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Laurel, Maryland 20708-4039 USA
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Publications of the

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February 1999 — January 2000

Altig, R. and R. W. McDiarmid. 1999. Diversity: Familial and generic characterizations. Pages 295-337 *in* Roy W. McDiarmid and Ronald Altig, editors. Tadpoles: the Biology of Anuran Larvae. University of Chicago Press, Chicago, IL. xiv, 444 pp.

Altig, R. and R. W. McDiarmid. 1999. Body plan: Development and morphology. Pages 24-51 *in* Roy W. McDiarmid and Ronald Altig, editors. Tadpoles: the Biology of Anuran Larvae. University of Chicago Press, Chicago, IL. xiv, 444 pp.

Bart, J., C. Kepler, P. Sykes, and C. Bocetti. 1999. Evaluation of mist-net sampling as an index to productivity in Kirtland's Warblers. Auk 116(4):1147-1151.

Beardmore, C. J. and J. S. Hatfield. 1999. Population and Habitat Viability Assessments for Golden-cheeked Warblers and Black-capped Vireos: Usefulness to Partners in Flight Conservation Planning. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/beardmore.htm.

Golden-cheeked Warblers and Black-capped Vireos are Neotropical migratory birds that are federally listed as endangered. Recovery plans for both species advise the use of viability modeling as a tool for setting specific recovery and management targets. Population and Habitat Viability Assessment workshops were conducted to develop population targets and conservation recommendations for these species. Results of the workshops were based on modeling demographic and environmental factors, as well as discussions of management issues, management options, and public outreach strategies. The approach is intended to be iterative, and to be tracked by research and monitoring efforts. This paper discusses the consensus-building workshop process and how the approach could be useful to Partners in Flight.

Population and Habitat Viability Assessments (PHVA) were used to develop population targets and conservation recommendations for Golden-cheeked Warblers (Dendroica chrysoparia) and Black-capped Vireos (Vireo atricapillus). This paper explains what PHVAs are, discusses how they are conducted, describes the general results that are produced, and suggests how Partners in Flight (PIF) might use a similar process for bird conservation planning. Detailed results of the assessments are not discussed here; however they can be found elsewhere (U. S. Fish and Wildlife Service 1996a, U. S. Fish and Wildlife Service 1996b).

PHVAs were considered for Golden-cheeked Warblers and Black-capped Vireos because they are controversial, endangered species, and the species' recovery plans list PHVAs as tools to develop recovery recommendations. he U. S. Fish and Wildlife Service (USFWS) realized that the data needed to perform PHVAs for these species is limited, but that various conservation efforts, such as the Balcones Canyonlands Conservation Plan and other endeavors, were proceeding without benefit of the biological summarization and guidance that a PHVA could provide.

Bennetts, R. E., V. J. Dreitz, W. M. Kitchens, J. E. Hines, and J. D. Nichols. 1999. Annual survival of Snail Kites in Florida: Radio telemetry versus capture-resighting data. Auk 116(2):435-447.

We estimated annual survival of Snail Kites *(Rostrhamus sociabilis)* in Florida using the Kaplan-Meier estimator with data from 271 radio-tagged birds over a three-year period and capture-recapture (resighting) models with data from 1,319 banded birds over a six-year period. We tested the hypothesis that survival differed among three age classes using both data sources. We tested additional hypotheses about spatial and temporal variation using a combination of data from radio telemetry and single- and multistrata capture-recapture models. Results from these data sets were similar in their indications of the sources of variation in survival, but they differed in some parameter estimates. Both data sources indicated that survival was higher for adults than for juveniles, but they did not support delineation of a subadult age class. Our data also indicated that survival differed among years and regions for juveniles but not for adults. Estimates of juvenile survival using radio

telemetry data were higher than estimates using capture-recapture models for two of three years (1992 and 1993). Ancillary evidence based on censored birds indicated that some mortality of radio-tagged juveniles went undetected during those years, resulting in biased estimates. Thus, we have greater confidence in our estimates of juvenile survival using capture-recapture models. Precision of estimates reflected the number of parameters estimated and was surprisingly similar between radio telemetry and single-stratum capture-recapture models, given the substantial differences in sample sizes. Not having to estimate resighting probability likely offsets, to some degree, the smaller sample sizes from our radio telemetry data. Precision of capture-recapture models was lower using multistrata models where region-specific parameters were estimated than using single-stratum models, where spatial variation in parameters was not taken into account.

Bennetts, R. E., W. A. Link, J. R. Sauer, and P. W. Sykes, Jr. 1999. Factors influencing counts in an annual survey of Snail Kites in Florida. Auk 116(2):316-323.

Snail Kites *(Rostrhamus sociabilis)* in Florida were monitored between 1969 and 1994 using a quasi-systematic annual survey. We analyzed data from the annual Snail Kite survey using a generalized linear model where counts were regarded as overdispersed Poisson random variables. This approach allowed us to investigate covariates that might have obscured temporal patterns of population change or induced spurious patterns in count data by influencing detection rates. We selected a model that distinguished effects related to these covariates from other temporal effects, allowing us to identify patterns of population change in count data. Snail Kite counts were influenced by observer differences, site effects, effort, and water levels. Because there was no temporal overlap of the primary observers who collected count data, patterns of change could be estimated within time intervals covered by an observer, but not for the intervals among observers. Modeled population change was quite different from the change in counts, suggesting that analyses based on unadjusted counts do not accurately model Snail Kite population change. Results from this analysis were consistent with previous reports of an association between water levels and counts, although further work is needed to determine whether water levels affect actual population size as well as detection rates of Snail Kites. Although the effects of variation in detection rates can sometimes be mitigated by including controls for factors related to detection rates, it is often difficult to distinguish factors wholly related to detection rates from factors related to population size. For factors related to both, count survey data cannot be adequately analyzed without explicit estimation of detection rates, using procedures such as capture-recapture.

Beyer, W. N., J. Spann, and D. Day. 1999. Metal and sediment ingestion by dabbling ducks. Science of the Total Environment 231:235-239.

The chemical analysis of intestinal digesta from hunter-killed carcasses or of wildlife scat is a promising means of estimating the exposure of wildlife to those environmental contaminants that, like lead, are poorly absorbed in the digestive tract. When evaluating contaminants at a site, biologists may find the results of this non-destructive approach more straightforward to interpret in terms of exposure to wildlife than would be analyses of soils, sediments, water, or wildlife tissues. To illustrate the approach, we collected digesta from 47 waterfowl shot by hunters at Prime Hook National Wildlife Refuge, in Delaware, USA. The waterfowl digesta contained an average of approximately 2.4% sediment, estimated from the Al concentrations in the digesta, a marker for sediment. Al concentrations were significantly correlated with concentrations of Cr (Spearman's rank correlation coefficient, r=0.57), V (r=0.70), Ni (r=0.31), and Pb (r=0.55), and we concluded that these metals were ingested mainly with sediment. American widgeon *(Anas americana)* ingested sediment at a rate of about four times that of three other species of dabbling ducks *(Anas crecca, A. acuta, A. rubripes)* and had several times the exposure to the sediment-associated metals. The digesta of one American black duck contained a high concentration of lead (70 mg/kg, dry wt.), presumably from lead shot, but none of the other samples had notably elevated metal concentrations. We suggest that scat and digesta be analyzed more widely by biologists and resource managers seeking a simple, inexpensive assessment of contaminants in local wildlife habitat.

Blus, L. J., C. J. Henny, D. J. Hoffman, L. Sileo, and D. J. Audet. 1999. Persistence of high lead concentrations and associated effects in Tundra Swans captured near a mining and smelting complex in northern Idaho. Ecotoxicology 8(2):125-132.

Lead poisoning of waterfowl, particularly tundra swans *(Cygnus columbianus),* has been documented in the Coeur d'Alene River Basin in northern Idaho for nearly a century. Over 90% of the lead-poisoned tundra swans

in this area that were necropsied have no ingested lead shot. Spent lead shot from hunting activities over the years is therefore a minor source of lead in these swans. The migrating swans accumulated lethal burdens of lead from ingestion of sediments and aquatic vegetation during a short stopover in the spring. The lead originated from mining and smelting activities. Lead concentrations and physiological characteristics of blood were compared in swans captured in swim-in traps, with moribund swans caught by hand in the lead-contaminated area in 1987 and 1994-1995 and with birds captured by night-lighting in reference areas in 1994-1995. Blood lead concentrations in swans were highest in moribund birds (3.3 µg g^{-1} in 1987 and 1995), intermediate in those trapped in the contaminated area (0.82 µg g^{-1} in 1987 and 1.8 µg g^{-1} in 1995), and lowest (0.11 µg g^{-1}) in those trapped in the reference areas. δaminolevulinic acid dehydratase (ALAD) was significantly inhibited in swans from the contaminated area. Hematocrit and hemoglobin were significantly depressed only in moribund swans. Of the 19 swans found moribund and euthanized, 18 were classified as having lead toxicosis on the basis of lead levels in blood (1.3 to 9.6 µg g^{-1}) and livers (6 to 40 µg g^{-1}) and necropsy findings. The 19th swan had aspergillosis. There was no evidence that effects of lead on tundra swans had diminished from 1987 to 1995.

Carleton, M. D., R. D. Fisher, and A. L. Gardner. 1999. Identification and distribution of cotton rats, genus *Sigmodon* (Muridae: Sigmodontinae), of Nayarit, Mexico. Proceedings of the Biological Society of Washington 112(4):813-856.

Cole, K. L., M. B. Davis, F. Stearns, G. Guntenspergen, and K. Walker. 1998. Historical land cover changes in the Great Lakes Region. Pages 45-50 *in* Thomas D. Sisk, editor. Perspectives on the land use history of North America: A context for understanding our changing environment. Biological Science Report USGS/BRD/BSR-1998-0003. vi, 104 pp.

Two different methods of reconstructing historical vegetation change, drawing on General Land Office (GLO) surveys and fossil pollen deposits, are demonstrated by using data from the Great Lakes region. Both types of data are incorporated into landscape-scale analyses and presented through geographic information systems. Results from the two methods reinforce each other and allow reconstructions of past landscapes at different time scales. Changes to forests of the Great Lakes region during the last 150 years were far greater than the changes recorded over the preceding 1,000 years. Over the last 150 years, the total amount of forested land in the Great Lakes region declined by over 40%, and much of the remaining forest was converted to early successional forest types as a result of extensive logging. These results demonstrate the utility of using GLO survey data in conjunction with other data sources to reconstruct a generalized "presettlement" condition and assess changes in landcover.

Conroy, M. J., J. C. Senar, J. E. Hines, and J. Domenech. 1999. Development and application of a mark-recapture model incorporating predicted sex and transitory behaviour. Large-scale Studies of Marked Birds, proceedings of EURING 97 Conference, April 7-12, University of East Anglia, Norwich, UK, edited by S. R. Baillie and P. M. North. Bird Study 46(suppl.):S62-73.

We developed an extension of Cormack-Jolly-Seber models to handle a complex mark-recapture problem in which (a) the sex of birds cannot be determined prior to first moult, but can be predicted on the basis of body measurements, and (b) a significant portion of captured birds appear to be transients (i.e. are captured once but leave the area or otherwise become ' untrappable'). We applied this methodology to a data set of 4184 serins (*Serinus serinus*) trapped in northeastern Spain during 1985-96, in order to investigate age-, sex-, and time-specific variation in survival rates. Using this approach, we were able to successfully incorporate the majority of ringings of serins. Had we eliminated birds not previously captured (as has been advocated to avoid the problem of transience) we would have reduced our sample sizes by >2000 releases. In addition, we were able to include 1610 releases of birds of unknown (but predicted) sex; these data contributed to the precision of our estimates and the power of statistical tests. We discuss problems with data structure, encoding of the algorithms to compute parameter estimates, model selection, identifiability of parameters, and goodness-of-fit, and make recommendations for the design and analysis of future studies facing similar problems.

Cooch, E. G. and W. A. Link. 1999. Estimating transition probabilities in unmarked populations --entropy revisited. Large-scale Studies of Marked Birds, proceedings of EURING 97 Conference, April 7-12, University of East Anglia, Norwich, UK, edited by S. R. Baillie and P. M. North. Bird Study 46(suppl.):S55-61.

The probability of surviving and moving between 'states' is of great interest to biologists. Robust estimation of these transitions using multiple observations of individually identifiable marked individuals has received considerable attention in recent years. However, in some situations, individuals are not identifiable (or have a very low recapture rate), although all individuals in a sample can be assigned to a particular state (e.g. breeding or non-breeding) without error. In such cases, only aggregate data (number of individuals in a given state at each occasion) are available. If the underlying matrix of transition probabilities does not vary through time and aggregate data are available for several time periods, then it is possible to estimate these parameters using least-squares methods. Even when such data are available, this assumption of stationarity will usually be deemed overly restrictive and, frequently, data will only be available for two time periods. In these cases, the problem reduces to estimating the most likely matrix (or matrices) leading to the observed frequency distribution of individuals in each state. An entropy maximization approach has been previously suggested. In this paper, we show that the entropy approach rests on a particular limiting assumption, and does not provide estimates of latent population parameters (the transition probabilities), but rather predictions of realized rates.

Cooper, R. J., R. R. Wilson, G. D. Zenitsky, S. J. Mullin, J. D. Dececco, M. R. Marshall, D. J. Wolf, and L. Y. Pomara. 1999. Does nonrandom nest placement imply nonrandom nest predation? - A reply. Condor 101(4):920-923.

In response to the critique by Schmidt and Whelan (Condor 101(4):916-920, 1999), we find that the relationship between nest success and tree selectivity is dependent upon inclusion or exclusion of particular tree species, whether or not years are pooled, and the selectivity index used. We question their use of point estimates of nest success with extremely high variances, defend our index, question the application of the Chesson (1983) index to our data, and explain the need to analyze years separately. Bottomland hardwood forest systems are extremely variable; hydroperiods alter the suitability of nesting substrates, availability of alternative food, and behavior of predators and their prey. Given these features, actively searching for Acadian Flycatcher *(Empidonax virescens)* nests is seldom an efficient predator foraging strategy. Therefore, these predation events are best described as random; nests are principally encountered opportunistically by generalist predators while searching for other prey.

Custer, T. W., C. M. Custer, R. K. Hines, S. Gutreuter, K. L. Stromborg, P. D. Allen, and M. J. Melancon. 1999. Organochlorine contaminants and reproductive success of Double-crested Cormorants from Green Bay, Wisconsin, USA. Environmental Toxicology and Chemistry 18(6):1209-1217.

In 1994 and 1995, nesting success of double-crested cormorants *(Phalacrocorax auritus)* was measured at Cat Island, in southern Green Bay, Lake Michigan, Wisconsin, USA. Sample eggs at pipping and unhatched eggs were collected and analyzed for organochlorines (including total polychlorinated biphenyls [PCBs] and DDE), hepatic microsomal ethoxyresorufin-*O*-dealkylase (EROD) activity in embryos, and eggshell thickness. Of 1,570 eggs laid, 32% did not hatch and 0.4% had deformed embryos. Of 632 chicks monitored from hatching to 12 d of age, 9% were missing or found dead; no deformities were observed. The PCB concentrations in sample eggs from clutches with deformed embryos (mean = 10.2 µg/g wet weight) and dead embryos (11.4 µg/g) were not significantly higher than concentrations in sample eggs from nests where all eggs hatched (12.1 µg/g). A logistic regression of hatching success versus DDE, dieldrin, and PCB concentrations in sibling eggs identified DDE and not dieldrin or PCBs as a significant risk factor. A logistic regression of hatching success versus DDE and eggshell thickness implicated DDE and not eggshell thickness as a significant risk factor. Even though the insecticide DDT was banned in the early 1970s, we suggest that DDE concentrations in double-crested cormorant eggs in Green Bay are still having an effect on reproduction in this species.

Dove, C. J. and R. C. Banks. 1999. A taxonomic study of crested caracaras (Falconidae). Wilson Bulletin 111(3):330-339.

The taxonomic status of the crested caracaras *(Caracara* spp., Falconidae) has been unsettled for many years. Current sources such as the AOU Check-list recognize a single species that includes three taxa formerly considered distinct, citing observations by Hellmayr and Conover (1949) on two specimens considered to be intermediate. We studied plumage characters and measurements of over 392 museum specimens and found no evidence of clinal change between the northern and southern continental populations. Sixteen specimens from localities near the Amazon River where these two populations sporadically meet exhibit a mosaic of plumage elements from both forms. Measurements of wing chord, bill length, and bill depth indicate that size is positively correlated with latitude north and south of the equator and that females are larger than males in

the northern population. These populations do not meet in western South America. We conclude that three biological species can be identified in the crested caracaras: the insular Guadalupe Caracara *(Caracara lutosus);* and two continental species, Northern (C. *cheriway)* and Southern caracara *(C. plancus),* neither of which shows subspecific variation.

Drewien, R. C. and W. L. Kendall. 1999. Analysis of survival, local and seasonal movements of the Rocky Mountain population of Sandhill Cranes. Page 47 *in* David D. Dolton, compiler. Webless migratory game bird research program: Project abstracts - 1998. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Denver, CO. 49 pp.

Eisler, R. 1999. Cumulative index to chemicals and to common and scientific names of species listed in Contaminant Hazard Reviews 1 through 34. Biological Science Report USGS/BRD/BSR--1999-0002, Contaminant Hazard Reviews Report 35, U.S. Department of the Interior, Geological Survey. iii, 67 pp.

The Patuxent Wildlife Research Center Contaminant Hazard Reviews (CHR) series synthesizes ecotoxicological data of selected environmental contaminants, with emphasis on hazards to native species of flora and fauna. From 1985 through 1998 a total of 34 reviews were published in various Reports series of the U.S. Department of the Interior on agricultural pesticides (carbofuran, chlordane, chlorpyrifos, diazinon, diflubenzuron, fenvalerate, mirex, paraquat, toxaphene), herbicides (acrolein, atrazine), metals and metalloids (arsenic, boron, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, tin, zinc), predacides (sodium monofluoroacetate), organic industrial wastes (dioxins, pentachlorophenol), veterinary chemicals (famphur), polycyclic aromatic hydrocarbons, polychlorinated biphenyls, mining wastes (cyanide), and ionizing radiations. This report is a cumulative index to the common and scientific names of all biological species listed in the first 34 reports in the CHR series, with individual species cross-referenced by contaminant and corresponding page numbers. A similar index is shown for chemicals.

Ellis, D. H., K. R. Clegg, J. C. Lewis, and E. Spaulding. 1999. Golden Eagle predation on experimental Whooping Cranes and Sandhill Cranes. Condor 101:664-666.

There are very few published records of Golden Eagles preying upon cranes, especially in North America. During our experiments to lead cranes on migration behind motorized craft in the western United States, we experienced 15 attacks (four fatal) and believe many more attacks would have occurred (and more would have been fatal) without human intervention. We recognize eagle predation as an important risk to cranes especially during migration.

Ellis, D. H. and J. W. Lish. 1999. Trash-caused mortality in Mongolian raptors. Ambio 28(6):536-537.

On four expeditions (1994, 1995, 1997, and 1998) through Mongolia, we found two kinds of mortality associated with trash gathered by parent raptors as part of the nest building process. Our observations of actual mortality were limited to three species: the golden eagle *(Aquila chrysaetos)* (2 clutches of eggs), the saker falcon *(Falco cherrug)* (4 nestlings), and the upland buzzard *(Buteo hemilasius)* (1 nestling); all from the eastern half of Mongolia.

Ellis, D. H., P. L. Whitlock, P. Tsengeg, and R. W. Nelson. 1999. Siblicide, splayed-toes-flight display, and grappling in the Saker Falcon. Journal of Raptor Research 33(2):164-167.

We observed two incidents of novel social behavior in the saker falcon (*Falco cherrug*) in Mongolia. First, we provide an account of a two-week-old saker falcon chick killing its nest mate, the first direct observation of siblicide in the genus *Falco*. We also report aerial combat between three adult saker falcons including observations of talon grappling, whirling, and Splayed-toes-flight, a previously undescribed social display.

Erwin, R. M. 1999. [Book review] *Wetland birds: Habitat resources and conservation implications*, by Milton W. Weller. Waterbirds 22(2):320-321.

Milton Weller's love of wetlands and their inhabitants comes through in this book, and he continues a leadership role in a world of field ecologists where fewer and fewer are really experiencing the wet and wild.

Erwin, R. M. 1999. [Book review] *Habitats for birds in Europe: a conservation strategy for the wider environment*, compiled by Graham M. Tucker and Michael I. Evans. Birdlife International, Cambridge, U.K., 1997. Wilson Bulletin 111(3):454-456.

Erwin, R. M., T. B. Eyler, J. S. Hatfield, and S. McGary. 1998. Diets of nestling gull-billed terns in coastal Virginia. Colonial Waterbirds 21(3):323-327.

We studied the diets of nestling Gull-billed Terns (*Sterna nilotica*) at colonies in coastal Virginia during the breeding seasons of 1995 and 1996 as part of a long-term study of the species. No previous quantitative assessments had been made of diets of this species anywhere along the Atlantic Coast, and only a few observations had been reported from other coastal areas in the southern United States. During 80 h of observations over the two seasons, 757 feeding observations were made, primarily at two colony sites. We examined how prey type (fish, marine invertebrates, terrestrial prey) and size were influenced by year, tide cycle, season (early and late) and age of the young (small chicks < 7 d old versus large chicks > 7 d). We did not find significant year differences, but all other factors revealed statistically significant results. Older (>7 d) chicks were fed relatively more terrestrial and marine invertebrate prey than were younger chicks. In June (early season), fewer fish and terrestrial prey were fed to chicks than later (July-August). Most prey were less than one bill length in size, with the majority of the smallest prey being marine invertebrates. Tide cycle influenced prey delivered with terrestrial prey becoming relatively more important during high and ebb periods than during low and flood tides when aquatic prey dominated. The major marine invertebrate prey taken was the fiddler crab (*Uca* spp.). Terrestrial prey consisted mostly of large odonates and orthopterans. Unlike earlier reports from Europe, we found no regurgitated food pellets in any of the colonies in either year. This study confirms that the Gull-billed Tern is an extremely opportunistic feeder and has adapted to a variety of habitats, helping to explain its cosmopolitan distribution.

Erwin, R. M., T. B. Eyler, D. B. Stotts, and J. S. Hatfield. 1999. Aspects of chick growth in Gull-billed Terns in coastal Virginia. Waterbirds 22(1):47-53.

Because of concerns about apparent population declines and low productivity of Gull-billed Terns *(Sterna nilotica)* along the coast of Virginia, we investigated whether food limitations may result in retarded growth rates of young. Several colonies of Gull-billed Terns were monitored from May to July each year from 1994 to 1996 on both sandy barrier islands and marsh/shellpile islands in coastal Virginia. Nests were visited one to three times a week to monitor clutch size and hatching success, and enclosures were installed around selected nests to monitor chick growth from hatching to at least two weeks of age. When comparing chick growth, we found significant year, habitat and hatch order effects. Chicks from marsh shellpiles had higher mass and culmen growth rates than did those from barrier islands, and first-hatched (A) chicks had significantly higher culmen growth rates than did second-hatched (B) chicks. Year effects were only found for mass growth rates. Growth rates of Gull- billed Terns in these Virginia colonies seem to be low relative to those of six other North American tern species from other geographic areas. These findings suggest that growth rates of young Gull-billed Terns, as well as other reproductive parameters, need to be examined in detail in other coastal areas such as Texas, where the species is more abundant, to determine whether our growth results are species- or region-specific.

Erwin, R. M., M. K. Laubhan, J. E. Cornely, and D. M. Bradshaw. 1999. Managing wetlands for waterbirds: How managers can make a difference in improving habitat to support a North American Bird Conservation Plan. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/intro_PHA_A.htm.

Wetlands are the most productive ecosystems in the world, yet they have suffered more loss and degradation than any other ecosystem. Not surprisingly, 50% (29 of 58) of all the bird species in the U. S. (excluding Hawaii and territories) that are listed either as federally threatened or endangered, or are on the U. S. Fish & Wildlife Service 1995 List of Migratory Nongame Birds of Management Concern, occupy wetland or aquatic habitats even though many remaining wetlands across the North American landscape already are managed primarily for waterbirds. Some of these wetlands are administered by federal and state entities (e.g., national wildlife refuges, national and state parks, state wetland management areas) or are maintained on private lands

through federally supported restoration and enhancement programs (e.g., Conservation Reserve Program, Wetland Reserve Program, Waterfowl Production Areas, and Partners for Wildlife). Private organizations, such as the National Audubon Society, The Nature Conservancy, and private hunting clubs, also own wetland areas that are managed specifically to benefit wildlife. If management philosophies are altered to consider the entire complex of wetlands, many wetlands can provide benefits to a broad array of waterbirds, as opposed to just one or a few species. However, challenges for natural resource managers are in forming partnerships with owners-managers of wetlands where the objectives are not primarily wildlife oriented. These owners or managers need to be included in wetland training workshops in an attempt to educate them about wetland values and secondary wildlife benefits that may be derived in flooded agricultural lands, aquaculture ponds, altered coastal marshes (mosquito control), and salt evaporation ponds. In some cases, compensation for crop damages by wildlife may be a necessary part of any cooperative agreements. In the development of a North American Bird Conservation Plan we propose a four-step approach and recommend that emphasis be placed on working with Joint Ventures of the North American Waterfowl Management Plan to ensure that a diverse array of waterbird species will benefit. Efforts also should be devoted to developing similar partnerships in areas where important wetland resources exist but no Joint Ventures are planned.

Eyler, T. B., R. M. Erwin, D. B. Stotts, and J. S. Hatfield. 1999. Aspects of hatching success and chick survival in Gull-billed Terns in coastal Virginia. Waterbirds 22(1):54-59.

Because of a long-term population decline in Gull-billed Terns (*Sterna nilotica*) nesting along the coast of Virginia, we began a three year study in 1994 to monitor hatching success and survival of Gull-billed Tern chicks at several Virginia colony sites. Colonies were located on either small, storm-deposited shellpiles along marsh fringes or large, sandshell overwash fans of barrier islands. Nests were monitored one to three times a week for hatching success, and enclosures were installed around selected nests to monitor chick survival from hatching to about two weeks of age. Hatching success was lower in marsh colonies than island colonies, and was lower in 1995 than in 1994 and 1996, primarily because of flooding. The average brood size of nests where at least one chick hatched was 1.99 chicks. Survival rates of chicks to 14 days depended on hatch order and year but not brood size (one vs. two or more) or time of season. A-chicks had higher survival rates than B-chicks and third-hatched C-chicks (0.661 compared to 0.442 and 0.357, respectively). The year effect was significant only for A-chicks, with lower survival in 1994 (0.50) than in 1995 (0.765) or 1996 (0.758). Overall, productivity was low (0.53 chick per nest) compared to estimates for colonies in Denmark, and was attributable to nest flooding by spring and storm-driven high tides and chick predation, presumably mostly by Great Horned Owls (*Bubo virginianus*).

Fabrizio, M. C., J. D. Nichols, J. E. Hines, B. L. Swanson, and S. T. Schram. 1999. Modeling data from double-tagging experiments to estimate heterogeneous rates of tag-shedding in lake trout *(Salvelinus namaycush)*. Canadian Journal of Fisheries and Aquatic Science 56:1409-1419.

Data from mark-recapture studies are used to estimate population rates such as exploitation, survival, and growth. Many of these applications assume negligible tag loss, so tag shedding can be a significant problem. Various tag shedding models have been developed for use with data from double-tagging experiments, including models to estimate constant instantaneous rates, time-dependent rates, and type I and II shedding rates. I n this study, we used conditional (on recaptures) multinomial models implemented using the program SURVIV (G.C. White. 1983. J. Wildl. Manage. 47: 716-728) to estimate tag shedding rates of lake trout *(Salvelinus namaycush)* and explore various potential sources of variation in these rates. We applied the models to data from several long-term double-tagging experiments with Lake Superior lake trout and estimated shedding rates for anchor tags in hatchery-reared and wild fish and for various tag types applied in these experiments. Estimates of annual tag retention rates for lake trout were fairly high (80-90%), but we found evidence (among wild fish only) that retention rates may be significantly lower in the first year due to type I losses. Annual retention rates for some tag types varied between male and female fish, but there was no consistent pattern across years. Our estimates of annual tag retention rates will be used in future studies of survival rates for these fish.

Farrell, T., A. Kendra, J. Roggenbuck, T. Hall, and J. Marion. 1999. Offroad vehicle riders in Big Cypress National Preserve: Results from a survey of permit holders. Research/Resources Management Report. U.S. Department of the Interior, National Park Service, Big Cypress National Preserve, Ochopee, FL. 48 pp.

A survey of 800 offroad vehicle (ORV) owners at Big Cypress National Preserve, Florida, was conducted to obtain information on visitor characteristics and management preferences. This report characterizes survey results for riders of all-terrain vehicles, swamp buggies, standard 4-wheeled street vehicles, and airboats. Riders tended to feel satisfied with their ORV experiences and Preserve conditions. Riders were strongly opposed to management approaches that would restrict use or require certain behaviors. More favored were management actions to encourage low impact use practices

Freeman, M. C., Z. H. Bowen, and K. D. Bovee. 1999. Transferability of habitat suitability criteria: Response to comment. North American Journal of Fisheries Management 19:626-628.

Response to comment by Williams, et al., 1999. North American Journal of Fisheries Management 19:623-625.

Gardner, A. L. 1999. Case 3018. *Cervus gouazoubira* Fischer, 1814 (currently *Mazama gouazoubira*; Mammalia, Artiodactyla): proposed conservation as the correct original spelling. Bulletin of Zoological Nomenclature 56(4):1-4.

Gardner, A. L. and P. Cortes-Calva. 1999. Didelphidae. Pages 29-38 *in* S. T. Alvarez-Castaneda and J. L. Patton, editors. Mamiferos del noroeste de Mexico. Centro de Investigaciones Biologicas del Noroeste. La Paz, Baja California Sur, Mexico. 583 pp.

Gardner, A. L. and C. B. Robbins. 1999. Case 3058. *Arctocephalus* F. Cuvier, 1826 and *Callorhinus* Gray, 1859 (Mammalia, Pinnipedia): proposed conservation by the designation of *Phoca pusilla* Schreber, [1775] as the type species of *Arctocephalus;* and *Otaria* Peron, 1816 and *Eumetopias* Gill, 1866: proposed conservation by the designation of *Phoca leonina* Molina, 1782 as the type species of *Otaria*. Bulletin of Zoological Nomenclature 56(2):136-141.

The purpose of this application is to conserve the accustomed understanding and usage of the fur seal name *Arctocephalus* F. Cuvier, 1826 by the designation of *Phoca pusilia* Schreber, [1775] as the type species, thus conserving also the name *Callorhinus* Gray, 1859. At present *Phoca ursina* Linnaeus, 1758 is the valid type species of both *Arctocephalus* and *Callorhinus.* The name *Arctocephalus* relates to a genus of some seven fur seals from the southern hemisphere, while *Callorhinus* is used for the single species *C. ursinus* (Linnaeus) from the northern hemisphere. It is also proposed that the universal understanding of the names *Otaria* Peron, 1816 and *Eumetopias* Gill, 1866 should be conserved for the southern and northern sea lions respectively by designating *Phoca leonina* Molina, 1782 (for which the valid specific name is *P. byronia* de Blainville, 1820) as the type species of *Otaria.* At present *Phoca jubata* Schreber, [1776] is the type species of *Otaria* and the name *Otaria* is a senior subjective synonym of *Eumetopias.* The four genera *Arctocephalus, Callorhinus, Otaria* and *Eumetopias* are all placed in the family OTARIIDAE Gray, 1825.

Gentile, J. H., K. R. Solomon, J. B. Butcher, M. Harrass, W. G. Landis, M. Power, B. A. Rattner, W. J. Warren-Hicks, and R. Wenger. 1999. Linking stressors and ecological responses. Pages 27-50 *in* Jeffery A. Foren and Susan A. Ferenc, editors. Multiple stressors in ecological risk and impact assessment : proceedings from the Pellston Workshop on Multiple Stressors in Ecological Risk and Impact Assessment, 13-18 September 1997, Pellston, Michigan . SETAC special publications series. Society of Environmental Toxicology and Chemistry, Pensacola, Fla. xv, 100 pp.

To characterize risk, it is necessary to quantify the linkages and interactions between chemical, physical and biological stressors and endpoints in the conceptual framework for ecological risk assessment (ERA). This can present challenges in a multiple stressor analysis, and it will not always be possible to develop a quantitative stressor-response profile. This review commences with a conceptual representation of the problem of developing a linkage analysis for multiple stressors and responses. The remainder of the review surveys a variety of mathematical and statistical methods (e.g., ranking methods, matrix models, multivariate dose-response for mixtures, indices, visualization, simulation modeling and decision-oriented methods) for accomplishing the linkage analysis for multiple stressors. Describing the relationships between multiple stressors and ecological effects are critical components of "effects assessment" in the ecological risk assessment framework.

Ginsberg, H. S. and E. Zhioua. 1999. Influence of deer abundance on the abundance of questing adult *Ixodes scapularis* (Acari: Ixodidae). Journal of Medical Entomology 36(3):376-381.

Nymphal and adult *Ixodes scapularis* Say were sampled by flagging at 2 sites on a barrier island, Fire Island, NY, and at 2 sites on the nearby mainland. Nymphal densities did not differ consistently between island and mainland sites, but adult densities were consistently lower on the island. We tested whether lower adult densities on the island resulted from greater nymphal mortality on the island than the mainland, or whether adult ticks on the island were poorly sampled by flagging because they had attached abundantly to deer, which were common on Fire Island. Differential nymphal mortality on islands vs. mainland did not explain this difference in adult densities because survival of flat and engorged nymphs in enclosures was the same at island and mainland sites. Ticks were infected by parasitic wasps on the island and not the mainland, but the infection rate (4.3%) was too low to explain the difference in adult tick densities. In contrast, exclusion of deer by game fencing on Fire Island resulted in markedly increased numbers of adult ticks in flagging samples inside compared to samples taken outside the exclosures. Therefore, the scarcity of adult ticks in flagging samples on Fire Island resulted, at least in part, from the ticks being unavailable to flagging samples because they were on deer hosts. Differences in the densities of flagged ticks inside and outside the exclosures were used to estimate the percentage of questing adults on Fire Island that found deer hosts, excluding those that attached to other host species. Approximately 56% of these questing adult ticks found deer hosts in 1995 and 50% found deer hosts in 1996. Therefore, in areas where vertebrate hosts are highly abundant, large proportions of the questing tick population can find hosts. Moreover, comparisons of tick densities at different sites by flagging can potentially be biased by differences in host densities among sites.

Greenberg, R. and S. Droege. 1999. On the decline of the Rusty Blackbird and the use of ornithological literature to document long-term population trends. Conservation Biology 13(3):553-559.

Unlike most North American blackbirds, Rusty Blackbirds *(Euphagus carolensis)* have shown steep population declines. Declines of approximately 90% are indicated for three recent decades from the Breeding Bird Survey, Christmas Bird Counts, and Quebec Checklist Program. Analyses of abundance classifications in bird distribution books and annotated checklists reveal an overlooked but long-term decline dating back to at least the early part of this century. Rusty Blackbirds were described as very common to abundant in 5656 of the pre-192O published accounts, 19% of the 1921-1950 accounts, and only 7% of the post-1950 accounts. Rusty Blackbirds were described as uncommon in none of the pre-1950 accounts, 18% of the 1951-1980 accounts, and 43% of the post-1980 accounts. A similar pattern was found for analyses based on local checklists. Destruction of wooded wetlands on wintering grounds, acid precipitation, and the conversion of boreal forest wetlands could have contributed to these declines. Systematic analysis of regional guides and checklists provides a valuable tool for examining large-scale and long-term population changes in birds.

Hahn, D. C. 1999. [Book review] *Cowbirds and Other Brood Parasites* by Catherine Ortega. Tucson, Arizona: University of Arizona Press (1998). *The Avian Brood Parasites: Deception at the Nest* by Paul A. Johnsgard. New York: Oxford University Press (1997) *Parasitic Birds and their Hosts: Studies in Coevolution* edited by S.I. Rothstein & S.K. Robinson. New York: Oxford University Press (1998). Animal Behaviour 58:1155-1160.

Hahn, D. C., J. A. Sedgwick, I. Painter, and N. Casna. 1999. A spatial and genetic analysis of Cowbird host selection. Pages 204-217 *in* M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn, and T. D. Rich, editors. Research and management of the Brown-headed Cowbird in western Landscapes. Studies in Avian Biology 18.

Our study of brood parasitism patterns in forest communities revealed the egg-laying frequency and host selection patterns of female cowbirds. By integrating molecular genetics and spatial data, we have the first published estimate on cowbird laying rates in field studies. The 29 females in the study laid only 1-5 eggs each, much lower than previous estimates from captive cowbirds and extrapolations from ovarian development in capture/recapture studies that had suggested that as many as 40 eggs could be laid per individual cowbird. Cowbird females also were shown for the first time to lay significantly more eggs within the home range areas they established rather than outside the home range. No patterns were uncovered for individual females preferentially parasitizing particular host species

Hall, R. J., P. F. P. Henry, and C. M. Bunck. 1999. Fifty-year trends in a box turtle population in Maryland. Biological Conservation 88:165-172.

A survey conducted in 1995 investigated long term declines reported in a population of box turtles *Terrapene Carolina* monitored each decade since 1945 in bottomland hardwood forest at the Patuxent Wildlife Research Center, Maryland. Methods duplicated past surveys in most respects, but were supplemented by radiotelemetry and a survey of dominant vegetation. Seventy different turtles were found on the 11.8 ha study area, a decline of >75% since peak populations were recorded in 1955. Searchers were less efficient in 1995 than in 1945-1975 for a variety of possible reasons. Among turtles recorded, approximately equal numbers persisted from each of the past five decades, with some individuals surviving >70 years. A sex ratio strongly favoring males was first recorded in 1975 and continued in 1995, but juveniles and subadults were found in greater proportion in 1995 than in any other survey. Six of nine radio-marked turtles left the bottomland study area and migrated to the adjoining bluffs to hibernate, suggesting more extensive movements and perhaps less stable home ranges than formerly thought. Age structure of trees indicated a gradual change to more shade-tolerant species. Examination of rates of change from survey data suggested that major losses probably resulted from changes in hydrology that exacerbated flooding in 1972, with recovery only beginning in 1995 and perhaps limited both by repeated flood events and successional changes in the forest. Slow recovery from losses may indicate that populations of the species would respond poorly to exploitation.

Haramis, G. M. and G. D. Kearns. 1999. Length of stay, survival, habitat use and migration characteristics of fall migrant Soras on the Patuxent River marsh as determined by radio telemetry. Pages 16-17 *in* David D. Dolton, compiler. Webless migratory game bird research program: Project abstracts - 1998. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Denver, CO. 49 pp.

Hays, H., P. Lima, L. Monteiro, J. DiConstanzo, G. Cormons, I. C. T. Nisbet, J. E. Saliva, J. A. Spendelow, J. Burger, J. Pierce, and M. Gochfeld. 1999. A nonbreeding concentration of Roseate and Common Terns in Bahia, Brazil. Journal of Field Ornithology 70:455-464.

We report recoveries of banded Roseate *(Sterna dougallii)* and Common *(S. hirundo)* Terns netted at Mangue Seco, Bahia, Brazil (11º 27'S, 37º 21'W). Mangue Seco is the first reported South American location where large numbers of Roseate Terns concentrate December-March, and where members of both the North American and Caribbean populations occur together during these months. A Roseate Tern recovered at Mangue Seco sets an age record of 25.6 years for the species. Recoveries at Mangue Seco of Common Terns banded in the Azores (37º -38ºN, 25º -29ºW) suggest there is a regular transatlantic movement by Common Terns between the two locations.

Heinz, G. H., D. J. Hoffman, L. Sileo, D. J. Audet, and L. J. LeCaptain. 1999. Toxicity of lead-contaminated sediment to Mallards. Archives of Environmental Contamination and Toxicology 36:323-333.

Because consumption of lead-contaminated sediment has been suspected as the cause of waterfowl mortality in the Coeur d'Alene River basin in Idaho, we studied the bioavailability and toxicity of this sediment to mallards (*Anas platyrhynchos*). In experiment 1, one of 10 adult male mallards died when fed a pelleted commercial duck diet that contained 24% lead-contaminated sediment (with 3,400 :g/g lead in the sediment). Protoporphyrin levels in the blood increased as the percentage of lead-contaminated sediment in the diet increased. Birds fed 24% lead-contaminated sediment exhibited atrophy of the breast muscles, green staining of the feathers around the vent, viscous bile, green staining of the gizzard lining, and renal tubular intranuclear inclusion bodies. Mallards fed 24% lead-contaminated sediment had means of 6.1 :g/g of lead in the blood and 28 µg/g in the liver (wet-weight basis) and 1,660 µg/g in the feces (dry-weight basis). In experiment 2, we raised the dietary concentration of the lead-contaminated sediment to 48%, but only about 20% sediment was actually ingested due to food washing by the birds. Protoporphyrin levels were elevated in the lead-exposed birds, and all of the mallards fed 48% lead-contaminated sediment had renal tubular intranuclear inclusion bodies. The concentrations of lead in the liver were 9.1 µg/g for mallards fed 24% lead-contaminated sediment and 16 µg/g for mallards fed 48% lead-contaminated sediment. In experiment 3, four of five mallards died when fed a ground corn diet containing 24% lead-contaminated sediment (with 4,000 µg/g lead in this sample of sediment), but none died when the 24% lead-contaminated sediment was mixed into a nutritionally balanced commercial duck diet; estimated actual ingestion rates for sediment were 14% and 17% for the corn and commercial diets. Lead exposure caused elevations in protoporphyrin, and four of the five mallards fed 24%

lead-contaminated sediment in a commercial diet and all five fed the contaminated sediment in a corn diet had renal intranuclear inclusion bodies. Lead was higher in the livers of mallards fed 24% lead-contaminated sediment in the corn diet (38 µg/g) than in the commercial diet (13 µg/g).

Hines, J. E., T. Boulinier, J. D. Nichols, J. R. Sauer, and K. H. Pollock. 1999. COMDYN: Software to study the dynamics of animal communities using a capture-recapture approach. Large-scale Studies of Marked Birds, proceedings of EURING 97 Conference, April 7-12, University of East Anglia, Norwich, UK, edited by S. R. Baillie and P. M. North. Bird Study 46(suppl.):S209-217.

COMDYN is a set of programs developed for estimation of parameters associated with community dynamics using count data from two locations or time periods. It is Internet-based, allowing remote users either to input their own data, or to use data from the North American Breeding Bird Survey for analysis. COMDYN allows probability of detection to vary among species and among locations and time periods. The basic estimator for species richness underlying all estimators is the jackknife estimator proposed by Burnham and Overton. Estimators are presented for quantities associated with temporal change in species richness, including rate of change in species richness over time, local extinction probability, local species turnover and number of local colonizing species. Estimators are also presented for quantities associated with spatial variation in species richness, including relative richness at two locations and proportion of species present in one location that are also present at a second location. Application of the estimators to species richness estimation has been previously described and justified. The potential applications of these programs are discussed.

Hoff, K. vS., A. R. Blaustein, R. W. McDiarmid, and R. Altig. 1999. Behavior: Interactions and their consequences. Pages 215-239 *in* Roy W. McDiarmid and Ronald Altig, editors. Tadpoles: the Biology of Anuran Larvae. University of Chicago Press, Chicago, IL. xiv, 444 pp.

Jarvi, S. I., R. M. Goto, G. F. Gee, W. E. Briles, and M. M. Miller. 1999. Identification, inheritance, and linkage of *B-G*-like and MHC class I genes in cranes. Journal of Heredity 90(1):152-159.

We identified *B-G*-like genes in the whooping and Florida sandhill cranes and linked them to the major histocompatibility complex (MHC). We evaluated the inheritance of *B-G*-like genes in families of whooping and Florida sandhill cranes using restriction fragment patterns (RFPs). Two B-G-like genes, designated *wcbgl* and *wcbg2,* were located within 8 kb of one another. The fully sequenced *wcbg2* gene encodes a *B-G* IgV-like domain, an additional Ig-like domain, a transmembrane domain, and a single heptad domain typical of "-helical coiled coils. Patterns of restriction fragments in DNA from the whooping crane and from a number of other species indicate that the B-G-like gene families of cranes are large with diverse sequences. Segregation of RFPs in families of Florida sandhill cranes provide evidence for genetic polymorphism in the *B-G*-like genes. The restriction fragments generally segregated in concert with MHC haplotypes assigned by serological typing and by single stranded conformational polymorphism (SSCP) assays based in the second exon of the crane MHC class I genes. This study supports the concept of a long-term association of polymorphic *B-G*-like genes with the MHC. It also establishes SSCP as a means for evaluating MHC genetic variability in cranes.

Johnson, G. D., D. J. Audet, J. W. Kern, L. J. LeCaptain, M. D. Strickland, D. J. Hoffman, and L. L. McDonald. 1999. Lead exposure in passerines inhabiting lead-contaminated floodplains in the Coeur d'Alene River Basin, Idaho, USA. Environmental Toxicology and Chemistry 18(6):1190-1194.

Blood collected from song sparrows *(Melospiza melodia)* and American robins *(Turdus migratorius)* captured with mist nets in a lead-contaminated (assessment) area and nearby uncontaminated (reference) areas within the Coeur d'Alene Basin in northern Idaho was analyzed for δ-aminolevulinic acid dehydratase activity (ALAD) and hematocrit levels, and livers were analyzed for lead. Mean ALAD inhibition in the assessment area was 51% in song sparrows and 75% in American robins. The proportion of the sampled population with ALAD inhibition >50% was calculated to be 43% for song sparrows and 83% for American robins. Assessment area hematocrit values for song sparrows (0 = 39.9) and American robins (0 = 39.5) were lower than in reference areas (0 = 42.4 for song sparrows and 40.2 for American robins); however, differences were not statistically significant ($p > 0.05$). Significantly higher levels of lead (wet weight) were found in livers from song sparrows captured on the assessment area (0 = 1.93 ppm) than on reference areas (0 = 0.10 ppm) ($p = 0.0079$). Study results indicate that 43% (95% confidence interval [CI] = 12.9-77.5%) of the song sparrows and 83% (95% CI

= 41.8-99.2%) of the American robins inhabiting the floodplain along the Coeur d'Alene River in the assessment area are being exposed to lead at levels sufficient to inhibit ALAD by > 50%. Variability in lead exposure indicators was attributed to high variability in environmental lead concentrations in the Coeur d'Alene River Basin.

Kendall, W. L. 1999. Robustness of closed capture-recapture methods to violations of the closure assumption. Ecology 80:2517-2525.

Closed-population capture-recapture methods have been used extensively in animal ecology, both by themselves and within the context of Pollock's robust design and multistate models, to estimate various parameters of population and community dynamics. The defining assumption of geographic and demographic closure (i.e., no births, deaths, immigration, or emigration) for the duration of sampling is restrictive, and likely to be violated in many field situations. I evaluated several types of violations of the closure assumption and found that completely random movement in and out of a study area does not introduce bias to estimators from closed-population methods, although it decreases precision. In addition, if capture probabilities vary only with time, the closed-population Lincoln-Petersen estimator is unbiased for the size of the superpopulation when there are only births/immigration or only deaths/emigration. However, for other cases of nonrandom movement closed-population estimators were biased when movement was Markovian (dependent on the presence/absence of the animal in the previous time period), when an animal was allowed one entry to and one exit from the study area, or when there was trap response or heterogeneity among animals in capture probability. In addition, the probability that an animal is present and available for capture (e.g., breeding propensity) can be estimated using Pollock's robust design only when movement occurs at a broader temporal scale than that of sampling.

Kendall, W. L. and J. E. Hines. 1999. Program RDSURVIV: an estimation tool for capture-recapture data collected under Pollock's robust design. Large-scale Studies of Marked Birds, proceedings of EURING 97 Conference, April 7-12, University of East Anglia, Norwich, UK, edited by S. R. Baillie and P. M. North. Bird Study 46(suppl.):S32-38.

Several papers have demonstrated the advantages of collecting capture-recapture data using subsamples (i.e., Pollock's robust design). Compared to a standard design (i.e., one sample per period), this approach (1) permits the estimation of more demographic parameters and (2) in many cases produces more efficient estimators. Program SURVIV is a powerful tool for computing parameter estimates under the robust design. However, multinomial models developed for the robust design require cells for each possible capture history that occurs across the subsamples within a period. This makes the process of entering cell probabilities in SURVIV very tedious and subject to errors. Program RDSURVIV combines SURVIV with a front end that converts capture histories taken under the robust design to the proper input format for estimating parameters under a general model, and builds that model. This model permits Markovian temporary emigration, trap response in capture probabilities, and time variation in all parameters. Program RDSURVIV also automatically computes estimates under a series of submodels, but also permits the user to specify other submodels.

Knutson, M. G., J. R. Sauer, D. A. Olsen, M. J. Mossman, L. M. Hemesath, and M. J. Lannoo. 1999. Effects of landscape composition and wetland fragmentation on frog and toad abundance and species richness in Iowa and Wisconsin, USA. Conservation Biology 13:1437-1446.

Management of amphibian populations to reverse recent declines will require defining high-quality habitat for individual species or groups of species, followed by efforts to retain or restore these habitats on the landscape. We examined landscape-level habitat relationships for frogs and toads by measuring associations between relative abundance and species richness based on survey data derived from anuran calls and features of land-cover maps for Iowa and Wisconsin. The most consistent result across all anuran guilds was a negative association with the presence of urban land. Upland and wetland forests and emergent wetlands tended to be positively associated with anurans. Landscape metrics that represent edges and patch diversity also had generally positive associations, indicating that anurans benefit from a complex of habitats that include wetlands. In Iowa the most significant associations with relative abundance were the length of the edge between wetland and forest (positive) and the presence of urban land (negative). In Wisconsin the two most significant associations with relative abundance were forest area and agricultural area (both positive). Anurans had positive associations with agriculture in Wisconsin but not in Iowa. Remnant forest patches in agricultural landscapes may be providing refuges for some anuran species. Differences in anuran associations with deep water and

permanent wetlands between the two states suggest opportunities for management action. Large-scale maps can contribute to predictive models of amphibian habitat use, but water quality and vegetation information collected from individual wetlands will likely be needed to strengthen those predictions. Landscape habitat analyses provide a framework for future experimental and intensive research on specific factors affecting the health of anurans.

Krementz, D. G. 1999. The effects of clearcutting on survival rates, movements and abundance of wintering American Woodcock in Georgia. Page 48 *in* David D. Dolton, compiler. Webless migratory game bird research program: Project abstracts - 1998. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Denver, CO. 49 pp.

Krementz, D. G. and J. S. Christie. 1999. Scrub-successional bird community dynamics in young and mature longleaf pine-wiregrass savannahs. Journal of Wildlife Management 63(3):803-814.

Public agencies are required to manage for threatened and endangered species and for biodiversity. However, at times, management for threatened and endangered species precludes consideration of other species. We investigated how managing for red-cockaded woodpeckers *(Picoides borealis)* and biodiversity at the Savannah River Site (SRS), South Carolina, affected communities of bird species that use early-successional scrub habitat (hereafter, scrub-successional species). Management for red-cockaded woodpeckers at the SRS involved both (1) manipulating mature longleaf pine *(Pinus palustris)*-wiregrass *(Andropogon* spp.) stands via canopy thinning, removal of midstory trees, and prescribed burning; and (2) even-aged timber harvesting. The former management practice encouraged red-cockaded woodpeckers to establish new colonies in previously unoccupied stands (hereafter, "recruitment" stands). The latter management practice is used to remove off-site planted pines and replant with preferred longleaf pines. We conducted a constant-effort mist net study in recruitment and regenerating stands (stands clearcut and planted with longleaf pine) during the breeding seasons of 1995-96. We hypothesized that the scrub-successional bird community in recruitment stands would have greater species richness and higher survival and reproductive rates per species than in regenerating stands. However, recruitment stands always had fewer scrub-successional species (1995:36 species; 1996:31 species) than regenerating stands (1995:54 species; 1996:55 species), and all species that occurred in recruitment stands also occurred in regenerating stands. Species which commonly occurred in both recruitment and regenerating stands had similar adult:juvenile ratios ($P > 0.15$) and relative proportion of adults in breeding condition ($P > 0.05$). We detected no difference in survival rates of Bachman's sparrows *(Aimophila aestivalis),* indigo buntings *(Passerina cyanea),* and of "combined" scrub-successional birds between stand types ($P > 0.05$). We found that even-aged forestry is an important management practice for maintaining and increasing avian biodiversity on public lands, as well as an acceptable management practice for red-cockaded woodpeckers.

Leung, Y.-F. and J. L. Marion. 1999. The influence of sampling interval on the accuracy of trail impact assessment. Landscape and Urban Planning 43(4):167-179.

Trail impact assessment and monitoring (IA&M) programs have been growing in importance and application in recreation resource management at protected areas. Census-based and sampling-based approaches have been developed in such programs, with systematic point sampling being the most common survey design. This paper examines the influence of sampling interval on the accuracy of estimates for selected trail impact problems. A complete census of four impact types on 70 trails in Great Smoky Mountains National Park was utilized as the base data set for the analyses. The census data were resampled at increasing intervals to create a series of simulated point data sets. Estimates of frequency of occurrence and lineal extent for the four impact types were compared with the census data set. The responses of accuracy loss on lineal extent estimates to increasing sampling intervals varied across different impact types, while the responses on frequency of occurrence estimates were consistent, approximating an inverse asymptotic curve. These findings suggest that systematic point sampling may be an appropriate method for estimating the lineal extent but not the frequency of trail impacts. Sample intervals of less than 100 m appear to yield an excellent level of accuracy for the four impact types evaluated. Multiple regression analysis results suggest that appropriate sampling intervals are more likely to be determined by the type of impact in question rather than the length of trail. The census-based trail survey and the resampling-simulation method developed in this study can be a valuable first step in establishing long-term trail IA&M programs, in which an optimal sampling interval range with acceptable accuracy is determined before investing efforts in data collection.

Link, W. A. 1999. Modeling pattern in collections of parameters. Journal of Wildlife Management 63(3):1017-1027.

Wildlife management is increasingly guided by analyses of large and complex datasets. The description of such datasets often requires a large number of parameters, among which certain patterns might be discernible. For example, one may consider a long-term study producing estimates of annual survival rates; of interest is the question whether these rates have declined through time. Several statistical methods exist for examining pattern in collections of parameters. Here, I argue for the superiority of "random effects models" in which parameters are regarded as random variables, with distributions governed by "hyperparameters" describing the patterns of interest. Unfortunately, implementation of random effects models is sometimes difficult. Ultrastructural models, in which the postulated pattern is built into the parameter structure of the original data analysis, are approximations to random effects models. However, this approximation is not completely satisfactory: failure to account for natural variation among parameters can lead to overstatement of the evidence for pattern among parameters. I describe quasi-likelihood methods that can be used to improve the approximation of random effects models by ultrastructural models.

Link, W. A. and J. R. Sauer. 1999. Controlling for varying effort in count surveys --an analysis of Christmas Bird Count Data. Journal of Agricultural, Biological, and Environmental Statistics 4(2):116-125.

The Christmas Bird Count (CBC) is a valuable source of information about midwinter populations of birds in the continental U.S. and Canada. Analysis of CBC data is complicated by substantial variation among sites and years in effort expended in counting; this feature of the CBC is common to many other wildlife surveys. Specification of a method for adjusting counts for effort is a matter of some controversy. Here, we present models for longitudinal count surveys with varying effort; these describe the effect of effort as proportional to $\exp(B\ \text{effort}^p)$, where B and p are parameters. For any fixed p, our models are loglinear in the transformed explanatory variable $(\text{effort})^p$ and other covariables. Hence we fit a collection of loglinear models corresponding to a range of values of p, and select the best effort adjustment from among these on the basis of fit statistics. We apply this procedure to data for six bird species in five regions, for the period 1959-1988.

Link, W. A. and J. R. Sauer. 1999. On the importance of controlling for effort in analysis of count survey data: Modeling population change from Christmas Bird Count data. Vogelwelt 120 Suppl. 1:15-20.

Count survey data are commonly used for estimating temporal and spatial patterns of population change. Since count surveys are not censuses, counts can be influenced by "nuisance factors" related to the probability of detecting animals but unrelated to the actual population size. The effects of systematic changes in these factors can be confounded with patterns of population change. Thus, valid analysis of count survey data requires the identification of nuisance factors and flexible models for their effects. We illustrate using data from the Christmas Bird Count (CBC), a midwinter survey of bird populations in North America. CBC survey effort has substantially increased in recent years, suggesting that unadjusted counts may overstate population growth (or understate declines). We describe a flexible family of models for the effect of effort, that includes models in which increasing effort leads to diminishing returns in terms of the number of birds counted.

Loesch, C. R., D. J. Twedt, K. Tripp, W. C. Hunter, and M. S. Woodrey. 1999. Development of management objectives for waterfowl and shorebirds within the Mississippi Alluvial Valley. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/loesch.htm.

The goal of the Lower Mississippi Valley Joint Venture of the North American Waterfowl Management Plan is to provide sufficient habitat to support 4.3 million wintering ducks and 1.0 million wintering geese annually. Under the assumption that the amount of foraging habitat is the primary limitation to supporting waterfowl population goals in the Mississippi Alluvial Valley (MAV), a habitat objective to make available 285,000 ha of waterfowl foraging habitat is divided among seven states. This habitat objective is further divided between public and private ownership and among three habitat types: Bottomland hardwood forest, moist-soil sites, and agricultural fields. Management objectives for shorebirds within the MAV which provide foraging habitat for 0.5 million shorebirds during their southward migration have been tentatively established. Several as yet unverified assumptions were used in establishing these objectives; consequently, we caution that the objectives are subject to revision as the assumptions are tested. We assumed that 0.5 million shorebirds move through the

MAV during late summer and fall, each foraging for an average of 10 days. During this migration period, foraging shorebirds are assumed to require sufficient forage to gain 1 g of biomass per day, in addition to their basal metabolic needs. Given an invertebrate food supply that provides 17.6 kj • g^{-1}, we calculated that an average 45 g shorebird requires about 8 g of invertebrate forage per day. Further assuming that each ha of managed shorebird habitat can provide 20 kg of invertebrate food resources available to shorebirds, we extrapolated a need for 2000 ha of shorebird foraging habitat. We suggest that the bulk of this foraging habitat be provided on public lands and that it be distributed throughout the MAV.

Longmire, J. L., D. C. Hahn, and J. L. Roach. 1999. Low abundance of microsatellite repeats in the genome of the Brown-headed Cowbird *(Molothrus ater)*. Journal of Heredity 90(5):574-578.

A cosmid library made from brown-headed cowbird (Molothrus ater) DNA was examined for representation of 17 distinct microsatellite motifs including all possible mono-, di-, and trinucleotide microsatellites, and the tetranucleotide repeat (GATA)n. The overall density of microsatellites within cowbird DNA was found to be one repeat per 89 kb and the frequency of the most abundant motif, (AGC)n, was once every 382 kb. The abundance of microsatellites within the cowbird genome is estimated to be reduced approximately 15-fold compared to humans. The reduced frequency of microsatellites seen in this study is consistent with previous observations indicating reduced numbers of microsatellites and other interspersed repeats in avian DNA. In addition to providing new information concerning the abundance of microsatellites within an avian genome, these results provide useful insights for selecting cloning strategies that might be used in the development of locus-specific microsatellite markers for avian studies.

Marion, J. L. and Y.-F. Leung. 1998. Campsite survey implications for managing designated campsites at Great Smoky Mountains National Park. Pages 146-155 *in* D. L. Kulhavy and M. H. Legg, editors. Wilderness and natural areas in Eastern North America :research, management and planning. Center for Applied Studies in Forestry, Stephen F. Austin State University, Nacogdoches, TX. v, 321 pp.

Backcountry campsites and shelters in Great Smoky Mountains National Park were surveyed in 1993 as part of a new impact monitoring program. A total of 395 campsites and shelters were located and assessed, including 309 legal campsites located at 84 designated campgrounds, 68 illegal campsites, and 18 shelters. Primary campsite management problems identified by the survey include: (1) campsite proliferation, (2) campsite expansion and excessive size, (3) excessive vegetation loss and soil exposure, (4) lack of visitor solitude at campsites, (5) excessive tree damage, and (6) illegal camping. A number of potential management options are recommended to address the identified campsite management problems. Many problems are linked to the ability of visitors to determine the location and number of individual campsites within each designated campground. A principal recommendation is that managers apply site-selection criteria to existing and potential new campsite locations to identify and designate campsites that will resist and constrain the areal extent of impacts and enhance visitor solitude. Educational solutions are also offered.

Marion, J. L. and R. D. Proudman. 1999. Management options for minimizing camping impacts along the Appalachian Trail. Register 23(2):12-15.

Visitation has reached record levels along the Appalachian Trail, a 2000+ mile footpath extending from Maine to Georgia along the crest of the Appalachian Mountains. Camping impacts associated with this use have also expanded rapidly in recent years, particularly in popular National Parks and at attraction features such as lakes and ponds. This article reviews recreation ecology research on camping impacts and their relationship to amount of use and environmental attributes. Management options for responding to camping management problems are described, including the manipulation of use-related, environmental, and managerial factors.

Marshall, M. R., R. R. Wilson, and R. J. Cooper. 1999. Problems in demographic modeling of neotropical-nearctic migratory birds: Are they dead or just dispersed? Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay.

We summarized breeding-season demographic parameters from studies of 49 populations of Neotropical-Nearctic migratory passerines that assessed return rate for each sex.

McAuley, D. G., J. R. Longcore, R. B. Allen, G. F. Sepik, S. Williamson, W. Palmer, J. Dunn, and K. Evans. 1999. Effects of hunting on survivial and habitat use by American Woodcock on breeding and migration areas. Pages 27-29 *in* David D. Dolton, compiler. Webless migratory game bird research program: Project abstracts - 1998. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Denver, CO. 49 pp.

McDiarmid, R.W and R. Altig, editors. 1999. Tadpoles: the Biology of Anuran Larvae. University of Chicago Press, Chicago, IL. xiv, 444

McDiarmid, R. W. and R. Altig. 1999. Introduction: the tadpole arena. Pages 1-6 *in* Roy W. McDiarmid and Ronald Altig, editors. Tadpoles: the Biology of Anuran Larvae. University of Chicago Press, Chicago, IL. xiv, 444 pp.

McDiarmid, R. W. and R. Altig. 1999. Research: Materials and techniques. Pages 7-23 *in* Roy W. McDiarmid and Ronald Altig, editors. Tadpoles: the Biology of Anuran Larvae. University of Chicago Press, Chicago, IL. xiv, 444 pp.

McDiarmid, R. W., J. A. Campbell, and T. Touré. 1999. Snake Species of the World: A Taxonomic and Geographic Reference. v. 1. Herpetologists' League, Washington, DC. xi, 511 pp.

Meyers, J. M., editor. 1999--. Southeastern Section, The Wildlife Society Newsletter 41(1) --

Miller, M. W. 1999. Relative effects of plumage coloration and vegetation density on nest success. Condor 101:255-261.

Many passerine species are highly dichromatic with brightly-colored males and cryptically-colored females. Bright plumage in males is commonly thought to arise as a result of sexual selection by females such that males with bright coloration possess high fitness. However, bright plumage potentially could expose males to increased predation risk. Consistent with this idea, males of many highly dichromatic passerine species do not incubate. I tested whether brightly-colored males avoid incubation to reduce the probability of visual predators locating their nest. This hypothesis predicts greater hatching success for clutches incubated by cryptically-colored individuals than by brightly-colored individuals. The Northern Cardinal *(Cardinalis cardinalis)* is a common dichromatic species that breeds throughout the eastern U.S. I placed two button-quail *(Turnix st).)* eggs in each of 203 simulated cardinal nests. Dull brown cardboard, simulating a female cardinal, was placed over about half of all clutches. Bright red cardboard, simulating a male cardinal, was placed over the other clutches. Nest success was highest for well-concealed nests (87%) and lowest for nests in open habitat (54%). Nests containing red cardboard did not have significantly lower success than nests with brown cardboard, nor did I detect a significant color X vegetation-density interaction. My analysis may have had insufficient power to detect an effect of color on nest success; alternatively, brightly-colored males that do not incubate may achieve benefits unrelated to predation risk.

Morrison, M. L., L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn, and T. D. Rich, editors. 1999. The ecology and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology 18. Cooper Ornithological Society, Camarillo, California. 312 pp.

Mueller, A. J., D. J. Twedt, and C. R. Loesch. 1999. Development of management objectives for breeding birds in the Mississippi Alluvial Valley. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/mueller.htm.

We used a six-step process to set habitat objectives and population goals for breeding birds in the Mississippi Alluvial Valley. Specifically, we used existing empirical studies and mathematically derived viable population estimates to define habitat objectives and population goals for bottomland hardwood forest, the most important habitat type in this physiographic area. Although habitat objectives must address both quality and quantity, we concentrate here on the size and number of forest patches in this highly fragmented landscape. To support source populations of all forest breeding birds we recommend the protection/restoration of 52 forest patches that are 4,000-8,000 ha in size, 36 patches of 8,000-40,000 ha, and 13 patches greater than 40,000 ha.

Although every physiographic area is unique, the methodology applied here should be applicable in other situations.

Nichols, J. D. 1999. Monitoring is not enough: on the need for a model-based approach to migratory bird management. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/nichols.htm.

Informed management requires information about system state and about effects of potential management actions on system state. Population monitoring can provide the needed information about system state, as well as information that can be used to investigate effects of management actions. Three methods for investigating effects of management on bird populations are (1) retrospective analysis, (2) formal experimentation and constrained-design studies, and (3) adaptive management. Retrospective analyses provide weak inferences, regardless of the quality of the monitoring data. The active use of monitoring data in experimental or constrained-design studies or in adaptive management is recommended. Under both approaches, learning occurs via the comparison of estimates from the monitoring program with predictions from competing management models.

Nichols, J. D. and C. J. Coffman. 1999. Demographic parameter estimation for experimental landscape studies on small mammal populations. Pages 287-309 *in* Gary W. Barrett and John D. Peles, editors. Landscape ecology of small mammals. Springer, New York. xix, 347 pp.

Nichols, J. D. and A. Kaiser. 1999. Quantitative studies of bird movement: a methodological review. Large-scale Studies of Marked Birds, proceedings of EURING 97 Conference, April 7-12, University of East Anglia, Norwich, UK, edited by S. R. Baillie and P. M. North. Bird Study 46(suppl.):S289-298.

The past several years have seen development of a number of statistical models and methods for drawing inferences about bird movement using data from marked individuals. It can be difficult to keep up with this rapid development of new methods, so our purpose here is to categorize and review methods for drawing inferences about avian movement. We also outline recommendations about future work dealing both with methods development and actual studies directed at hypotheses about bird movement of interest from conservation, management, or ecological perspectives.

Nisbet, I. C. T., J. S. Hatfield, W. A. Link, and J. A. Spendelow. 1999. Predicting chick survival and productivity of Roseate Terns from data on early growth. Waterbirds 22(1):90-97.

Early growth of Roseate Tern (*Sterna dougallii*) chicks is a strong predictor of chick survival and hence of productivity. We developed discriminant functions to predict chick survival from body-masses measured during the first 3 days of life. Productivity is estimated by assuming that almost all *A*-chicks (first-hatched in each brood) survive to fledging, and using the discriminant functions to predict survival of *B*-chicks (second-hatched in each brood). A relation between survival rates and classification rates is derived, allowing discriminant function results to be used in predicting survival rates. In the absence of predation, the resulting estimates of chick survival and productivity are almost as good as those obtained by more intensive methods, but require much less effort and much less disturbance. This approach might be useful for other seabird species in which chick survival is determined primarily by parental performance.

Nisbet, I. C. T. and J. A. Spendelow. 1999. Contribution of research to management and recovery of the roseate tern: review of a twelve-year project. Waterbirds 22(2):239-252.

The Northwest Atlantic population of the Roseate Tern (*Sterna dougallii)* is largely confined to a small breeding area along the northeast coast of the USA between 40E and 42EN. This population was listed as endangered in the USA in 1987 because it was dangerously concentrated into a few breeding sites (85% on two islands in the 1980s). The nesting population in the area from Long Island, New York to Cape Cod, Massachusetts has been studied intensively since 1987, in conjunction with a program of management of the breeding colonies. This paper summarizes the results of the research program and discusses the extent to which it has contributed to effective management. The regional population now numbers about 4,000 breeding pairs and has been increasing slowly since 1987, except between 1991 and 1992 when it declined by about 17%. This

decline was probably caused by Hurricane `Bob' in August 1991. Roseate Terns have specialized foraging habits and are concentrated into a small number of foraging areas near the nesting colonies. The historically important breeding sites were taken over by large gulls between 1930 and 1972. Many of the terns moved to less suitable sites near the mainland, where they are subject to predation by mainland-based predators. Despite this, Roseate Terns breed with high success at many sites. The sex-ratio is skewed towards females; about 12% of nests are attended by female-female pairs. The annual adult survival rate (0.83) is unusually low for a seabird. Most mortality occurs away from the breeding grounds, but the winter quarters remained unknown until one roost site was found in Brazil in 1995-1997. A major management goal has been to restore former colony-sites by eliminating nesting gulls, but the success of some of these projects has been questionable because they may have attracted birds to sites with higher levels of predation. Although the research has yielded important information about the biology and demography of the species, it has taken longer than expected to obtain and analyze data from multiple sites on this long-lived species. Most work has been carried out at breeding sites: critical studies on feeding ecology and winter ecology have been hampered by insufficient funding and the paucity of self-motivated biologists. Hence, the program has not yet provided all the keys to restoring the population.

O'Connell, A. F., Jr., Elyse, L., and Zimmer, J. 1999. Annotated bibliography of methodologies to census, estimate, and monitor the size of white-tailed deer *Odocoileus virginianus* populations. Technical Report NPS/BSO-RNR/NRTR/00-2, National Park Service, Boston Support Office. 59 pp.

Olsen, G. H. 1999. Using endoscopy to diagnose hatching problems in cranes. Association of Avian Veterinarians Proceedings 1999:147-148.

Olsen, G. H. 1999. Birds and the Animal Welfare Act. Journal of Avian Medicine and Surgery 13(2):79-80.

Peterjohn, B. and J. R. Sauer. 1999. Population status of North American grassland birds from the North American Breeding Bird Survey. Pages 27-44 *in* Peter D. Vickery and James R. Herkert, editors. Ecology and conservation of grassland birds of the western hemisphere. Studies in Avian Biology 19.

We summarize population trends for grassland birds from 1966 to 1996 using data from the North American Breeding Bird Survey. Collectively, grassland birds showed the smallest percentage of species that increased of any Breeding Bird Survey bird group, and population declines prevailed throughout most of North America. Although 3 grassland bird species experienced significant population increases between 1966 and 1996, 13 species declined significantly and 9 exhibited non-significant trend estimates. We summarize the temporal and geographic patterns of the trends for grassland bird species and discuss factors that have contributed to these trends.

Porter, W. F. and H. B. Underwood. 1999. Of elephants and blind men: Deer management in the U.S. National Parks. Ecological Applications 9(1):3-9.

Overabundant populations of white-tailed deer *(Odocoileus virginianus)* are becoming common in the eastern United States. Faced with burgeoning deer populations in eastern parks, the National Park Service (NPS) formulated policy based on its long experience with ungulate management in western parks. That the NPS failed to find a management solution acceptable to its many constituencies was inevitable. Like blind men touching different parts of an elephant and disagreeing about its form, those engaged in the debate about deer management in parks are viewing different parts of the ecological system. None has seen the entire system, and consequently, there is neither common agreement on the nature of the problem nor on the solutions. We explore the quandary of deer management in eastern parks by addressing three questions: (1) Can the National Park Service reconcile its management goals with those of its neighbors? (2) Can thresholds be identified for determining when to intervene in natural processes? (3) Is there a scientific foundation for proceeding with effective management of deer? We argue that reconciling the NPS management with that of state conservation agencies is not possible because management policy guides these agencies in opposite directions: the NPS is charged with limiting human impact on ecological processes, and state agencies are charged with exerting human control over population abundance. Questions about thresholds and a scientific basis for management arise from concern that irrupting deer populations are a manifestation of disrupted natural processes. Several population growth paradigms are at the heart of this ecological question. The science provides no consensus about which of these paradigms are appropriate to deer in eastern ecosystems. Thus, it is premature to expect science to identify if or when natural processes have been disrupted. While the NPS cannot effectively achieve

its goals without better *science,* neither can it wait for science to fully understand the dynamics of plant-herbivore interactions. The best hope for resolving both the biological and political dilemmas surrounding deer management is through an adaptive management approach.

Powell, L. A., M. J. Conroy, D. G. Krementz, and J. D. Lang. 1999. A model to predict recruitment for multibrooded songbirds. Auk 116(4):1001-1008.

Renauld, A. E., M. J. Melancon, and L. M. Sordillo. 1999. Identification of in vitro cytochrome P450 modulators to detect induction by prototype inducers in the mallard duckling (*Anas platyrhynchos*). Comparative Biochemistry and Physiology Part C 122:273-281.

Seven modulators of mammalian monooxygenase activity were evaluated for their ability to selectively stimulate or inhibit in vitro monooxygenase activities of hepatic microsomes from mallard ducklings treated with phenobarbital, ß-naphthoflavone, 3,3',4,4',5-pentachlorobiphenyl or vehicle. Microsomes were assayed fluorometrically for four monooxygenases: benzyloxy, ethoxy, methoxy, and pentoxyresorufin-*O*-dealkylase, in combination with each of the seven modulators. Four combinations: ß-naphthoflavone and 2-methylbenzimidazole with benzyloxyresorufin, and Proadifen with methoxy- and ethoxyresorufin, respectively, were evaluated further. ß-naphthoflavone-treated groups were clearly distinguished from the corn oil vehicle control group by all of the assays and by the effects of the modulators in three of the four assay/modulator combinations. Enzyme activities of the phenobarbital and saline groups were statistically similar (P ³.05) when assayed without modulator added, but each assay/modulator combination distinguished between these groups. The PCB-treated group was distinguished from the corn oil vehicle control group only for BROD activity, with or without the presence of modulator. Graphing of per cent modulation of BROD activity versus initial BROD activity provided the clearest distinction between all of the study groups. Identification of these selective in vitro modulators may improve detection and measurement of low level cytochrome P450 induction in avian species.

Robbins, C. S. 1999. [Book review] *A neotropical companion: an introduction to the animals, plants, and ecosystems of the new world tropics*. Second edition, by John Kricher, Princeton University Press, 1997. Wilson Bulletin 111(1):146-147.

Rodda, G. H., T. H. Fritts, C. S. Clark, S. W. Gotte, and D. Chiszar. 1999. A state-of-the-art trap for the brown treesnake. Pages 268-284 *in* G. Y. Rodda, Y. Sawai, D. Chiszar, and H. Tanaka, editors. Problem snake management: the habu and the brown treesnake. Comstock Pub. Associates, Ithaca, NY. xix, 534 pp.

Rodda, G. Y., Y. Sawai, D. Chiszar, and H. Tanaka, editors. 1999. Problem snake management: the habu and the brown treesnake. Comstock Pub. Associates, Ithaca, NY. xix, 534 pp.

Rosenberg, D. K., D. F. DeSante, and J. E. Hines. 1999. Monitoring survival rates of landbirds at varying spatial scales: An application of the MAPS Program. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay.

Rosenberg, D. K., D. F. Desante, K. S. Mckelvey, and J. E. Hines. 1999. Monitoring survival rates of Swainson's Thrush *Catharus ustulatus* at multiple spatial scales. Large-scale Studies of Marked Birds, proceedings of EURING 97 Conference, April 7-12, University of East Anglia, Norwich, UK, edited by S. R. Baillie and P. M. North. Bird Study 46(suppl.):S198-208.

We estimated survival rates of Swainson's Thrush, a common, neotropical, migratory landbird, at multiple spatial scales, using data collected in the western USA from the Monitoring Avian Productivity and Survivorship Programme. We evaluated statistical power to detect spatially heterogeneous survival rates and exponentially declining survival rates among spatial scales with simulated populations parameterized from results of the Swainson's Thrush analyses. Models describing survival rates as constant across large spatial scales did not fit the data. The model we chose as most appropriate to describe survival rates of Swainson's Thrush allowed survival rates to vary among Physiographic Provinces, included a separate parameter for the probability that a newly captured bird is a resident individual in the study population, and constrained capture probability to be constant across all stations. Estimated annual survival rates under this model varied from 0.42 to 0.75 among

Provinces. The coefficient of variation of survival estimates ranged from 5.8 to 20% among Physiographic Provinces. Statistical power to detect exponentially declining trends was fairly low for small spatial scales, although large annual declines (3% of previous year's rate) were likely to be detected when monitoring was conducted for long periods of time (e.g. 20 years). Although our simulations and field results are based on only four years of data from a limited number and distribution of stations, it is likely that they illustrate genuine difficulties inherent to broadscale efforts to monitor survival rates of territorial landbirds. In particular, our results suggest that more attention needs to be paid to sampling schemes of monitoring programmes, particularly regarding the trade-off between precision and potential bias of parameter estimates at varying spatial scales.

Sauer, J. R. 1999. Combining information from monitoring programs: Complications associated with indices and geographic scale. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/sauer.htm.

To adequately monitor Neotropical migratory birds, information must be collected to assess population change at local, regional, and continent-wide scales. I suggest that large-scale survey results (such as those derived from the North American Breeding Bird Survey) should not be used to predict population attributes on parks, refuges, and other protected areas. These areas are often managed, and generally contain habitats that can be poorly sampled in large scale surveys, hence local bird populations might be quite different from those sampled in the large-scale surveys. Furthermore, we are limited in our capabilities to combine information from local surveys with large-scale survey data. Most surveys of bird populations collect indices of abundance which are often not comparable among surveys due to habitat and region specific differences in probabilities of detecting birds. In assessing the effects of management, it is important to understand the limitations of monitoring at different geographic scales and to design programs to monitor at the scale at which management is conducted.

Sauer, J. R. and R. J. Cooper. 1999. Population and habitat assessment: Monitoring bird populations over large areas: Introduction. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/intro_PHA_A.htm.

Monitoring provides essential information about status and change in bird populations. For Neotropical Migrant Birds (NTMBs), the North American Breeding Bird Survey (BBS) has been particularly influential in documenting regional population change and often is cited as justification for management actions. However, as with most bird surveys, the design of the BBS, and the geographic scale of the information, often limits its use either in evaluating the response of bird populations to management, or in identifying causes of population change.

Sauer, J. R., J. Hadidian, C. Swarth, S. Droege, P. Handly, G. Diddan, and J. Huff. 1999. DC birdscape: a program for monitoring neotropical migrant birds in Washington, DC. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology,
http://birds.cornell.edu/pifcapemay/sauer_etal.htm.

Urban and suburban habitats often contain a variety of Neotropical migratory birds, but are poorly sampled by programs such as the North American Breeding Bird Survey. DC Birdscape was developed to inventory and monitor birds in Washington, D.C. Birds were surveyed using a systematic sample of point counts during 1993-1995. Results indicate that species richness of Neotropical migratory birds varied among land-use categories, and that maximum species richness occurred in parkland habitats. Although DC Birdscape has provided relevant information on bird distribution and species richness, it is unclear whether the information is of sufficient management interest to support its continuation as a long-term monitoring program.

Sauer, J. R. and W. A. Link. 1999. Regional analysis of population trajectories from the North American Breeding Bird Survey. Vogelwelt 120 Suppl. 1:15-20.

Smith, W. P. and D. J. Twedt. 1999. Temporal differences in point counts of bottomland forest landbirds. Wilson Bulletin 111(1):139-143.

We compared number of avian species and individuals in morning and evening point counts during the breeding season and during winter in a bottomland hardwood forest in west-central Mississippi. USA. In both seasons, more species and individuals were recorded during morning counts than during evening counts. We also compared morning and evening detections for 18 species during the breeding season and 9 species during winter. Blue Jay *(Cyanocitta cristata),* Mourning Dove *(Zenaida macroura),* and Red-bellied Woodpecker *(Melanerpes carolinus)* were detected significantly more often in morning counts than in evening counts during the breeding season. Tufted Titmouse *(Baeolophus bicolor)* was recorded more often in morning Counts than evening counts during the breeding season and during winter. No species was detected more often in evening counts. Thus, evening point counts of birds during either the breeding season or winter will likely underestimate species richness, overall avian abundance, and the abundance of some individual species in bottomland hardwood forests.

Sykes, P. W., Jr., C. B. Kepler, K. L. Litzenberger, H. R. Sansing, E. T. R. Lewis, and J. S. Hatfield. 1999. Density and habitat of breeding Swallow-tailed Kites in the lower Suwannee ecosystem, Florida. Journal of Field Ornithology 70(3):321-336.

Historically the Swallow-tailed Kite *(Elanoides forficatus)* bred in the United States in at least 16 eastern states. Currently it is restricted to seven southeastern states, with most of its breeding range in Florida. Breeding Bird Surveys indicate a declining trend for this Neotropical migrant in most of Florida. Using a rapid survey technique at the Lower Suwannee NWR on 25-27 Mar. 1997, we scanned for kites from 16 sampling stations above the forest canopy, using 10X binoculars for 45 min per station. An effective detection distance of 2.4 km provided almost complete coverage of kite habitat (excluding salt marsh) on the refuge (14,620 ha) and in a 1.6-km buffer (13,526 ha). A mobile observation platform, extended to heights of 30-34 m provided an unobstructed view above the forest canopy where foraging bouts, feeding, courtship displays, and other activities by this species occur. This technique was found to be efficient in obtaining an estimate of potential breeding pairs. An estimated 19 breeding pairs were observed, with possibly five additional pairs, a density of at least one pair per 1173-1407 ha. There was no opportunity to search for nests so we were unable to correlate number of active nests with the number of kites observed, and linear nature of study area might concentrate birds, including nonbreeders, so our density of kites may or may not be typical for other areas. The refuge has a mosaic of 11 different habitats (7 forest types, freshwater and salt marshes, open water and urban/suburban) providing much linear edge to the matrix of different plant communities that range in height from less than 1 m to greater than 30 m. Such structure provides quality habitat for Swallow-tailed Kites.

Tautin, J., L. Metras, and G. Smith. 1999. Large-scale studies of marked birds in North America. Large-scale Studies of Marked Birds, proceedings of EURING 97 Conference, April 7-12, University of East Anglia, Norwich, UK, edited by S. R. Baillie and P. M. North. Bird Study 46(suppl.):S271-278.

The first large-scale, co-operative, studies of marked birds in North America were attempted in the 1950s. Operation Recovery, which linked numerous ringing stations along the east coast in a study of autumn migration of passerines, and the Preseason Duck Ringing Programme in prairie states and provinces, conclusively demonstrated the feasibility of large-scale projects. The subsequent development of powerful analytical models and computing capabilities expanded the quantitative potential for further large-scale projects. Monitoring Avian Productivity and Survivorship, and Adaptive Harvest Management are current examples of truly large-scale programmes. Their exemplary success and the availability of versatile analytical tools are driving changes in the North American bird ringing programme. Both the US and Canadian ringing offices are modifying operations to collect more and better data to facilitate large-scale studies and promote a more project-oriented ringing programme. New large-scale programmes such as the Cornell Nest Box Network are on the horizon.

Twedt, D. J., M. W. Brown, and J. R. Nassar. [1999.] Evaluation of a mallard HSI model for the Lower Mississippi Valley. Proceedings of the 1997 Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 51:319-328.

We evaluated a habitat suitability (HSI) model developed for mallards (*Anas platyrhynchos*) wintering in the Lower Mississippi Valley by comparing mallard densities obtained from aerial surveys with habitat suitability indices derived from satellite imagery for 25, 256-km^2 sampling units. Regression models that related mallard densities to habitat suitability indices accounted for only 29% of the variability in the data and the 95% confidence interval of predicted mallard densities included zero for most habitat suitability indices evaluated.

Thus, we conclude that the published HSI model is a poor predictor of wintering mallard density in the Lower Mississippi Valley. We suggest model revision to allow users to remotely obtain model inputs for habitat characteristics at landscape scales. Further, we suggest the model be revised to consider yearly variation in habitat and flood conditions that better reflect the ability of an area to support wintering mallards.

Twedt, D. J., P. B. Hamel, R. J. Cooper, and M. S. Woodrey. 1999. An evaluation strategy for conservation goals of the Mississippi Alluvial Valley. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/twedt.htm.

The population goals and habitat objectives established by the Mississippi Alluvial Valley Migratory Bird Initiative are based on several unverified assumptions. We have developed an evaluation strategy that identifies research needed to verify these assumptions. We also have outlined a monitoring strategy designed to track progress toward achieving habitat objectives and population goals.

Twedt, D. J. and C. R. Loesch. 1999. Conservation planning and monitoring avian habitat. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/twedtloesch.htm.

Migratory bird conservation plans should not only develop population goals, they also should establish attainable objectives for optimizing avian habitats. Meeting population goals is of paramount importance, but progress toward established habitat objectives can generally be monitored more easily than can progress toward population goals. Additionally, local or regional habitat objectives can be attained regardless of perturbations to avian populations that occur outside the geographic area covered by conservation plans. Assessments of current avian habitats, obtained from remotely sensed data, and the historical distribution of habitats should be used in establishing habitat objectives. Habitat planning and monitoring are best conducted using a geographic information system. Habitat objectives are assigned to three categories: maintaining existing habitat, restoring habitat, and creating new or alternative habitat. Progress toward meeting habitat objectives can be monitored through geographic information systems by incorporating georeferenced information on public lands, private lands under conservation easements, corporate lands under prescribed management, habitat restoration areas, and private lands under alternative management to enhance wildlife values. We recommend that the area and distribution of habitats within the area covered by conservation plans be reassessed from remotely sensed imagery at intervals appropriate to detect predicted habitat changes.

Twedt, D. J., R. R. Wilson, J. L. Henne-Kerr, and R. B. Hamilton. 1999. Impact of bottomland hardwood forest management on avian densities in the Mississippi Alluvial Valley, USA. Forest Ecology and Management 123:261-274.

Avian territory densities were determined from 20 Breeding Bird Censuses in mature (>30 years) bottomland hardwood stand: and 18 Breeding Bird Censuses in young (6-9 years old) cottonwood *(Populas deltoides)* plantations in the Mississippi Alluvial Valley. Avian species richness, diversity, and territory density were greater ($p < 0.01$) in bottomland hardwood stands than in intensively-managed cottonwood stands but these parameters were not impacted by selective timber harvest within bottomland hardwood stands nor by method of regeneration within cottonwood plantations ($p > 0.05$). Even so, detrended correspondence analysis based on avian territory densities readily segregated forest types and silvicultural treatments. Timber harvest within bottomland hardwood stands resulted in a shift in bird communities toward those found in cottonwood stands by increasing the densities of early-successional species such as Indigo Bunting *(Passerina cyanea),* Yellow-breasted Chat *(Icteria virens),* and Common Yellowthroat *(Geothlypis* trichas). Conversely, regenerating cottonwood stands from root sprouts, rather than planting stem cuttings, resulted in a shift in bird communities toward those found in bottomland hardwood stands by increasing densities of species such as White-eyed Vireo (*Vireo griseus)* and Wood Thrush *(Hylocichla mustelina).* Tree species diversity, angular canopy cover, and midstory density were positively associated with bird species assemblages in bottomland hardwood stands, whereas vegetation density at ground level was positively associated with bird communities in cottonwood plantations. Conversion of agricultural fields to short-rotation cottonwood plantations results in increased breeding bird populations by adding up to 140 additional territories 40 $ha^{-1.}$ Even so, relative

conservation values, derive, from indicator species analysis and Partners in Flight concern scores, suggest that mature bottomland hardwood forests are twice as 'valuable' for bird conservation as are cottonwood plantations.

Vickery, P. D., J. R. Herkert, F. L. Knopf, J. Ruth, and C. E. Keller. 1999. Grassland Birds: An Overview of Threats and Recommended Management Strategies. Rick Bonney, David N. Pashley, Robert Cooper, and Larry Niles, editors. Strategies for Bird Conservation: The Partners in Flight Planning Process. Cornell Laboratory of Ornithology, http://birds.cornell.edu/pifcapemay/vickery.htm.

Grassland ecosystems are dependent on periodic disturbance for habitat maintenance. Historically, grazing by native herbivores and prairie fires were the agents principally responsible for maintaining grassland areas. However, elimination of native herbivores, wide-spread fire suppression, and conversion for agriculture have greatly altered grasslands in the United States and Canada. Because of these landscape changes, many grassland birds are increasingly dependent on land managers for habitat creation, maintenance, and health. Grazing, prescribed burning, and mowing/haying are the most frequently used, and versatile, grassland management techniques. Grassland birds prefer a wide range of grass heights and densities, with some species preferring short sparse vegetation, and others preferring taller, more dense vegetation. Due to differences in species habitat preferences and regional differences in soils and floristics, the responses of individual grassland species to specific grassland management practices can be variable and often are regionally dependent. As a result, management of grassland areas is best directed toward the creation of a mosaic of grassland habitat types. This habitat mosaic is probably best maintained through some type of rotational management system in which sections of large grassland areas receive management on a regular schedule. Such a rotational system would provide a variety of habitat types in every year, would ensure the availability of suitable habitat for birds at either end of the grassland management spectrum, and also would provide habitat for birds whose preferences lie between these extremes.

Vickery, P. D., P. L. Tubaro, J. M. Cardoso da Silva, B. Peterjohn, J. R. Herkert, and R. B. Cavalcanti. 1999. Conservation of grassland birds in the western hemisphere. Pages 2-26 *in* Peter D. Vickery and James R. Herkert, editors. Ecology and conservation of grassland birds of the western hemisphere. Studies in Avian Biology 19.

White, D. H., B. R. Chapman, J. H. Brunjes, IV, R. V. Raftovich, Jr., and J. T. Seginak. 1999. Abundance and reproduction of songbirds in burned and unburned pine forest of the Georgia Piedmont. Journal of Field Ornithology 70(3):414-424.

We studied the abundance and productivity of songbirds in prescribed burned and unburned mature (>60 yr) pine forests at Piedmont National Wildlife Refuge, Georgia, during 1993-1995. We estimated species abundance, richness, and evenness using data from 312 point counts in 18 burned sites and six unburned sites. We measured gross habitat features in 0.04-ha circles centered on each point count station. We calculated productivity estimates at nests of seven of the most common nesting species. Habitat components we measured in 1-, 2-, and 3-yr post-burn sites were similar, but most components differed between burned and unburned sites. Although 98 species were detected during point counts, we report only on the 46 species that nested in the area and were detected $\geq$10% of the counts in either habitat class. Twenty-one species preferred burned sites and six preferred unburned sites. Avian species richness and evenness were similar for burned and unburned sites. Burned sites were preferred for nesting over unburned sites. Only nine nests of six species were found in unburned sites. Productivity estimates were low in burned sites. One or more eggs hatched in only 59 of 187 nests monitored, and an average of only 0.82 chicks per nest were estimated to have fledged. Predation .was the most common probable cause for nest failure, ranging from 45% in the Northern Cardinal (*Cardinalis cardinalis)* to 64% in the Summer Tanager *(Piranga rubra).* Because the sources of predation at the refuge are unknown, future research should address this issue.

Wilson, R. R. 1999. Sex determination of the Acadian Flycatcher using discriminant analysis. Journal of Field Ornithology 70(4):514-519.

I used five morphometric variables from 114 individuals captured in Arkansas to develop a discriminant model to predict the sex of Acadian Flycatchers *(Empidonax virescens).* Stepwise discriminant function analyses selected wing chord and tail length as the most parsimonious subset of variables for discriminating sex. This two-variable model correctly classified 80% of females and 97% of males used to develop the model. Validation

of the model using 19 individuals from Louisiana and Virginia resulted in 100% correct classification of males and females. This model provides criteria for sexing monomorphic Acadian Flycatchers during the breeding season and possibly during the winter.

Winger, P. V., P. J. Lasier, D. H. White, and J. T. Seginak. 2000. Effects of contaminants in dredge material from the Lower Savannah River. Archives of Environmental Contamination and Toxicology 38(1):128-136.

Contaminants entering aquatic systems from agricultural, industrial, and municipal activities are generally sequestered in bottom sediments. The environmental significance of contaminants associated with sediments dredged from Savannah Harbor, Georgia, USA, are unknown. To evaluate potential effects of contaminants in river sediments and sediments dredged and stored in upland disposal areas on fish and wildlife species, solid-phase sediment and sediment pore water from Front River, Back River, an unnamed Tidal Creek on Back River, and Middle River of the distributary system of the lower Savannah River were tested for toxicity using the freshwater amphipod *Hyalella azteca.* In addition, bioaccumulation of metals from sediments collected from two dredge-disposal areas was determined using the freshwater oligochaete *Lumbriculus variegatus.* Livers from green-winged teals *(Anas crecca)* and lesser yellowlegs *(Tringa fiavipes)* foraging in the dredge-spoil areas and raccoons *(Procyon lotor)* from the dredge-disposal/river area and an upland site were collected for metal analyses. Survival of *H. azteca* was not reduced in solid-phase sediment exposures, but was reduced in pore water from several locations receiving drainage from dredge-disposal areas. Basic water chemistry (ammonia, alkalinity, salinity) was responsible for the reduced survival at several sites, but PAHs, metals, and other unidentified factors were responsible at other sites. Metal residues in sediments from the Tidal Creek and Middle River reflected drainage or seepage from adjacent dredge-disposal areas, which could potentially reduce habitat quality in these areas. Trace metals increased in *L. variegatus* exposed in the laboratory to dredge-disposal sediments; As, Cu, Hg, Se, and Zn bioaccumulated to concentrations higher than those in the sediments. Certain metals (Cd, Hg, Mo, Se) were higher in livers of birds and raccoons than those in dredge-spoil sediments suggesting bioavailability. Cadmium, Ct, Hg, Pb, and Se in livers from raccoons collected near the river and dredge-disposal areas were significantly higher than those of raccoons from the upland control site. Evidence of bioaccumulation from laboratory and field evaluations and concentrations in sediments from dredge-disposal areas and river channels demonstrated that some metals in the dredge-disposal areas are mobile and biologically available. Drainage from dredge-disposal areas may be impacting habitat quality in the river, and fish and wildlife that feed and nest in the disposal area pm the lower Savannah River may be at risk from metal contamination.

Zhioua, E., A. Bouattour, C. M. Hu, M. Gharbi, A. Aeschliman, H. S. Ginsberg, and L. Gern. 1999. Infection of *Ixodes ricinus* (Acari: Ixodidae) by *Borrelia burgdorferi* sensu lato in North Africa. Journal of Medical Entomology 36(2):216-218.

Free-living adult *Ixodes ricinus* L. were collected in Amdoun, situated in the Kroumiry mountains in northwestern Tunisia (North Africa). Using direct fluorescence antibody assay, the infection rate of field-collected *I. ricinus* by *Borrelia burgdorferi* sensu lato was 30.5% (n = 72). No difference in infection rate was observed between male and female ticks. Spirochetes that had been isolated from *I. ricinus* from Ain Drahim (Kroumiry Mountains) in 1988 were identified as *Borrelia lusitaniae* (formerly genospecies PotiB2). This is the first identification of a genospecies of *Borrelia burgdorferi* sensu lato from the continent of Africa.

Zhioua, E., H. S. Ginsberg, R. A. Humber, and R. A. Lebrun. 1999. Preliminary survey for entomopathogenic fungi associated with *Ixodes scapularis* (Acari: Ixodidae) in southern New York and New England, USA. Journal of Medical Entomology 36:635-637.

Free-living larval, nymphal and adult *Ixodes scapularis* Say were collected from scattered locales in southern New England and New York to determine infection rates with entomopathogenic fungi. Infection rates of larvae, nymphs, males, and females were 0% (571), 0% (272), 0% (57), and 4.3% (47), respectively. Two entomopathogenic fungi were isolated from field-collected *I. scapularis* females from Fire Island, New York. Isolates were identified as *Verticillium lecanii* (Zimmermann) Viegas and *Verticillium* sp. (a member of the *Verticillium lecanii* species complex).

Presentations of the

USGS Patuxent Wildlife Research Center

February 1999 — January 2000

Alpizar-Jara, R., J. D. Nichols, J. E. Hines, J. R. Sauer, K. H. Pollock, and C. Rosenberry. 1999. The relationship between species detection probability and local extinction probability. 13th Annual Meeting of the Society for Conservation Biology in College Park, MD. June 19-20.

Banks, R. C. 1999. Variation in Greater White-fronted Geese in the Central Flyway [poster]. Presented at external review of BRD Status and Trends Program in Tucson, May 17-21, and at Wilson Ornithological Society in Maine in June.

I applied formulas that Orthmeyer et al. (1995) developed to distinguish populations of Greater White-fronted Geese in California to wintering and migrant birds from the Central Flyway to determine if the birds could be separated into subpopulations based on bill measurements Both males and females grouped into three size classes. I used the same formulas on small population samples from the northern breeding grounds of the species, and on one large sample from the north slope of Arctic Alaska. These populations also separated into three size classes that are slightly different in formula values from the wintering birds. The different size classes were not geographically restricted; all sizes occurred in all populations. Possible interpretations of these findings are: 1) the size classes are meaningless artifacts in a single highly variable population; 2) the size classes are distinct species; 3) some members of the population samples are breeding birds whereas others in the sample are non-breeders that are in the area for molting. I suspect that 3) is correct, but data on the specimen labels are insufficient to allow separation of breeding from non-breeding specimens.

Barboza, P. S. and D. G. Jorde. 2000. Digestive and metabolic responses to foraging risk in a dabbling duck. Society for Integrative and Comparative Biology, Atlanta, GA, January 4-8.

Feeding was restricted without limiting the quality and quantity of food for black duck (*Anas rubripes*). Nine adult males were fed an extruded diet of 2% fat, 17% protein and 9% fiber. Ducks were caged indoors from September (12h light; 17-24 C) to measure balances over 14d when fed ad libitum each day (unfasted) and then fasted for 2d/wk (low-risk) or 4d/wk (high-risk). Birds held mass at 1089g, body water at 800g and dry matter intake at 604g/14d. Intakes increased by 40% (low-risk) and by 133% (high-risk) on feeding days but energy metabolizability (82% to 79%; $P<0.01$), and fiber digestibility (44% to 9%; $P<0.05$) were reduced. Fasting regimes were continued in individual outdoor pens for 9wk. Birds gained mass and body water as temperatures declined from 14-21 C to -9-16 C. At week 5, low-risk ducks were heavier (1372 vs. 1241g; $P<0.05$) and fatter (276 vs. 140g; $P<0.001$) than high-risk birds while body water (894g) and protein were similar between groups (222g). Ducks are unable to increase digestible intakes to compensate for lost foraging time in the fall when nutrient demands for tissue synthesis, thermoregulation and activity are elevated.

Barboza, P. S. and D. G. Jorde. 1999. Nutritional risk in a migratory waterfowl: digestive and metabolic responses to restricted foraging time. American Association for the Advancement of Science, Arctic Science Conference, Denali National Park, AK, September.

Dabbling ducks are vulnerable to icing events, changes in water level and to human disturbance at migratory stopovers, breeding grounds and winter refugia. Black duck (*Anas rubripes*) were studied during the fall by increasing the risk of lost foraging opportunity without limiting the quality and quantity of food. Nine adult males were fed an extruded diet (Mazui #5642; PMI Feeds, St Louis MO) which contained 5.2% water, 1.6% crude fat, 16.7% crude protein and 9.0% acid detergent fiber. Birds were accustomed to metabolism cages during September and held indoors on 12h light/d at 17-24 C. Feed intake and excretion were measured over successive periods of 14d when birds were fed on each day (unfasted) and on one of two fasting regimes. Four animals were fasted for 2 consecutive days in each of the following two weeks (low-risk) while 5 animals were fasted for 4 consecutive days in each week (high-risk). Body composition was measured by deuterated water dilution at the end of each period. Birds maintained body mass at 1089 ± 55g and body water at 800 ± 30g on

both unfasted and fasted regimes. Food intakes compensated for fasted days to maintain intakes at 604 ± 127g dry matter over 14d. That is, intakes increased by 40% (low-risk) and by 133% (high-risk) on the days food was provided. These high intakes were accompanied by a reduction in metabolizability of gross energy from 82% (unfasted) to 79% (fasted; P<0.01). Fiber digestion also declined from 44% in unfasted birds to 13% and 6% (P<0.05) in low- and high-risk regimes respectively. This reduction in digestive efficiency probably reflects increased digesta passage at high rates of food intake.

Ducks were transferred to individual outdoor pens and kept on the same feeding regimes for 8 weeks through December as temperatures declined from 14-21E C to -9-16^{E} C. Although body mass increased in all birds, low-risk animals were heavier than the high-risk group from week 4 (1372 vs. 1241g; P<0.05). Body water content also increased in both groups but did not differ between the feeding regimes (894 ± 48g) at week 4. Estimated body protein was similar between groups (225 vs. 229g) whereas body fat content was greater for low-risk birds than for high-risk birds (252 vs. 120g; P<0.001). This difference in body mass between the groups was abolished within 1 ld of returning all animals to an unfasted regime. The ability to compensate for lost foraging time through increased intake is limited when requirements for tissue synthesis and thermoregulation increase during the fall. Digestive efficiency may be further constrained by diets of low quality with high concentrations of indigestible components such as plant fiber. Waterfowl may be averse to foraging risks in the fall because birds must gain fat and protein while meeting costs of thermoregulation and activity when traveling through uncertain foraging grounds with additional risks of predation.

Barboza, P. S. and D. G. Jorde. 1999. Stable isotopes as indicators of diet in wintering black duck. The Wildlife Society 6th Annual Conference, Austin, TX, September 8-11.

American black duck *(Anas rubripes)* lose mass from fat but maintain lean tissues during winter. Can isotopic enrichments of tissues indicate diet selection during this period of mass depletion at low food intake? Birds (12 male :18 female) hatched in 1997 were segregated by sex and housed in identical pens and ponds. Each group of three was fed one of two extruded rations from January to March 1998. These complete rations were formulated to mimic the composition and isotopic enrichment of an animal diet (based on marine shrimp and wheat) and a plant diet (based on corn and its byproducts) for breeding waterfowl. Although the animal diet contained more protein than the plant diet (21 vs. 16%), concentrations of lipid (0.9 vs. 1.1%), gross energy (15 vs. 17 kJ,g^{-1}) and acid detergent fiber (10 vs. 11%) were similar. In comparison with the plant diet, the animal ration was enriched in ^{15}N (5.9 vs. 4.3‰) and depleted in ^{13}C (-22.0 vs. -13.7‰). Body mass loss was similar between diets at 7±11% of the initial mass (1153 ± 218g). Abundance of ^{15}N in blood and muscle exceeded dietary levels after 67d (10.0‰ animal, 7.1‰ plant) with the greatest enrichment in blood plasma suggesting high rates of amino acid conservation. Abundance of ^{15}N was significantly different between diet groups for plasma sampled at 3d, but slower to equilibrate in blood cells (11d) and muscle (11-42d) indicating slow rates of protein mover. Conversely, ^{13}C abundance differed between diet groups for blood fractions sampled at 3d and for muscle at 11d. This rapid equilibration of the C pool probably reflects high rates of lipid metabolism. Abundance of ^{13}C in plasma indicate acute changes in diet within days whereas changes in ^{15}N enrichment of muscle and blood cells reflect sustained dietary shifts over 2-4 weeks. These comparisons between tissue enrichments could be used to describe the chronology of diet selection in over-wintering birds.

Blanco, J. M., G. Gee, D. E. Wildt, K. Tselutin, and A. M. Donoghue. 1999. Semen cryopreservation in poultry and non-domestic species: A comparative approach to understand the fundamentals of avian sperm cryobiology. International Conference on Bird Reproduction, Tours, France, September 24.

Despite extensive research on the cryopreservation of poultry semen, there has been limited success in moving these procedures to the farm or adapting it to in situ collection and storage of sperm from nondomestic avian species. We take a comparative approach to analyze how avian sperm survives cryostorage. We compare across species how sperm tolerate 1) osmotic stress in hypo and hypertonic media; and 2) the demembranating effect on extraction with Triton X-100. Also, we compare spermatozoa tolerance to 1) different concentrations of dimethylacetamide (DMA) (0.68M to 3.44 M) using two different equilibration times (2 and 4 hours), 3) at both rapid (50ºC/min) and slow cooling rates (1-2ºC/min); and 4) how temperature (4ºC and 21ºC) influences membrane permeability to the cryoprotectant.

Species in the study included: domestic chicken (*Gallus domesticus*, n=10), domestic turkey (*Meleagris gallopavo*, n=40, golden eagle (*Aquila chrysaetos*, n=4), Bonelli's eagle (*Hieraaetus fasciatus*, n=2), imperial eagle (*Aquila adalberti*, n=2, peregrine falcon (*Falco peregrinus*, n=4), and the sandhill crane (*Grus canadensis*, n=10. We obtained semen from poultry using the massage method (Burrows and Quinn 1935) or adaptations

of it in other species (Gee and Temple 1978, Bird and Rehder 1981). Except cranes, we collected semen once a day, five days a week using the same daily schedule. Cranes were collected once a day twice weekly.

Blanco, J. M., K. Tselutin, G. Gee, D. E. Wildt, and A. M. Donoghue. 1999. Comparative cryopreservation of poultry sperm: Characterization of sperm survival after rapid or slow freezing methods and the use of 6% dimethylacetamide as a cryoprotectant for chicken and turkey sperm. Beltsville Agricultural Research Center, Poster Day, April 7.

Boulinier, T., J. Nichols, J. Hines, and J. Sauer. 1999. Using capture-recapture methodology for inference on the dynamics of communities at large scales. Norwegian Academy of Science and Letters Symposium: Dynamics in Time and Space: Basic and Applied Issues, Oslo, Norway, September.

Buchsbaum, R., D. M. Burdick, R. Cook, T. Diers, M. Dionne, K. Hughes, R. Milton, H. Neckles, L. Roberts, C. T. Roman, J. Taylor, and D. Thompson. 1999. Standards and criteria for evaluating tidal wetland restoration in the Gulf of Maine: workshop results. Estuarine Research Federation Conference, New Orleans, September 25-30.

Human activities have altered, degraded, or destroyed many of the original tidal wetlands within the Gulf of Maine. Although emphasis is now on restoring these systems, the overall effectiveness of restoration efforts is uncertain. Project monitoring to gauge the return of ecological functions is uneven, due largely to the lack of funds, perceived need, and scientifically defensible evaluation criteria. Consequently, development of regional standards for evaluating the success of tidal wetland restoration efforts is being sponsored by the Global Programme of Action Coalition for the Gulf of Maine (GPAC), a US-Canadian partnership organized by the Commission for Environmental Cooperation under the auspices of the UN Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. We will compare tidal wetland characteristics between restoration and reference sites across the Gulf of Maine by applying a common sampling protocol to a regional network of sites. We will host a workshop in June, 1999, to establish sites, identify participants, and develop a protocol (common indicators, methods, and sampling designs) for data collection. The workshop results reported here include a common, regionally applicable protocol for monitoring tidal restoration and reference sites in the Gulf of Maine.

Cam, E., J. D. Nichols, J. R. Sauer, J. E. Hines, and C. H. Flather. 1999. Influence of urbanization on integrity of bird communities in the Mid-Atlantic states. 13th Annual Meeting of the Society for Conservation Biology, College Park, MD, June 19-20.

Dawson, D. 1999. Avian research and conservation at Rancho Sandoval, Campeche, Mexico. Southern Maryland Audubon Society, Charlotte Hall, MD, December.

Dawson, D. 1999. Presentation on avian benefits from rights-of-way habitats. USFWS National Conservation Training Center's course on Rights-of-Way Habitat Management, National Wildlife Visitor Center, October 20-21.

Dawson, D. 1999. Bird banding demonstration and discussion. Avian ecology class, Johns Hopkins University, Baltimore, MD., October 17.

Dawson, D. K. 1999. Distribution and conservation of forest-nesting birds in a suburbanizing landscape. Balancing the Landscape--Retaining Forests in the Chesapeake Bay Watershed, a conference held in Annapolis, MD, sponsored by the Alliance for the Chesapeake Bay, Chesapeake Bay Program, U.S. Forest Service, Society of American Foresters, and the forestry departments of Maryland, Pennsylvania, and Virginia, November 17-19.

Dawson, D. and J. R. Sauer. 1999. Bird banding demonstration. Blackwater National Wildlife Refuge, Open House, October 16.

Dayton, G. H., R. E. Jung, and I. L. Thomas. 1999. Distribution of amphibians in Big Bend National Park, Texas: Results of night driving surveys [poster]. Joint Meeting of the American Society of Ichthyologists and Herpetologists, American Elasmobranch Society, Herpetologist's League, and Society for the Study of Amphibians and Reptiles, Pennsylvania State University, State College, PA, June 24-30.

We used night driving surveys to assess chorusing, movements, presence/absence, and relative abundance of desert anurans in Big Bend National Park, TX. Four paved road transects dissecting Big Bend National Park totaling 152 km were surveyed after sunset within two days of a rain event from 1 June – 30 October 1998. Each road section was surveyed at least 5 times. A total of 344 *Bufo speciosus, Scaphiopus couchii, Bufo punctatus, Gastrophryne olivacea, Bufo debilis*, and *Rana berlandieri* were detected in our surveys. *Bufo speciosus* was the most frequently observed species and *Rana berlandieri* was the least frequently encountered. Sex, mass, snout-vent length, and precise location were recorded for each individual. Preliminary results suggest amphibian distributions are highly clustered and often in conspecific groups with little species overlap. We are examining whether anuran species presence or absence, abundance, and spatial clustering are related to various environmental variables including soil type, vegetation, proximity to perennial water, and topography.

Demarest, D. W. 1999. Planning and evaluation in the Lower Mississippi Valley Joint Venture. North American Joint Ventures Technical and Evaluation Workshop, Willows, California, December.

Management objectives of the Lower Mississippi Valley Joint Venture (LMVJV) specify winter water management and reforestation acreage objectives for private and public lands. Objectives are biologically linked to regional population targets/habitat goals. Biological relationships underlying these linkages are critical in driving planning and implementation, but many are poorly understood or assumed. LMVJV structures assumptions of its biological plan in a 3-tier hierarchy, whereby validity of an assumption at one tier affects linkages assumed for lower tiers. Evaluation of upper-tier biological assumptions (e.g., that foraging habitat is limiting) has been minimal due to the practicalities of developing research programs that adequately address them. Lower-tier evaluations planned or underway include reassessment of waste grain availability in flooded agricultural habitats, advancement of habitat monitoring programs, and investigation of new performance monitoring criteria. Results should permit refinement and improved performance monitoring of current acreage objectives, and/or re-expression of management objectives in a manner more directly related to waterfowl populations (e.g., survival rates, condition indices) and which facilitates region-wide performance monitoring.

Droege, S. 1999. Pollinators, variance, and indices to abundance, and evaluation. Workshop on "Causes and Extent of Declines among Native Invertebrate Pollinators: Detection, Evidence and Consequences," at the National Center for Ecological Analysis and Synthesis, Santa Barbara, CA, October 8-10.

Droege, S., R. E. Jung, L. A. Weir, B. Plesky, and K. Werner. 1999. Capture-recapture population estimates of terrestrial salamanders (poster). Joint Meeting of the American Society of Ichthyologists and Herpetologists, American Elasmobranch Society, Herpetologist's League, and Society for the Study of Amphibians and Reptiles, Pennsylvania State University, State College, PA, June 24-30.

Adjusted population estimates using capture-recapture for terrestrial salamanders have been difficult to obtain because of low recapture rates. Over the past year, we marked salamanders using visible implant fluorescent elastomer (Northwest Marine Technologies, Inc.) at 8 plots at the USGS Patuxent Wildlife Research Center, 30 plots at Shenandoah National Park, and at 3 areas using 4 survey methods at the Great Smoky Mountains National Park. Recapture rates varied from 0 to 37%, and were higher at Patuxent (21%) than at Shenandoah and the Smokies (3%). Recapture rates were typically higher at plots where artificial cover boards were used (17%) alongside natural cover objects as compared to plots where only natural cover objects were surveyed (3%). When population closure was not violated, Program Capture revealed extremely variable adjusted population estimates. In most cases, however, salamander visibility, or detection probabilities (p), differed among plots, suggesting that capture-recapture population estimates may be necessary.

Duncan, L. K. and J. M. Meyers. 1999. Reproductive success and nesting habitat of Painted Buntings on Sapelo Island, Georgia. American Ornithologists' Union meeting, Cornell University, August 12.

Painted Bunting (*Passerina ciris*) population levels have declined at an annual rate of 3.2% since 1966. We determined and compared modified Mayfield reproductive success estimates of Painted Buntings between years and among three habitat types - maritime shrub habitat, managed pine-oak forest, and old growth maritime evergreen forest - on Sapelo Island, GA. Number of nests in the old growth maritime forest were too low to include in reproductive success analysis. Clutch sizes and number of fledglings were also determined and compared (t - test) between years and habitats. We measured 57 habitat variables to compare habitat of

successful and unsuccessful nests (t - test). The maritime shrub habitat was analyzed separately from the forested habitats. Reproductive success was similar between shrub maritime and managed pine-oak forest habitats in 1997 (P = 0.71) and 1998 (P = 0.63); however, we found higher reproductive success in 1997 than in 1998 (P = 0.01, habitats pooled). Mean clutch sizes were similar between habitats (P = 0.42) and between years (P = .25). Mean number of fledglings were similar between habitats (P = 0.87) but differed between years (1997 = 1.4; 1998 = 0.59; P = 0.01). Of the 57 habitat variables, only habitat patchiness of the overstory and vegetation volume at 3-8 m heights differed between successful and unsuccessful nests in the maritime shrub habitat, and only habitat patchiness of the understory differed in forests. Reproductive success decreased in 1998. Mean daily temperatures in the spring and summer of 1998 were warmer than in 1997 and may have influenced and possibly increased snake predation. Buntings do not appear to be selecting nesting sites to assure success, but may be using microhabitats based on nesting requirements or niche gestalt.

Erwin, R. M. and J. Gill. 1999. Dredged material, wetland restoration, and beneficial uses to wildlife: Poplar Island restoration. [poster]. USGS Chesapeake Bay Workshop, St. Michaels, MD, November.

Erwin, R. M., B. R. Truitt, R. Dueser, and N. D. Moncrief. 1999. Nowhere to hide: beach-nesting waterbirds and mammalian predators in the Virginia barrier island landscape. American Ornithologists' Union 117th Stated Meeting, Ithaca, NY, August 8-14.

We examined changing patterns of distribution of two large mammalian predators, the raccoon and red fox, and beach-nesting terns and Black Skimmers along the 100 km Virginia barrier island landscape from 1977 to 1998. Based on evidence from trapping, scent stations, den observations and sightings of the two predators, there has been a marked increase in their island ranges. In 1977, only 5 of 13 barrier islands definitely harbored at least one of the two mammals, but by 1998, 11 of 14 islands showed evidence of one or both during the spring and summer. Concurrently, annual beach-nesting bird surveys have been conducted since the mid 1970s during June. From 1977 to 1998, the number of colonies of terns (Common, Gull-billed, Least, Royal, and Sandwich) and Black Skimmers declined from 23 colonies on 11 barrier islands to 13 on 9 islands. In addition, the populations decreased dramatically for all species except the marginal Sandwich Tern and Least Tern. This correlative pattern suggests that mammalian predation may be a major factor in colony site selection or success, although we have no data on success at most locations. The only consistently large colony over the years has been the Royal Tern colony on Fisherman Island, one of the few with no resident large mammals. Because these declining waterbirds appear to be running out of options for safe colony sites in coastal Virginia, we discuss the prospects of conducting limited predator removals on certain islands.

Farrell, T. A. and J. L. Marion. 1999. Identification and management of visitor impact problems within protected areas in Costa Rica and Belize . On the Frontiers of Conservation: The 10th George Wright Society Conference on Research and Resource Management in Parks and on Public Lands, Asheville, NC, March 22-26.

Visitor related natural resource impacts have increasingly become management concerns for many Central American protected areas. A variety of visitor activities contribute to these resource impacts, including hiking, viewing, camping, snorkeling, and diving. Visitor impacts potentially affect soil, vegetation, wildlife and water resources, and may be localized or widespread in their distribution. Case study research of seven protected areas in Belize and Costa Rica reveal the occurrence of many of these visitor related impacts. Findings also reveal that the nature, severity and extent of these resource impacts depend on the category of development (undiscovered, newly discovered, or established), on aspects of management, on the amount and type of use, and on the characteristics of the environment or terrain. Management strategies and actions used by managers of these protected areas to prevent or minimize these impacts are presented and discussed.

Farrell, T. and J. L. Marion. 1999. A critique of carrying capacity applications in developing country protected areas. 1999 Congress on Recreation and Resource Capacity, Aspen, CO, November 29-December 3.

Developing countries, particularly in Central and South America, have tended to use informal decision making processes to inform managers about the occurrence and severity of impact problems and carrying capacity estimates. In some cases, complicated equations have been developed to determine carrying capacities, typically based on administrative capabilities like number of staff, size of facilities, or length of trails.

Developing country protected areas are experiencing natural resource impacts related to visitation, in spite of carrying capacity limits. U.S. researchers and managers have found the traditional carrying capacity concept

to be overly restrictive and biased towards use limitation as the principal management response. Scientific studies and management experience have documented the importance of numerous other use-related, environmental and managerial factors.

This presentation discusses carrying capacity application and its relative advantages and disadvantages for selected developing country protected areas. The effectiveness of the various management strategies and actions employed by developing country protected area managers to minimize visitor impacts is also discussed. Innovative and creative solutions have been employed by some developing country protected areas managers in response to visitor impact problems, solutions that have some applicability to U.S. protected areas.

Flather, C. H., M. Bevers, E. Cam, J. D. Nichols, and J. R. Sauer. 1999. Habitat arrangement and extinction thresholds: Do forest birds conform to model predictions? 5th World Congress of the International Association for Landscape Ecology, Snowmass Village, CO, July 29 - August 3.

Freeman, M. C. 1999. Thoughts on minimum flows, natural flow and instream flow assessment. Invited paper, Annual Meeting of the Georgia Chapter of the American Fisheries Society, Tifton, GA, February 26-28.

Freeman, M. C., E. R. Irwin, and D. J. Orth, organizers. 1999. What's natural about managing instream flows? Symposium at the Annual Meeting, American Fisheries Society, Charlotte, NC, August 29 - September 2.

The importance of protecting natural patterns of flow regimes for sustaining the structure and function of river ecosystems has received renewed interest and publicity over the past few years. Ecologists from academia, to The Nature Conservancy, to federal agencies including the Army Corps of Engineers have presented arguments for protecting natural patterns of spatial and temporal variability in managed river systems. We have witnessed the unprecedented experimental release of flood waters in the Southwest, calls for reevaluation of flood-control policy in the East and Midwest, and the initiation of multibillion-dollar projects to restore natural form and flows to the aquatic systems of south Florida. Managers have access to new methodologies (e.g., Indicators of Hydrologic Alteration, the Riverine Community Habitat Assessment and Restoration Concept) for assessing how far managed regimes depart from natural patterns. These methodologies are intended to augment or replace criteria-based approaches (principally IFIM) widely used by fisheries managers to negotiate for fish-friendly flows in regulated streams. However, resource managers may partly view the natural flow approach, as an appealing ecological theory that lacks extensive empirical backing - how natural is close enough? Further, how may other emerging approaches, including individual-based and basin-management models, complement or diverge from strategies to protect natural flow variability? This symposium will delve the theoretical and empirical bases for justifying instream flows to protect fishes and fisheries as well as stream ecosystems. By bringing together ecologists and fisheries scientists (in the same corpus, in some cases), we will facilitate discussion of the evolving roles of natural flow regimes and habitat models in improving the management of flow-regulated streams.

French, J. B., Jr., P. Henry, B. A. Rattner, and M. A. Ottinger. 1999. Endocrine, developmental and reproductive impacts of polychlorinated biphenyl (Aroclor 1242) in American kestrels. Society of Integrated and Comparative Biology, January 6-10, Denver, CO.

Diverse field and experimental studies suggest that abnormal sexual and reproductive development in wildlife could be caused by endocrine-like action of pollutants on embryos, and that functional deficits would be evident only later in life, during breeding. We tested these hypotheses in American kestrels (*Falco sparverius*). Aroclor 1242 is a commercial mixture of PCB congeners shown to be estrogenic in mice and the mixture approximates the environmental exposure of Common terns (*Sterna hirundo*) where abnormal development of gonads in male tern chicks was seen. Pairs of kestrels were exposed to high and low levels of Aroclor in food resulting in mean egg concentrations of 80.4 and 9.4 ppm respectively. The gonadal morphology of hatchlings was consistent with their genetic sex, and male testes showed only little histological intersexuality; fledglings had normal gonadal morphology and histology. Female hatchlings tended to show increased androgen and decreased estrogen in their serum with increased dose of Aroclor. Similarly exposed siblings were raised to breeding age and displayed some differences in incubation behavior, but no difference in reproductive output from controls. Overall, kestrels exposed to Aroclor 1242 as embryos showed some moderate disruption of normal development, but siblings showed little functional deficit at breeding age.

French, J. B., Jr., I. C. T. Nisbet, and H. Schwabl. 2000. Does maternal polychlorinated biphenyl exposure affect steroid deposition into eggs of common terns *(Sterna hirundo)* [poster]. 7th International Symposium on Avian Endocrinology, Varanasi, India, January 28 - February 2.

Much publicity has been given to the possibility that the endocrine activity of environmental contaminants acting on embryos may alter the course of reproductive development. Gonads of male common tern (*Sterna hirundo*) embryos, collected at pipping from parents exposed to PCBs by eating fish gathered from an EPA Superfund site, showed evidence of feminization, i.e. PGCs in the cortex. However, there was poor correlation with the levels of PCB exposure in these birds. If there were an endocrine cause for these gonadal deformities, we suspected that it may have been caused by maternal hormone deposited to eggs, rather than PCB action on embryonic endocrine production. Therefore, we collected clutches of three eggs immediately after the third egg was laid and looked for correlation between yolk steroid concentration and whole egg contaminants levels; both determinations should reflect levels in maternal serum. Clutches were collected from a clean and PCB-exposed colony. Concentrations of PCBs increased with laying order, but not significantly; concentrations of androgens also increased with laying order, and significantly only between egg 1 and eggs 2 and 3. The correlation between androgen or estrogen and PCB concentrations were low and not significant, and there was no difference between the exposed and clean colonies. These data show little evidence to support a contaminant cause for gonadal deformity mediated through a maternal endocrine mechanism in common terns.

French, J. B., Jr., M. A. Ottinger, B. A. Rattner, and P. Henry. 2000. Reproductive and developmental effects of polychlorinated biphenyls on American Kestrels: endocrine disruption? 7th International Symposium on Avian Endocrinology, Varanasi, India, January 23- February 2.

A lot of publicity about the action of "endocrine disrupters" in the United States and European nations, and a great deal of time and effort has been expended on developing programs for identifying chemicals with endocrine activity. For birds, there are very few studies on this issue to help determine if endocrine disruption is a likely mechanism in the wild, despite the initial plausibility of the mechanism. We have studied the effects of polychlorinated biphenyls (PCBs) on captive American kestrels at food concentrations that range from those likely to cause reproductive effects to those at the very low levels suggested to be responsible for effects through endocrine disruption. PCBs are one of the most ubiquitous and toxic industrial contaminants; they are very stable environmentally and biologically, and are highly lipophilic, hence biomagnify up trophic levels. We dosed breeding pairs and measured responses on the F1 generation at several stages of development, from hatching through breeding. Reproduction in the parental generation was impaired at the highest dose (mean of 80 ppm in eggs), but not at the lower dose (means of 9.4 ppm in eggs). Gonadal development appeared normal in surviving fledglings. Reproduction of the siblings of these F1 birds was not different among the dose groups and there was little evidence of difference in plasma steroid concentration during breeding. Hence, we found little evidence for "endocrine disruption" by PCBs, a widespread contaminant that is of great environmental interest. Some evidence exists for endocrine effects in other birds or by other chemicals.

French, J. B., Jr. and M. B. Voltura. 1999. A review of the use of a bioenergetics approach for evaluating sublethal effects of environmental contaminants. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Analysis of energy budgets at the level of individual organisms and extrapolation to population effects is a well-developed approach in ecology. The advantages of a bioenergetics approach in wildlife toxicology include the possibility of providing a mechanistic basis for sublethal effects, and the ability to compare contaminants to other ecological parameters (e.g. fluctuating food supply) as to their effect on energetically costly life history events, most importantly growth and reproduction. A review of the literature reveals a preponderance of studies have used these concepts to interpret effects of contaminants on aquatic organisms (mainly mussels and Daphnia); one important result is the demonstration that "scope-for-growth" (the amount of energy in the budget available for growth) can be compromised with exposure to a variety of contaminants. Several investigators have used these results as the basis for modeling individual growth and reproduction, and extrapolated the results to population growth rates. Much less work has been done using terrestrial vertebrates. Several studies in diverse taxa have estimated contaminants exposure using energetics models of food intake; fewer studies have attempted to measure the various components of an animal's energy budget when exposed to contaminants. The availability of these well-developed concepts that are so appropriate for the challenges of

wildlife toxicology would seem to be a strong inducement for more research on the bioenergetics of contaminants exposure.

Ginsberg, H. S. 1999. Use of the Procter survey as a baseline to assess faunal change on Mount Desert Island. Maine Biological & Medical Sciences Symposium, Jackson Laboratory, Bar Harbor, ME, May 6-7.

Golden, N. H., M. A. Ottinger, B. A. Rattner, J. B. Cohen, and L. M. Loges. 1999. A new website for ecotoxicological risk assessment of vertebrate species residing in estuaries. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

The Biomonitoring of Environmental Status and Trends program is designed to assess and monitor the effects of environmental contaminants on biological resources. As part of this program, the threat of contaminants and other anthropogenic activities to terrestrial vertebrates residing in or near coastal estuarine ecosystems is being evaluated by analysis of retrospective data and active field monitoring. Written summaries of biological characteristics and contaminant exposure and effects of data have been completed for 25 terrestrial vertebrates residing in estuaries, and made available on the world wide web. Species were selected based on the belief that they are valued natural resources and as representatives of various taxonomic groups. The characterizations were compiled from over 725 references obtained from numerous computerized literature searches, and total over 300 pages in length. The purposes of this undertaking are at least twofold. First, as a handy reference guide, these species characterizations will assist biologists that routinely evaluate environmental contaminant issues. For example, upon receipt of results from a monitoring study, a natural resource manager might ask, "What is the biological significance of 1 µg/g PCB in the heron egg, and how does this value compare to concentrations historically reported in this species?" Secondly, the characterizations are being used as a "base data set" to qualitatively and quantitatively rank the relative suitability and sensitivity of various species for their utility in regional biomonitoring of estuaries. This website is a valuable tool for resource managers and scientists in assessing the threat of contaminants to terrestrial vertebrates. The website address is: http://www.pwrc.usgs.gov/bioeco/

Golden, N. H., M. A. Ottinger, B. A. Rattner, P. C. McGowan, S. R. Schmidt, J. E. Iacobucci, and K. C. Parsons. 1999. Metal concentrations in feathers of nestling Black-crowned Night-Herons (*Nycticorax nycticorax*) in Chesapeake and Delaware Bays. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Over the past decade, destruction and degradation of wetland habitat has contributed to the decline of wading bird colonies on the Atlantic Coast. In 1998, an initial assessment of the possible contribution of metal pollution to declining heron populations in Chesapeake and Delaware Bays was conducted. Study sites included two heronries in industrialized locations (Pea Patch Island, DE and Baltimore Harbor, MD), and a reference site (Holland Island) remotely located in the southern Chesapeake Bay. Concentrations of 19 metals, metalloids, and trace elements were examined in blood and breast feathers of 14-16 day old nestling black-crowned night-herons. Metal concentrations in blood were low and showed few site differences, though mercury was elevated at Pea Patch Island as compared to other sites. In feathers, metal concentrations appeared to be in the low to moderate range at all sites, though limited data exist for interpreting pollutant concentrations in feathers of nestling wading birds. Where differences were detected, concentrations at Pea Patch Island were consistently greater than those at Baltimore Harbor and Holland Island. Feathers collected at Pea Patch Island had significantly greater concentrations of aluminum, barium, iron, lead, magnesium, and manganese. Breast feathers appear to be a useful and sensitive matrix in which to detect metal exposure and can be a valuable tool for non-invasive monitoring. Controlled exposure studies and additional feather monitoring in the Chesapeake are in progress, and will presumably aid in the interpretation of metal concentrations in feathers for this species.

Hahn, D. C. and R. J. O'Connor. 1999. Scaling of host and environmental patchiness in the distribution of Brown-headed Cowbirds. Symposium, "Predicting Species Occurrences: Issues of Scale and Accuracy", co-sponsored by USGS-BRD, FWS, USDA-FS, BLM, Wildlife Society, and American Fisheries Society, Snowbird, Utah, October 20.

Hammerschlag, R. S. 1999. Effects of deer herbivory upon regeneration of a hardwood bottomland forest. On the Frontiers of Conservation: The 10th George Wright Society Conference on Research and Resource Management in Parks and on Public Lands, Asheville, North Carolina, March 22-26.

A mature bottomland hardwood forest dominated by American beech and tulip poplar is located along the Patuxent River (Laurel, Maryland). Partial characterization has been achieved through a timber cruise (1946-1947) and 33 permanent plots (1992). High deer populations have recently impacted forest structure. Data concerning forest regeneration have been gleaned from a set of 10 exclosures (11M X 11M) and 10 controls split into two groups with each of 5 exclosures and controls being located under the canopy of either an American beech or tulip poplar. Data has been collected from four randomly selected subplots (1.8M X 1.8M) within each site for herbaceous plants: species, number of species and % cover; as well as seedlings: species, number and frequency of species, basal diameter and height. Importance values have been determined. Significant differences between vegetation from exclosures and controls were found for seedling height, number of seedlings and frequency of seedlings, but not for basal diameter. There was considerably less herbaceous cover and species in the control sites.

Hestbeck, J. B., A. Banner, J. R. Sauer, J. D. Taylor, H. P. Laskowski, and S. H. Giorgi. 1999. Predicting species occurrence at appropriate scales for management of U.S. Fish and Wildlife Service, Northeastern refuges. Predicting Species Occurrences: Issues of scale and accuracy, sponsored by USGS-BRD, U.S. Forest Service and others, Snowbird, Utah, October 18-22.

Hines, J. E., J. D. Nichols, and C. Schwarz, presenters. 1999. Workshop on Estimation of Animal Abundance and Related Parameters. Canadian Statistical Society, Regina, Saskatchewan, June 6.

Irwin, E. R., M. C. Freeman, B. J. Freeman, and J. J. Isely. 1999. Defining Flow Regime Criteria for Southeastern Rivers. Annual Meeting, American Fisheries Society, Charlotte, NC, August 29 - September 2.

Definition of flow regimes to protect fish communities and provide productive fisheries should involve collection of data over time to encompass variability in hydrologic regimes and fish population parameters. More often, instream flow negotiations are based on a necessarily incomplete understanding of mechanisms linking fish populations to hydrologic regimes, and then the resulting effects go unmonitored. Empirical relations between biological and hydrological parameters are being studied in several southeastern rivers with the potential to support adaptive flow management. Responses of fish assemblages to variously depleted and restored base flows and to short-term flow instability are providing insight to mechanisms of population persistence in altered flow regimes. Species-specific efforts include addressing depressed young-of-year recruitment by *Micropterus* and a *Moxostoma* species in hydropeaking regimes. Based on these longer-term studies, we identify biologically-critical aspects of the flow regime, including: incidence of prolonged, high spring flows, stable low flows during summer, and mitigation of low temperatures during hydropower production. We recommend using available biological data in conjunction with hydrologic data to develop adaptive management regimes for regulated southeastern rivers.

Jorde, D. G. 1999. Mid-winter waterfowl survey database in relation to management of habitat for Black Ducks on FWS Region 5 National Wildlife Refuges. US Fish and Wildlife Service Region 5 1999 Refuge Biologist Workshop, National Conservation Training Center, Shepherdstown, WV., March 31.

Jung, R. E., S. W. Droege, and J. R. Sauer. 1999. Amphibian survey techniques at Shenandoah and Big Bend National Parks. On the Frontiers of Conservation: The 10th George Wright Society Conference on Research and Resource Management in Parks and on Public Lands, Asheville, NC, March 22-26.

In response to concerns about widespread amphibian declines, a study evaluating and validating amphibian survey techniques was initiated in the spring of 1998 at two National Parks. Shenandoah and Big Bend National Parks were selected for their extremes in amphibian communities and environments (temperate deciduous forest and desert). The goals of the project are to: 1) test and validate amphibian survey methods, 2) assess relationships between amphibian distribution and abundance and environmental factors in the parks, and 3) propose standardized, long-term monitoring protocols. The project is funded by PRIMENet (Park Research and Intensive Monitoring of Ecosystems Network), an interagency effort of the EPA and NPS. The amphibian survey methods and questions addressed at the two parks differ dramatically. At Shenandoah

National Park, population size of terrestrial salamanders was estimated from mark-recapture using area-constrained searches under natural and artificial cover objects during the day. For stream salamanders, four survey methods (leaf litter bags, streamside transect searches, 1 m^2 quadrat searches, and electroshocking) were used throughout the Park. Survey methods evaluated at Big Bend National Park included area- and time-constrained searches at permanent springs and temporary rainpools, night driving after rains, chorus surveys using frog-loggers (automated tape-recording devices), and spotlighting for amphibians while canoeing the Rio Grande at night. We will discuss survey results, pros and cons of the survey techniques, and observer and sampling bias.

Jung, R. E., S. Droege, J. R. Sauer, J. Mitchell, M. Crossland, C. Leary, M. Larson, L. Raulerson, and M. Hagerty. 1999. Streamside amphibian survey method comparison in Shenandoah National Park. Joint Meeting of the American Society of Ichthyologists and Herpetologists, American Elasmobranch Society, Herpetologist's League, and Society for the Study of Amphibians and Reptiles, at Pennsylvania State University, State College, PA, June 24-30.

From June to August 1998, we evaluated the use of four survey methods (1 m^2 quadrats, leaf litter bags, 50 x 1 m transects, and electroshocking) for streamside amphibians at nine streams throughout Shenandoah National Park. The quadrats, leaf litter bags, and transects were run in transects adjacent to the electroshocking transects and two transects were conducted per stream. In general, the 50 x 1 m transects yielded the highest species richness. Certain techniques worked better for some species than others. For example, 1 m^2 quadrats always revealed the presence of and provided the highest counts of *Desmognathus monticola*. For other species (e.g., *Gyrinophilus porphyriticus*, *Pseudotriton ruber*), no single method consistently showed species presence or greatest abundance. *Eurycea bislineata* abundance differed among streams, but not among survey methods. The stream x survey interaction did not differ significantly, indicating that the survey methods showed similar bias or patterns of *E. bislineata* abundance. Electroshocking was not a reliable technique as a survey method, and the three-pass removal technique did not yield adequate estimates of population size. We will address sample size issues and variability in counts for the 1 m^2 quadrat and leaf litter bag techniques.

Keough, J., organizer. 1999. The State of Bay Science: Advances and Challenges for Aquatic and Wetland Resources of the Chesapeake Bay. A symposium presented at the annual conference of the Society of Wetland Scientists in Norfolk, VA, June 6-12.

Twelve invited speakers were included in the all-day program. Speakers were well-known experts on science, management, and policy from the Chesapeake Bay community. Speakers were drawn from federal agencies (EPA, USGS, FWS), academia (VIMS, Old Dominion Univ., Univ. Virginia), and from the Chesapeake Bay Program. Topics included many biological and environmental themes, as well as the use of science in developing management and policy.

Kirkland, G. L., Jr., M. J. Quinn, and J. B. French, Jr. 1999. Community ecology of forest-dwelling small mammals in a PCB-contaminated site, Indiana County, Pennsylvania. Pennsylvania Academy of Sciences, annual meeting, Pocono Manor, PA., April.

Forest small mammals were sampled during three growing seasons (1996-98) at a PCB-contaminated site (P2) and in a nearby control site (R) near Armagh, Indiana Co., Pennsylvania. Sampling was by live-trapping on 10 x 10 station (1 ha) grids with 1 Sherman and 1 Bolton trap per station and pitfalls at 25 evenly distributed stations. Overall, the two sites did not differ either in mean number of individuals captured per 3-day sampling period (P2 = 63.4; R = 67.4) or mean number of species (P2 = 6.8; R = 7.0). There was substantial year-to-year variation in abundance of small mammals but the variation was significant only in the PCB-contaminated site. There was no significant year-to-year variation in the abundance of rodents in either study plot; however, the abundance of shrews varied significantly among years in both study sites.

Kreger, M. and J. S. Hatfield. 1999. Behavioral profiles of the captive juvenile Whooping Crane *(Grus americana)* as an indicator of reintroduction behavior and survival [poster]. Earthwatch Conference, Harvard University, Cambridge, MA, November 11-14.

Kus, B., S. Rothstein, and D. C. Hahn. 2000. Beyond crisis management: a comprehensive plan for cowbird control in the U.S. The Wildlife Society Western Section meeting, session on "Bird Ecology and Conservation", San Diego, CA, January 10-13.

Brood parasitism by brown-headed cowbirds has been implicated in the declines of many sensitive bird species of the western U.S., including the endangered least Bell's vireo, black-capped vireo, golden-cheeked warbler, and southwestern willow flycatcher. Cowbird control in the form of trapping and removal of cowbirds from hosts' breeding areas is a large component of the management efforts to arrest and reverse these species' declines. While successful in increasing productivity and facilitating population growth in some(e.g. Bell's vireo) although not all (e.g. willow flycatcher) species, questions remain regarding the long-term value of cowbird control, and its role in the management of other species.

Concern regarding the impacts of parasitism on endangered species, and neotropical migrants in general, has achieved national prominence as evidenced by two recent conferences focusing on cowbird ecology and management. These conferences revealed the need for a coherent and comprehensive plan for evaluating the impacts of parasitism, and identifying appropriate management measures to control it. The National Cowbird Advisory Council, comprised of scientists and managers, was established to serve as a centralized information source on current control programs, with the goal of providing direction on when to initiate and terminate control, how to evaluate the need for and effectiveness of control, and procedures to employ. Ultimately, the objective of the Council is to facilitate development of a cowbird plan that goes beyond crisis management, is ecologically and economically sound, and coordinated across the various entities responsible for resource management.

Lasier, P. J., P. V. Winger, and K. J. Bogenrieder. 1999. Sensitivity of *Ceriodaphnia dubia* and *Hyalella azteca* to Manganese. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia November 14-18.

Manganese is a toxic element frequently overlooked when assessing toxicity of effluents, sediments and pore waters. Manganese can be present at toxic levels in anoxic solutions due to its increased solubility under chemically-reducing conditions, and it can remain at those levels for days in aerated test waters due to slow precipitation kinetics. *Ceriodaphnia dubia* and *Hyalella azteca* are freshwater organisms often used for toxicity testing and recommended for assessments of effluents and pore waters. Lethal and reproductive-inhibition concentrations of Mn were determined for *C. dubia* in acute 48h tests and chronic 3-brood tests using animals <24 h old and between 24 and 48 h old. Sensitivity of *H. azteca* was determined with 7d old animals in acute 96h tests. Tests were run at three levels of water hardness to assess the amelioratory effect, which was often significant. Manganese concentrations were measured analytically at test initiation and after 96 h for calculations of toxicity endpoints and determinations of Mn precipitation during the tests. Minimal amounts of Mn (below 3%) precipitated within 96 h. LC_{50}s determined for *H. azteca* progressively increased from 3.0 to 8.6 to 13.7 mg Mn/L in soft, moderately-hard and hard waters, respectively. The tolerance of *C. dubia* to Mn was not significantly different between moderately-hard and hard waters, but was significantly lower in soft water. There was no significant difference in Mn sensitivity between the ages of *C. dubia* tested. Acute LC_{50} values for *C. dubia* averaged 6.2, 14.5 and 15.2 mg Mn/L and chronic IC_{50} values averaged 3.9, 8.5 and 11.5 mg Mn/L for soft, moderately-hard and hard waters, respectively. Manganese toxicity should be considered when assessing solutions with concentrations near these levels.

Lasier P.J., P. V. Winger, K. J. Bogenrieder, and J. L. Shelton, Jr. 1999. Contaminant impacts to early life stages of the robust redhorse from the Lower Oconee River. 129th Annual Meeting, American Fisheries Society, Charlotte, NC, August 29 - September 2.

The robust redhorse *(Moxostoma robustum*) was rediscovered in the Oconee River, GA in 1991 after being thought extinct for over 100 years. The effects of contaminants and water quality in the Oconee River on survival of the early life stages of this species are unknown. The objectives of this study were to determine potential contaminant impacts through field and laboratory investigations. Toxicity tests of sediment, pore water and surface water from the Oconee River were conducted using surrogate species (*Hyalella azteca* and *Ceriodaphnia dubia*). Toxicities of selected sediments and their pore waters as well as trace metals (Cu, Cd, Zn, Mn) and NH_3 were determined for robust redhorse eggs, yolksac fry and swimup fry. Tests with surrogate species indicated surface waters to be as good or better than laboratory controls, sediments in the lower half of the reach were not toxic but impaired growth of *H. azteca*, and pore waters from all sites were toxic.

Manganese appears to be a possible cause of toxicity. Early life stages of the robust redhorse were generally equally or more tolerant of the trace metals and NH_3 than *H. azteca* and *C. dubia*. Data suggests that inputs from tributaries may adversely affect robust redhorse.

Leirs, H., J. Nichols, R. Julliard, N. G. Yoccoz, and R. Verhagen. 1999. The population dynamics of the multimammate rat in Africa. Norwegian Academy of Science and Letters Symposium: Dynamics in Time and Space: Basic and Applied Issues, Oslo, Norway, September.

Leung, Y.-F. and J. L. Marion. 1999. Solving recreation carrying capacity problems without use reductions: Some empirical examples. 1999 Congress on Recreation and Resource Capacity, Aspen, CO, November 29-December 3.

Resource impacts resulting from recreational and tourist activities have been a growing management problem in parks, wildernesses and other protected areas, increasingly challenging managers to find effective solutions to control such impacts while sustaining visitation. Traditionally, managers have looked for solutions from a carrying capacity perspective. In the past, their efforts have been directed at determining a numeric capacity for their resource. More recently, public debates continue to arise in numerous public land management planning efforts involving controversies related to use limitations embodied in planning documents. Decades of research and management experience in the park and recreation fields, however, have demonstrated that numeric carrying capacities and related use limitations are not always the most appropriate or effective response to visitation-related social or resource impacts. Rather, use reductions should be considered as one of many alternative options for addressing such troublesome recreation management problems.

The objective of this paper is to provide empirical support to the premise that management interventions other than use reductions can be effective in avoiding or minimizing visitation-related resource impacts. Campsite assessment results from several national parks where different management actions have been applied will be discussed and compared. These examples include Isle Royale National Park, Big Bend National Park, Great Smoky Mountains National Park, and Delaware Water Gap National Recreation Area. Factors that have contributed to the success and failure of these programs will be presented with discussions directed at the implications for other recreation settings such as trails and attraction areas.

Leung, Y.-F. and J. L. Marion. 1999. Research on recreational impacts in wilderness: A state-of-the-knowledge review. Wilderness Science in a Time of Change, sponsored by the U.S. Forest Service, Missoula, MT, May.

Leung, Y.-F. and J. L. Marion. 1999. Managing visitor use and impact along the Denali National Park Road, Alaska. On the Frontiers of Conservation: The 10th George Wright Society Conference on Research and Resource Management in Parks and on Public Lands, Asheville, NC, March 22-26.

Denali National Park in Alaska is one of a few NPS units that are managed to be a trailless wilderness. A 100-mile road, however, bisects the park, creating a front-country zone along the road corridor where a public transportation system is operated to accommodate visitor use and reduce its to wildlife. High levels of visitor use, coupled with unrestricted visitor front-country movement, have caused a growing management problem of proliferating and degrading visitor-created social trails within the road corridor. The objectives of this paper are: (1) to review this visitor impact problem in a management context, (2) to present preliminary results from an ongoing study that examines the relationship between visitor use and trail impact patterns, and (3) to evaluate alternative strategies for minimizing trail-related visitor impacts. Implications for trail management in protected areas are also provided.

Link, W. A. and J. R. Sauer. 1999. Multivariate models for avian population count data, with application to the North American Breeding Bird Survey. 9th Lukacs Symposium, Bowling Green, Ohio, April 24.

Marion, J. L. 1999. Visitor experience and resource protection: Selection of resource condition indicators. 1999 Congress on Recreation and Resource Capacity, Aspen, CO, November 29-December 3.

Newer carrying capacity decision frameworks require the selection of resource indicators for which standards may be established to identify the limits of acceptable change. This presentation reviews and applies indicator selection criteria to identify potential resource indicators for visitor impacts to trail and campsite resources. Assessment and monitoring techniques for selected indicators are also reviewed.

Marion, J. L. 1999. Resolving carrying capacity problems: A review of management strategies and actions. 1999 Congress on Recreation and Resource Capacity, Aspen, CO, November 29-December 3.

By virtue of their massive numbers, protected area recreationists pose a real and significant threat to the very resource they so cherish. This is particularly true at protected area attraction sites, campsites, and trails, where visitation and its effects are concentrated. Specific consequences of visitation to these areas include the trampling and subsequent loss of ground vegetation, shrubs, tree seedlings, and felling of saplings; erosion of surface litter and humus; exposure, erosion, and compaction of soil; and exposure of tree roots and damage to tree trunks.

Protected area managers recognize the need for visitor management and resource protection programs to balance visitation with its associated resource impacts. Expanding visitor use increasingly challenges managers to develop and implement management policies, strategies, and actions that permit recreational use of protected areas while preserving their ecological and aesthetic integrity. Three categories of influential factors and their potential for manipulation by managers are reviewed: use-related, environmental, and managerial factors. Use-related factors include type and amount of use and visitor behavior. Environmental factors include various physical and biological attributes (e.g., vegetation and soil type, topography, climate) that influence the type and extent of recreation impact. Managerial factors include visitor impact management strategies (e.g., dispersal vs. containment) and actions (e.g., development of visitor facilities, educational programs, regulations).

This review illustrates the large and diverse array of options available to managers for avoiding and reducing visitor impacts. Limiting visitor use, a traditional but controversial response to carrying capacity problems, can often be avoided by implementing one or more of these alternative actions. The selection of appropriate and effective management interventions must be guided by a thorough problem analysis so that actions will address the underlying causes of problems. Managers are also cautioned to consider the costs of implementation and costs to the quality of visitor experiences associated with alternative actions.

Marion, J. L. 1999. Resource capacity research: A state-of-knowledge review. 1999 Congress on Recreation and Resource Capacity, Aspen, CO, November 29-December 3.

This presentation reviewed recreation resource capacity research findings for implications related to carrying capacity determinations and management decision making. Visitor impacts to vegetation, soils, water resource, wildlife, and recreation experiences were reviewed, including their ecological, social, and managerial significance. Principle findings were reported and discussed in light of carrying capacity decision making.

Marion, J. L. 1999. Determining carrying capacities for ecotourism protected areas: Alternative frameworks and methods and 2) Monitoring and managing visitor impacts. The Mountain Institute course: Ecotourism and Protected Area Management in the Peruvian Andes, Huascaran National Park, Peru, June.

Presentation 1 reviewed the concept of carrying capacity and examined alternative management planning and decision making frameworks such as the Limits of Acceptable Change and Visitor Experience and Resource Protection. These management-by-objectives models employ indicators and standards for evaluating the acceptability of resource and social conditions. Monitoring objective data on current condition for selected biophysical and social indicators for comparison to established indicator standards. Application of these models to Central and South American protected areas was explored, with a focus on modifications needed to accommodate staffing and funding limitations common to popular ecotourism parks in developing countries. The second presentation reviewed the different types of resource impacts that can result from visitor use of protected environments and examined options available to managers for a) monitoring, and b) managing such impacts. Alternative monitoring approaches include photographic, qualitative condition class ratings, and quantitative multi-indicator assessments. Alternative management approaches include reducing or altering the type of visitor use, educating or regulating visitors to encourage low impact behavior, altering the timing of visitation, dispersing or concentrating visitation, encouraging use of resistant environments, and providing or enhancing facilities to increase resource resistance.

Marion, J. L. 1999. Recreation ecology research findings: Implications for Leave No Trace practices. Interagency Federal Land Manager course, Master of Leave No Trace, Philmont Scout Ranch and Explorer Base, Boy Scouts of America, Cimarron, NM, October.

This presentation provided an overview of the resource impacts of recreational visitation in protected environments. Recreational activities can alter vegetation, soils, wildlife, and water resources. Important relationships between the type and extent of recreation impacts with use related, environmental, and managerial factors were described. Implications for visitor education and Leave No Trace low impact hiking and camping practices were highlighted.

Marion, J. L. 1999. Recreation ecology research findings: Implications for Leave No Trace practices. Interagency Federal Land Manager course, Master of Leave No Trace, George Washington National Forest, Augusta Springs, VA, September.

This presentation provided an overview of the resource impacts of recreational visitation in protected environments. Recreational activities can alter vegetation, soils, wildlife, and water resources. Important relationships between the type and extent of recreation impacts with use related, environmental, and managerial factors were described. Implications for visitor education and Leave No Trace low impact hiking and camping practices were highlighted.

Marion, J. L. 1999. Camping management on the Appalachian Trail: Solutions for the 21st Century. The Appalachian Trail Biennial Conference, Radford, VA, July.

Visitation has reached record levels along the Appalachian Trail, a 2000+ mile footpath extending from Maine to Georgia along the crest of the Appalachian Mountains. Camping impacts associated with this use have also expanded rapidly in recent years, particularly in popular National Parks and at attraction features such as lakes and ponds. This presentation reviewed ecology research on camping impacts and their relationship to amount of use and environmental attributes. Management options for responding to camping management problems were described, including the manipulation of use-related, environmental, and managerial factors.

Marion, J. L. 1999. Trail design for environmental protection. Governor's Conference on Greenways and Trail, Roanoke, VA, May.

This presentation identified and reviewed the role of environmental factors that influence the degradation of trails. Key factors include soil and vegetation type, topography, and soil wetness. Practices for designing, constructing, and maintaining trails to minimize environmental degradation were highlighted.

Marion, J. L. 1999. Application of recreation ecology knowledge in developing backcountry camping policies in Shenandoah National Park. On the Frontiers of Conservation: The 10th George Wright Society Conference on Research and Resource Management in Parks and on Public Lands, Asheville, NC, March 22-26.

Shenandoah National Park has managed backcountry camping under a visitor dispersal policy since 1974, yet a 1992 survey of backcountry campsites located 725 campsites. One-third of these sites had lost sufficient vegetation cover and organic litter to expose soil and two-thirds of these sites were illegal by one or more of five campsite legality criteria (e.g., 56% of the sites were within sight of park trails). These findings raised questions about the effectiveness of visitor dispersal as a management strategy for minimizing resource impacts and promoting visitor solitude. Reasons for this lack of success are reviewed, as are current plans for implementing a new multi-option camping policy in 1999. The new policy is based on recreation ecology knowledge and emphasizes visitor containment in popular areas, dispersed pristine site camping in remote areas, and established site camping in intermediate use areas. Expectations for improved success in promoting resource protection and visitor solitude are presented and discussed.

Marion, J. L. and D. Watts. 1999. Leave No Trace, a national educational program that can expand recreation carrying capacity. 1999 Congress on Recreation and Resource Capacity, Aspen, CO, November 29-December 3.

This presentation reviewed the national Leave No Trace (LNT) program, an interagency educational effort designed to develop and communicate low impact ethics and skills for visitors to the federal lands. Topics included a review of the seven LNT principles, current program leadership and direction, training courses, and relevance to the carrying capacity and visitor management

McGary, S., M. A. Ottinger, and P. F. P. Henry. 1999. Effects of embryonic exposure to vinclozolin on reproductive behavior and endocrinology in Japanese quail. [poster]. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Melancon, M. J., G. F. Gee, G. Olsen, J. Russell, and S. Hereford. 1999. Nonlethal assessment of hepatic cytochrome P450 status of Mississippi Sandhill Cranes (*Grus canadensis*) at the Mississippi Sandhill Crane National Wildlife Refuge (MSCNWR). Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Because of problems with Mississippi sandhill cranes at MSCNWR that could be due to organic contaminants, we used Florida sandhill cranes as a surrogate species to develop cytochrome P450 as a marker for contaminant exposure. We previously reported (Proceedings of the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 1994, p. 179) about both monooxygenase activity and western blotting for P450 assessment, along with a surgical nonlethal liver sampling method. Early studies showed that normal Florida sandhill cranes raised at the Patuxent Wildlife Research Center (Patuxent) had surprisingly high levels of cytochrome P4501A (CYP1A), a cytochrome whose presence is not expected in animals that have not been exposed to certain classes of chemicals. Studies with both cranes and mallard ducks demonstrated that diet supplements (DS) normally administered to cranes reared at Patuxent are responsible for the CYP1A in the cranes at Patuxent. These methods have now been applied to Mississippi sandhill cranes captured and liver biopsied at MSCNWR. We found little monooxygenase activity, presumably due to the small amount of tissue available. However, western blotting, using an antibody developed against the major cytochrome P450 from beta-naphthoflavone-treated mallard ducks, showed the presence of low but measurable levels of a band that coincided with that appearing in beta-naphthoflavone-treated and DS-treated cranes at Patuxent. The band, approximately 1/3 to ½ of that found in DS-treated cranes, represents only a very low level of CYP1A. Thus, free-ranging Mississippi sandhill cranes appear to be exposed to a very low level of CYP1A-type inducers at MSCNWR. This agrees with previous contaminant assessments at MSCNWR.

Melancon, M. J., B. A. Rattner, D. J. Hoffman, T. Custer, D. Beeman, and D. Day. 1999. Comparison of basal and induced cytochromes P450 in 6 species of waterfowl. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Cytochrome P450-associated monooxygenase activities were measured in control and prototype inducer-treated mallard duck, black duck, wood duck, lesser scaup, Canada goose and mute swan. Ages of the birds ranged from pipping embryos (that were treated approximately 3 days before pipping) to adults. Three or more of the following hepatic microsomal monooxygenases were assayed in each species: Benzyloxyresorufin-O-dealkylase (BROD), Ethoxyresorufin-O-dealkylase (EROD), methoxyresorufin-O-dealkylase (MROD), and pentoxyresorufin-O-dealkylase (PROD). Baseline activities differed between species, but because of differences in ages, sources of the eggs or birds, and diets, these cannot be viewed as absolute differences. The cytochrome P450 inducers utilized were beta-naphthoflavone (BNF), 3-methylcholanthrene (3MC) and phenobarbital (PB). In general, there was little response to PB; only lesser scaup were induced to greater than three times control level and most species were well under this. Responses to BNF and 3MC occurred in each species studied, but differed in which of the monooxygenases was most induced (absolute values and ratios to control values) and in relative induction between species. BROD frequently had an induction ratio ÿ EROD. Overall, lesser scaup were the most responsive, Canada geese the least responsive, and the other species intermediate in responsiveness to the cytochrome P450 inducers studied.

Melancon, M. J. and J. Russell. 1999. Assessment of cytochromes P450 in hepatic microsomes of snapping turtles (*Chelydra serpentia*) captured in locations with a range of contaminant concentrations. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Snapping turtles were collected by the Ohio State EPA from six locations in Ohio believed to have different contaminant concentrations. Liver samples were maintained at 80C and shipped to the Patuxent Wildlife Research Center for cytochrome P450 assessment. Initially, pooled microsomes were used to determine appropriate incubation conditions for resorufin producing assays using a fluorescence microwell plate scanner. Fifty-four individual liver samples were then assayed for four dealkylases: Benzyloxyresorufin-O-dealkylase (BROD), Ethoxyresorufin-O-dealkylase (EROD), methoxyresorufin-O-dealkylase (MROD), and pentoxyresorufin-O-dealkylase (PROD). Microsome samples were also subjected to western blotting against antibodies for

CYP1A and CYP2B. EROD activity was highest, with MROD slightly lower, while both BROD and PROD were much lower. Significant correlations were observed among all four dealkylases and CYP1A. Comparison of EROD vs MROD gave the highest r value (0.949). Samples from two of the locations had much more CYP1A, whether assessed by monooxygenase activity or western blotting, than did samples from the other four sites. This work is part of a large project headed by the Ohio EPA and, as detailed contaminant data and other physiological and biochemical data become available, comparisons will be made between cytochrome P450 data and the other values.

Meyers, J. M. 1999. The Painted Bunting of Atlantic Coastal Barrier Islands: Can we reverse the population decline. Oconee Rivers Audubon Society, Athens, GA, November 4.

Meyers, J. M. and D. L. Miller. 1999. Time activity budgets of captive- and wild-reared bald eagle nestlings. American Ornithologists' Union meeting, Cornell University, August 12.

We hacked 22 bald eagle (*Haliaeetus leucocephalus*) chicks in northeastern Alabama from 1986-1988. Twelve eaglets originated from northern Florida and were transported, during early incubation, to captive-rearing facilities in Oklahoma. Later, at age 55-64 days, we transported the eaglets to hacking facilities in Alabama. Ten wild bald eagles were obtained, with estimated ages of 43-52 days, from nests in northern Florida and were placed at the same Alabama hacking facilities. During the nestling stage, eaglets gradually decreased use of artificial nests and increased use of perches. Preening activity peaked at about age 75 days. Higher maximum daytime temperatures may have depressed preening activity, feeding activity, and overall activity levels. All eaglets exhibited normal behavioral ontogeny and fledged successfully. Some differences in behavior associated with rearing method (captive or wild) were apparent. Wild-reared birds spent more time resting, and less time feeding. Captive-reared birds were more active and adapted quickly to the hacking cage. Wild-reared eaglets were more sensitive to disturbances. These differences may affect survival and return rates in restoration projects that use translocated wild-reared eagles.

Munro, R. E., L. M. Loges, K. Boone, and R. Eisler. 1999. Contaminant Hazard Reviews on CD [poster]. National meeting of the American Chemical Society in New Orleans, August 22-26.

Neckles, H. A. 1999. Developing regional standards for tidal wetland restoration in the Gulf of Maine. Maine Water Conference, Augusta, ME, April 15.

Human activities have altered, degraded, or destroyed many of the original tidal wetlands within the Gulf of Maine. Although emphasis is now on restoring these systems, the overall effectiveness of restoration efforts is uncertain. Project monitoring to gauge the return of ecological functions is uneven, due largely to the lack of funds, perceived need, and scientifically defensible evaluation criteria. Consequently, development of regional standards for evaluating the success of tidal wetland restoration efforts is being sponsored by the Global Programme of Action Coalition for the Gulf of Maine (GPAC), a US-Canadian partnership organized by the Commission for Environmental Cooperation under the auspices of the UN Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. We will compare tidal wetland characteristics between restoration and reference sites across the Gulf of Maine by applying a common sampling protocol to a regional network of sites. We will host a workshop in June, 1999, to establish sites, identify participants, and develop a protocol (common indicators, methods, and sampling designs) for data collection. The workshop result will include a common, regionally-applicable protocol for monitoring tidal restoration and reference sites in the Gulf of Maine.

Neckles, H. A. and D. M. Burdick. 1999. Restoration of coastal wetlands in the Gulf of Maine: results of a regional workshop. Estuarine Research Federation, Restore America's Estuaries, Northeast Regional Roundtable on the Science and Practice of Estuarine Habitat Restoration, Stamford, CT, June 21-22.

Human activities have altered, degraded, or destroyed many of the original tidal wetlands within the Gulf of Maine. Although emphasis is now on restoring these systems, the overall effectiveness of restoration efforts is uncertain. Contributing to this uncertainty are lack of a regionally coordinated mechanism for prioritizing restoration opportunities and lack of standard, scientifically defensible criteria for evaluating restoration success. A bi-national (US and Canada) project was initiated in 1999 to address these needs, sponsored by the Global Program of Action Coalition for the Gulf of Maine. The goals of this project are to develop a

comprehensive inventory of potential salt marsh restoration sites throughout the Gulf of Maine and to acquire a large data set by applying a common monitoring protocol to a regional network of restored and reference salt marsh sites. Comparisons of wetland characteristics between restored and reference sites will then be used to identify indicator variables of marsh function and to develop regionally applicable success criteria for restoration projects.

A workshop was held in June, 1999, to develop uniform inventory and monitoring protocols needed to establish regional networks. The first workshop product presented here is a model for inventorying potential salt marsh restoration opportunities in the Gulf of Maine, consisting of standard descriptors of site location and size, type of alteration, and the method and cost of planned restoration. This information will provide a basis for identifying those sites most appropriate for projects. The second workshop product is a common, regionally-applicable protocol for monitoring restored and reference salt marshes. The monitoring protocol consists of sampling methods and sampling designs for collecting data on a standard, minimum set of core variables related to marsh physical characteristics, vegetation, and fauna.

Nichols, J. D. 1999. Estimation of absolute and relative abundance of bird populations: general principles and specific applications for colonial waterbirds. Symposium on Waterbird Monitoring at the 22nd Annual Meeting of the Waterbird Society, Grado, Italy, November 8-12.

Investigations of avian population dynamics, and monitoring programs developed to inform management decisions, require estimates of absolute or relative abundance. Abundance estimates can be based on a variety of different count statistics. A near-universal characteristic of such count statistics is that they will not represent the entire population present in the sampled location. Instead, birds and nests have detection probabilities <1, and inferences about abundance require estimates or assumptions about these unknown probabilities. Many useful approaches exist for estimation of detection probabilities, and some of these can be tailored for use with colonial waterbirds. Sometimes, the area of interest is much larger than can be covered completely by survey methods. In these cases, the investigator must select an approach to sampling space that permits inference about the large area of interest. Sampling designs of potential use for colonial waterbirds are identified and discussed.

Nichols, J. D. 1999. Basic population modeling. Eastern Management Unit Mourning Dove Workshop, National Wildlife Visitors Center, Laurel, MD, October 19-20.

Nichols, J. D. 1999. Viewing communities through the foggy glasses of field sampling: Inference methods for community dynamics at geological and ecological time scales. A seminar presented at the Department of Environmental Sciences, University of Virginia, Charlottsville, VA, October 7.

Nichols, J. D. 1999. Challenges and opportunities for statisticians in wildlife population research. An invited paper, Canadian Statistical Society, Regina, Saskatchewan, June 8.

Nichols, J. D. 1999. The relative contributions of demographic components to population growth: A direct estimation approach based on reverse-time capture-recapture; Effects of habitat fragmentation on meadow vole populations: A field-experimental approach; Inference for animal community dynamics: Some methods and some results for mid-Atlantic forest birds. Three seminars presented at Colorado State University, Ft. Collins, April 14-16.

Nichols, J. D. 1999. Use of reverse-time capture-recapture for estimation of relative contributions of demographic components to population growth. Seminar presented at the University of Montana, Missula, April 1-2 .

Nichols, J. D., J. Clobert, E. Danchin, and A. Dhondt, organizers. 1999. The Evolution of Dispersal. A joint NSF-CNRS symposium held at the CNRS Station Biologique, Roscoff, France, April 24-30.

Nichols, J. D., P. J. Heglund, J. R. Sauer, J. Fallon, and F. Fallon. 1999. Incorporating habitat into estimations of avian detection probabilities based on the double-observer method. 2nd International Wildlife Management Congress, Godollo, Hungary, July.

Nichols, J. D., J. E. Hines, J.-D. Lebreton, R. E. Bennetts, R. Pradel, and W. M. Kitchens. 1999. Methods for studying dispersal using marked animals. The Evolution of Dispersal, a joint NSF-CNRS symposium held April 24-30 at the CNRS Station Biologique in Roscoff, France.

Nichols, J. D., J. E. Hines, J.-D. Lebreton, and R. Pradel. 1999. The relative contributions of demographic components to population growth: A direct estimation approach based on reverse-time capture-recapture. Statistics in Ecology and Environmental Monitoring Conference held in honor of professor George Seber, Otago, New Zealand, December 6-10.

Nichols, J. D., J. E. Hines, R. Pradel, and J.-D. Lebreton. 1999. Direct estimation of population growth rate and elasticity using capture-recapture data. 13th Annual Meeting of the Society for Conservation Biology in College Park, MD, June 19-20.

Nichols, J. D. and J. R. Sauer. 1999. Population monitoring of breeding birds. American Ornithologists' Union symposium in conjunction with the 117th Stated Meeting, Citizen Science: Two decades of progress and prospects for the volunteer in ornithology, Ithaca, New York, August 13-14.

Olsen, G. H. 1999. Using endoscopy to diagnose hatching problems in cranes. Annual Conference of the Association of Avian Veterinarians, New Orleans, Louisiana, August 31-Sept 4.

Just as with the adult avian patient, endoscopic examination of the egg was normally reserved for those cases experiencing problems. Problems were suspected based on history, physical examination, and in some cases, laboratory testing and radiology. History included the history of the parent birds and previous eggs from these birds. Physical examination of the egg was primarily from candling. Radiology was first used in 1988 at Patuxent Wildlife Research Center to diagnose problems in bald eagle eggs (*Haliaeetus leucocephalus*). Diagnostic radiology with whooping crane eggs (*Grus americana*) and sandhill crane eggs (*G. canadensis*) has been used since 1989 at Patuxent. Techniques for using radiology to diagnose problems in crane eggs were reported at last year's conference, and these techniques are useful for many other species.

Ottinger, M. A., M. A. Abdelnabi, P. F. P. Henry, S. McGary, N. Thompson, and J. B. French. 1999. Behavioral implications of contaminant exposure: neuroendocrine mechanisms. 2nd International Symposium on Environmental Endocrine Disruptors, Kobe, Japan, December 8-11.

Pattee, O. H., B. A. Rattner, R. Eisler, and V. L. B. D. L. Wegner. 1999. The role of contaminants and pollution in species decline. [poster]. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Members of over 1,200 taxa have been listed as Threatened or Endangered, and over 4,000 additional organisms have been identified as Candidate Species or Species of Concern. Both naturally-occurring and anthropogenic activities (e.g., environmental contaminants and pollution) have been demonstrated to be a significant factor in depressing populations or catalyzing the final crash of some species. The objective of this project is to develop a synthesis document and database that lists and ranks the presumed causes of decline, with special emphasis on contaminants and pollutant-related situations. This will be accomplished by a synoptic review of all recovery plans (n=517) with listing packages (n=1180) serving as a secondary source of information, followed by itemization, cross-referencing, enumeration, and ranking of contributing and limiting factors. To date we have analyzed most of the available recovery plans for freshwater mussels (n=39), reptiles (n=26), and amphibians (n=6). We categorized 116 reasons for the decline in freshwater mussels, subsuming them into 6 classes: habitat alteration/availability (44.4%); contaminants (24.1%); pollution (18.0%); exploitation/harvest (1.7%); introduction of exotic species (2.7%); miscellaneous others (9.2%). The 171 causes of decline for reptiles can be subsumed into the same categories: habitat alteration/availability (32.7%); contaminants (6.4%); pollution (9.9%); exploitation/harvest (28.7%); introduction of exotic species (11.1%); miscellaneous others (11.1%). The 34 causes for amphibian decline fall into 5 classes: habitat alteration/availability (50.0%); contaminants (5.9%); pollution (5.9%); exploitation/harvest (5.9%); miscellaneous others (32.3%). The contaminant and pollution related causes for the decline in mussels can be attributed to four classes of alterations: water quality (47.2%); effluents/spills (46.7%); biocides (3.3%); other toxic compounds (2.8%). For reptiles, the contamination and pollution factors can also be divided similarly: water quality (2.0%); effluents/spills (51.0%); biocides (27.5%); other toxic compounds (19.6%). The amphibian

data yields comparable results: water quality (16.67%); effluents/spills (16.67%); biocides (33.33%); and other toxic compounds (33.3%) as causes affecting amphibian decline. The applicability of these data is extensive, including facilitating reviews of Section 7 consultations and Environmental Impact Statements, reviewing permit applications, conducting environmental contaminant risk assessments, identifying specific data gaps and research needs, selecting potential management actions, and establishing priorities for broad-based research on limiting factors applicable to groups of species rather than the current species-by-species approach. However, caution must be exercised in the use of these data because of the speculative nature of the causes; most of the causes (66.5%) are based on poorly documented expert opinion and/or guesswork. This is particularly true of the contaminant/pollution categories where only 17.6% of the incidents are documented in the literature.

Perry, M. C., A. S. Deller, and A. M. Farrand. 1999. Effects of two long-term mowing regimes on vegetation. Second Eastern Native Grass Symposium, Baltimore Convention Center, Baltimore, MD, November 18.

Wildlife managers have for many years been interested in the role of mowing as a management technique to benefit wildlife. Two long-term mowing regimes (60 years of similar management) were evaluated at Patuxent Research Refuge during the summer of 1997 to better understand the influence of mowing on vegetation communities. Mowing ceased in 1997 due to reduction in maintenance funds, which facilitated the identification of mature grasses. The previous mowing regimes included (1) lawn areas that had been mowed with rotary mowers approximately every 24 weeks and (2) meadow areas that had been mowed approximately once a year with a brushhog. Each regime had two replications. Vegetation was sampled in 20, 1 m^2 plots per area (n=80) and percent cover visually estimated by species. The percent ground cover of the dominant vegetation on the lawn area was 40.0% red fescue (*Festuca rubra*), 26.5% white clover (*Trifolium repens*), and 18.0% Kentucky blue grass (*Poa pratensis*). The percent ground cover of the dominant vegetation in the meadow area was 33.2% meadow fescue (*Festuca elatior*), 9.9% sweet vernal grass (*Anthoxanthum odoratum*), 9.2% orchard grass (*Dactylis glomerata*), 6.3% Japanese honeysuckle (*Lonicera japonica*), and 5.2% red fescue. The sites were sampled again in 1999 with the major difference being the absence of white clover in the lawn areas, believed to be a result of the drought conditions in recent years. All percent ground covers for the dominant vegetation were significantly different ($P<0.01$) between the two mowing regimes. Species richness was higher in both years in the meadow regime (74, 62) versus the lawn regime (33, 23). Frequently mowed lawn areas may provide better grazing forage for herbivores, such as geese, rabbits, and deer, however, meadow areas may provide greater plant biomass (232 vs. 63 g/m^2) and greater diversity of plant species. The meadow regime also appeared to have greater seed production and cover, which is favored by a wider variety of wildlife species, especially passerine birds and small mammals.

Perry, M. C., A. S. Deller, S. B. Pugh, and P. C. Osenton. 1999. Mammal use of restored wetlands as an index of biological integrity. Wetlands '99 Symposium - Restoration: Applying Restoration Science, Association of State Wetland Managers, Annapolis, MD, October 25-27.

Mammals were surveyed during 1997 and 1998 at 17 restored wetlands on the Eastern Shore of Maryland to evaluate these vertebrates as an index to biological integrity (IBI) of restored wetlands. Trapping techniques included use of Sherman Live Traps and pitfall traps for small mammals. Standard humane box traps were used to capture medium-sized mammals. A total of 14 mammal species was captured in traps and four additional species were seen, but not captured. Trapping was a good technique to determine comparative mammalian species richness of these areas. The meadow vole (*Microtus pennsylvanicus*) and the house mouse (*Mus musculus*) were the most commonly trapped small mammals on newly restored habitats. Raccoons (*Procyon lotor*) were the medium-sized mammal most frequently trapped on all habitats surveyed. The presence of some species seemed related to the use of land immediately adjacent to the wetland. Size of wetland did not appear to be a factor affecting species richness. Mammal diversity and numbers obtained from trapping can be used as a good technique to evaluate the habitat quality and management activities. However, mammal use alone is not sufficient as an IBI for restored wetlands and should be used in conjunction with other biotic and abiotic parameters when assessing the success of restored wetlands.

Perry, M. C. and R. S. Hammerschlag. 1999. Deer herbivory in hardwood forests of Patuxent Research Refuge, MD. Northeast Fish and Wildlife Conference, Manchester, NH, April 11-14.

Large portions of the hardwood forest at Patuxent Research Refuge (Laurel, MD) consist of mature communities that have had no tree cutting for approximately 140 years. There are numerous large specimen trees of many species and some have been U. S. record trees. When Patuxent Research Refuge was established in 1936 there were no white-tailed deer *(Odocoileus virginianus*) on the Refuge or in that part of Maryland. Deer were reintroduced in Maryland in the 1940s, but did not reach problem population levels at Patuxent until the 1970s. Populations of deer increased during the 1980-90s and now are at record levels of over 40 deer per hectare. Exclosures and paired control plots were established in 1992 to evaluate the impact of deer herbivory on the bottomland hardwood forest, especially in regard to seedling recruitment. Results of several vegetation surveys in exclosures were compared to paired controls outside exclosures and indicate that major seedling depression has occurred and that all native woody species seem to be impacted. Woody species that appears to be doing well despite heavy browsing in the area are the exotic barberry (*Berberis thunbergii*) and the native paw paw (*Asimina triloba*). There also are numerous historically common herbaceous plants that have not been reported in control plots, but now are being recorded in low numbers in the exclosures. Herbaceous plants in the bottomland understory that seem to be avoided by deer include an exotic grass (*Microstegium vimineum*) and an exotic mint (*Perilla frutescens*). There also is information that populations of migratory birds that are dependent on understory vegetation for nesting have declined during the breeding season. Special harvests of deer are being conducted to reduce the impact of the deer on the forest. Long-term vegetation surveys will provide more information on the role deer herbivory is having on the hardwood forest.

Perry, M. C. and P. C. Osenton. 1999. Emergent and woody vegetation at the Patuxent Wildlife Visitor Center Constructed Wetland Treatment System. Wetlands for Wastewater Recycling Conference, Baltimore, MD, November 4-5.

A 6-acre tertiary wastewater treatment facility consisting of seven water storage pools, 14 treatment cells, and a constructed forested wetland was constructed in 1993-94 at the National Wildlife Visitor Center in Laurel, MD. The facility is unique in that it is the first known wastewater treatment system that uses a combination of emergent and woody plants in treatment cells (30 x 150 feet each) in combination with a constructed forested wetland (2 acres) to remove nutrients from wastewater. Eight of the cells were planted with a variety of broad- and narrow-leaved emergent plants and six of the cells were planted with three species of woody plants. The cells were designed to facilitate research on nutrient removal from wastewater by plants. Current studies in the 14 cells are determining the survival and growth of the various herbaceous and woody transplants and the volunteer plants. Based on percent ground cover after five growing seasons, none of the broad-leaved emergents (Cells 14) covered more than 10% of the ground and the total cover for all five species was only 14%. Olney threesquare (*Schoenoplectus americanus*) and river bullrush (*Bolboschoenus fluviatilis*) formed 14.2% and 12.5%, respectively, of the ground cover for the narrow-leaved emergent plants (Cells 58) and total ground cover for all five species was 46%. Soft rush (*Juncus effusus*) and woolgrass (*Scirpus cyperinus*) were the predominant volunteer species in the cells. Based on percent survival, buttonbush (*Cephalanthus occidentalis*) was the most successful among the woody plants in the six woody plant cells, and bald cypress (*Taxodium distichum*) was the most successful among the woody plants in the created forested wetland. Overall, however, woody plant mortality was over 80% in both areas. Nutrients (nitrate, ammonia, and phosphate) in water samples declined in concentration as water moved through the system from the upper to the lower end. The open system has the added advantage of being a haven for a variety of wildlife species that utilize the plants and invertebrates thriving in the area. Visitors to the National Wildlife Visitor Center frequently use the area for observation of plants and wildlife.

Perry, M. C., P. C. Osenton, and N. Allen. 1999. Macroinvertebrates in wetlands of tertiary treatment facility in Maryland. Wetlands for Wastewater Recycling Conference, Baltimore, MD, November 4-5.

Macroinvertebrates using eight wetland cells (30 x 150 feet) of a 6-acre tertiary wastewater treatment facility in Laurel, MD were surveyed to determine species diversity and overall abundance in regard to vegetation type and nutrient levels in the water. Four of the cells (#14) were planted with broad-leaved emergent plants and four cells (#58) with narrow-leaved emergent plants. Collections of macroinvertebrates were taken with net sweeps through the emergent vegetation and upper substrate in open water depths # 8 inches. Separate collections were made at the inflow and outflow ends of each cell. A total of 25 taxa were identified in the cells. More taxa (23 vs. 14) and more individuals (157 vs. 34) were collected in the cells with broad-leaved compared to the narrow-leaved emergent plants. More taxa (20 vs. 17) and more individuals (120 vs. 71) were collected in the outflow end compared to the inflow end of the cells. The differences noted in the locations are believed to be

related to the greater amount of open water that was noted in the broad-leaved plant cells and the outflow end of all cells. However, nutrients (nitrate, ammonia, and phosphate) in water samples declined in concentration as water moved through the system from the upper to the lower end. Nutrient levels in the cells were relatively low and were probably not a major factor in regard to macroinvertebrate distribution. All taxa collected and identified represent organisms that are tolerant of moderate to gross organic contamination using Hilsenhoff's classification. No organisms intolerant of organic pollution were identified. Dominant taxa were the mayfly *Callibaetis* (30.4%) and the scavenger beetle *Tropisternus* (15.1%). In another survey, flying dragonflies (ODONATA) were identified on the wing or when perched on vegetation to determine their relationship to plant species and nutrient levels in the water. Results of the dragonfly observations were similar to the net sweep data in regard to location of organisms. The emergent cells provide abundant numbers of macroinvertebrates that are utilized by a diversity of wildlife at the facility.

Perry, M. C., P. C. Osenton, G. A. Gough, and E. J. R. Lohnes. 1999. Establishment of warm season grasses with and without the use of compost soil amendments. Second Eastern Native Grass Symposium, Baltimore Convention Center, Baltimore, MD, November 18.

Two compost materials (COMPRO and LEAFGRO) were evaluated as soil amendments to enhance wildlife habitats, while maintaining optimal floral and faunal biodiversity. Special emphasis was placed on the role of compost in the establishment and retention of native warm season grasses (*Andropogon gerardi, Schizachyrium scoparium*, and *Sorghastrum nutans*). This study was conducted at two sites that were degraded by previous military and farming operations. Sites were plowed twice in 1996 and then a one inch layer of COMPRO or LEAFGRO was applied with a modified manure spreader and disked into the soil to a depth of 3 inches. Vegetation sampling was conducted in 1996, 1997, 1998, and 1999. Initially the greatest vegetation cover occurred in plots treated with LEAFGRO. Plots treated with COMPRO had less vegetation cover than both types of controls plots (with and without warm season grasses). The reduced plant growth in the plots treated with COMPRO may have been related to the much higher soil pH of these plots on both sites. In subsequent years, amounts of warm season grasses increased, however, in general there was more cover of warm season grasses in plots that did not receive compost than those that did receive compost. *Sorghastrum nutans* was more abundant on the sites than either of the other two species of warm season grasses. Invertebrate and mammal data collected for three years indicated that there was not more faunal activity in the plots treated with LEAFGRO or COMPRO compost soil amendments. Results indicate that compost amendments did not improve establishment of warm season grasses and the resultant faunal diversity or abundance.

Porter, J., R. M. Erwin, B. Watts, and B. Truitt. 1999. Landscape ecology of colonial waterbirds in the Virginia Coast Reserve [poster]. Ecological Society of America, Spokane, WA, August.

Powell, L. A., M. J. Conroy, J. E. Hines, J. D. Nichols, and D. G. Krementz. 1999. Simultaneous use of mark-recapture and radio telemetry to estimate survival, movement, and capture rates. Annual Meeting, Association of Field Ornithologists, Ottumwa, Iowa, September.

Rattner, B. A., N. H. Golden, J. B. Cohen, L. M. Loges, and M. A. Ottinger. 1999. Contaminant exposure and effects--Terrestrial Vertebrates Database: a web-based risk assessment tool [invited interactive poster]. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

In order to examine the condition of terrestrial vertebrates in Atlantic coast estuaries, a “Contaminant Exposure and Effects--Terrestrial Vertebrates” database (CEE-TV) has been compiled through computerized search of published literature, review of existing databases, and solicitation of unpublished reports from conservation agencies, private groups, and universities. The database is being developed as part of the Biomonitoring of Environmental Status and Trends (BEST) program of the US Geological Survey. Summary information has been entered into the 101-field database, including species, collection year (1965-present), site coordinates, estuary name, sample matrix, contaminant concentrations, biomarker and bioindicator responses, and reference source. This relational database can be directly queried or imported into a Geographic Information System to examine spatial patterns and identify data gaps and areas of concern. Currently, the CEE-TV database contains 3,699 records representing 190 vertebrate species and >140,000 individuals residing in estuaries from Maine through Florida. Information on birds make up the vast majority (83%) of the database, with only a modicum of data on amphibians (<0.1%). Of the >75,000 chemical compounds in commerce, only 118 commonly measured environmental contaminants were quantified in tissues of terrestrial vertebrates. There

are no CEE-TV data records in 15 of the 67 estuaries in the study area. Applications of the CEE-TV database include focusing biomonitoring efforts to generate critically needed ecotoxicological data in the numerous “gaps” along the coast, reducing uncertainty about contaminant risk, identifying areas for mitigation, restoration or special management, and ranking ecological conditions of estuaries. It will be available on the world wide web for database queries by September 1999.

Rattner, B. A., J. S. Hatfield, P. C. McGowan, C. S. Hong, and S. Chu. 1999. Organochlorine contaminant exposure and reproductive success of black-crowned night- herons (*Nycticorax nycticorax*) nesting in Chesapeake Bay. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

The declining size of the Baltimore Harbor black-crowned night-heron (BCNH) colony has been hypothesized to be linked to PCB exposure as evidenced by high concentrations of toxic coplanar PCB congeners and cytochrome P450 induction in embryos, and substantial accumulation rates of PCBs in nestlings (ETC 16:2315-2322, 1997). In 1998, a “sample egg” was collected from 65 nests (each containing $\geq$ three eggs) at the Baltimore Harbor BCNH colony for contaminant analysis, and the remaining eggs in these 65 nests, plus 4 two-egg nests, were monitored for hatching and fledging success. Eggs were also collected from 12 nests at a reference colony (Holland Island) in southern Chesapeake Bay. Samples were analyzed for 26 organochlorine pesticides and metabolites, total PCBs, and 145 PCB congeners. Pesticide and metabolite concentrations, including *p,p’*DDE, were well below thresholds associated with adverse reproductive effects. Average concentration of total PCBs, 12 *Ah* receptor-active PCB congeners, and Toxic Equivalents (TEQs) in eggs from Baltimore were greater (2- to 123-fold) than that observed at Holland Island. Despite substantial contaminant exposure, overall nest success in Baltimore Harbor was estimated by the Mayfield method to be 0.74. The mean number of young fledged/hen was 2.05, which exceeds the value necessary to maintain a stable BCNH population. Logistic regression is being used to determine if, and at what threshold concentration, total PCBs, coplanar congeners and TEQs adversely affect BCNH reproduction. Processes other than poor reproduction (e.g., impaired post-fledging survival, emigration) may be responsible for the declining size of the Baltimore Harbor colony.

Robbins, C. S. 1999. Conservation issues and citizen science. 2nd conference of the Bird Conservation Network (BCN) at Prairie State College, Chicago Heights, IL, November 13.

Topics included review of changing priorities in bird conservation in the 20th century, major unresolved environmental problems and opportunities for citizen science

Robbins, C. S. 1999. Harford County Bird Club's contributions to fifty years of conservation progress. 50th Anniversary meeting of the Harford County Bird Club, Churchville, MD, November 5.

An illustrated historical review of 50 years of activities of the Harford County Bird Club, a chapter of the Maryland Ornithological Society (MOS). Including: habitat protection (MOS's first sanctuary); education (lectures, field trips, junior nature camp, web site); training (banding, census techniques); scholarship program (sending teachers to Audubon nature camps); habitat protection in the tropics (Belize, Guatemala); participation in monitoring projects (Breeding Bird Survey, Winter Bird Survey, banding projects, raptor migration studies, Breeding Bird Census, Breeding Bird Atlas, Christmas Bird Count, nest records, migration counts); partnerships with other Harford County conservation organizations; support of county, state, and national conservation efforts; outlook for the future

Robbins, C. S. 1999. Using forest indicator bird species to designate conservation priorities. Invited paper, Symposium on the Ecology and Conservation of Birds in Fragmented Landscapes at the VI Neotropical Ornithological Congress, Monterrey, Mexico, October 8.

Robbins, C. S. 1999. La Conservacion de las Aves en el Siglo Veintiuno. Partners in Flight symposium at the VI Neotropical Ornithological Congress, Monterrey, Mexico, October 7.

Robbins, C. S. 1999. Taught a course on statistics and interpretation of data. VI Neotropical Ornithological Congress, Monterrey, Mexico, September 29 - October 2.

Robbins, C. S., B. A. Dowell, J. Bucklin, A. Cerezo, and I. Arias. 1999. Roadside and off-road transects to monitor tropical bird populations. VI Neotropical Ornithological Congress, Monterrey, Mexico, October 3-10.

162 species were recorded at 180 roadside stops in 4 years (1 visit per year). 99 of the 162 species detected (61%) were not recorded at any of the offroad stops on the Reserve and thus are unprotected at present. Conservation efforts by FUNDAECO will attempt to secure protection for critical habitats outside the Reserve in order to benefit some of these other species. The roadside count methodology presented a few logistical problems, but provided a rapid means of sampling extensive areas. Four years is too short a time for this small sample to detect population trends for individual species; no significant trends were detected among bird families, however. Bird distributions are mapped on satellite imagery to show relations between bird distribution and land use. Extensive commercial monocultures (rubber, gmelina) have notably poor species diversity, but in a normal year lightly grazed pasture has high diversity. 12 common species made up 50% of the bird population along the roadsides. In the forest, the 12 most common species represented only 45% of the population detected. 40% of the roadside species were found at less than 1% of the stops and can be classified as locally rare in the roadside habitats.

Robbins, C. S., B. A. Dowell, J. Bucklin, B. Cerezo, and I. Arias. 1999. Transectos al Borde del Camino y Fuera del Camino para Vigilar Poblaciones Tropicales de Aves [poster]. VI Neotropical Ornithological Congress, Monterrey, Mexico, October 7-9.

Royle, J. A., W. A. Link, and J. R. Sauer. 1999. Non-Gaussian spatial models for mapping species distributions. Symposium, "Predicting Species Occurrences: Issues of Scale and Accuracy", co-sponsored by USGS-BRD, FWS, USDA-FS, BLM, Wildlife Society, and American Fisheries Society, Snowbird, UT, October 20.

Sauer, J. R. 1999. Presentation on survey design and estimation of species richness from survey data. Workshop on "Causes and Extent of Declines Among Native Invertebrate Pollinators: Detection, Evidence and Consequences," at the National Center for Ecological Analysis and Synthesis, Santa Barbara, CA, October 8-10.

Sauer, J. R. 1999. A Critical Look at National Monitoring Programs for Birds and Other Wildlife Species. Bat Population Monitoring Workshop in Estes Park, CO, September 19-23.

Concerns about declines in a variety of taxa have created a great deal of interest in survey development. Because birds have traditionally been monitored by a variety of methods, bird surveys form natural models for development of surveys for other taxa. Here, I suggest that most bird surveys are not appropriate models for survey design. Most lack important design components associated with estimation of population parameters at sample sites or with sampling over space, leading to estimates that may be biased. I discuss the limitations of national bird monitoring programs designed to monitor population size. Although these surveys are often analyzed, careful consideration must be given to factors that may bias estimates but cannot be evaluated within the survey. The bird surveys with appropriate designs are generally components of management programs that have specific information needs. The experience gained from bird surveys provides important information for other taxa, and statistical developments in estimation of population sizes from counts provide new approaches to overcoming the limitations evident in many bird surveys. Design of surveys is a collaborative effort, requiring input from biologists, statisticians, and from the managers who will use the information from the surveys.

Sauer, J. R. 1999. Validation of existing monitoring methods. A Capstone Presentation at the Status and Trends National Program Review, Tucson, AZ, May 17-21.

Sauer, J. R., J. Hines, J. D. Nichols, J. Fallon, W. A. Link, and I. Thomas. 1999. Summary and use of information from bird surveys: Analyses of regional and local bird populations and their habitats. US Fish and Wildlife Service Region 5 1999 Refuge Biologist Workshop, National Conservation Training Center, Shepherdstown, WV, March 31. The presentation is available on the Internet at: http://www.mbr-pwrc.usgs.gov/demo3/slide1.htm.

Sauer, J. R. and W. A. Link. 1999. Analysis and comparison of Mourning Dove population surveys in the (Eastern) United States. Eastern Management Unit Mourning Dove Workshop, National Wildlife Visitors Center, Laurel, MD, October 19-20.

Sauer, J. R. and W. A. Link. 1999. Analysis and comparison of Mourning Dove population surveys in the United States. [poster]. American Ornithologists' Union 117th Stated Meeting, Ithaca, NY, August 12.

Sauer, J. R. and W. A. Link. 1999. Estimating regional abundance and population trajectories from count data. An invited paper, 9th Lukacs Symposium at Bowling Green, OH, April 24.

Sauer, J. R. and J. D. Nichols. 1999. Statistical aspects of design of amphibian monitoring programs. A workshop designed to assist in development of a plan for amphibian monitoring and research on DOI lands, Seattle, WA, July 13-15. Available online at: http://www.mbr-pwrc.usgs.gov/amphib/amphib.htm.

Sauer, J. R., J. D. Nichols, J. E. Hines, T. Boulinier, C. H. Flather, and W. L. Kendall. 1999. Regional variation in detection probabilities of species counts from the North American Breeding Bird Survey. 2nd International Wildlife Management Congress, Godollo, Hungary, July.

Sauer, J. R., J. D. Nichols, and W. A. Link. 1999. Detection of changes in populations and faunas. An invited paper, USDA/DOI Joint Workshop on Declining Pollinators, Logan, UT, May 27-28.

Smith, G., J. Nichols, and H. Viljugrein. 1999. Spatial and temporal dynamics in North American waterfowl. Norwegian Academy of Science and Letters Symposium: Dynamics in Time and Space: Basic and Applied Issues, Oslo, Norway, September.

Sparling, D. W., P. T. Lowe, A. E. Pinkney, L. Mazanti, and D. Day. 1999. Bridging the gap: Field investigations under a controlled setting [poster]. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

A common criticism of laboratory investigations is that they lack reality that is, they cannot approach the myriad combinations of species, chemicals and other environmental factors that can influence any response under "natural" conditions. On the other hand, strictly field investigations are criticized for exactly the opposite problem that there are too many factors or that "real" controls cannot be identified. For the past 10 years we believe we have found a workable compromise by conducting research in a set of 24 constructed wetlands which are of sufficient size to allow for natural variation but small and uniform enough to permit realistic controls and study designs. By carefully regulating the type of studies that occur in these wetlands - only contaminants with very short environmental half lives are used - we have been able to conduct investigations on the effects of acidification and soil on metal uptake in aquatic macrophytes and amphibians; mosquito control chemicals on non-target invertebrates; amphibian malformations caused by pesticides; and the interactive effects of insecticides and herbicides on amphibian populations. Such sites are not without problems, however, in that it may be difficult or impossible to conduct studies on wide ranging species such as blackbirds or on species which need large areas from which to feed such as waterfowl without substantial artificial enhancement of the complex.

Spendelow, J. A. 1999. The Falkner Island Tern Project (FITP) and related research on the birds of the Stewart B. McKinney NWT, Guilford, CT [poster]. Stewart B. McKinney National Wildlife Refuge, Falkner Island Open House, September 11.

Spendelow, J. A. and I. C. T. Nisbet. 1999. Implications of recent research to the management and recovery of Roseate Terns. Annual meeting of the Society for Conservation Biology, University of Maryland, College Park, June 17-21.

Recovery of the endangered Northwest Atlantic Roseate Tern breeding population has been slow since listing in 1987. Results from a cooperative multi-site population dynamics and ecology project in the warm-water region (New York - Massachusetts) have shown that factors thought responsible for past population declines (competition for colony sites/predation by gulls, capture by humans in winter) probably are not main causes of this population's (a) short-term crash between 1991-92, (b) continued concentration into a few large colonies, and (c) slow rate of increase. Instead, (a) typical annual mortality (17%) of breeding adults is relatively high despite a recent lack of significant human predation, and can be much greater in years of catastrophic events, (b) concentration into few productive colonies probably results from limited distribution of nearby foraging areas

where Roseate are not out-competed by Common Terns, (c) the slow increase probably results mainly from the combination of high postfledging mortality and a skewed sex-ratio which reduces productivity from the potential of all male-female pairs. Some management techniques to increase productivity have been successful, but we suggest the critical need for further studies of foraging and winter ecology, and that more care be taken in choosing colony restoration sites.

Springborn, E. G. and J. M. Meyers. 1999. Survival, home range and movements of Painted Buntings in managed pine-oak forest and maritime shrub habitat on Sapelo Island, GA. American Ornithologists' Union meeting, Cornell University, Ithaca, NY, August 12.

The Painted Bunting (*Passerina ciris*) is a species of high concern in the southeast because of population declines and habitat loss. Managers need information on critical habitats to maintain bunting populations. Survival and home range provide information on habitat quality. We radio-tracked 45 Painted Buntings on Sapelo Island, GA, from April to July, 1997 and 1998, to determine survival and home range. We studied after-hatching-year female and after-second-year male buntings in a managed pine-oak forest (age 60 yr) and in an unmanaged maritime shrub habitat by homing to radio-marked birds and recording GPS locations. We calculated survival using the Kaplan Meyer method and we used ArcView's animal movement extension to determine home ranges (95% volume) using the fixed kernel method. Painted Bunting survival was high for both habitat types (>90%). Home range analysis show that an interaction between bird sex and habitat may be present ($P = 0.079$). Mean home range size varied from 3.12-6.95 ha, with buntings in the managed pine-oak forest having a larger home range than buntings in the shrub-scrub habitat ($P = 0.01$). Birds of the managed pine-oak forest flew long distances (>800 m) to coastal marshes, wetlands, and moist forest clearings. In maritime shrub habitat, buntings occupied a compact area and rarely moved long distances. This research suggests that buntings in managed habitat may require a larger home range.

Tautin, J. 1999. The application of banding in large-scale monitoring of birds in North America. [Poster]. USGS-BRD Status and Trends Program Review, Tucson, AZ, May.

Tautin, J., M. Gustafson, L. Metras, and E. Welling. 1999. The redesign of electronic data management in the North American bird banding program. Bird Ringing 100 Year Conference, Helgoland, Germany, October.

Twedt, D. J. and W. B. Uihlein, III. 1999. Landscape level reforestation priorities for forest breeding landbirds in the Mississippi Alluvial Valley. Ecology and management of bottomland hardwood systems: the state of our understanding. Memphis, TN., March 11-13.

Twedt, D. J. and R. R. Wilson. 1999. Avian colonization of bottomland hardwood afforestation in the Mississippi Alluvial Valley. The Wildlife Society 6th Annual Conference, Austin, Texas, September 8-11.

Twedt, D. J., R. R. Wilson, C. Best, P. B. Hamel, and S. Schweitzer. 1999. Habitat restoration for migratory landbird conservation: species and local issues. Management of migratory landbirds: state of knowledge and research needs. Southeast Partners in Flight, Biloxi, MS., January 28-30.

Voltura, M. B. and J. B. French, Jr. 1999. Reproduction of female white-footed mice *(Peromyscus leucopus)* exposed to low levels of dietary PCBs [poster]. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Exposure to contaminants can reduce fitness not only by preventing breeding, but also by affecting the way animals allocate energy to reproduction. Exposure to toxic compounds is likely to be metabolically expensive, and energy spent on detoxification is not available for reproduction. We fed diets containing PCBs to female white-footed mice (*Peromyscus leucopus*), and examined measures of reproductive energetics. Females that had already weaned one litter were fed diets containing PCBs (2:1 Aroclor 1242:1254) at 0, 10 or 25 ppm. After 3 months, females were bred again. Pups did not have access to the mother's food, and were weaned at 21 days. On the control diet, 13 out of 14 females had litters; 12 raised them to weaning. Fifteen out of 16 females on the 10 ppm diet had litters; 12 raised them to weaning (2 lost litters for known reasons unrelated to dose). Only 11 out of 16 females on the 25 ppm diet had litters, but all successfully weaned their pups. There was no effect of PCB dose on litter size at birth or weaning. Although there were no differences in maternal body mass on the day of parturition or at weaning, pups from 10 ppm females were significantly

heavier on days 1, 7, 14 and 21 of age ($p<0.05$), but differences disappeared by day 28. Despite producing larger pups, females on the 10 ppm diet did not eat more during lactation. Although PCB exposure did not increase total energy need during lactation, as measured by food intake, the higher mass of pups from females on the 10 ppm diet indicates a greater energy allocation to reproduction.

Voltura, M. B. and J. B. French, Jr. 1999. Energetic cost of dietary exposure to polychlorinated biphenyls (PCBs) for white-footed mice, *Peromyscus leucopus.* [poster]. Society of Integrated and Comparative Biology, January 6-10.

Contaminant exposure is an environmental factor often overlooked in ecological studies. Yet exposure to toxicants is likely to be metabolically expensive, and result in a trade-off between energy spent to detoxify and excrete contaminants, and energy allocated to growth or reproduction. To quantify the energetic cost of PCB exposure, we fed mice diets containing 0, 0.1, 10 and 25 ppm PCBs (mg PCBs/kg food). After 6 weeks, there were no differences in food intake or body mass related to the level of dietary PCBs. We continued to feed mice the PCB diets for one year, and then measured food intake and resting metabolic rate. After one year, all mice had gained mass, but mice on the 25 ppm diet were significantly heavier than mice in the other groups. Mice on the 25 ppm diet also showed an increase in both food intake ($p=0.06$) and metabolic rate ($p=0.01$), after correction for differences in body mass. Food intake averaged 4.1 g/d for mice on the 25 ppm diet, compared to 3.7 g/d for control mice. Oxygen consumption at 30EC averaged 40.1 ml O_2/h for mice on the 25 ppm diet, compared to 36.6 ml O_2/h for control mice. These results show that for white-footed mice, there is an energetic cost to contaminant exposure that when combined with other environmental stresses, will influence patterns of energy acquisition and allocation.

Wilson, R. R. 1999. Migratory bird conservation initiatives in the Mississippi Alluvial Valley. Hattiesburg, MS. Audubon Society, October 7.

Wilson, R. R., J. M. Oliver, D. J. Twedt, and W. B. Uihlein, III. 1999. Reforestation in the Mississippi Alluvial Valley: concepts and goals for the future. Ecology and management of bottomland hardwood systems: the state of our understanding, Memphis, TN, March 11-13.

Wilson, R. R. and D. J. Twedt. 1999. Bottomland hardwood establishment and avian colonization of reforested sites in the Mississippi Alluvial Valley. Ecology and management of bottomland hardwood systems: the state of our understanding, Memphis, TN, March 11-13.

Wilson, R. R. and D. J. Twedt. 1999. Avian colonization of reforested areas in the Mississippi Alluvial Valley [poster]. Management of migratory landbirds: state of knowledge and research needs. Southeast Partners in Flight, Biloxi, MS, January 28-30.

Wilson, R. R. and D. J. Twedt. 1999. Tree and avian colonization of reforested bottomland hardwood sites in the Mississippi Alluvial Valley. Ecology and management of bottomland hardwood systems: the state of our understanding, Memphis, TN, March 11-13.

Winger, P. V. and P. J. Lasier. 1999. Management effects on chemistry and toxicity of wetland sediments at Savannah National Wildlife Refuge, GA and SC [poster]. Society of Environmental Toxicology and Chemistry, 20th Annual Meeting, Philadelphia, November 14-18.

Wetlands associated with many National Wildlife Refuges (NWR) are managed by the U.S. Fish and Wildlife Service for use by migratory waterfowl. The Savannah NWR in coastal Georgia and South Carolina seasonally floods impoundments for optimal growth and seed production of plants used for forage. Periodically, the impoundments are allowed to dry after draw down and undesirable vegetation in some areas is burned or disked. The effects of these management practices on wetland sediments are not completely known. To assess their effects, sediments from undisturbed, burned and disked areas within selected impoundments were collected for chemical and physical analyses and evaluation of solid-phase (28d exposure) and pore water (96 h) toxicity using the freshwater amphipod *Hyalella azteca*. Survival of *H. azteca* in solid-phase sediment from the different treatment areas was not significantly different from laboratory controls, but survival was markedly reduced in pore water, especially those with low pH (# 4), low alkalinity (< 20 mg/L), high sulfate (> 1200 mg/L), high specific conductance (> 1000 µS/cm), and elevated concentrations of major cations (Ca, Fe, K, Mg, Mn).

Significantly higher concentrations of trace elements, such as Pb and Ni, in pore water from these sites may be available for uptake by plants and animals. The acidic conditions of sediments showing toxicity and reduced pore water quality were characteristic of sulfidic wetland sediments. The variability in toxicity and chemistry among impoundments may reflect temporal and spatial differences in management applications. Periodic drying of the sediments coupled with disking and burning of the vegetation may facilitate decomposition of organic matter and enhance accumulation of sulfur and acidic conditions in these wetland sediments.

Woodrey, M. S., W. Barrow, K. Ouchley, S. E. Maybe, C. Riley, F. R. Moore, and R. R. Wilson. 1999. What we know and don't know about habitat associations of migrating birds. Management of migratory landbirds: state of knowledge and research needs. Southeast Partners in Flight, Biloxi, MS., January 28-30.

Wright, T. F., C. A. Toft, M. Albornoz, S. Beissinger, V. Berovides A., A. T. Brice, J. Eberhard, E. Enkerlin-Hoeflich, X. Gálvez A., J. Gilardi, J. Gonzalez-Elizondo, K. Joyner, S. E. Koenig, P. Martuscelli, J. M. Meyers, K. Renton, A. M. Rodríguez, A. Rodríguez-Ferraro, F. Rojas-Suárez, V. Sanz, A.C. Sosa-Asanza, S. Stoleson, A. Trujillo, F. Vilella, and J. W. Wiley. 1999. Nest poaching in Neotropical parrots: A meta-analysis. Annual meeting of the Society for Conservation Biology, University of Maryland, College Park, June 17-21.

Although the harvest of parrot chicks for the pet trade is thought to be a factor in the decline of many species, its importance has been the subject of much debate. We examined rates of mortality due to nest poaching in 19 studies of neotropical parrots. We studied 3960 nesting attempts in 17 species and 11 countries between 1979-98. We found substantial rates of nest poaching: 13 studies reported poaching rates of 20% or greater, and four studies reported greater than 70% of nests poached. Only three studies had no documented nest poaching. Overall 32% of all nesting attempts failed due to capture of the chicks by humans. Poaching rates were significantly greater than rates of mortality due to natural causes. Three studies afforded direct comparisons between poaching at sites with active nest protection (i.e. enforcement of prohibitions against poaching) versus sites without such protection. In all three studies poaching rates were significantly lower at protected sites, suggesting that active protection efforts can be effective in reducing nest poaching. There was no correlation between US retail price for a given species and the level of poaching it experienced. Most species, however, were valued at over US $500; the two species that had retail prices below $500 experienced no poaching. These result indicate that poaching of parrot chicks for the pet trade is a widespread and substantial source of nest mortality in neotropical parrots.

Ziewitz, J. W. and M. C. Freeman. 1999. Beyond Minimum Flows: Assessing Interstate Water Allocation Proposals in the Southeastern U.S. Annual Meeting, American Fisheries Society, Charlotte, NC, August 29 - September 2.

The states of Alabama, Georgia, and Florida are negotiating water allocation formulas under the Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallapoosa River Basin Interstate Compacts, created by federal legislation in 1997. Many reaches of these two large interstate basins are highly altered by dams, pollution, and exotic species; however, both basins rank high nationally in aquatic species richness and many reaches retain much of their native biodiversity. The future of this biodiversity may largely depend on how the states affect flow regimes through their water allocation decisions. Using the results of hydrologic models developed by the states, we compare simulated river flow under the states' various allocation proposals to observed flow records and to a synthesized unimpaired flow data set. We interpret the biological significance of these comparisons using available data to relate flow regime alterations with effects on riverine biota. In particular, we present evidence for the biological significance of frequency, duration, and timing of low- and high-flow pulses, regime features not usually addressed in instream flow investigations or policies. We recommend that the state negotiators adopt allocation formulas that protect water quality and minimize alterations to natural flow regimes through limits on water consumption and controls on reservoir operations.