

ABSTRACTS OF PRESENTATIONS MADE AT THE ANNUAL MEETING OF THE
RAPTOR RESEARCH FOUNDATION, INC., HELD AT
CHARLOTTE, NORTH CAROLINA, ON 3-7 NOVEMBER 1993

**SPECIAL SYMPOSIUM: ADAPTATIONS OF RAPTORS TO
HUMAN-ALTERED ENVIRONMENTS**

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**DIURNAL RAPTORS IN THE FRAGMENTED RAIN FOREST
OF THE SIERRA IMATACA, VENEZUELA**

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The rain forest of the Sierra Imataca in eastern Venezuela has been subjected to extensive deforestation for pastures and agricultural settlements. In the last decade the opening of access roads combined with intensified logging and mining activities have fragmented a significant portion of the remaining forest. We noted local distribution and habitat use for 40 species of diurnal raptors observed in ten affected areas, including raptors considered as forest interior species and some open country species utilizing the man-made openings inside the forest for roosting and foraging.

RAPTOR NESTS ON ELECTRIC UTILITY FACILITIES

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Electric utility power line facilities have been shown to provide nesting, roosting, and perching sites for raptors. A two-part questionnaire was distributed to the electric utility industry through the Edison Electric Institute Biologists' Task Force to document the utilization of electric utility facilities for nesting by raptors. Part A of the survey was designed to determine the number and species of raptors nesting on power line structures in the United States. Because many electric utilities have participated in activities such as erecting nest platforms or hacking sites, Part B of the survey was designed to solicit information on these various raptor enhancement programs. Respondents were asked to list any agencies or groups they had worked cooperatively with on raptor enhancement projects. They were also asked to provide information on raptor nests on utility facilities other than power lines. To quantify the percent response from the industry a comparison was made

between the total generating capacity and circuit miles represented by the respondents and the industry total. In keeping with the theme of the symposium, adaptations to human-altered environments, the primary purpose of the survey was to describe the positive aspects of the relationship between raptors and electric utility facilities.

**USE OF RESERVOIRS AND OTHER ARTIFICIAL
IMPOUNDMENTS BY BALD EAGLES IN THE
SOUTHEASTERN UNITED STATES**

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The southeastern United States, exclusive of Florida, lacks any large natural standing bodies of water. As a result, the distribution of bald eagles (*Haliaeetus leucocephalus*) in this region historically has been along the coast, with nearly all past nesting activity occurring in this area. Over the past several decades, a number of inland impoundments have been constructed in this region, ranging in size from hydroelectric reservoirs of many km² to smaller impoundments for fish hatcheries and other aquacultural facilities. Bald eagles are becoming associated with these man-made wetlands, and nesting activity at these sites is increasing. Analysis of data from South Carolina suggests that the nesting productivity of eagles associated with man-made impoundments ($\bar{x} = 1.23 \pm 0.88$ fledglings/nest) is greater ($P < 0.05$) than that of eagles nesting in non-impounded areas ($\bar{x} = 1.03 \pm 0.80$ fledglings/nest). Multi-year surveys of the avifauna found at a series of reactor cooling reservoirs on the U.S. Department of Energy's Savannah River Site near Aiken, South Carolina indicate the patterns by which bald eagles and other avifaunal components use such reservoirs and their response to management practices such as reservoir drawdown.

PEREGRINE FALCONS IN URBAN NORTH AMERICA

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No fewer than 75 pairs of peregrine falcons (*Falco peregrinus*) are known to be nesting in at least 50 urban areas in North America. The primary criteria needed for urban nesting peregrine falcons are a safe nest site, and sufficient food. Nest sites are provided in urban areas by man-made structures including buildings, bridges, smokestacks and other miscellaneous structures. Oftentimes the birds use specially designed nest boxes attached to these structures. Prey items of urban peregrine falcons are varied and change seasonally. A wide variety of migratory species have been recorded, with some of the most common species being found in highest numbers at urban peregrine nests. Additionally, evening hunting has been reported at urban sites. Urban nesting by peregrine falcons is a significant factor in the recovery of some regional populations. In the midwestern U.S. in 1993, 31 of 43 successful pairs were found in urban areas. It may be possible for peregrine falcon populations to exceed their known historical highs due to the availability of urban nest sites. The use of these sites will provide a unique, yet challenging opportunity for wildlife management.

THE WHITE-TAILED KITE: GIS ANALYSIS OF HABITAT SELECTION IN THE SACRAMENTO VALLEY, CALIFORNIA WITH IMPLICATIONS FOR CONSERVATION OF WILDLIFE IN AGRICULTURAL LANDSCAPES

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Current agricultural practices in the Sacramento Valley, California reduce native wildlife habitat resulting in loss of nest sites and foraging areas for the black-shouldered kite (*Elanus caeruleus*). Data were collected by means of road transect surveys (1990–93) and nest surveys (1993) and analyzed with a GIS program. Preliminary data show that these microtine specialists select specific habitats, such as natural vegetation, rice stubble (winter), and fallow fields, which are relatively rare elements in the agricultural landscape. Eight of 20 original courting pairs (in a 20 × 24 km area) successfully defended nest territories and fledged young ($\bar{x} = 2/\text{nest}$). A majority of the courting kites were displaced by Swainson's hawks (*Buteo swainsoni*)—a threatened species in California). The competition straining the coexistence of the kite and other hawks warrants further investigation. Identification of patterns of wildlife use in areas limited in natural habitat patches will assist conservation efforts to farmscape (agricultural land management to encourage wildlife compatibility). In the future engineered landscapes may be necessary to ensure survival of interrelated species across all trophic levels.

THE USE OF MAN-MADE NEST-SITES BY AN INCREASING POPULATION OF OSPREYS IN THE CANADIAN GREAT LAKES BASIN

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The Great Lakes drainage basin is inhabited today by over 36 million people, and ospreys (*Pandion haliaetus*) breed in many parts of the basin. Considerable changes to habitats utilized by ospreys have occurred, particularly during the 20th century, associated with urban, industrial and recreational development. Prior to 1945, ospreys in Canadian parts of the basin bred only in trees. Since then an increasing proportion have bred on a wide range of man-made structures, including hydro poles, transmission line towers, navigation and communication towers, buildings, and customized artificial platforms (single poles, tripods and quadropods). In the period 1988–93, nests on man-made structures occurred significantly more often along the Great Lakes shorelines (48%) than further inland (29%). On Lake Huron, 82% of artificial platforms were occupied within one year of installation, suggesting a shortage of suitable natural nest-sites on the main Great Lakes. Nests on man-made structures fell down only slightly less often (9%) than did those in trees (12%), and reproductive output was only slightly higher (1.14 versus 1.06 young per nest occupied in mid-May, respectively). Osprey population increases, following restricted use of organochlorine pesticides, appear to have been assisted by nesting on man-made structures, as well as a general high degree of tolerance to human activities near nests.

HOW URBANIZATION INFLUENCES RAPTOR ECOLOGY

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Eastern screech-owls (*Asio otus*) were studied in a rural area, an adjacent 10-yr-old suburb isolated by countryside, and a nearby 30-yr-old suburb of Waco, Texas, 1979–1987. Those in the younger suburb were intermediate in most ecological features, suggesting gradual urbanization linked to city age and growth. Owls in the older suburb were more productive and denser, benefiting from a more moderate climate, more food, and fewer predators compared to the rural population. No similar study exists for other raptors. Data on tawny owls (*Strix aluco*) and merlins (*Falco columbarius*) suggests similar features in cities relative to the countryside. This is true of birds generally.

SPOTTED OWLS IN MANAGED FORESTS OF WESTERN WASHINGTON AND OREGON

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Spotted owls (*Strix occidentalis*) in western Washington and Oregon are known to select older, unmanaged forests at spatial scales ranging from the foraging and roosting sites of individuals to the landscapes inhabited by local populations. But the current distribution of old forests is inadequate to maintain a network of interacting local populations. Thus, the success of any conservation strategy for spotted owls is contingent, in part, upon owls finding habitat in managed forests. Spotted owls are known to use managed forest stands throughout the region for dispersal, roosting, foraging, and breeding. Owls use managed forests in home ranges containing a mix of cover-types, from old-growth to young plantations, and in ranges with little or no old forest cover. Several homogeneous, managed-forest landscapes in the region contain numbers of reproductive owl pairs. However, the degree to which these varying uses of managed forests suggests that spotted owls are adapting to human-altered environments is unknown. Information needed to address that question includes relationships among: stand structure and owl use; characteristics of managed-forest landscapes and occupancy by owls; performance of owl populations in managed-forest landscapes; and the relationships among owl populations in old-forest and managed-forest landscapes. Ongoing investigations of those aspects of owl ecology will strengthen our understanding of the nature of spotted owls' adaptation to managed forests and will support more effective conservation strategies.

VULTURES IN A MAN-MADE WORLD

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Scavenging birds differ from other raptors in their reaction to human disturbance to the environment. Some vulture species appear to benefit from human activities, and occur at higher densities in areas of high human population than in natural wildlife communities. But other species have shown serious population declines. In all species so far studied the size of the food supply is not an important factor in the decline of vulture species. Increased mortality rates are the major cause, and are particularly important because of the slow reproductive output of vulture populations. Human-induced causes of mortality for vultures differ from those affecting most raptors, with poisoning and bad power line design being the major factors. Fortunately vulture populations respond well to management methods, and techniques for the recovery of vulture populations and reintroduction programs will be discussed.

POPULATION VIABILITY ANALYSIS OF URBAN MERLINS

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Population viability analyses are usually conducted on declining wildlife populations. One of the central goals of conservation biology is the restoration of such populations. It is therefore important to understand the dynamics of increasing populations. However, such populations are relatively rare and little studied. We present a population viability analysis of an increasing urban merlin (*Falco columbarius*) population that has been under study for over 20 yr. Our hope is to provide a framework with which to measure the success of future increases in threatened raptor populations.

THE BREEDING ECOLOGY OF TAWNY OWL, *STRIX ALUCO*, IN URBAN AND RURAL ENVIRONMENTS: A COMPARATIVE STUDY

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Nesting boxes were erected in urban ($N = 17$), suburban ($N = 8$) and rural ($N = 11$) environments during 1986 in and around Bedford town, England. Breeding attempts by tawny owl (*Strix aluco*) were monitored. Time of breeding season, numbers of eggs and numbers of young fledged were recorded, as was prey recorded in nesting sites. Pellets were analyzed from adults and fledged young. Dispersal of young was monitored by ringing and radiotelemetry. During the study, avian prey species recorded were comparable between environments, though micro-mammals were absent in the diet of the urban population. Reproductive levels fluctuated in the rural and suburban environments, but were constant at the urban sites. Therefore, the cycling of reproductive levels appears to be driven by small mammal populations. Urban pairs did not breed in seasons of low productivity in the rural environment. This effect affects the lifetime reproductive success of individuals in the urban population which raise only half the number of young in comparison with the other environments. Time of breeding season was 4–5 wk advanced in the urban environment in comparison with rural birds. Young raised in the urban environment dispersed into the rural environment. Competition for nesting boxes by other species did not restrict the use of boxes by tawny owls in this study.

GOSHAWK ADAPTATION TO DEFORESTATION IN EUROPE

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Palaearctic goshawks (*Accipiter gentilis*) are often perceived as birds of the northern forests. In European taiga their densities are rarely as high as five breeding pairs per 100 km², with nests in mature forest, and breeding diet primarily young grouse. Winter home ranges often exceed

50 km², and squirrels hunted in mature forest are their main prey. However, European goshawks are most abundant in temperate areas with fragmented forest. Breeding densities reach 10 pairs per 100 km² in areas with less than 20% woodland, and home ranges are typically 5–20 km². Diet features thrushes and corvids in summer, but in winter goshawks hunt primarily along woodland edges. Where land use has favored rabbits, hares, game birds and pigeons, these dominate goshawk winter diet, sometimes causing conflict with human interests. Goshawks now have few natural predators in these habitats, so it is uncertain how much their present abundance reflects scarcity of other large raptors, especially eagle owls (*Bubo bubo*).

ON THE BREEDING SUCCESS OF THE OSPREY IN GERMANY: COMPARISON BETWEEN TREE NESTERS AND NESTERS ON POWER LINES

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As a regular breeding species in central Europe the osprey (*Pandion haliaetus*) is today confined to the Federal States of Mecklenburg-Vorpommern and Brandenburg in eastern Germany and the former German areas in Poland. In Mecklenburg the population reached its lowest level in the DDT period between 1968 and 1972. A slow but steady increase has occurred ever since, in Brandenburg from ca. 45–50 pairs in the early 1980s to over 120 pairs today. One important limiting factor has been the scarcity of suitable trees for nesting since the species prefers the top of isolated old trees or trees on the edge of the forest dominating the surrounding trees. Due to forestry such trees have become increasingly rare to the point that no substantial population could presently reproduce in the traditional way. Fortunately ospreys started as early as 1938 to breed on power lines where the nests are safer than in trees. Presently the majority of ospreys nest on these artificial structures in Germany, while in Poland no such breeding is known. We studied the breeding success of 9–13 tree-nesting and several dozen power-line-nesting pairs for the last 20 yr and compare our findings with data in the literature from Germany and Poland.

CONSERVATION OF WEDGE-TAILED EAGLES AND GREY GOSHAWKS IN TASMANIA: A COMPARISON OF EXTREMES

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Both the wedge-tailed eagle (*Aquila audax*) and the grey goshawk (*Accipiter novaehollandiae*) have small (less than 180 pairs), resident populations in Tasmania which are threatened by loss of breeding habitat and persecution.

Eagles use traditional nests and are widely distributed at low densities in direct contrast to goshawks. Both populations are insufficiently protected in state reserves. Less than 10% of eagle nests are in riparian areas and therefore protected by stream-side reserves under the Forest Practices Code. To conserve a viable population of eagles, special prescriptions for nests by nest conservation have been implemented. These are standard in state forests but some aspects are negotiable on private land in an effort to promote goodwill and personal responsibility. In most of their range, goshawks nest in riparian habitat and are therefore protected from logging, but the optimal habitat is swamp forest where special Wildlife Priority Areas will have to be established away from streams. The riparian preference of the hawks makes them vulnerable to unregulated clearing for agriculture but they are less disrupted by forced moves in nesting sites. Foraging habitat is adequate for eagles but the highly dimorphic, forest-specialist goshawk may require additional protection of wet forest. Local densities of both species and breeding distribution of goshawks is limited by persecution. Elevation of the effects of persecution is by legal protection, public education and peer pressure, rehabilitation, protection of stock by caging and proximity to people, scaring and occasional capture for relocation or replacement.

EUROPEAN SPARROWHAWKS IN CONIFER PLANTATIONS

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The aim was to find how sparrowhawk (*Accipiter nisus*) numbers and breeding success varied with the age and management of conifer monocultures, which form the main nesting habitat available to the species in parts of western Europe. In south Scotland sparrowhawks occupied such plantations after they had been thinned for the first time at about 20 yr after planting. For about the next 10 yr, occupancy of territories and nest success was high, but declined as the plantations matured. The birds continually moved from older to younger plantations as they became available. To maintain maximum sparrowhawk populations in this area, the plantations should ideally be managed on a 35–40 yr rotation, but in a staggered manner, so as to ensure at any one time equal proportions of plantation in the 1–10, 11–20, 21–30 and 31–40 yr age classes.

URBAN ECOLOGY OF MISSISSIPPI KITES

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The Mississippi kite (*Ictinia mississippiensis*) is the most abundant urban raptor in North America, and possibly in existence. My studies of this species since 1968, and other recent studies of lesser extent, indicate that its choice of food, and foraging/nesting habitats suit it for urban existence. Its life history characteristics, however, do not

seem so conducive to its extraordinary urban success. The species began to draw attention as an urban nester in the mid- and late-1970s because of its diving at humans. Since then kites have become recognized as common in scores of towns of all sizes in four states. Urban densities are high and roosts often exceed 50 birds. Parks, residence and school yards, and golf courses are prime sites of diving incidents. Comparisons of urban versus rural colonies indicate urban populations are probably more successful in key ways. Since about 1980 several state and private agencies and individuals have cooperated in management and education programs in response to diving. Management has been successful, and the potential for public education about raptors and predation should be expanded. An associated project to transfer nestlings of diving adults to Tennessee for hack release into an endangered population continues.

AGE OF MALE, WEATHER CONDITIONS, AND ENVIRONMENTAL TYPE: MAIN FACTORS FOR TIMING OF BREEDING IN EUROPEAN SPARROWHAWKS

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There are 113 stable and 29 occasional nesting places of European sparrowhawks (*Accipiter nisus*) within the Prague central urban area of about 200 km². The number of breeding pairs fluctuates in the range of 60–90. Since 1985, the maximum number of breeders have been banded and marked and the maximum number of fledglings have been banded. Birds living within the central (urban) area reveal different breeding data, age structures, fidelity and especially the timing of breeding, than those living in suburban or rural sites. During the study, we collected 540 male/nest/year observations of 325 banded and tagged males. One hundred and four of the birds were banded as nestlings. Analyses show that the age of males is crucial for the timing of nesting. The older birds tend to breed earlier in the year. If we take nesting time for adult males only, then the fluctuation from year to year will be largely determined by annual differences in suitability of the weather in winter and early spring. The relationship between mild winters and early nesting times during 1988–90 and the differences between urban and rural timing of nesting are evident from the data. Urban conditions tend to result in earlier breeding and to eliminate weather effects.

DIURNAL RAPTOR SPECIES OCCURRENCE AND DISTRIBUTION IN THE SEVERELY ALTERED LANDSCAPE AT ROCKY MOUNTAIN ARSENAL, COLORADO

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Rocky Mountain Arsenal (RMA) is a major superfund

site surrounded by urban and agricultural lands near Denver. The 70-km² site has recently been designated a national wildlife refuge, pending extensive contamination cleanup. As part of a broad study of the effects of human activity on wildlife at RMA, we began conducting bi-weekly roadside surveys of diurnal raptors in 1991, noting position of birds in relation to landscape features and human activities. We recorded a total of 14 diurnal raptor species. American kestrel (*Falco sparverius*), Swainson's hawks (*Buteo swainsoni*), and red-tailed hawks (*B. jamaicensis*) were the most frequently observed raptors in summer months, and ferruginous hawks (*B. regalis*), red-tailed hawks, and bald eagles (*Haliaeetus leucocephalus*) were the most frequently observed raptors during winter. Log-linear analyses indicate that different species responded differently to landscape features and human activities, and that the response of some species varied with season. The results provide guidance in designing future landscape alterations and human activity schedules to minimize negative impact on raptors during contamination cleanup at RMA and similar sites.

RESPONSE OF THREE RAPTORS TO HUMAN ACTIVITIES IN MEXICO

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A great many raptors have been affected by human activities in several ways. However, some raptors have also benefited from human activities. In México, the common black-hawk (*Buteogallus anthracinus*) apparently has increased its breeding densities in the Rio Bavispe, Sonora, as a result of the increase in the extent of the riparian woodland due to the upstream construction and operation of the Angostura Reservoir. The crested caracara (*Polyborus plancus*) and the turkey vulture (*Cathartes aura*) have been closely associated to old garbage sites and hen houses in Baja California Sur and turkey vultures usually roost in palms of the city of La Paz and Los Cabos. However, changes in the management of garbage and chicken carcasses, tourism developments, urbanism and agriculture are changing the longtime stable relationships between men and raptors in Baja. All these three examples show that some raptors are capable of evolving together with moderate human activities because they can be benefited from habitat changes that produce suitable nest-sites and/or increase food availability.

RELATIVE ABUNDANCE OF NORTHERN HARRIERS AND ASSOCIATED RAPTORS USING STRIP-MINE AND AGRICULTURAL HABITATS IN PENNSYLVANIA

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We developed a protocol to survey northern harriers (*Circus cyaneus*) and associated raptors in strip-mine and agricultural habitats of northcentral and northwestern Pennsylvania. Our primary objective was to compare the relative abundance of harriers and associated raptors in the two habitat types and geographical regions. Relative abundance of harriers and other raptors using strip-mine and agricultural habitats is important to determine how these species respond to different types of human-altered environments. We selected 20 survey routes (i.e., a network of roads); 10 per geographical region and habitat type. We conducted one survey per month during January and February 1993 on each route, giving 40 total surveys per winter. We conducted surveys for breeding raptors on each route twice per month in April, May, and June, yielding 120 surveys per breeding season. A survey consisted of driving the route in a vehicle and stopping at 0.8 km intervals for 5 min to survey the available habitat. We observed northern harriers, red-tailed hawks (*Buteo jamaicensis*), rough-legged hawks (*Buteo lagopus*), American kestrels (*Falco sparverius*), and Cooper's hawks (*Accipiter cooperii*) in both habitat types and geographical regions. During winter surveys we observed 0.41 and 0.83 raptors per hour in strip-mine and agricultural habitats, respectively. During breeding raptor surveys we observed 1.23 and 1.50 raptors per hour in strip-mine and agricultural habitats, respectively.

QUANTIFICATION OF MILITARY NOISE IN BALD EAGLE HABITAT AT ABERDEEN PROVING GROUND, MARYLAND

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As the U.S. Army trains to be ready to meet the challenges of the future it must maximize the use of installation resources. This use will create high levels of noise that may affect wildlife. In assessing the potential impact of activities, the effects of noise on wildlife have become a frequent topic during the public participation process. The bald eagle (*Haliaeetus leucocephalus*) has been a continuous resident and visitor to Aberdeen Proving Ground. Today there are 10 active nest sites and several roost areas on the installation. From the large numbers of the bald eagle it would appear that the impulsive noise from large caliber weapons firing and other military related noise have no effect. To examine this circumstance we quantified the noise environment at two nest and two roost sites over a one-year period. In this way the noise levels bald eagles are exposed to, and appear to tolerate, will be documented. The preliminary results show A-weighted equivalent sound levels of 59.0 to 61.3 and C-weighted peak levels of 79.3 to 131.5. These levels indicate these sites are subject to many military noise events. Yet this bald eagle habitat remains active and productive. This data provides an indication potential noise impacts from military noise.

PEREGRINES, POWER PLANTS, AND MIGRATION ROUTES

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In Wisconsin, peregrine falcons (*Falco peregrinus*) traditionally migrate along two corridors, the Mississippi River and the western shore of Lake Michigan. Historically, peregrine falcons also nested along the Mississippi River. Because of habitat changes and predation, peregrines have not successfully reoccupied their historic nest sites along the river. However, along the western shore of Lake Michigan, a plan was developed and carried out which utilized man-made structures such as power plants as nest box sites. These sites are all in urban areas and have proven to be suitable for peregrines to nest. Because of their placement and relatively open spaces around these nest boxes, nesting peregrines have been able to defend themselves and their young from avian predators. With power plants strategically located along both migration routes and the safety provided by placing nest boxes on the tall generating stations or smokestacks, these historic migration routes may now become the stronghold for nesting peregrines in Wisconsin and elsewhere in the Midwest.

ASSOCIATION ANALYSIS OF RAPTORS IN A FARMING LANDSCAPE

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We developed an extensive sampling program for raptors in the farming landscape of the Sacramento Valley, California. By March, 1993, after 41 mo and 89 surveys along a 200-km road transect, we mapped 4045 observations of 11 species of Accipitridae, 1470 of three species of Falconidae and 902 of *Cathartes aura*. With each observation, we recorded activity or perch used, and association with landscape elements and other species. We are conducting association analyses by using a geographic information system to overlay raptor observation maps with temporally dynamic maps of land-use, cultural practices, potential perches, and roadside vegetation. Pooled observations of Accipitridae demonstrate a strong migratory cycle and aggregation in the landscape. They most strongly select alfalfa fields, then riparian, wetland and upland habitats, irrigated pasture, dry pasture, and rice stubble. They avoid human settlements and most grain and row crops. All raptors avoid artificial hawk perches (narrow dowel on thin pole). Accipitridae prefer oaks, cottonwoods, elms, willows and telephone poles with multiple horizontal beams. The associations we are identifying will help agriculturists develop effective strategies for increasing rap-

tor populations in farmland. Strategies under study include farmscaping (e.g., raptor perches, owl nest boxes, trees), changes in cultural practices (e.g., tolerating pests, leaving crop debris on ground, reduced chemical inputs), and landscape engineering (e.g., revegetating potential corridors), all of which will contribute to farming efficiency, the aesthetic value of the landscape, and to the goals of biological conservation.

**RAIN FOREST RAPTOR COMMUNITY IN SUMATRA:
THE CONSERVATION VALUE OF TRADITIONAL
AGROFORESTS**

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Managed agroforests increasingly replace natural forests in western Indonesia. The raptor community of three of the richest types of agroforests was compared to that of the primary forest and to the open cultivated areas, using 1-km² sample plots. Both species richness and density in agroforests were more than twice as high as in cultivated areas, but they were twice as low as in primary forests. The twelve raptor species recorded were divided into four groups according to their increasing tolerance to forest degradation or management. Six species had no viable population outside mature natural forest and three species were more abundant in primary forest than elsewhere. The last three species were more frequent in agroforests but only one of them was absent from the primary forest. It is concluded that agroforests conserve no more than a quarter of the original forest raptor community and provide an adequate habitat for only one additional open woodland species. An even smaller subset of species was found in the little wooded cultivated areas.

GENERAL SCIENTIFIC PROGRAM

CHAIRS: KEITH L. BILDSTEIN AND LAURIE J. GOODRICH. *Hawk Mountain Sanctuary, Route 2, Box 191, Kempton, PA 19529 U.S.A.*

**DNA PROFILE TESTING OF VANCOUVER AND CALIFORNIA
POPULATIONS OF BALD EAGLES**

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In this study we attempted to assay the genetic composition of bald eagles (*Haliaeetus leucocephalus*) involved in the California reintroduction program using multi-locus DNA probes. Two populations were sampled: birds of California natal origin ($N = 18$) and birds of Vancouver, B.C. natal origin ($N = 10$). Both populations of eagles are a potential source for colonization of California bald eagle habitat via expansion of the existing population or the release of birds. The California bald eagle population has experienced a genetic bottleneck—genetic variation within the popula-

tion is much less than that observed in a more geographically confined population that has not experienced depletion. In addition, only one allele appeared at a >0.25 frequency in both populations. This fact coupled with the number of distinct alleles found in each population indicated that crossbreeding of the two populations would increase genetic diversity.

**HARPY EAGLE (*HARPIA HARPYJA*) NESTING IN
MANIPULATED FORESTS**

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Continental records point to shooting, removal of young and destruction of nests as the primary conservation problems for harpy eagles (*Harpia harpyja*); bird-observer visits are a new source of concern. Nesting events are roughly 3 yr apart. Nests are used during and after intensive manipulation of the surrounding habitat, and minimum distance between active sites was 3–5 km. In nine nesting sites along a 100-km stretch of the Imalaca Mountains in Venezuela, we fitted five fledglings with satellite-tracked tags from NASA. One of these birds was hacked with the help of the loggers who destroyed its nest. All these nests were active while logging ensued. Out of three re-nesting attempts, one failed when the nest collapsed. We salvaged two additional fledglings found in captivity. We are monitoring five nests in the buffer area of the Darien National Park in Panama, all within 3 km of human settlements where trees are regularly felled for firewood, lumber, and to clear more cropland. Eagles have been killed at two sites, a third site remains inactive since 1991, and the other two nests currently have fledglings.

**SEXUAL SIZE DIMORPHISM AND FOOD REQUIREMENTS OF
NESTLING AMERICAN KESTRELS**

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Food requirements of dependent sons and daughters have important implications for evolution of the sex ratio, according to current sex allocation theory. We studied food requirements of nestling American kestrels (*Falco sparverius*), a moderate-sized, dimorphic falcon, by hand-feeding 61 birds from hatching to fledging. Daughters, the larger gender, consumed 6.99% more food than did sons. Sons did not have higher energy expenditure, from higher effort during sibling competition, than daughters did, so parents must supply more food to satisfy daughters' needs than to

satisfy sons'. A review of all related studies shows a strong positive association between degree of sexual size dimorphism and gender difference in food requirements in nestling birds.

THE EFFECT OF WEATHER ON BREEDING SUCCESS IN ELEONORA'S FALCON (*FALCO ELEONORAE*)

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During five breeding seasons (August–October, 1987–1991) data on the reproductive biology and ecology of the Eleonora's falcon (*Falco eleonorae*), an endemic raptor of the Mediterranean region, were collected in a breeding colony in southwestern Sardinia (Italy). Since this population is not affected by human or natural predation or diseases, and it is almost undisturbed, the aim of the study was to verify whether and how weather conditions can influence the breeding performance of this rare falcon. Data from my own long-term study lead to the hypothesis that Eleonora's falcons are highly dependent on weather factors during their breeding cycle. This paper examines some breeding parameters in relation to rainfall, temperature, humidity and wind during the breeding season. Breeding performance of Eleonora's falcon was highly negatively correlated with rainfall in August and September. The number of young fledged per laying pair was related to September–October temperature and negatively correlated with humidity of September–October. Wind did not apparently influence the breeding cycle of this species; only in nests on open ledges were the number of young fledged per successful pair negatively related to wind speed in September. All these relationships showed that the hatching period and the subsequent 3 wk were most important for chick survival and that weather can affect breeding success either directly (with the death of chicks) or indirectly (by reducing the food supply of adults and chicks). Because of the vulnerability of this falcon to meteorological factors and because of its rarity, all known breeding colonies need to be included in natural parks.

COMPARISON OF ROADSIDE COUNTS AND RADIOTELEMETRY TO DETERMINE HABITAT USE OF FERRUGINOUS HAWKS WINTERING ON ROCKY MOUNTAIN ARSENAL, COLORADO

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The ferruginous hawk (*Buteo regalis*) is currently classified as a candidate species for inclusion on the federal Threatened and Endangered species list. As a migratory raptor, the over-wintering condition of ferruginous hawks is important to the overall reproductive rate of the species. However, little information is available on the habitat use of wintering ferruginous hawks. We used two standard methods, roadside counts and radiotelemetry tracking, to

evaluate habitat use of ferruginous hawks wintering on Rocky Mountain Arsenal (RMA), northeast of Denver, Colorado. A comparison of the similarities and differences of the two survey methods will be presented. The results of this study will provide information on the advantages, disadvantages, and applicability of survey methods to evaluate raptor habitat use. The RMA has recently been designated a national wildlife area and is also a major superfund site currently in the initial stages of extensive cleanup operations. Providing habitat use information will allow the U.S. Fish and Wildlife Service to manage resources, wildlife viewing opportunities, and provide input into cleanup operations that may impact ferruginous hawks

BALD EAGLE MANAGEMENT IN ARIZONA

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Arizona supports a small (31 breeding areas), isolated population of desert nesting bald eagles (*Haliaeetus leucocephalus*) located near the Phoenix metropolitan area. Environmental conditions and increasing demands for development, recreation and water use present management challenges. The Southwestern Bald Eagle Management Committee affords a means of coordinating interagency projects such as annual statewide nest surveys and winter counts, banding of nestlings, monthly occupancy and reproduction assessment flights and the Arizona Bald Eagle Nestwatch Program. Relative success of these efforts toward management, conservation, and recovery of the bald eagle in the southwest will be evaluated.

THE EFFECTS OF HUMAN ACTIVITIES ON THE PRODUCTIVITY OF BIRDS OF PREY IN THE LOS MEDANOS AREA, NEW MEXICO

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We monitored productivity of Harris' hawks (*Parabuteo unicinctus*), Swainson's hawks (*Buteo swainsoni*), and great horned owls (*Bubo virginianus*) in the vicinity of the construction site of the Waste Isolation Pilot Plant (WIPP) and an adjacent CONTROL area between 1985 and 1990. In most cases, reproductive performance of raptors was slightly lower inside the WIPP study plot than within the CONTROL site. The only significant difference occurred in 1985 when development of the WIPP project proceeded without any management buffer zones placed around occupied raptor nests. Since 1985, no perceptible difference in reproductive performance occurred between the WIPP and the CONTROL sites in years when prey were plentiful. Raptor productivity, however, exhibited discernible reductions near the vicinity of WIPP when prey popu-

lations were depressed. Results indicate that researchers addressing the potential impacts of human activities on raptors need to monitor prey populations and interpret their data in reference to the relative availability of prey.

USE OF ARTIFICIAL BURROWS IN THE STUDY OF WESTERN BURROWING OWL NESTING BIOLOGY

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We used artificial burrows to study parental care in burrowing owls (*Speotyto cunicularia*) during the 1993 breeding season on the New Mexico State University campus in Las Cruces, New Mexico. Four artificial burrows installed as direct replacements of natural burrows were adopted and nesting attempted in each. Nine other artificial burrows installed in the vicinity of natural burrows were not used. Clutch size in the four artificial nests ranged from 6 to 11 eggs; the productivity of these nests, however, was very low, with only 3 of 34 eggs (about 9%) resulting in fledged young. The death of two young and then predation on the remaining young in one nest resulted in 100% failure of that nest. Loss of the male resulted in the abandonment of a total of 14 eggs prior to hatching in two other nests. The average number of fledglings seen at all active burrows ($N = 21$) on the study sites was 2 (range 0 to 5 young per pair). We were surprised that no owls occupied the nine artificial burrows placed in what seemed to be prime habitat. These burrows will continue to be monitored to determine if they are eventually used. If they are not, then the efficacy of artificial burrows in reattracting burrowing owls to certain areas would certainly be in doubt. The use of artificial burrows to improve or provide human access to already existing burrows, has, in contrast, worked quite well.

GOSHAWK REPRODUCTION AND FOREST MANAGEMENT IN NORTHERN ARIZONA: A REANALYSIS

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Crocker-Bedford reported that tree harvests in northern Arizona during the late 1970s and early 1980s caused a significant decline in northern goshawks (*Accipiter gentilis*). Recent data (1991–1993) did not support his contention. We reviewed his study design, data, and his interpretation of his results and then compared his 1985–1987 occupancy and nest productivity data to data collected from the same territories in 1988–1993. We concluded

that his experimental design and critical assumptions were sufficiently faulted to render his determination equivocal. We found he could not demonstrate cause and effect between tree harvesting and goshawk demographics as he contended. The fact that we could not find a significant pattern of change in the number of control and treatment territories that were occupied or unoccupied through 1993 supported our conclusions.

YEAR-ROUND MOVEMENTS OF SATELLITE-TRACKED GOLDEN EAGLES BREEDING IN QUEBEC

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As part of an ecological study of golden eagles (*Aquila chrysaetos*) breeding on the east coast of Hudson Bay, Quebec where construction of a hydroelectric complex is planned, a radiotelemetry program was initiated in June 1992 to study their year-round migratory movements. Five adult and a juvenile eagle were fitted with lightweight satellite transmitters. While the fates of two eagles remain unknown, four adults left their breeding area in mid- to late-October and migrated to the United States using different routes. One eagle flew through Ontario, crossed the Great Lakes, and spent the winter in Michigan. The other three crossed Quebec and followed the Appalachian Mountains. One remained in southern Pennsylvania, one wintered in West Virginia, and the other eagle wandered as far south as Alabama. After three to four months, the Pennsylvania and Alabama eagles headed north using the same routes back to their former breeding territories. The Virginia bird disappeared for reasons unknown, while the Michigan eagle wandered along the western coast of James Bay before heading back to its former territory. Movements of these eagles are discussed in the context of prey, weather, terrain and historical records for eastern North America.

ATTRACTION TO DAMS AND THEIR USE BY BALD EAGLES IN NORTH AND SOUTH CAROLINA

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Mid-winter surveys of bald eagles (*Haliaeetus leucocephalus*) were conducted from 1983–93. Flights were made along the Yadkin, Pee Dee, and Catawba Rivers in Piedmont North and South Carolina in fixed-wing planes or helicopters. Of 117 eagles seen, more were found just below dams ($N = 103$; 88.0%) than in other parts of the reservoirs and rivers ($N = 14$; 12.0%) ($\chi^2 = 67.701$, $df = 1$, $P < 0.0001$). Additional year-round observations support these

findings. Dams serve as good "eagle feeders" so long as other habitat features are present. While a few fish may go through turbines, increased water turbulence and the current below dams may attract feeding fish, hence the eagles. Perch sites below dams and other features of surrounding habitats may also be important attraction factors. Of 15 dams in the study area, only six had consistent eagle use. Studies are needed to determine why some dams are more attractive to eagles than others. Habitat management at dams should increase their use by bald eagles.

ODDITY OR CONSPICUOUSNESS: PREY SELECTION BY FREE-RANGING AMERICAN KESTRELS

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Tests were conducted to determine if oddity or conspicuousness was the greatest determining factor in prey selection by free-ranging American kestrels (*Falco sparverius*). Previous studies have had difficulty separating these characteristics. Dual-cell bal-chatris were dropped along roadsides giving kestrels a choice of brown and white mice on natural vegetation and snow. Mice were paired in sex, size, and activity. Bal-chatris were painted to match the background. On natural vegetation, kestrels showed no preference ($P = 0.6547$) for brown mice ($N = 9$) over odd, conspicuous white mice ($N = 11$). On snow, kestrels showed a highly significant preference ($P \leq 0.005$) for conspicuous brown mice ($N = 17$) over odd white mice ($N = 3$). Conspicuousness of prey seems to play a more important role than oddity in prey selection by American kestrels. There might be a tendency to avoid odd prey even though they are conspicuous, because they do not fit the specific searching image and are an unknown risk.

EFFECTS OF FOOD AVAILABILITY ON BREEDING AMERICAN KESTRELS IN SOUTHWESTERN IDAHO

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I studied the effects of food supply on the reproduction of American kestrels (*Falco sparverius*) near Boise, Idaho in 1992 and 1993. Evidence suggests that availability of the principal prey, mountain voles (*Microtus montanus*) declined during the 2-yr study. The breeding activity of kestrels at 126 available boxes was monitored, and some pairs were supplementally fed Japanese quail (*Coturnix coturnix*) and house mice (*Mus musculus*). Reproductive variables monitored included timing of breeding, proportion of pairs abandoning eggs, clutch size, egg mortality/fertility, hatching synchrony within broods, brood sex ratio, nesting success, and productivity. Pairs occupying nest boxes received one of three treatments: visited frequently and supplementally fed; visited frequently and not supplementally fed; or visited infrequently and not supplementally fed. Each year, 60 boxes (48% of those available)

were occupied by kestrels. I compared reproductive variables of treatment groups between and within years. Kestrels in all treatment groups bred later, showed increased abandonment, laid smaller clutches, and had lower productivity in 1993 than in 1992. A higher proportion of 1993 pairs abandoned boxes prior to hatching at frequently visited sites relative to infrequently visited ones; in addition, abandonment was more common at sites not supplemented with food. These results indicate that food-stressed kestrels may breed later, produce smaller clutches, and be more sensitive to human disturbance than better-fed birds

ARTIFICIAL NESTING SITES AND NON-MIGRATORY OSPREYS IN A COASTAL LAGOON OF BAJA CALIFORNIA SUR, MEXICO

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The use of artificial nesting sites to raise osprey (*Pandion haliaetus*) populations in North America is well documented in the literature. However, practical experiences in this matter with the nonmigratory ospreys of México are scarce or nonexistent. In this work, we present a case-study of the use of artificial nesting sites for an osprey population at Scammon's Lagoon in the Baja California peninsula. In 1946, 27 ground-nesting pairs were breeding on small islands in the lagoon. In the late-1970s, several nests were located on man-made structures outside the islands. In 1982, 87 of 111 nests were on natural sites and 24 were on artificial sites; 14 of these were constructed as specific nesting sites on the islands. Since 1982, more artificial nest sites have been added or occupied by ospreys. In 1993, 58 of 126 nests (46%), were on man-made structures. We suggest that their population and distribution may have been positively influenced by the availability of artificial nesting sites. In addition, we discuss the role of the local community on these changes.

STATUS OF THE OSPREY AT SCAMMON'S LAGOON, BAJA CALIFORNIA SUR, MEXICO

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In this work we present information on the changes in abundance and distribution over the last 47 yr of the non-migratory osprey (*Pandion haliaetus*) at a lagoon on the west coast of the Baja California peninsula. According to our 1993 surveys, 126 pairs were breeding at the lagoon, 67.4% of them were located on four small islands and 32.5% on channel markers, shorelines and inland. These figures represent an increase of 366% over the 1946 population. Changes in breeding pairs, as well as in the size

of the breeding area, are not attributable to better surveys, but to increased population during this period. The effects of biological and physical factors on this increase are discussed.

THE INFLUENCE OF SHORELINE PERCH TREE DISTRIBUTION ON THE DISTRIBUTION OF BALD EAGLES ALONG THE NORTHERN CHESAPEAKE BAY

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Forested shoreline is important perching habitat for bald eagles (*Haliaeetus leucocephalus*). Measures for perch tree abundance were determined for segments of the Chesapeake Bay shoreline during 1990–1991 to determine the influence of shoreline perch tree availability on the distribution of bald eagles. Shoreline segments used by eagles had more suitable perch trees, a larger percent of forest cover, and greater distances from water to the closest tree ($P < 0.01$). Differences between used and unused segments appear to be due to the influence of marsh shoreline. Logistic regression models were created to predict the probability of eagle use of the shoreline, given different densities of human development and perch tree availability.

INBREEDING, LINKAGE AND GENETIC DRIFT IN CAPTIVE AMERICAN KESTRELS

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The effects of inbreeding on the decreased fitness of a species as a result of increased homozygosity have been well documented. The main goal of captive-breeding programs is to maintain the founder population's allele survival. DNA fingerprinting was performed on the breeding colony of pedigreed American kestrels (*Falco sparverius*) maintained at McGill in order to: A) establish an inbreeding curve; B) determine allelic linkage; and C) compare band-sharing of free-ranging and captive-bred kestrels. Minimal inbreeding was found within the colony. The degree of allelic sharing between individuals was proportional to their degree of relatedness. Only one case of allelic linkage was identified, therefore the majority of bands resolved represent independently segregating loci and the allelic band sharing represents an accurate estimate of relatedness. The allelic band sharing between randomly selected captive-bred and free-ranging kestrels was not appreciably different.

DIFFERENTIAL MIGRATION IN SHARP-SHINNED HAWKS AND COOPER'S HAWKS

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We examined differential timing and distance of migration in sharp-shinned hawks (*Accipiter striatus*) and Cooper's hawks (*A. cooperii*) migrating through the intermountain west. Seven seasons (1985–1991) of spring and fall migration observations were conducted from two sites in central New Mexico. Significant differences in seasonal patterns and mean dates of migration for adult and immatures were detected for both species. Immature sharp-shinned hawks and Cooper's hawks preceded adults during fall migration by 15 and 7 d, respectively; adults preceded immatures during spring migration by 10 and 20 d, respectively. Band recoveries from the nonbreeding season indicated that immatures wintered farther south than adults and females wintered farther south than males. However, not all differences were significant. Results are discussed with respect to existing hypotheses for differential migration.

THE USE OF A GEOGRAPHICAL INFORMATION SYSTEM TO STUDY THE EFFECTS OF FORESTRY PRACTICE ON GOLDEN EAGLE (*AQUILA CHRYSAETOS*) REPRODUCTIVE SUCCESS

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It has been hypothesized that recent afforestation of extensive areas of the Scottish uplands, consisting largely of single species conifer planting, have caused a decline in golden eagle (*Aquila chrysaetos*) survival and breeding success, through the reduction in suitable hunting habitat. However, there is also some evidence that the forests contain sizeable prey populations at the pre-thicket stage, prior to canopy closure. The effects of forestry practice on golden eagle reproductive success were investigated on the Cowal Peninsula in Argyll, Scotland, using a geographical information system, chosen as a powerful tool to organize, manipulate and analyze the very large data set. The spatial data were held in ARC/INFO, linked to an attribute database in ORACLE.

READING PROJECT BANDS WITH TELESCOPES

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Reading peregrine falcon (*Falco peregrinus*) project bands is crucial to assessing the status of restoration populations. Short of individual captures, the only way this can be done with consistency is with telescopes. The average observer has little success with telescopic band reading due to a lack

of technical understanding and proper equipment. Telescope aperture dimension and quality optical design are vital to discerning band numbers at distances sometimes in excess of two hundred yards. Also, recognizing locational and atmospheric problems detrimental to good "seeing" will help overcome a poor success rate. By first logically assessing the obstacles that one might encounter in his or her band reading predicament, the observer can deduce the most suitable equipment for the circumstance. Recognizing situational pitfalls before initiating any band reading attempts will help the observer maximize the utilization of the most likely opportunities and avoid poor scheduling and time wasting. Proper accessory equipment will help maintain the service life of the selected telescope, thus promoting optimum band reading for years to come. Charts and graphs and test targets that are included will help determine the strengths and weaknesses of the various equipment being considered as well as provide insights to theoretical and practical or typical application limits. With a little forethought the most suitable optical equipment will be selected and with a little patience here-to-fore unidentified band numbers will be recorded and a more accurate view of peregrine population dynamics can be achieved.

SHOULD WE TERMINATE AN "ARTIFICIAL," TREE-NESTING RAPTOR POPULATION IN ARIZONA?

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The Altar Valley in southcentral Arizona was once a tallgrass prairie. Overgrazing prevented fire and spread mesquite, allowing the area, now a savanna, to be heavily used by tree-nesting raptors in summer and heavily hunted by perch-hunting raptors in winter. The breeding raptor community (over 150 pairs) consists primarily of red-tailed hawks (*Buteo jamaicensis*), great horned owls (*Bubo virginianus*), and Swainson's hawks (*Buteo swainsoni*). Common ravens (*Corvus corax*) are also common and there is a recently discovered small population of black-shouldered kites (*Elanus caeruleus*). Recent efforts to restore the endangered masked bobwhite (*Colinus virginianus*) to the area clash with habitat needs of the raptors. This conflict focuses attention on the "multiple use" concept and calls for implementation of a "prime use" or "highest and best use" management strategy. Prime use (this is the only area in the United States managed for the masked bobwhite) will likely call for the removal of trees over much of the Altar Valley. This removal will likely result in the nearly total loss of nesting and perching sites for breeding, migrating, and wintering raptors.

CONSERVATION ASSESSMENT AND MANAGEMENT PLANS: PROCESS, SCOPE, AND IMPACT

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Reduction and fragmentation of wildlife populations and habitats are occurring at a rapid and accelerating rate. As populations diminish in their natural habitat, wildlife managers realize that management strategies must be adopted that will reduce the risk of species extinction. These management strategies must be global in nature, and will include habitat preservation, intensified information gathering, research management, and in some cases, scientifically-managed captive populations that can interact genetically and demographically with wild populations. The Captive Breeding Specialist Group is one of nearly 100 Specialist Groups of the Species Survival Commission of the IUCN-The World Conservation Union. CBSG's main strength is in providing a link between *in situ* and *ex situ* conservation efforts. In collaboration with experts in the Species Survival Commission and Bird Life International Specialist Groups, wildlife agencies, the academic community, non-governmental organizations, captive breeding community, and the private sector, CBSG is evolving a series of programs, activities, and partnerships to respond to the challenge of rapidly diminishing biodiversity. One of the programs central to CBSG's function is the Conservation Assessment and Management Plan or CAMP program. This paper discusses the CAMP process and evolution, and the impact of this program.

RESIDUE LEVELS OF ORGANOCHLORINE CONTAMINANTS AND SHELL THICKNESS OF EGGS LAID BY KNOWN-AGE FEMALE OSPREYS IN MICHIGAN DURING THE 1980S

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Ospreys (*Pandion haliaetus*) nesting on artificial platforms on floodings in central Michigan have been studied intensively for the past 30 yr. We collected unhatched eggs laid by banded females ranging from 3-15 years old during the 1980s, which provided a unique opportunity to investigate any age-related changes in shell thickness or organochlorine contaminant (OC) concentrations. Thinner-shelled eggs had significantly higher concentrations of DDE, but female age was not related to shell thickness. Analysis of variance revealed no significant interaction between OC level and year, or female age class (3-6-yr-olds vs. 7-15-yr-olds), nor between female age and year. Eggs collected in more than one year from the same individual showed no consistent or significant trend in OC levels. These findings indicate that, at least in this population during the 1980s, OC residues in female ospreys had reached an

equilibrium level by the age of first breeding (usually 3–5 yr). This confirms predictions of pharmacokinetic models, and suggests that unhatched eggs of any female osprey provide an indication of her overall body burden of organochlorine contaminants.

SYSTEMATICS OF THE "RED-BACKED HAWKS" OF SOUTH AMERICA: HOW SPECIES DIAGNOSIS CAN BE CONFOUNDED BY ALLOMETRY AND SEXUAL SIZE DIMORPHISM

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Red-backed hawks (*Buteo polyosoma*) and puna hawks (*B. poecilochrous*), ranging widely throughout the high Andes, Patagonia, and several islands, have always been difficult to separate both in the field and in museums. Overlapping distributions, extensive similarity in morphology and plumage, and a lack of good field data have made the task of understanding their systematics a formidable challenge. Use of the most widely accepted diagnostic characters, wing formula and wing length, has not simplified matters. I explored the possibility that allometry might exist among these and other traditionally used diagnostic characters by analyzing data collected from museum specimens of both taxa in adult plumage. The following statistically significant patterns appeared: (1) wing formula and wing length are negatively related in males, (2) wing formula and altitude are negatively related in females, and (3) wing length differentially affects other outer primary lengths between the sexes resulting in sexually dimorphic wing tip contours. These results are best explained by allometry and wing-loading requirements of larger birds, and because the principle diagnostic characters are clinally distributed in morphometric space I believe the characters in question do not serve sufficiently well to separate the species. Examination of alternative characters is required.

PRELIMINARY REPORT ON THE STATUS OF STELLER'S SEA EAGLES IN RUSSIA

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We visited the Kamchatka and Magadan Regions of east-

ern Russia to study Steller's sea eagles (*Haliaeetus pelagicus*). Nests were surveyed by boat, helicopter, and ultralight aircraft. Of 28 territories visited in the Magadan Region, 18 were active and produced 1.16 chicks/nest. On Kamchatka, about one-half of the nesting attempts were successful. Nest substrates included cliffs, sea stacks, and trees. Nestlings were equipped with color bands, and bled for genetic and contaminant analyses. Initial studies on the seasonal movements of the eagles were initiated in conjunction with B. Meyburg. One juvenile eagle was tracked from the Kamchatka Peninsula to Japan. Threats to the eagles vary within the range of the species and include shooting, timber harvest, mining, oil extraction, and natural losses.

THE CARE OF RESIDENT RAPTORS AT AN ENVIRONMENTAL EDUCATION CENTER

GRIFFIN, D.S. *Carolina Raptor Center, P.O. Box 16443, Charlotte, NC 28297 U.S.A.*

This is an overview of the maintenance and care of the non-releasable raptors kept at the Carolina Raptor Center for public education, and a look at the evolution of our cage designs to meet the psychological and physical needs of the disabled birds while facilitating maintenance and cleaning. We use a rigorous volunteer training program emphasizing the need for consistency in methodology in handling the manned program birds. This presentation will also include a quick look at the equipment and record keeping that we use to monitor the health of our resident birds.

PHYLOGENETIC RELATIONSHIPS OF THE FALCONIFORMES

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The systematic relationships of the diurnal birds of prey (order: Falconiformes) are unresolved. The monophyly of the order has not been established, and the relationships of the families within the order, and of genera within the three polytypic families are unclear. To derive a phylogeny for the order, I analyzed variation in syringeal morphology of genera within each of the currently recognized families in the order as well as among four orders of outgroups. The phylogeny derived from these syringeal data support the monophyly of the Falconiformes. In addition, syringeal data provide strong support for the monophyly of three clades within the Falconiformes: the Cathartidae, the Falconidae, and an Accipitrinae-Sagittariidae-Pandioninae cluster. Within the order, the Cathartidae are positioned as basal to the other two clades. The results of this analysis will provide a phylogenetic framework for a wide variety of research studies of this order, including ecological and conservation biological research.

ECOMORPHOLOGICAL FEEDING DIVERSITY IN PAST AND PRESENT VULTURE GUILDS

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Wherever there is a high diversity of sympatric vultures, competition for available carrion is likely to be intensified and differences in behavior and/or morphology may be expected. Morphological indices intended to reflect feeding capabilities among these specialized scavengers were analyzed from the cranium, beak, and mandible. A principal component analysis and a discriminant function analysis were used to determine the distribution of functional types of extant vultures from several regions where they occur in the greatest diversity: Amazonia, East Africa, South Africa, and India. These results were then compared with species from the Pleistocene Rancho La Brea tar pits in California to assess changes through time. Although there are phylogenetic differences between Old and New World vultures, there appears to be a similar array of functional types and body sizes among the different regions, suggesting competition is an important determinant of feeding morphology.

THE SWAINSON'S HAWK PRODUCTIVITY CRASH

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Swainson's hawks (*Buteo swainsoni*) were healthy and reproducing consistently well in western Saskatchewan from 1969 through 1987. Suddenly, trouble became apparent with six consecutive "bad" years in a row, the six worst in 25 yr. Decreased productivity became evident in both grassland pastures and croplands near Kindersley in 1988, but at Alsask only in 1992. By 1993 the number of nesting pairs at Kindersley was less than half of that found 10 yr previously, most pairs failed, and even the successful pairs raised only one young per nest. The decline began in drought years and accelerated in two wet years. Drastically decreased numbers of Richardson's ground squirrels (*Spermophilus richardsonii*), the hawk's main prey species, may in part be related to increased numbers of foxes (*Vulpes* spp.) and coyotes (*Canis latrans*). The hawk decline began 2 yr after the peak year of carbofuran use.

FALL MIGRATION ROUTES OF FOUR PEREGRINE FALCONS DESCRIBED BY SATELLITE RADIOTELEMETRY

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We attached satellite radio transmitters to four adult female peregrine falcons (*Falco peregrinus*) on their breeding

territories to describe their migratory routes and wintering areas. Two of the falcons were captured and radiotagged in July 1993 on the upper Yukon River in eastcentral Alaska. Two other falcons were captured and marked in August 1993 on Lake Powell in southern Utah and northern Arizona. The 27 g transmitters used were miniaturized versions of the 95 g PTT-100 design that has been used extensively to track large raptors. They were attached using neoprene backpack-style harnesses. To conserve battery power, the transmitters were programmed to transmit for 8 hr in a 128-hr cycle and are projected to transmit for 10 mo to allow documentation of wintering areas and spring migratory routes. The Yukon River falcons departed from their breeding territories in late August and early September and are currently in southern Florida and Honduras. The Lake Powell falcons departed their breeding territories in late September and are currently on the coast of western Mexico in the states of Sinaloa and Nayarit.

TERRITORIAL WITHDRAWAL EXPERIMENTS IN A POPULATION OF PEREGRINE FALCONS

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The results of a preliminary series of territorial withdrawal experiments conducted in a dense population of peregrine falcons (*Falco peregrinus*) around Rankin Inlet, N.W.T., Canada are reported. This represents the first experimental attempt to establish the presence of "floaters," non-breeding non-territorial adults, and the size of the floating component in a population of peregrine falcons. It is from this component of the population that birds are recruited to the breeding population when an available territory arises due to the death of one of the occupants, or when an increase in food supply is sufficient to sustain more breeding pairs in the population. Vacancies were created by trapping one of a breeding pair during the courtship period and holding it for up to 24 hr. Of nine withdrawals, six involved holding the male temporarily, three the female. All female vacancies were filled, and three out of six males were replaced during the observation period. All of the original territory holders, except for one female, subsequently regained their territories from the individual replacing it. None of the replacements could be accounted for by the movement of an individual from a neighboring territory. This initial series of withdrawal experiments provided interesting results while confirming the safety and feasibility of such experimentation. The completion of a future series of withdrawal experiments will help elucidate the role of spacing behavior in limiting the density of breeding populations of raptors.

ACCURACY OF AERIAL SURVEYS FOR WINTERING BALD EAGLES

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The accuracy of aerial surveys for estimating wildlife populations has long been questioned because biases associated with them may lead to undercounting. Due to plumage differences between age classes in bald eagles (*Haliaeetus leucocephalus*), adults are easier to see from the air than are immatures. We conducted bi-monthly aerial surveys of a wintering population of bald eagles in the Boise River drainage in southern Idaho during the winters of 1990–1991 and 1991–1992. We assessed the accuracy of aerial results by ground-truthing with counts from a vehicle, and compared results of the two methods to determine if ground and aerial counts differed between age groups or between different topographies. Aerial counts differed significantly from ground counts for both adult and immature eagles. Adults were underestimated by 31%, while immatures were underestimated by 48% during aerial surveys compared to ground surveys. Bias did not differ between river and reservoir habitats for adult eagles, but immatures were significantly easier to count from the air in river topographies than near reservoirs. These findings indicate that in western river drainages where steep, winding terrain occurs, results from aerial surveys of wintering bald eagle populations may be less accurate than previously reported, and that the amount of bias present may depend on the topography of the terrain surveyed.

DISAPPEARANCE OF ADULT FEMALES DURING THE FLEDGLING-DEPENDENCY PERIOD: IS IT MORTALITY OR DESERTION?

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In a 4-yr study of the reproductive strategies of Cooper's hawks (*Accipiter cooperii*) nesting in northcentral New Mexico, >50% of the females deserted during the fledgling-dependency period and did not reneest. In this study the males continued to rear the fledglings until dependence. Although this is only the second published record of mate desertion in raptors (ambisexual desertion in the polygamous snail kite [*Rostrhamus sociabilis*]), I suggest that it is a common reproductive strategy used by females when the risks to her current offspring are low (e.g., males provide ample food and predation risks are low) and future survival is enhanced (e.g., pre-migratory fattening). I surmise that the low reporting incidence of this behavior is a result of assuming female disappearances during the nesting season are mortalities. To evaluate this hypothesis, I reviewed the literature to determine the extent to which nesting female raptors disappear prior to offspring inde-

pendence and summarize the explanations presented for their disappearance.

EFFECTS OF TRIANGULATION ERROR ON HOME RANGE ESTIMATES OF PRAIRIE FALCONS (*FALCO MEXICANUS*)

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One problem with radio tracking is to decide how precise a location estimate must be. What is acceptable precision an error ellipse of 10 ha, 100 ha, 1000 ha, or even larger? Concurrent with this problem is the one of accuracy: do precise estimates reflect the transmitter's true location? We radio-tracked over 90 prairie falcons (*Falco mexicanus*) in the Snake River Birds of Prey Area during the nesting seasons of 1991–93. During that time, we also took fixes on beacon transmitters placed at known locations to estimate the accuracy of our triangulations. We examined beacon data to see if smaller polygons are also more accurate, using the center of the polygon as a point fix. Then we compared nesting season home ranges resulting from varying acceptable hectare sizes of 100–5000 ha. Polygon sizes up to 5000 ha may produce results comparable to those resulting from smaller hectare sizes. Using less precise fixes results in a larger sample size, and may be acceptable for point analyses. Larger error ellipses also increase coverage and ensure that the ellipse contains the transmitter location. Smaller error ellipses, while more precise, reduce sample size and may produce inaccurate results because they miss the transmitter's true location. If smaller polygons are accurate as well as precise, though, they represent a better estimate than do larger polygons.

COMPETITION-MEDIATED HABITAT USE OF RESIDENT AND MIGRANT VULTURES IN SOUTH AMERICA

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I studied spatial and temporal differences in the foraging densities of migrant (*Cathartes aura meridionalis*) and resident turkey vultures (*C. a. ruficollis*) in the Venezuelan Llanos in relation to hypotheses concerning habitat use in migrant and resident birds. In the wet season (May–October), residents foraged in all habitats, although most were counted over gallery forest. During the dry season (November–April), the larger North American migratory race coexisted with residents. Migrants foraged primarily over open savanna and relatively few birds foraged over forest. When sympatric with these migrants, residents foraged almost exclusively over gallery forest, and avoided open habitats. Three pieces of evidence suggested that this might be due to interference competition. Observations at carcasses in gallery forest demonstrated that residents discovered carcasses first more often than migrants, despite there being equal densities of each race in this habitat.

Residents had a higher peck rate than migrants and resident group size was negatively correlated with that of migrants. The feeding rate of residents also declined in response to increased group size of migrants but not residents. Consistent with their larger size, migrants dominated residents in almost all agonistic encounters. Second, radio-tagged residents shifted their foraging ranges from forest to savanna after migrants had departed. Lastly, the condition of captured residents was below average when sympatric with migrants, whereas they were in above-average condition when migrants were absent. By contrast, in migrants condition improved following their autumn migration. These results suggest that competition-mediated habitat use may occur between other migrant and resident races or congeners and has important conservation implications.

EFFECT OF MATE REMOVAL ON THE VOCAL BEHAVIOR AND MOVEMENT PATTERNS OF EASTERN SCREECH-OWLS

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Male ($N = 6$) and female ($N = 7$) eastern screech-owls (*Otus asio*) typically increased singing rates and movement rates and distances after removal of mates. Such behavior appears to represent an attempt either to reestablish contact with an absent mate or to attract a new mate. In support of the mate attraction hypothesis, five owls apparently acquired new mates after mate removal. Male screech-owls sang more and moved more than females after mate removal, suggesting either that males place a higher priority on reestablishing contact with an absent mate or that males use a more active strategy than females to attract new mates. Both males and females used bounce songs more than whinny songs after mate removal, suggesting that bounce songs are more important in intersexual communication. Extended bounce songs were given more frequently after mates were released and were typically uttered near cavities. Males may use these songs to advertise potential nesting cavities, a resource that may be important in mate choice.

MANAGING ACTIVE NEST SITES AND TERRITORIES OF THE PEREGRINE FALCON IN AN URBAN ENVIRONMENT

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With the releases of captive produced peregrine falcons (*Falco peregrinus*) coming to a halt in most of North America, future management of the species will focus on providing suitable nest sites, and monitoring of active territories. Because a majority of active territories in the Midwest are in urban settings, the unique situation posed to managers must be addressed differently than those in a non-

urban setting. Over the past 7 yr, the Wisconsin Peregrine Society (WPS) has worked with several corporations to install, monitor, and maintain nest boxes on their buildings and associated structures. A year-round system of monitoring urban peregrines and using this to plan seasonal activity with our corporate contacts is necessary to ensure proper consideration for the falcons and businesses alike. Although the falcons' seasonal activities (i.e., nesting and fledging) are somewhat predictable, corporate activities at and around nest sites can be quite erratic (i.e., building maintenance and renovations, changes in management, etc.). Proper planning has allowed the WPS to set up effective communication channels with building managers and key personnel which in turn has enabled us to effectively manage urban nest sites and minimize disturbances and losses during the nesting season.

FORAGING RELATIONSHIPS BETWEEN CORVIDS AND GOLDEN EAGLES: MUTUAL PARASITISM?

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The interaction of golden eagles (*Aquila chrysaetos*), common ravens (*Corvus corax*), and black-billed magpies (*Pica pica*) during foraging was studied during the winters of 1991-92 and 1992-93 in southwestern Idaho. These species appear to have a closely intertwined relationship best described as mutual parasitism. Magpies are typically the first species to discover new foods (carcasses), but ravens quickly cue in on magpies to find food, and eagles cue in on both corvids to locate food. Eagles dominate ravens which dominate magpies in foraging groups. Thus, one-half of the parasitism involves dominant foragers using subordinates to locate rare, ephemeral foods which the dominants then exploit, often to the exclusion of the subordinates. The second half of the parasitism involves corvids cueing in on hunting eagles and foraging upon the scraps remaining from kills. Corvids increased in abundance as soon as eagles killed large prey items (black-tailed jackrabbits [*Lepus californicus*]), but no significant increase was detected after small prey items were killed (ground squirrels). I conclude that the foraging activities of ravens, magpies and eagles are important cues that each species uses to opportunistically locate food items during winter.

PARENTAL INVESTMENT BY EASTERN SCREECH-OWLS: ROLES OF MALES AND FEMALES IN FEEDING NESTLINGS

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Among monogamous species that rear altricial young, male parental effort may be substantial and nearly equal to

female effort. However, in species that exhibit reversed sexual dimorphism (RSD), smaller males may forage more efficiently and, therefore, male parental effort might be greater than that of females. We sought to examine the parental behavior of a species exhibiting RSD, the eastern screech-owl (*Otus asio*). The behavior of male and female screech-owls was studied during the breeding seasons of 1992 and 1993. Observations were made using camcorders placed inside specially constructed nest boxes. Preliminary analyses suggest that (1) females feed young more frequently than males, (2) feeding rates remain constant throughout the nestling period, and (3) males and females feed young similar prey (mainly invertebrates). The relevance of our results to the evolution of RSD, plus other aspects of parental and nestling behavior, will be discussed.

A MODIFIED POWER SNARE TO CATCH BREEDING GOLDEN EAGLES (*AQUILA CHRYSAETOS*)

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A radiotelemetry study of the ranging behavior of golden eagles (*Aquila chrysaetos*) in Scotland demanded that territorial breeding birds be caught so that backpack transmitters could be fitted. Since the population of golden eagles is not migratory in Scotland, efforts were made to trap the eagles at all times of the year. Although some success was had during the winter, successes were not predictable, and a method for trapping the eagle on the nest in the summer was devised. Adult golden eagles are difficult to catch during the breeding season, particularly when the use of live lures is not permitted. We describe a method for trapping breeding golden eagles which does not use lure animals to attract the target birds. Instead, the desire of adults to return to feed their offspring is the motivation which brings them within the trapping area. Essentially a modification of a trap described by Hertog, our trap with its modifications has proved to be a safe, sure, and inexpensive method for catching eagles at the nest.

USING SATELLITE TELEMETRY TO MONITOR MOVEMENTS OF GYRFALCONS IN NORTHERN ALASKA AND THE RUSSIAN FAR EAST

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Gyrfalcons (*Falco rusticolus*) are commonly found nesting in northern and western Alaska. However, little information is available on juvenile dispersal and wintering areas of the species in Alaska. In July 1992 we marked

two juvenile female gyrfalcons with 45 g satellite transmitters using backpack harnesses at an eyrie on the central Seward Peninsula, Alaska. From August 1992 to January 1993 we monitored the movements of the gyrfalcons using the ARGOS polar orbiting satellite system. One gyrfalcon left its natal area approximately 4 wk after fledging. It was located near the Anadyr River in eastern Siberia in mid-September and moved to southwestern Alaska (Kodiak Island) in early October. The second gyrfalcon remained near its natal area until mid-September, then moved south along the western coast of Alaska and was last located in December on northern Nunivak Island in western Alaska. In July 1993 we marked seven juvenile gyrfalcons with 28 g satellite transmitters using backpack harnesses at three eyries on the central Seward Peninsula, Alaska. We are currently monitoring these gyrfalcons using the ARGOS polar orbiting satellite system. Our results demonstrate that satellite telemetry is a valuable tool for monitoring broad-scale movements of gyrfalcons and other avian species, capable of carrying the transmitter, in remote areas. As satellite transmitters continue to decrease in size and weight, satellite telemetry will become an important research tool for examining movements of an increasing number of avian species.

SATELLITE TRACKING OF EAGLES

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Many species of eagles spend more than half of the year away from their breeding grounds on migration and in their wintering areas where they are difficult to study by conventional methods. This much needed knowledge is, however, an important prerequisite for their protection. Satellite telemetry is a new technique to study the movements, orientation and ecology during migration of large- and medium-sized birds on a worldwide basis which has been little-used so far. The short battery life, the weight and cost of transmitters as well as the difficulties in capturing adult and immature eagles are the most important limiting factors of this promising technique. In 1992 and 1993 we fitted satellite transmitters to juvenile, immature, and adult eagles of six species (*Haliaeetus albicilla*, *H. pelagicus*, *Aquila heliaca*, *A. nipalensis*, *A. pomarina* and *A. clanga*) in various parts of Eurasia. Up to eight transmitters were available per species. Some birds have been tracked for several thousand kilometres which will be discussed in detail. A new generation of solar-powered transmitters has become available in 1993 which gives some hope that the movements of at least large species could be studied in greater detail and for longer periods. Such a transmitter has been fitted to a juvenile sea eagle in July 1993 to study its dispersal, movements, and ecology after becoming independent from its parents.

COMMUNAL ROOSTS OF AMERICAN SWALLOW-TAILED KITES: IMPLICATIONS FOR MONITORING AND CONSERVATION

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American swallow-tailed kites (*Elanoides forficatus*), which are social and roost communally year-round, gather in exceptionally large numbers at the close of the breeding season in Florida. Late-season roosts, which may contain hundreds of kites, probably serve as premigration staging areas. The largest, located in 1987 by Brian Millsap, was studied from July–September 1992 and 1993 to develop census methods and to examine phenology, the potential for population monitoring, and the implications of roosting behavior for conservation. Photographs taken from fixed-wing aircraft provided the best and most cost-effective estimates of total numbers, which peaked during late July (1550 in 1992; 2000 in 1993); 90% of total 1992 attendance was from 20 June to 18 August. Ground-based photographs of departing flocks revealed that the relative number of juveniles (young of the year) increased from 17% at the peak (predictable from observed nesting success and productivity) to 70% on 29 August, indicating that adults generally staged for shorter periods and did not migrate with their young. Photographs also permitted counts of adults in different stages of molt; observations at nests tentatively suggest that molt schedules may be related to breeding status (breeders molt later). Five kites radiotagged 80 km to the south provided data on attendance, foraging range, and activity, including cues for predicting migration. Tests of aerial searching methods using naive observers and smaller roosts provided a protocol for future surveys. Regular monitoring of large roosts should indicate trends in annual production and population size. Protection of large roost sites through acquisition of easement probably is essential to the long-term conservation of the United States population of swallow-tailed kites, which has been recommended for listing as endangered at state and federal levels.

REDUCING THE EFFECTS OF PIGEON FANCIER/PEREGRINE CONFLICT

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Conflicts usually involve passionate exchanges in the press. Although pigeon fanciers rarely affect healthy raptor populations, their public claims can alter the public's attitudes to raptors in general. The media can be used to respond but fanciers who are featured should also be met and veracity of their statements checked. This often embarrasses and removes them from debate. Many of the current perpetrators are the same people who killed raptors before protection. It is almost impossible to change the attitudes of these old fanciers. Policing is necessary to reduce their

impact. During the change to a new generation it is possible to take advantage of better education. It is the role of wildlife authorities and naturalists to research the methods of the most successful fanciers and those who have the least losses. Fanciers that have a tolerant attitude can be empowered with facts about peregrine falcons (*Falco peregrinus*) and advice on reducing losses creating demand for knowledge from the less-tolerant fanciers. This can be done without bringing the clubs together and so increase their lobbying power. Information should be written to lessen inaccuracies in relay. Wildlife authorities, with their access to scientific literature, can forward articles on pigeons to create goodwill. Similarly, recovered pigeon rings should be returned to fanciers. Management should concentrate on fanciers changing their flying methods to reduce losses. Manipulating raptors should be a tactic of last resort and should only involve individual raptors. Situations in which it is practical are discussed.

OBSERVATIONS ON FEEDING ECOLOGY OF STRIPED OWLS IN SOUTHEASTERN BRAZIL

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We studied the diet and prey selectivity of the poorly known striped owl (*Asio clamator*) occurring in a grassland savannah ("campo cerrado") in Sao Carlos, Sao Paulo State, southeastern Brazil (21°58'S, 47°52'W). Pellets ($N = 31$) and debris were collected between August 1992 and July 1993 beneath diurnal roosting sites in shrubs (*Piptocarpharotundi folia*, Compositae). Snap-trapping for small mammals was performed simultaneously with pellet collecting. Pellet and debris analysis yielded 136 prey items; of these, rodents comprised 53%, birds 24%, mouse opossums (*Marmosa* spp.) 15%, insects 6%, and bats 2%. Biomass estimates (total = 3591.8 g) showed rodents (65.6%) and birds (24.1%) to be the most important prey items followed by mouse opossums (8.7%), bats (1.4%), and insects (0.2%). It is interesting to point out that many small mammals were partially or completely arboreal (*Oryzomys* spp. and mouse opossums, 27.9% and 15.4% of 136 prey, respectively). Chi-square tests showed striped owl selectivity towards the poorly trapped *Oryzomys nigripes* and mouse opossums, whereas *Bolomys lasiurus* and *Calomys callosus* were more common in savannah than in pellets ($\chi^2 = 608.5$, $df = 3$, $P < 0.0001$). The first author was sponsored by CAPES and WWF-Brazil.

HURRICANE HUGO AND BALD EAGLES—MANAGEMENT IMPLICATIONS OF NATURE'S EXPERIMENT IN HABITAT ALTERATION

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On 22 September 1989, a category four hurricane made landfall in South Carolina. Hurricane Hugo's sustained winds of 220 km/h and local winds of 290 km/hr damaged in excess of six-billion board feet of timber. Damage to bald eagle (*Haliaeetus leucocephalus*) nesting areas was both intensive and extensive. Twenty-five of the state's fifty-four breeding areas had all eagle nests destroyed. Twenty-two pairs rebuilt nests during the 1989-90 nesting season and the other three pairs rebuilt the following year. The mean distance between nest sites used before and after the hurricane was 1.02 km (SD = 1.12). Eighteen of twenty-five pairs rebuilt nests outside both the primary (radius = 201 m) and secondary (radius = 402 m) management zones. There was no significant difference ($t = 0.42$, $P = 0.68$) in chick production in the twenty-five affected breeding areas between the season prior to Hurricane Hugo (1.28 young per breeding area) and the year of Hurricane Hugo (1.12 young per breeding area). Nor was there a significant difference ($t = 0.94$, $P = 0.35$) in chick production between impacted breeding areas ($N = 25$) and breeding areas outside the path of the hurricane (0.90 young per breeding area). Bald eagles displayed a high degree of nest site fidelity and successfully adjusted to extensive habitat alterations which occurred during the nonnesting season. However, the site tenacity displayed by nesting eagles suggests that they are likely to persist in an area despite extensive habitat alterations or repeated nest failures.

EFFECTS OF SHORT-TERM FOOD DEPRIVATION ON GROWTH OF HAND-RAISED AMERICAN KESTRELS (*FALCO SPARVERIUS*)

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Sudden prey reductions were simulated to examine their impact on growth parameters of nestling American kestrels (*Falco sparverius*) hand-raised in captivity. The experimental design consisted of three treatments: (1) 15 nestlings fed *ad libitum* (control individuals), (2) 15 nestlings that were starved for 24 hr when 7 d old, and for 36 hr when 21 d old, (3) 15 nestlings which starved for 36 hr when 14 d old, and 48 hr when 28 d old. The starved birds were fed *ad libitum* outside the starvation periods. Fitting biometrical data to logistic models (body mass and bone measurements) or linear models (feather measurements), revealed no significant differences for the growth parameters between control birds and the experimental groups. This reveals no long-term effects caused by temporary starvation. Although starved birds suffered a significant loss of weight, they did not reduce the growth rate of bones and feathers and quickly recovered mass by in-

creasing food ingestion when the *ad libitum* diet was restored. The response of males and females to starvation was similar.

POLYGAMY IN BALD EAGLES

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While individuals of several species of raptors have been described as having multiple mates, little such documentation exists for bald eagles (*Haliaeetus leucocephalus*) beyond some anecdotal accounts. Cases of both polygyny and polyandry have been witnessed and monitored in New York State over a period of 8 yr, involving three birds in each case. A polyandrous trio at a single nest site was successful in six of eight breeding attempts, fledging a total of nine young. The polygynous trio used two nests in close (0.8 km) proximity to successfully fledge 11 young during six breeding attempts. Periodic observations revealed that, in both cases, all three eagles participated in nest building, incubation and rearing (food provisioning).

EFFECTS OF HABITAT ALTERATION ON THE BREEDING DENSITY AND PRODUCTIVITY OF ROADSIDE HAWKS IN THE PETEN, GUATEMALA

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As part of the Peregrine Fund's Maya Project, I conducted systematic and intensive searches for nesting roadside hawks (*Buteo magnirostris*) in study plots established in the pristine forest of Tikal National Park and in a slash-and-burn habitat south of the park. The 8.25 km² forest plot supported 13 territories which were occupied but only five pairs attempted to nest. The 8 km² slash-and-burn plot contained 12 territorial pairs, 10 of which nested. Pairs nested earlier, in smaller trees, and at lower heights in the slash-and-burn habitat. Pairs in the pristine forest nested in bajo forest areas characterized by low elevation, seasonal inundation, and a low canopy (10-15 m). Productivity in the slash-and-burn habitat (0.42 young/pair) was greater than in the pristine forest (0.15 young/pair). Overall, a total of 26 nests were found during the field season in three habitat types, the highest productivity (0.83 young/pair) was found in slightly disturbed human-use areas in Tikal National Park.

FORAGING AND CREPUSCULAR/NOCTURNAL BEHAVIORS OF THE WESTERN BURROWING OWL

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Specific foraging habits and crepuscular/nocturnal be-

haviors of the western burrowing owl (*Athene cunicularia hypugaea*) are virtually unexplored. With the aid of a night-vision scope, these facets of the burrowing owls' behaviors were examined in 1992 and 1993 in Adams County, Colorado. Crepuscular/nocturnal behavioral data were then compared to analogous diurnal data. Due to the change in foraging responsibility associated with feeding hatchlings, diurnal and crepuscular/nocturnal behaviors were separated into pre-hatch and post-hatch periods for analysis. Several predictions of foraging behavior were based on central-place foraging theory: males should have longer foraging bouts than females, foraging bouts resulting in a small mammal capture should be longer than those with an insect capture, and males should capture proportionally more small mammals than females. Foraging results indicated male foraging bouts ($\bar{x} = 528$ sec) are longer ($P = 0.0001$) than female ($\bar{x} = 196$ sec). Foraging bouts resulting in a small mammal capture ($\bar{x} = 1063$) were longer ($P = 0.0001$) than those resulting in an insect capture ($\bar{x} = 220$ sec). Males captured proportionally more ($P < 0.05$) small mammals (21.4%) than females (4.9%). Furthermore, the majority of the burrowing owl foraging activity, which was once considered to be predominantly diurnal, occurs at dusk and throughout the night. Due to principle foraging activity occurring during dusk and after nightfall, calculations of home ranges for burrowing owls should include nocturnal data points. Both insect and small mammal prey bases are important aspects of burrowing owl habitat and should be taken into consideration when managing these owls.

OCCUPANCY AND PRODUCTIVITY OF NORTHERN SAW-WHET OWLS USING NEST BOXES IN SOUTHWESTERN IDAHO

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In 1982, BLM began placing nest boxes in riparian areas around C.J. Strike Reservoir and the Snake River Birds of Prey Area for western screech owls (*Otus kennicotti*). In 1986, northern saw-whet owls (*Aegolius acadicus*) began using these nest boxes and in 1987, three pairs of saw-whet owls successfully bred. In 1989, an additional three pairs of saw-whet owls occupied wood duck (*Aix sponsa*) boxes at Lake Lowell near Nampa, Idaho and, there have been three successful breeding attempts in 1991, four successful breeding attempts in 1992, and only a single successful attempt in 1993. Adult saw-whet owls were either captured in the nest box or in a mist net placed in front of the nest box. Over the 6-yr period that the nest boxes have been occupied, the mean hatch date has been 7 April and a total of 61 young have fledged for an average of 1.9 young/breeding pair. The clutches ranged in size from 5-7 eggs with an average clutch size of 5.8 eggs.

PRODUCTIVITY AND NESTING DENSITY OF COOPER'S HAWKS IN WISCONSIN

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There are no long-term data on the breeding ecology of the Cooper's hawk (*Accipiter cooperii*) in the eastern U.S., especially from suburban areas. Such information is essential to resource agencies charged with managing the species in the east, where it is listed as threatened or endangered by several states. Over 14 yr, we found means for clutch and brood sizes of 4.3 eggs ($N = 255$) and 3.8 bandable young per successful nest ($N = 318$), respectively. Of 378 nests, 79% produced young. The highest nesting density (1 nest/272 ha) known for the species was found in a central Wisconsin suburb. Nest area reoccupancy can be an adequate measure of population stability in some circumstances.

RAPTORS ASSOCIATED WITH AIRPORTS AND AIRCRAFT

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An ecological study of bird hazards at 22 Indian aerodromes was conducted between 1980 and 1988. An analysis of 552 bird- and bat-aircraft strike remains identified through microscopical and macroscopical methods between 1966 and July 1993, revealed that 55.43% of the incidents were caused by 18 species of raptors (of a total of 80 bird and bat species). Vultures and black kites (*Milvus migrans*) which caused 48.36% of them, are the commonest of the raptors in the Indian subcontinent and the economic loss due to their collision with aircraft ranged from over a dozen air crashes to severe damage to engine and other parts. The superabundant food in urban areas available at garbage and carcass dumps as well as sanitary landfills has attracted multitudes of raptors which took to scavenging following principles of ergonomics. Uncontrolled population explosion of scavenging raptors caused by this artificial food supply in cities has led to their collisions with aircraft and power lines as well as their interactions with utility structures. An aerodrome with its openness, vastness and tranquillity as well as natural plant and animal food for birds proves to be a favorable habitat for several raptors for feeding, resting, roosting and nesting. Inviting raptors to the scavenging table will prove catastrophic not only to the raptors and their natural prey but also to man and nature in the long run. Conserving raptors at the apex of food pyramids, preserving natural habitats of raptors and their prey as well as denying artificial habitats and food to them are very essential to maintain the balance in nature.

BALD EAGLE NESTING CHRONOLOGY AND IMPLICATIONS FOR SURVEYS

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Occupancy and reproduction surveys were conducted at 594 bald eagle (*Haliaeetus leucocephalus*) nests in Prince William Sound, Alaska, during the summer of 1990. Surveys began in early April and were repeated at 10 d intervals throughout the breeding season until young began to fledge in mid-August. The standard method of conducting two surveys to estimate nest occupancy and productivity probably results in underestimates of nest occupancy and nest failure and overestimates of nest success. Surveys must be planned with a good knowledge of local nesting chronology to minimize these errors.

MORPHOLOGICAL VARIATION IN MIGRATORY RED-TAILED HAWKS (*BUTEO JAMAICENSIS*) FROM THE GOSHUTE MOUNTAINS OF NEVADA AND THE MANZANO MOUNTAINS OF NEW MEXICO

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Because of the tendency of raptors to show fidelity to birthplace despite migratory habits, it is hypothesized that red-tailed hawks (*Buteo jamaicensis*) using two separate flyways come from distinct populations. Differences in selection pressures such as migratory habits, prey differences, and temperature/humidity gradients may serve to maintain unique morphological characteristics within populations. Multivariate and univariate statistics are used to provide information on patterns of morphological variation in migratory red-tailed hawks which were trapped in the Goshute Mountains of Nevada and the Manzano Mountains of New Mexico. A principle components analysis indicated that red-tails were significantly different in one "shape" component between flyways. Hatch-year red-tails were also found to be significantly different when analyzed character by character using univariate statistics. Red-tailed hawks which use different flyways were found to be significantly different ($P < 0.1$) for wing chord, hallux length, tarsus length and tarsus width measurements. Results for red-tailed hawks can be compared with other migratory birds which use the same routes for an understanding of population structure and variation that results from natural selection on populations from different habitats.

FERRUGINOUS HAWK MANAGEMENT: WAS IT FOR THE BIRDS?

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Judging from sightings and eggs collected over 75 years ago, the current breeding distribution of ferruginous hawks (*Buteo regalis*) in Canada includes only the southern 50% of the former range. In response to this decline, the ferruginous hawk was assigned "threatened" status in 1980. A recovery team first met to help enhance this species' recovery in 1990. A considerable amount of monitoring, nest management and habitat protection has been devoted to this species. During the last ten years, ferruginous hawks have remained stable or increased slightly on selected study areas in the three prairie provinces. In Alberta alone, an estimated 1702 pairs nested in 1992. There is some evidence that a surplus of breeders exists, although much of the former breeding range is still vacant. The purpose of this presentation is to evaluate to what degree management efforts have contributed to halting or reversing this species' decline.

PRELIMINARY EGGSHELL THICKNESS AND CONTAMINANT ANALYSIS OF URBAN NESTING PEREGRINE FALCONS IN WISCONSIN

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Since 1989, addled and infertile peregrine falcon (*Falco peregrinus*) eggs have been salvaged from urban nest sites in Wisconsin. They have been measured and weighed to determine the "Ratcliffe thickness index" and the contents have been analyzed for organochlorines and heavy metals. The results of these tests will serve both as baseline data for the recovering peregrine falcon population in Wisconsin and as a measurement gauge for comparisons of eggshell statistics from other geographic populations.

RED-SHOULDERED HAWK REPRODUCTIVE SUCCESS ALONG THE UPPER MISSISSIPPI RIVER DURING RECORD FLOODING IN 1993

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We monitored 27 of the 35 known red-shouldered hawk (*Buteo lineatus*) nesting sites along a 369-mile stretch of the Upper Mississippi River from Wabasha, Minnesota, to Burlington, Iowa, during 1993 when the river reached record high levels at most locations. Of 18 red-shouldered hawk (RSH) nesting attempts, only seven were successful, or at least produced nestlings. The remaining eleven nesting attempts were aborted or failed to produce nestlings. Although a total of 15 nestling RSH reached fledging age, at least nine drowned or failed to survive their first flight. Dangerously high water levels and U.S. Coast Guard boating restrictions kept us from determining the final outcome

of nine nesting attempts, but we suspect similar losses at these sites. Based on RSH nesting attempts for which we have data, survival rates in 1993 were 0.33 fledglings per nesting attempt or 0.86 fledglings per successful nesting attempt. In comparison, between 1983 and 1992 we determined the outcome of 44 nesting attempts within the Upper Mississippi River Valley; of these, 33 (75%) were successful producing 71 fledging-age RSH for an average of 1.61 fledglings per nesting attempt, or 2.15 fledglings per successful nesting attempt. Data on RSH nest site selection, nest site fidelity, differences in relative abundance in the refuge districts, and the proposed management recommendations for RSH nesting sites will also be presented.

PRODUCTIVITY AT STELLER'S SEA EAGLE AND OSPREY NESTS ON THE MAGADAN STATE NATURE RESERVE, MAGADAN, RUSSIA

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From 1991 through 1993 nesting Steller's sea eagles (*Haliaeetus pelagicus*) and osprey (*Pandion haliaetus*) were surveyed within the Kava-Chulomzhe portion of the Magadan State Nature Reserve to determine their productivity. In 1992 and 1993 these surveys were done by means of an ultralight aircraft. A total of 25 sea eagle territories were active during the three-year period. Nests of sea eagles were usually located in poplar (*Populus* sp.) or larch (*Larix* sp.) within 300 m of a river. The distance between neighboring nests varied between 3.5 km and 22 km for the sea eagles and between 2 and 26 km for the osprey. Steller's sea eagles produced 0.42 and 0.46 chicks per territorial pair in 1991 and 1992 respectively. Osprey produced two chicks per territorial pair in 1992. Production data for 1993 and information on food habits will also be presented. The use of an ultralight aircraft in the survey of eagle and osprey nests will be discussed.

EFFECTS OF RADIO-TRANSMITTERS ON PRODUCTIVITY OF PRAIRIE FALCONS AND GOLDEN EAGLES

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The use of radiotelemetry to study factors such as behavior or home range characteristics requires that researchers consider the potential influence that radio-transmitters may have on their subjects. Here we report the influence of radio-transmitters on the productivity of prairie falcons (*Falco mexicanus*) and golden eagles (*Aquila chrysaetos*) during the 1991-93 breeding seasons in the Snake River Birds of Prey Area. We determined the percent of occupied nesting areas that were successful and the number of young

fledged by instrumented and control pairs for both eagles and falcons. Additionally, we compared the weights of fledgling falcons and the prey delivery rates of adult falcons between instrumented and control pairs. Instrumented falcons failed to show an influence for any parameter during any of the three seasons, although success was slightly lower during the 1991 and 1993 seasons. We found no differences in the success or the number of young fledged for golden eagles during the 1992 breeding season (the first year with an adequate sample of instrumented eagles), but there was a highly significant difference between instrumented and control pairs for both measures during the 1993 season. We are currently examining estimates of prey densities and the responses of falcons and eagles to changes in prey, to understand the variable influence of radio-transmitters between falcons and eagles and between breeding seasons.

ARE AMERICAN KESTRELS PROMISCUOUS NYMPHOMANIACS?

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The American kestrel (*Falco sparverius*) has one of the highest copulation frequencies among birds known to date. Using a wild nestbox population in the Montreal area, our aim was to determine the frequency and timing of copulations throughout the breeding period and to observe any extra-pair copulations. In 1992 eight pairs of breeding kestrels were observed from pair formation to laying for 130 hr, and 10 pairs for 350 hr in 1993. The number of copulations per pair per season averaged 450. For the majority of the copulations the female was either the initiator or a very willing partner and overall seemed to regulate the act. Copulation rates were highest around -20 to -15 d from the laying of the first egg and typically dropped to near zero as the eggs were being laid (when the chances of fertilizing the female are highest). This pattern cannot be explained solely by sperm competition pressures. We believe that the early peak of copulations may be better explained as a way to strengthen the pair bond. No extra-pair copulations were observed from the focal birds. As a better estimate of the extent of extra-pair paternity, blood samples from 25 kestrel families have been DNA fingerprinted.

SHARP-SHINNED HAWK COUNTS AT HAWK MOUNTAIN, PA, AND CAPE MAY, NJ: AN INDICATOR OF POPULATION DECLINES OR A CHANGE IN GEOGRAPHIC DISTRIBUTIONS?

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We present sharp-shinned hawk (*Accipiter striatus*) migration data for Cape May, NJ, and Hawk Mountain, PA, from 1982 through 1993, together with Christmas Bird Count data for sharp-shinned hawks wintering north and south of Hawk Mountain. The results of an ongoing investigation into the general health and contaminant levels of migrant sharp-shins are also presented. The numbers of sharp-shinned hawks counted during 1992 at both sites were lower than in previous years. Organochlorine pesticides and PCBs continue to be recorded in adult sharp-shinned hawks collected in 1992 and 1993. We discuss the conservation implications of this work.

PEREGRINE FALCON MANAGEMENT IN ARIZONA

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The American peregrine falcon (*Falco peregrinus anatum*) is currently listed by the U.S. Fish and Wildlife Service as endangered. In 1983, 54 breeding sites were known in Arizona. The Arizona Game and Fish Department initiated a statewide survey in 1988. As a result, breeding activity has been documented at 181 locations. Occupancy and productivity data are collected using a protocol developed by Department biologists. Occupancy and young per monitored eyrie are 86 percent and 1.3, respectively, averaged over a 5-yr period. This information is used to protect nest sites and monitor peregrine falcon recovery in the southwest region. Data from two winter movements studies suggest Arizona's peregrine falcons migrate within or near the state borders, perhaps avoiding pesticide contamination hotspots located outside the U.S. Future management activities will be directed at developing a delisting monitoring protocol and includes collecting eggshell thickness and pesticide contamination information.

NESTING ECOLOGY AND THE REPRODUCTIVE PERFORMANCE OF MERLINS IN DENALI NATIONAL PARK AND PRESERVE, ALASKA

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A population of merlins (*Falco columbarius*) in Denali Park was intensively studied from 1990 through 1992. The objectives of this study were to report the broad nesting distribution, nest habitat use, and prey use of taiga merlins. Additionally, this study attempted to evaluate some factors which may influence population reproductive perfor-

mance. Nesting distribution was tied to black-billed magpie (*Pica pica*) nest clumps but merlins nested on the ground in a portion of the study area devoid of magpie nests. Ground nesting areas had less nesting fidelity than spruce stand nesting areas. Nesting habitat use during the study was 71.9% magpie nests, 19.3% ground sites and 8.8% other types. Prey use determined from remains at pluck perches consisted primarily of three sparrow species (40.7%) and two alpine passerines (10.2%). Avian density surveys allowed classification of prey species to broad habitat types. Low/medium shrub tundra was found to be the dominant habitat of prey utilized by merlins, both by frequency of occurrence and percent of total biomass of prey remains. Avian density estimates found low/medium shrub tundra to have the highest density of available merlin prey of the habitats available for hunting. Population reproductive performance was evaluated by various measures. Weather variables and an index to prey density were analyzed for their influence on population reproductive performance. The results of this study provide information for long-term monitoring of the population health of taiga merlins nesting in Alaska.

WATER USAGE PATTERNS AND WATER CONTENT OF PREY

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The use of an *ad libitum* water source by rehabilitating red-tailed hawks (*Buteo jamaicensis*) was investigated. The water content of prey available to these raptors was also determined. If a water source is not a necessity, it could be removed from the bird's cage decreasing the chances for the propagation and spread of pathogenic bacteria. Understanding the water intake needs of a raptor could be beneficial for care of rehabilitating and captive birds. Water usage behavior was videotaped by a camera focused on the available water source. Utilization of the water source consisted of drinking and bathing on both feeding and fast days during the warmest days sampled. Although no pattern between prey deprivation and water utilization emerged, a relationship between water utilization and temperature did show. Mice and small rats were subjected to three treatments (recently killed, frozen 1 wk and frozen 3 wk). The mean water content of the rodents after subtraction to treatments was determined by drying the rodents to a constant mass. Water content was investigated as a fraction of the initial body weight (%WCON). The freezer treatments did not significantly affect the mean %WCON in the rodents. Raptor centers or private rehabilitators that store prey in frosted freezers need not be concerned with water loss from prey due to freezer storage up to 3 weeks. The mean %WCON differed significantly between the mice and small rats although approximately two-thirds of each rodent's body weight is water. The water content of three mice approximates that of one small rat.

MERCURY CONCENTRATIONS IN BLOOD AND FEATHERS OF NESTLING FLORIDA BALD EAGLES

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High mercury levels occur in fish in several aquatic systems throughout Florida. As a top predator of aquatic systems relying heavily on fish as prey, bald eagles (*Haliaeetus leucocephalus*) can bio-accumulate mercury resulting in elevated mercury levels in tissues. The objective of this study is to determine the amount of mercury concentrated in the blood and feathers of nestling bald eagles in Florida and to determine the source of any mercury detected. These data will provide baseline information for the Florida eagle population. Samples were collected from nests throughout the state of Florida to examine several different river and wetland systems to assure detection of problem areas. Blood and feather samples were collected from 41 nestlings in March and April 1993. We removed the outer 2/3 of 5-7 breast and upper abdominal feathers from nestlings. Blood samples were drawn from the brachial vein in the right wing with a 2 cc sterilized syringe. We also collected molted feathers from adults at 16 nests.

DIET AND HABITAT UTILIZATION OF NORTHERN GOSHAWKS IN SHRUB-STEPPE HABITATS OF NEVADA

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In 1993, we used tail-mounted, posture-sensitive radios to monitor the habitat use of breeding male northern goshawks (*Accipiter gentilis*) in shrub-steppe habitats in the Independence and Bull Run Mountains of northeastern Nevada. Although male goshawks were sometimes seen foraging in nearby open sage (*Artemisia* spp.) habitats, they were most frequently observed using thick patches (<1 ha) of stunted "snowbank" aspen or streamside willows (*Salix* spp.) for hunting perches. Males caught Belding's ground squirrels (*Spermophilus beldingi*) in open areas by surprise. In 1992 and 1993 we spent over 450 hr observing nests. In 1992, males switched from hunting ground squirrels to birds as nestlings reached fledging age and drought conditions forced ground squirrels to estivate early. A similar switch did not occur in 1993, perhaps because above average winter and spring precipitation delayed estivation and prolonged the availability of ground squirrel prey.

POSTER PRESENTATIONS

BRIDGE USE BY PEREGRINE FALCONS IN THE SAN FRANCISCO BAY AREA

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Peregrine falcons (*Falco peregrinus*) have been resident in the highly urbanized San Francisco Bay Area at least since the mid 1980s. Two pairs of falcons make annual nesting attempts on the Oakland-San Francisco Bay Bridge, while a third pair uses the Golden Gate Bridge as a hunting post. The latter pair has shifted nest locations between near-urban sites and wild coastal sites, while the Bay Bridge pairs invariably use the bridge during the nesting season but tend to move to downtown areas for the winter. Foraging habits and prey species differ between each pair, as do eggshell thinning and hatching success. In most years eggs were removed from bridge nesting pairs, in one instance a pair was triple clutched. Three instances of chicks fledging from the Bay Bridge were noted. Fledging success from bridge sites is poor, and several factors appear to contribute to high mortality of young falcons at fledging. We conclude that bridge nest sites must be enhanced to improve fledging success.

HAWKS ALOFT WORLDWIDE: A COOPERATIVE STRATEGY FOR PROTECTING MIGRATING RAPTORS IN THE AMERICAS

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In the past, raptor conservation efforts like Hawk Mountain's have focused on single sites. Today, many threats facing migrating raptors are international, not local, and broad, geographic strategies are needed to protect these birds. Hawk Mountain is responding to this situation with Hawks Aloft Worldwide, the Sanctuary's cooperative conservation strategy designed to protect raptors throughout their migratory journeys. The new effort builds on the Sanctuary's 57 yr of conservation experience, and formalizes and expands its role as a mentor to many of the world's raptor conservationists. Hawks Aloft Worldwide uses the spectacle of raptor migration to unite local conservationists in their attempts to protect the world's wildlife resources. Specifically, the initiative will: collect scientific data needed for raptor conservation, publish the first global atlas of raptor migration, train individuals at raptor-migration watch sites, and forge a global network of raptor conservationists. Given the ambitious nature of training phases of the project, initial efforts in these areas will focus on Latin America, where raptor-migration watch sites and active Hawks Aloft Worldwide cooperators are currently being sought.

THE PEREGRINE FALCON ON A WESTERN COASTAL LAGOON AT BAJA CALIFORNIA SUR, MEXICO

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The peregrine falcon (*Falco peregrinus*) has been poorly studied in México, and for this reason there is no information on its current conservation status. Historically the largest numbers of peregrines were located in the Gulf of California and the Baja California peninsula; however, recent reports show that the population on the west coast of the peninsula has declined or disappeared. In 1993, we found three active nests in Scammon's Lagoon, a location without historical nesting records. Nesting occurred between March and June, and at least eight fledglings were reared. Based on our data and additional reports of eyries in the region, we believe that the middle portion of the west coast of the Baja peninsula is an important breeding area with a higher number of peregrines than that reported for the whole Baja Pacific coast during the years 1976–77. Consequently, we believe that special efforts need to be done by governmental agencies to study and protect this area.

FALCONIFORMES FROM TUXTEPEC, OAXACA, MEXICO

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Considering avian diversity in México, Oaxaca is one of the richest states in this country with both resident and migratory species. In the area of Tuxtepec, Oax. where a huge dam was recently built (about 3 yr ago), a study has been carried out by people from the Faculty of Science of the National University of México (UNAM), who in 1989–90 reported the presence of 15 different raptor species in the area. The observations done for this study, in November 1991 and June 1992, report the presence of eight species previously unrecorded for this area. Considering the species previously reported and the ones found in this study, the total (23 species) represents 43% of the Falconiformes known for México, and approximately 8% of the species of diurnal birds of prey known for the world. The results in this study show that this area can be of great importance for raptor biologists because of the number of species, both resident and migratory, that occur in the locality. Finally, it is important to mention that a lot of research on the different species is still needed in order to understand their biology, and ensure their permanence in the natural environment.

HOW ACCURATE ARE AERIAL SURVEYS FOR DETERMINING PRODUCTIVITY OF OSPREYS?

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In many parts of North America, reproductive performance of ospreys (*Pandion haliaetus*) is assessed by a mid-May aerial survey of nest occupancy, followed by a mid-July aerial count of medium-sized chicks. This technique is particularly cost effective where ospreys breed at low density, but survey error margins have not been investigated previously. In 1992 and 1993 we compared independent fixed-wing and rotor-winged counts of chicks in two study areas along Canadian shores of Lake Huron, each supporting about 40 occupied nests. We compared chick counts between two reasonably experienced surveyors, and determined actual nest contents in mid- and late-July for some nests. Fixed-wing surveys underestimated total chick numbers by up to 33%. On rotor-winged surveys counts by both observers were closer to actual nest contents, ranging from a 15% underestimate to a 6% overestimate. Marked variation between observers was found on one of six surveys—a fixed-wing flight. Distinguishing recently dead chicks from live chicks (which always lie flat) was difficult from either type of aircraft. Nestling mortality after mid-July surveys was 31% in both years on Georgian Bay, Lake Huron. These results indicate that precise interpretation of osprey productivity data should not be made without considering survey technique, observer error, and post-survey nestling mortality.

DISTRIBUTION OF BIRDS OF PREY IN MEXICO

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In México, the knowledge of the distribution of birds of prey is poor and therefore it is difficult to know the different species that can be found in each region of the country. Our objective was to put data together on the different localities in which these birds have been seen or captured. This information was obtained from ornithological collections and from different museums both Mexican and foreign and also from abstracts and publications done on these birds in México. Forty catalogs have been checked on different collections and museums from which 3308 registers were obtained for the 57 species of diurnal birds of prey in México and 1678 for the 28 species of nocturnal birds of prey. To the information mentioned above, we added the data obtained in 190 publications made on diurnal birds of prey and 75 on nocturnal birds of prey. We also collected information on the common names in Spanish and English for these birds, their habits, description meristics, endangered species status, and migratory species. This research will be a useful guide to anyone with interest in studying these groups. It will also help to identify which species in México have been studied better, which are totally unknown, which have a priority to keep a watch on, and to help identify different zones in the country in which species are more abundant and

which zones have a poor content and information of the different species.

RAPTOR-HUMAN IMPACTS IN ZIMBABWE

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With 60 species of diurnal and 12 nocturnal raptors, it is important to prioritize conservation measures, including removal of species from the protected list. Changing agriculture and artificial nest sites have assisted accipiters, lanner falcon (*Falco biarmicus*), black-shouldered kite (*Elanus caeruleus*) and barn owl (*Tyto alba*). However, habitat destruction, chemical pesticides and direct persecution are principal threats. Human population growth rate is $>3.0\%$ and peasant farming areas (40%) are generally overpopulated. Commercial farmlands (30%) offer some suitable habitats, especially extensive ranches; intensive farming areas have been sprayed with agrochemicals, cultivation has increased and bateleur eagles (*Terathopius ecaudatus*) have been eliminated. DDT spraying ceased in 1990, but poisoning of vultures and deforestation continue. Only the martial eagle (*Polemaetus bellicosus*) is under serious threat.

ECOLOGY OF THE NORTHERN SAW-WHET OWL (*AEGOLIUS ACADICUS*) IN THE SOUTHERN APPALACHIAN MOUNTAINS

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The breeding range of the northern saw-whet owl (*Aegolius acadicus*) extends south to the mountains of Virginia, Tennessee, and North Carolina. What little regional information exists suggests that the saw-whet owl is restricted to the fragmented, high elevation spruce/fir forests, which are declining due to introduced pests and acid deposition. This in part has led North Carolina to designate this owl as a "species of special concern." Radiotelemetry was employed on seven adult male owls to locate roost sites, pellets and to document nocturnal activity. Preliminary data indicate 72% of diurnal roosts are in conifers, with an average roost height of 4.6 m. Nocturnal activity was not confined to any specific forest type, yet hardwood forests were utilized more than previously thought. Pellet analysis shows that small mammals are the primary prey items; however, food caches at roosts indicate the importance of small passerines in saw-whet diets. Our data are too preliminary to offer concrete suggestions on the conservation and management of the saw-whet owl in this region; however, it is hoped that additional field seasons will reduce our ignorance on the ecology of the smallest owl in the southeast.

SEXING OF RED-TAILED HAWKS BY HALLUX TOE DEPTH

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If it is possible to sex red-tailed hawks (*Buteo jamaicensis*) by measurement rather than surgically, it would allow banders and raptor researchers to correctly sex red-tails in the field. I decided to measure the depth of the hallux. I extended the toe straight out, and measured the depth of the toe from the second scale from the end and then measured straight above it. I was careful not to squeeze the tissue. I used birds that had recently died. I verified their sex during necropsies. I collected data from 41 males and 30 females. Birds with a hallux measurement of 13.50 mm and below were males and birds 14.75 mm and above were females. Means of this measurement were significantly different between the sexes (*t*-test, $P = 0.001$). The birds between 13.50 and 14.75 mm could not be classified to sex by hallux depth, although 23 out of 28 necropsied birds in this range were males.

RAPTOR FEATHER FAUNA

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Feathers from 43 owls and 39 hawks, eagles and falcons were examined for arthropods. Insects found were lice and several mammal fleas from prey. Lice eggs were attached to feather vanes. A few skin and nidicolous mites were present, but most of the mites were feather and quill mites. Feather mites occur primarily ventrally near the rachis in the sheltered slots between the pennaceous barbs. Juvenile mites molt in the plumulaceous barbs, leaving masses of exuviae. Eggs are laid in grooves on the ventral rachis and on the posterior sides of pennaceous barbs. Quill mites complete their life cycle in the quill, filling it up with eggs, exuviae and excreta. To leave the quill and colonize other feathers, they use the superior umbilicus, or cut a round hole in the quill wall. Understanding the ecology of such feather fauna and the niches they occupy in the feather habitat will facilitate the diagnosis and treatment of ectoparasite infestations in raptors.

MONTAGU'S HARRIERS NESTING ON CORNFIELDS: VULNERABILITY AND POSSIBILITIES OF PRESERVATION

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Most of Montagu's harriers (*Circus pygargus*) in Belarus usually nest on cornfields. Late terms of nesting are the reason of losses of young caused by harvesting corn combines. We studied causes of nestling mortality and tried to help nestlings to escape abovementioned losses. Study began in neighborhoods of Grodno in June–August 1993.

We described 15 nests. There were 80% of nests on winter rye fields, 13.3% on rape/winter rye fields and 6.7% in high grass between fields. Clutch sizes were from 1–5 eggs ($\bar{x} = 3.42$). Clutches were initiated equally through one month from 14 May. Forty-four percent of nestlings could not fly at the beginning of harvesting and were killed. All

young from threatened nests were saved. Seven nests in fields had broods ranging from 2–3 ($\bar{x} = 2.57$). So even late harvesting (as in this year) is a locally serious regulator of productivity for Montagu's harriers. Other causes of nestling mortality and methods of preservation are discussed.