed.

Anecdotally, this article presents other examples, as diurnal species hunting for insects by night under street lights, birds learning from which make of automobile their beaks can reach insects in the radiator grille, birds absconding with milk cartons, dropping nuts on pavement so that traffic will crush the hard shells, waiting in the shallows along a stream for a passing motorboat's wake to wash small fish into reach, teaching their young how to scavenge in a dumpster. Species noted for shyness when encountered in the countryside are often more approachable in cities.

Such substantial changes in the ecology and behavior of birds have led ornithologists to conclude that in cities there have arisen urban populations of some bird species that are discrete from "natural" populations. Urban populations of European Starling (*Sturnus vulgaris*), Hooded Crow (*Corvus cornix*), and Mallard (*Anas platyrhynchos*) have developed in Moscow over the last 15–20 yrs. The author cautions that "urban population" is an ecological connotation, and that it would be erroneous to call a population of birds living in a city "urban" if its habitat is still close to natural and no behavioral or ecological changes are apparent. Birds now can be regarded as a component of human ecology, not just "neighbors," which means that bird-human relations need to be regulated and an ecologically integrated urban avifauna may develop.—Elizabeth C. Anderson.

**67. Flock-feeding on fish schools increases individual success in gulls.** F. Götzmark, D. W. Winkler, and M. Andersson. 1986. *Nature* 319:589–591.—Using captive Black-

headed Gulls (*Larus ridibundus*) foraging singly or in flocks of 3, 6, or 8 on a large number (350) of small ( $\bar{x}$  = 6.5 cm in length) fish (bleak *Alburnus alburnus*) in shallow water (14 cm) in a 5 × 5 m pool with sloping edges (40 cm wide) during 3 min tests, Götmark et al. demonstrate the individual advantages of feeding in larger flocks. Per capita catch in flocks of 6 was 20–50% higher than in flocks of 3 and >100% higher than for singles. The proportion of successful captures was 34, 43, and 50% for singles and flocks of 3 and 6, respectively. Similar trends are reported for flock sizes of 8. Flocks tended to fragment schools, and birds in flocks captured more fish from frontal and sideways orientations compared to singletons, and frontal and sideways attacks were more successful than attacks from the rear. The disproportionate distribution of attack orientations is attributed to the effects of flocks in dispersing schools. Owing to benefits that accrue to individuals hunting in flocks, the authors suggest that conspicuous white or contrasting plumage that facilitates flock formation may have been favored by individual selection. Moreover, animals that follow a "leader" from a colony may do so to gain flocking benefits in addition to or rather than for food information. Some new twists on some old ideas.—W. A. Montevecchi.

**68. Food of the Cape Pigeon (*Daption capense*) from Princess Elizabeth Land, East Antarctica.** K. Green. 1986. *Notornis* 33:151–154.—Understanding the impact of seabirds on the southern oceans requires more detailed knowledge of the feeding habits of species at all phases of their annual cycle. In a large sample ( $n = 73$ ) of food regurgitated by Cape Pigeons attending young, Green found that euphausiids comprised more than 99% of the diet. His results are similar to those obtained by workers in other colonies, who mostly have obtained much smaller samples, but differ from those obtained by workers on the open ocean, where cephalopods may make up an equal fraction of the diet (e.g., Ainley et al. 1984, *Ornithol. Monogr.* 32).

In obtaining the samples (10 in one day from one colony, 63 over three weeks in another) Green seems to have amassed a large cleaning bill, as he found that sophisticated water offloading techniques were less useful than merely scraping vomit from his clothing.

Interpreting the significance of Green's results requires some caution, because even though the samples are large by Antarctic standards, they are likely to have been obtained from birds feeding together on patchy prey located near the colony. Thus the data probably represent two samples taken 10 and 63 times, respectively, not 73 samples. The same caution applies to all studies of colonial birds, but is not often considered.—J. R. Jehl, Jr.

**69. Bill length of herons and egrets as an estimator of prey size.** R. D. Bayer. 1985. *Colonial Waterbirds* 8:104–109.—Bayer presents an assessment of the accuracy of using a bird's bill as "ruler" for estimating prey length, and the accuracy of the conversion of these prey lengths into prey weights. This measuring method has been widely used by ardeid biologists, but its accuracy has not been tested. Four factors which can lead to error in using this method are: (1) bill length varies within a species, (2) most heron foreheads are sloped and without an abrupt edge so that the edge of the exposed culmen is not always apparent, (3) bills are without reference marks that divide them fractionally, thus producing "rulers" without graduations, (4) some herons catch prey several times their bill length, making accurate comparison difficult. Prey lengths can only be judged to the nearest 1–2 cm for small herons, and 3–4 cm for large ones.

Four sources of error can occur when prey length is used to calculate prey weight: (1) length-weight relationships are exponential, so errors in length measurement are magnified, (2) length-weight equations are different for different fish species, (3) different conventional measurements of fish length may lead to the use of incorrect length-weight equations, and (4) actual weights of fish may differ from the length-weight equation predictions, which can be a serious source of error if the sample size is very small. The author suggests that more accurate measurements of prey length could be achieved by measuring prey against gape or eye-bill tip lengths. Further, using weight classes rather than length classes may produce more accurate estimates of ingested biomass. Prey weights can be more accurately estimated for shorter-billed ardeids, since prey weight varies less in shorter length classes, and they usually catch larger numbers of prey, hence allowing some of the variations in prey weights to cancel each other out.—William E. Davis, Jr.



**70. Ecology of migrant Black-necked Grebes *Podiceps nigricollis* at Mono Lake, California.** D. W. Winkler and S. D. Cooper. 1986. *Ibis* 128:483-491.—Large concentrations of Black-necked or Eared Grebes (*Podiceps nigricollis*) are found during the autumn migration at Mono Lake in the Sierra Nevada of California. The waters of the lake are nearly three times as saline as the ocean, are highly alkaline (pH = 10), and have very high concentrations of carbonates, sulfates, and chlorides. The extreme water chemistry of the lake precludes the survival of fish, and the only macroscopic inhabitants are an endemic brine shrimp and a brine fly. This paper summarizes information on the biology and feeding ecology of migrating grebes feeding under extreme water chemistry conditions.

Adult grebes arrived earlier in the fall than juveniles and the migration showed a peak in September and October, followed by their departure in November and December. Stomach analyses indicated that 90% of their diet was comprised of brine shrimp. The remainder of the grebe diet consisted of the larvae, puparia, and adults of brine fly and small numbers of shore bugs and other terrestrial arthropods. The grebes did not feed at night, but formed large rafts in the deeper water. Both total body weight and fat stores increased from August to October, and adults molted their remiges in August and September. The grebes left the lake in late fall when the brine shrimp densities declined dramatically. Within recent years the water level of the lake has been declining, due primarily to human intervention, and thus has become the focus of an environmental controversy. Should the waters continue to fall and influence brine shrimp densities, this grebe could be deprived of one of its most important migratory stop-overs in North America.—J. M. Wunderle, Jr.

#### SONGS AND VOCALIZATIONS

**71. Vocalizations and associated behaviour of Crested and Black-collared barbets.** D. Ward. 1986. *Ostrich* 57:129-137.—Crested Barbets (*Trachyphonus vaillanti*) sing a simple duet in which timing of calls is not synchronized, type of calls in the duet may vary, and initiation is by either sex. Pairs defend territories and reacted to song playback by quietly searching holes throughout the territory and by attacking a stuffed decoy. Black-collared Barbets (*Lybius torquatus*) sing a complex antiphonal duet, probably initiated by the male, consisting of alternating sequences of notes given only by the breeding pair of a territory. Several non-breeding birds also occupy the territory in what is presumably a cooperative breeding association. Black-collared Barbets reacted more aggressively to call playback, calling at the territory perimeter and displaying with threat postures.—Malcolm F. Hodges, Jr.

**72. Songs of isolation-reared sparrows function in communication, but are significantly less effective than learned songs.** W. A. Searcy, P. Marler, and S. S. Peters. 1985. *Behav. Ecol. Sociobiol.* 17:223-229.—Two questions were addressed and tested in this study using recorded songs of isolate-reared Song Sparrows (*Melospiza melodia*) and Swamp Sparrows (*Melospiza georgiana*) and wild (male) and captive (female) congeners. (1) Is there sufficient information in isolate songs to allow any degree of normal functioning? And (2) how important to function are the structural refinements added through learning? The methods section of this paper is exemplary; I recommend it to all students and others who have questions about how to present their work in a clear, straight-forward manner that will facilitate replication. Isolate songs and normal songs of Song and Swamp sparrows were recorded and played back to territorial males; the distance from the speaker of the resident was used as the measure of intensity response. Isolate songs and normal songs of both species were played back to estradiol-treated captive females; the number of solicitations by these females in response to these songs was used as a measure of intensity response. Male territorial owners of both species responded more to conspecific isolate song than to heterospecific normal song. Females responded to isolate song but not to heterospecific song. The conclusion that isolate song allows some degree of normal function is appropriate. Comparisons of response to isolate and natural conspecific songs led to the conclusion that learning significantly increases the efficacy of song communication.—Patricia Adair Gowaty.

**73. Vocalizations of the owls of the genus *Otus* in Pakistan.** T. J. Roberts and B. King. 1986. *Ornis Scand.* 17:299-305.—In the words of Roberts and King, there has been "considerable confusion" regarding the taxonomic status of some of the Asian scops-owls.

Here, sonagrams and wing formulae are presented for the 5 *Otus* species in Pakistan: *O. spilocephalus*, *O. scops*, *O. sunia*, *O. bakkamoena*, and *O. brucei*. Sonagrams of the territorial calls (primary songs?) are the first published for the subspecies of 4 of the species and the first for the species of *O. brucei*. The distinctive vocalizations, sympatric distributions, and wing formulae support the listing of these 5 owls as separate species. The vocalizations of *O. bakkamoena* from Pakistan and India are so distinct from those of the eastern Himalayas and eastern Asia that Roberts and King recommend they be treated as different species: the Indian Scops-Owl (*O. bakkamoena*) and the Collared Scops-Owl (*O. lempiji*).—Jeffrey S. Marks.

### BOOKS AND MONOGRAPHS

74. **Gli uccelli della Valle d'Aosta.** M. Bocca and G. Maffei. 1984. Tipografia La Vallée, Aosta, Italia. 252 pp. + i-vii, illustrations, distribution maps, 20 pages of color photographs. Soft bound. No price given.—The valley of Aosta is located in northern Italy and is contiguous to Switzerland to the north and France to the west. This work, written in Italian, treats the bird fauna of this region which occupies an area of only 3262 square kilometers which are characterized by a plain and some of the highest peaks of the Alps (Monte Bianco, 4810 m), thus providing a great diversity of habitats for birds. In the first part of the book the authors give information on the physical components such as physiography, climate, and vegetation. In the second part they discuss briefly the bird fauna of their region including biogeography, evolution, migrations, hunting, and conservation. The third and most important part of the book is an extensive annotated list which comprises a summary of the published distribution information, new ecological and distribution information by the authors, and where applicable a listing of museum specimens. An extensive bibliography follows with an index of scientific and Italian bird names. This work contains valuable information on a poorly understood but fascinating ornithological region and should become the basic reference for those who plan to watch birds in this picturesque region of Italy.—Henri Ouellet.

75. **Arkansas Birds.** D. A. James and J. C. Neal. 1986. The University of Arkansas Press, Fayetteville. 402 pp., numerous color plates, maps, and black-and-white drawings. Hardcover.—Approximately 40,000 bird records (through 1985) were used in compiling this, the fourth and most elaborate state bird book for Arkansas. Subtitled "Their Distribution and Abundance," this volume begins with a history of ornithology in Arkansas, a discussion of the relationships between bird distribution and Arkansas environments, an account of our knowledge of Arkansas birds prior to European settlement, and a brief section on finding birds in Arkansas. The main feature of the book is the collection of 366 accounts of bird species known from the state. Each account summarizes the status and general distribution of the species and details extremes for migration dates, numbers observed, nesting records, and habitats in which the species has been found. Where possible, population trends are noted and range expansions/contractions are documented. For selected species (e.g., several heron and duck species) maps illustrate movements as documented by banding records. The variety of sources of data used in the preparation of this book (e.g., banding records, hunter harvest surveys, archeological records, breeding bird surveys, Christmas Bird Counts, etc.) have resulted in uneven coverage of species, but a maximum amount of information—and this is as it should be. Arkansas Birds is as thorough as it could be. Gaps in our knowledge of Arkansas birds are made more evident and students of Arkansas' ornithology should have little difficulty in identifying subject and geographic areas where more study is needed. James and Neal have done future researchers a great service by providing an appendix which lists the locations of specimens of Arkansas birds and an extensive bibliography of Arkansas ornithology. Although it contains approximately 700 entries, I would not have had the courage to say that it was a "a complete list of written works concerning the birds of Arkansas." As thorough as it is, I'll bet . . .

The illustrations by David Plank and Sigrid James Bruch add greatly to the book's appeal, although there are some which simply don't do it for me. For example, I asked three ornithologists to identify the drawing on page 309—none could. The Swainson's Warbler there must have been drawn from a grossly overstuffed specimen. The numerous

color photographs of birds and their habitats add to the book and must be a source of pride for the numerous Arkansas photographers whose work is included. Some, however, have been enlarged beyond their potential, and the Prothonotary Warbler (p. 307) is printed sideways. Unfortunately, the contribution of all of the color illustrations is diminished by the poor quality of reproduction. The authors obviously did not get to see proof on the illustrations, since they are almost uniformly too dark. I hope that the publisher does better with revised editions.

In sum, *Arkansas Birds* is a monumental effort that the authors can justly be proud of. It belongs on the shelf of any birder in the mid-south, in every library in the region, and in any serious ornithological library.—Jerome A. Jackson.