USGS Patuxent Wildlife Research Center

Current Research Products

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September 1997 — February 1999

Banks, R.C. 1997. In memoriam: John Warren Aldrich, 1906-1995. Auk 114(4):748-751.

Berdeen, J.B. and D.G. Krementz. 1998. The use of fields at night by wintering American woodcock. Journal of Wildlife Management 62(3):939-947.

Because limited information is available regarding preferences for nocturnal habitat during winter, we studied use of nocturnal habitats by American woodcock (*Scolopax minor*) wintering in the Georgia Piedmont (1994-95). During the evening crepuscular period, woodcock on the wintering grounds move from forested to field habitats, presumably to feed, conduct courtship displays, roost, and avoid predators. We conducted crepuscular flight surveys and tracked radio-marked woodcock to compare the use of fields of different sizes (<5.5 ha, 5.540.0 ha, >40.0 ha) and types (seed tree-clearcuts, fallow-old fields, hayfields, pastures). Fields $\geq$ 5.5 ha were used more frequently than fields <5.5 ha ($P < 0.001$). Seed tree-clearcuts and fallow-old fields were more frequently used than pastures ($P = 0.003$). Woodcock also most frequently used fields with greater foliage volume at 0.82.0 m in height and a high percentage of bare soil ($P < 0.001$). Nocturnal use of fields or forests by radio-marked woodcock did not differ among age or sex classes. However, females moved an average of 230 $\pm$ 32.1 m between diurnal and nocturnal locations while males moved 525 $\pm$ 53.1 m ($P = 0.085$). Movements differed among moon phases ($P < 0.003$), ranging from 579 $\pm$ 79.6 m during the new moon to 213 $\pm$ 50.5 m during the full moon. To manage habitat on the wintering grounds, seed tree-clearcuts and fallow-old fields should be created or maintained near preferred diurnal habitats.

Beyer, W.N., D.J. Audet, J.K. Campbell, and L. LeCaptain. 1998. Lead exposure of waterfowl ingesting Coeur d'Alene River Basin sediments. Journal of Environmental Quality 27:1533-1538.

Feces from tundra swans (*Cygnus columbianus* [Ord]), Canada geese (*Branta canadensis* [L.]) and mallards (*Anas platyrhynchos* [L.]) were collected from the Coeur d'Alene River Basin and two reference areas to estimate exposure to lead from mining activities and to relate that exposure to the ingestion of contaminated sediments. The average acid-insoluble ash content of the feces, a measure of sediment, was 18% for Canada geese and tundra swans, and 12% for ducks. The 18% value corresponded to an estimated 9% sediment ingestion rate (dry weight). The 90th percentile for acid-insoluble ash in feces of tundra swans corresponds to an estimated 22% sediment in the diet. The average lead concentration (dry weight) of tundra swan feces from all Coeur d'Alene River Basin wetlands sampled was 880 mg/kg, compared to 2.1 mg kg^{1} from reference wetlands. The 90th percentile of lead in tundra swan feces from the Coeur d'Alene River Basin sites was 2700 mg kg^{1}. Fecal lead concentrations of tundra swans from Harrison Slough, the wetland studied in most detail, were correlated (Spearman's rho = 0.74, $p < 0.05$) with the acid-insoluble ash content of the feces. The very low lead concentrations in feces having low acid-insoluble ash contents established that the sediment was the primary source of the lead ingested by waterfowl. Sediment lead concentrations at 11 wetland sites were closely correlated ($r = 0.91$, $p < 0.05$) with average fecal lead concentrations for all waterfowl, corrected for the average percent acid-insoluble ash in the feces. The regression equation describing this relation, along with estimates of sediment ingestion, provides a straight-forward means of estimating the current exposure of waterfowl to lead and of predicting the potential exposure of waterfowl to lead under plans to clean up the contaminated sites.

Beyer, W.N., D. Day, A. Morton, and Y. Pachepsky. 1998. Relation of lead exposure to sediment ingestion in mute swans on the Chesapeake Bay, USA. Environmental Toxicology and Chemistry 17(11):2298-2301.

Forty-two mute swans (*Cygnus olor*) were collected from unpolluted portions of central Chesapeake Bay in spring 1995. Their intestinal digesta were analyzed for 13 metals (Al, B, Ba, Cd, Cu, Fe, Mg, Mn, Ni, Pb, Sr, V, Zn) and for acid-insoluble ash, a marker of sediment. Because metal concentrations in digesta depend on recent exposure, they are appropriate for evaluating local contamination. Swan livers and sediment samples also were analyzed for the same metals.

Group method of data handling demonstrated that the digesta Al was the best predictor of digesta Pb, and that adding concentrations of other metals as predictors did not improve the accuracy of the estimates of Pb concentrations from Al concentrations. The r^2 of the equation relating the log of digesta Pb to the log of digesta Al was 0.86, whereas the r^2 of the equation relating the log of digesta Pb to the log of digesta acid-insoluble ash was 0.50. Sediment ingestion was critical in determining exposure to Pb, as well as to some of the other metals, and should be considered in ecotoxicological risk assessments of waterfowl. The mean of 7.4% acid-insoluble ash in the digesta corresponded to an estimated 3.2% sediment in the diet. The Pb concentrations in the digesta were 2-3 times the concentration that would have been predicted from sediment Pb concentrations; presumably the swans had ingested clays high in Pb that had settled on the vegetation. The swans were not thought to have been exposed to high Cu concentrations but they had hepatic Cu concentrations that would be considered very high if found in other species.

Beyer, W.N., J.C. Franson, L.N. Locke, R.K. Stroud, and L. Sileo. 1998. Retrospective study of the diagnostic criteria in a lead-poisoning survey of waterfowl. Archives of Environmental Contamination and Toxicology 35:506-512.

Between 1983 and 1986 the National Wildlife Health Center (NWHC) conducted a nationwide study of lead poisoning of waterfowl from federal and state refuges. This survey was done to assist in identifying zones with lead-poisoning problems. One thousand forty one moribund or dead waterfowl were collected and examined. The presence or absence of 13 gross lesions selected as indicators of lead poisoning and 3 lesions indicating body condition was recorded. Lead-poisoning diagnoses were based on the finding of at least 6 8 ppm (wet weight) lead in the liver and either lead shot in the gizzard content or at least one convincing gross lesion indicative of lead poisoning. Four hundred and twenty-one of these waterfowl were diagnosed as lead-poisoned. The NWHC survey provided a comprehensive basis for estimating the sensitivities, specificities, and likelihood ratios of the gross lesions of lead poisoning and the associated hepatic lead concentrations for several species of waterfowl. Some of the 13 defined gross lesions were more common than others; frequencies ranged from 3% to 80% in the 421 lead-poisoned waterfowl. The most reliable indicators of lead poisoning were impactions of the upper alimentary tract, submandibular edema, myocardial necrosis, and biliary discoloration of the liver. Each of the 13 lesions occurred more frequently in the lead-poisoned birds, but each of the lesions also occurred in waterfowl that died of other causes. The number of lead shot present in a bird's gizzard was only weakly correlated with its hepatic lead concentration; however, this weak correlation may have been adequate to account for differences in hepatic lead concentrations among species, once the weights of the species were taken into account. Although lead-poisoned ducks tended to have higher hepatic mean lead concentrations than did lead-poisoned geese or swans, the differences were probably a result of a greater dose of shot per body weight than to kinetic differences between species. Hepatic lead concentrations were independent of age and sex. Ninety-five percent of waterfowl diagnosed as lead-poisoned had hepatic lead concentrations of at least 38 ppm, dry weight (10 ppm, wet weight). Fewer than 1% of the waterfowl that died of other causes had a concentration that high. This 5th percentile, of 38 ppm dry weight (10 ppm wet weight), is a defensible criterion for identifying lead-poisoned waterfowl when interpreting hepatic lead concentrations in the absence of pathological observations.

Blus, L. J. and J. W. Connelly. 1998. Radiotelemetry to determine exposure and effects of organophosphorus insecticides on sage grouse. Pages 21-29 *in* Larry Brewer and Kathleen Fagerstone editors. Radiotelemetry applications for wildlife toxicology field studies: Proceeding of the Pellston workshop on avian radiotelemetry in support of pesticide field studies, January 5-8, 1993. SETAC Special Publication Series SETAC Press, Pensacola, FL. xxiii, 201 pp.

Blus, L.J., M.J. Melancon, D.J. Hoffman, and C.J. Henny. 1998. Contaminants in eggs of colonial waterbirds and hepatic cytochrome P450 enzyme levels in pipped tern embryos, Washington State. Archives of Environmental Contamination and Toxicology 35(3):492-497.

Eggs of Forster's terns *(Sterna forsteri)* collected in 1991 from nesting colonies on Crescent Island (Columbia River) and the Potholes Reservoir in south central Washington generally contained low

residues of organochlorine pesticides and metabolites, 2,3,7,8-tetrachlorodibenzo-p-dioxin, 2,3,7,8-tetrachlorodibenzofuran, and polychlorinated biphenyls (PCBs). Hepatic cytochrome P450 enzyme activity in pipped embryos of Forster's terns from the two colonies seemed unaffected by contaminants. At Crescent Island, examination of 23 Forster's tern eggs with large embryos (19 viable [10 pipped] and four dead [two pipped]) revealed developmental abnormalities in two viable pipped embryos (missing maxilla and deformed pelvic girdle) and a viable prepipping embryos (shortened beak). Our limited sample sizes and number of compounds analyzed preclude us from determining whether or not the abnormalities are related to contaminants. No abnormalities were noted in 10 pipped eggs (nine viable and one dead at collection) of Forster's terns collected from the Potholes Reservoir colony. Eggs of Caspian terns *(Sterna caspia)* collected from Crescent Island in 1991 also contained generally low residues of contaminants, only one developmental abnormality was noted, and limited data indicated that cytochrome P450 enzyme activity apparently was unaffected by contaminants. Organochlorine contaminants were generally low in addled eggs of American white pelicans *(Pelecanus erythrorhynchos)* collected from Crescent Island in 1994

Blus, L.J., B.A. Rattner, M.J. Melancon, and C.J. Henny. 1997. Reproduction of black-crowned night-herons related to predation and contaminants in Oregon and Washington, USA. Colonial Waterbirds 20(2):185-197.

We studied reproductive characteristics of Black-crowned Night-Herons *(Nycticorax nycticorax)* at four colonies in south central Washington and one colony in north central Oregon in 1991. Nest success, adjusted using the Mayfield method, was significantly different between colonies and ranged from 12-84% to hatching and 12-73% to 14 days post-hatching. The mean number of young surviving to 14 days of age in each colony ranged from 0.47-1.94 per nesting female (includes recycling efforts that involve laying more than one clutch). They were marked intercolony differences in clutch size and incidence of recycling. Predation (primarily avian) was a major factor that adversely affected nest success in three colonies and was relatively unimportant in two colonies. Residues of DDE, total polychlorinated biphenyls, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and other compounds in eggs were generally low and apparently had little influence on reproductive success at any of the colonies. Mean eggshell thinning ranged from 7-1 1 % in comparison to a pre-1947 norm for eggs measured in museum collections. Cytochrome P450 enzyme (EROD, PROD, and BROD) induction in livers of pipped embryos by colony ranged from low to average in comparison with other colonies throughout the U.S. Average EROD and BROD activities were highest at Sand Dune Island and were lowest at Potholes Reservoir which was designated the reference colony. In relation to our study of three of the five colonies in the early 1980s, residues of DDE and several related compounds appeared to decline, nest predation rates increased, and nest success decreased at all three colonies.

Boobar, L.R., P.J. Spangler, K.E. Gibbs, J.R. Longcore, and K.M. Hopkins. 1998. Predaceous diving beetles in Maine: Faunal list and keys to subfamilies. Northeastern Naturalist 5(1):1-20.

Records of predaceous diving beetles (Coleoptera: Dytiscidae) collected in Maine are summarized. These records are augmented by field surveys of beetles in Aroostook Co., Maine during 1993-95. Keys to subfamilies are presented with color plates for selected species. A list of diving beetles that have been collected near Maine (state or province) is presented so that investigators will know what additional species might be expected in Maine. Basic taxonomy is presented to facilitate use of keys.

Boulinier, T., J.D. Nichols, J.E. Hines, J.R. Sauer, C.H. Flather, and K.H. Pollock. 1998. Higher temporal variability of forest breeding bird communities in fragmented landscapes. Proceedings of the National Academy of Sciences of the U.S.A 95(13):7497-7501.

Understanding the relationship between animal community dynamics and landscape structure has become a priority for biodiversity conservation. In particular, predicting the effects of habitat destruction that confine species to networks of small patches is an important prerequisite to conservation plan development. Theoretical models that predict the occurrence of species in fragmented landscapes, and relationships between stability and diversity do exist. However, reliable empirical investigations of the dynamics of biodiversity have been prevented by differences in species detection probabilities among landscapes. Using long-term data sampled

at a large spatial scale in conjunction with a capture-recapture approach, we developed estimates of parameters of community changes over a 22-year period for forest breeding birds in selected areas of the eastern United States. We show that forest fragmentation was associated not only with a reduced number of forest bird species, but also with increased temporal variability in the number of species. This higher temporal variability was associated with higher local extinction and turnover rates. These results have major conservation implications. Moreover, the approach used provides a practical tool for the study of the dynamics of biodiversity.

Boulinier, T., J. Nichols, J.R. Sauer, J. Hines, and K. Pollock. 1998. Estimating species richness: The importance of heterogeneity in species detectability. Ecology 79(3):1018-1028.

Estimating species richness (i.e. the actual number of species present in a given area) is a basic objective of many field studies carried out in community ecology and is also of crucial concern when dealing with the conservation and management of biodiversity. In most studies, the total number of species recorded in an area at a given time is taken as a measure of species richness. Here we use a capture-recapture approach to species richness estimation with North American Breeding Bird Survey (BBS) data in order to estimate species detectability and thus gain insight about its importance. We carried out analyses on all survey routes of four states, Arizona, Maryland, North Dakota, and Wisconsin, in two years, 1970 and 1990. These states were chosen to provide contrasting habitats, bird species composition and survey quality. We investigated the effect of state, year and observer ability on the proportions of different models selected, and on estimates of detectability and species richness. Our results indicate that model M_h, which assumes heterogeneous detection probability among species, is frequently appropriate for estimating species richness from BBS data. Species detectability varied among states and was higher for the more skilled observers. These results emphasize the need to take into account potential heterogeneities in detectability among species in studies of factors affecting species richness.

Bowen, Z.H. and M.C. Freeman. 1998. Sampling effort and estimates of species richness based on prepositioned area electrofisher samples. North American Journal of Fisheries Management 18(1):144-153.

Estimates of species richness based on electrofishing data are commonly used to describe the structure of fish communities. One electrofishing method for sampling riverine fishes that has become popular in the last decade is the prepositioned area electrofisher (PAE). We investigated the relationship between sampling effort and fish species richness at seven sites in the Tallapoosa River system, USA based on 1,400 PAE samples collected during 1994 and 1995. First, we estimated species richness at each site using the first-order jackknife and compared observed values for species richness and jackknife estimates of species richness to estimates based on historical collection data. Second, we used a permutation procedure and nonlinear regression to examine rates of species accumulation. Third, we used regression to predict the number of PAE samples required to collect the jackknife estimate of species richness at each site during 1994 and 1995. We found that jackknife estimates of species richness generally were less than or equal to estimates based on historical collection data. The relationship between PAE electrofishing effort and species richness in the Tallapoosa River was described by a positive asymptotic curve as found in other studies using different electrofishing gears in wadable streams. Results from nonlinear regression analyses indicted that rates of species accumulation were variable among sites and between years. Across sites and years, predictions of sampling effort required to collect jackknife estimates of species richness suggested that doubling sampling effort (to 200 PAEs) would typically increase observed species richness by not more than six species. However, sampling effort beyond about 60 PAE samples typically increased observed species richness by < 10%. We recommend using historical collection data in conjunction with a preliminary sample size of at least 70 PAE samples to evaluate estimates of species richness in medium-sized rivers. Seventy PAE samples should provide enough information to describe the relationship between sampling effort and species richness and thus facilitate evaluation of a sampling effort.

Bowen, Z.H., M.C. Freeman, and K.D. Bovee. 1998. Evaluation of generalized habitat criteria for assessing impacts of altered flow regimes on warmwater fishes. Transactions of the American Fisheries Society 127(3):455-468.

Assessing potential effects of flow regulation on southeastern warmwater fish assemblages is problematic because of high species richness and our poor knowledge of habitat requirements for most species. A previous attempt to reduce the complexity of describing habitat requirements for diverse assemblages defined five "key habitat" types based on quantitative descriptions of depth, velocity, substrate, and cover for assessing the effects of streamflow alteration on fish communities. Our study investigated relationships between availability and temporal stability of key habitats and fish abundances at regulated and unregulated sites in the Tallapoosa River system. Fish assemblage characteristics at seven sites were quantified based on 1,400 electrofishing samples collected during 1994 and 1995. Simulations were used to model availability and temporal stability of key habitats at regulated and unregulated sites, Associations between fish assemblages and availability or stability of key habitats were identified using correlation analysis. We found that hydropeaking dam operation reduced the average length of time that shallow-water habitats were stable during the spring and summer and also reduced year-to-year variation in the stability of shallow-water habitats compared to unregulated sites. Within-site comparisons of fish and habitat variables indicated that differences in fish abundances correlated with differences in the availability and temporal stability of shallow-water habitats. Additionally, groups of stream fishes defined by taxonomy or differences in orientation to the substrate and feeding mode responded similarly to changes in key habitat availability. These findings demonstrate that the temporal and spatial availability of key habitats could serve as a useful measure of the potential effects of flow alteration on lotic fish assemblages, and suggest that both short-term temporal stability of key habitats as well as annual variation in key habitat availability are important for maintaining diverse fish assemblages.

Bowen, Z.H., M.C. Freeman, and D.L. Watson. 1996. Index of biotic integrity applied to a flow-regulated river system. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 50:26-37.

Buckley, P.A., C.M. Francis, P. Blancher, D.F. DeSante, C.S. Robbins, G. Smith, and P. Cannell. 1998. The North American Bird Banding Program: into the 21st century. Journal of Field Ornithology 69(4):511-529.

Cam, E., J.E. Hines, J.-Y. Monnat, J.D. Nichols, and E. Danchin. 1998. Are adult nonbreeders prudent parents? The kittiwake model. Ecology 79(8):2917-2930.Understanding evolutionary consequences of intermittent breeding (non-breeding in individuals that previously bred) requires investigation of the relationships between adult breeding state and two demographic parameters: survival probability and subsequent breeding probability. One major difficulty raised by comparing the demographic features of breeders and nonbreeders as estimated from capture-recapture data is that breeding state is often suspected to influence recapture or resighting probability. We used multistate capture-recapture models to test the hypothesis of equal recapture probabilities for breeding and nonbreeding Kittiwakes and found no evidence of an effect of breeding state on this parameter. The same method was used to test whether reproductive state affects survival probability. Nonbreeding individuals have lower survival rates than breeders. Moreover, nonbreeders have a higher probability of being nonbreeders the following year than do breeders. State-specific survival rates and transition probabilities vary from year to year, but temporal variations of survival and transition probabilities of breeders and nonbreeders are in parallel (on a logit scale). These inferences led us to conclude that nonbreeders tend to be lower quality individuals. The effect of sex was also investigated: males and females do not differ with respect to survival probabilities when reproductive state is taken into account. Similarly, there is no effect of sex on transition probabilities between reproductive states. Chen, G., G. F. Gee, J. M. Nicolich, and J. Taylor. 1997. Semen collection and fertility in naturally fertile sandhill cranes. Page 258 (abstract) *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska. ix, 262 pp.

Clapp, R.B. 1997. Egg dates for Virginia birds. Virginia Avifauna No. 6. Virginia Society of Ornithology, Lynchburg, VA. iii, 123 pp.

Clark, D.R., Jr., C.M. Bunck, and R.J. Hall. 1997. Female reproductive dynamics in a Maryland population of ringneck snakes (*Diadophis punctus*). Journal of Herpetology 31(4):476-483.

Adult female ringneck snakes (*Diadophis punctatus*) collected from a Maryland population during five successive summers laid a total of 50 clutches in which all eggs hatched successfully under laboratory conditions. Mean hatchling mass was not significantly related to female mass or clutch size when each was evaluated in separate analyses, but was significantly related to these factors when they were evaluated in a joint analysis. Mean hatchling masses of 0.6-1 g appear most adaptive; when females are large enough to produce 1-g eggs, the tendency is to produce a larger number of relatively smaller eggs. The relationship of clutch mass to female mass was unaffected by clutch size. Reproductive effort, measured as relative clutch mass (RCM, clutch mass/female mass), increased with age, as indicated by snout-vent length (SVL); also, the relationship of clutch mass to female mass indicated that clutches equaled a larger percentage as female mass increased. Clutch size averaged 3.55 eggs and ranged from 2 to 6. Clutches were laid from 17 June through 21 July (35 d), median 2 July. Clutches hatched during the 20-d interval 8-27 August (median August 18). Larger clutches were laid earlier in the season on average than smaller clutches. Incubation periods for clutches averaged 47 (range 42-51) d. Clutches laid later in the season averaged shorter incubation periods than clutches laid earlier.

Clegg, K. R., J. C. Lewis, and D. H. Ellis. 1997 . Use of ultralight aircraft for introducing migratory crane populations. Pages 105-113 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska. ix, 262 pp.

Objectives were to determine if captive-reared cranes could be led behind an ultralight aircraft (UL) along a migration route and, if after release on a wintering area, they would integrate with wild cranes and migrate north in spring to their natal area without assistance. Greater sandhill cranes (*Grus canadensis tabida*) were used as the research surrogate for whooping cranes (*Grus americana*). In 1995, the senior author raised 15 cranes to fledging and trained them to respond to his vocal imitation of a sandhill crane brood call. Chicks learned to follow him as he walked, drove an all-terrain vehicle (ATV), or piloted an UL. The caretakers were not in crane costumes. Cranes were tame but allowed to roam at will without accompanying humans part of the day and were penned at night. Daily excursions provided exposure to habitats, foods, and predators the birds would encounter after release into the wild. In mid-October 1995, 11 radio-tagged cranes were led in migration from Grade, Idaho to Bosque del Apache National Wildlife Refuge (BdANWR), central New Mexico, and released near wild wintering sandhill cranes. The 1,204km migration took 11 days, including 1 day when the aircraft were grounded due to a winter storm. Hazards encountered enroute included mountainous terrain, turbulent air, and attacks by gold eagles (*Aquila chrysaetos*). On the wintering ground, hazards included crane hunters and coyotes (*Canis latrans*). Within 2 days after release at the BdANWR wintering site, the research cranes were associating with and imitating the behavior of wild cranes. The 4 surviving birds migrated north in spring 1996 and at the time of this writing 2 were within 53 km of their natal area in Idaho.

Committee on Classification and Nomenclature of the American Ornithologists' Union, R.C. Banks, chairman. 1998. Check-list of North American Birds: the species of birds of North America from the Arctic through Panama, including the West Indies and Hawaiian Islands. 7th edition. American Ornithologists' Union, Washington, DC. liv, 829 pp.

Conroy, M.J., J.D. Nichols, and E.R. Asanza. 1997. Metodos cuantitativas contemporancos para entender y manejar poblaciones y comunicades animales. Interciencia 22:247-258.

Custer, C.M., T.W. Custer, P.D. Allen, K.L. Stromborg, and M.J. Melancon. 1998. Reproduction and environmental contamination in tree swallows nesting in the Fox River drainage and Green Bay, Wisconsin, USA. Environmental Toxicology and Chemistry 17(9):1786-1798.

Concentration, accumulation, and effects of PCBs on reproduction in tree swallows (*Tachycineata bicolor*) were studied at four sites in the Fox River drainage and in Green Bay, Lake Michigan, Wisconsin in 1994 and 1995. Total PCBs in eggs and newly hatched young (mean = 3.01 µg/g wet weight, years and sites combined) and 12-day-old nestlings (mean = 2.34 µg/g wet weight) at two contaminated sites (Kidney Island and Arrowhead) were higher than concentrations at two reference sites, (Lake Poygan and High Cliff State Park, years and sites combined, pippers mean = 0.26 µg/g, nestlings mean = 0.01 µg/g). Concentrations of eleven PCB congener were also higher at contaminated compared to reference sites. PCBs accumulated in nestlings at a higher

rate (1.34 6.69 µg/day) at contaminated sites compared to reference locations (0.06 0.42 µg/day). DDE was the only other organochlorine found in all samples; concentrations for all samples averaged ≤ 0.20 µg/g wet weight. Total PCBs and p,p'DDE concentrations did not differ among clutches where all eggs hatched, some eggs hatched, and no eggs hatched.

Custer, T.W., R.K. Hines, P.M. Stewart, M.J. Melancon, D.S. Henshel, and D.W. Sparks. 1998. Organochlorines, mercury, and selenium in great blue heron eggs from Indiana Dunes National Lakeshore, Indiana. Journal of Great Lakes Research 24(1):3-11.

In 1993, 20 great blue heron (*Ardea herodias*; GBH) eggs (one per nest) were collected from a colony at the Indiana Dunes National Lakeshore, Indiana (INDU). The eggs were artificially incubated until pipping and were then analyzed for organochlorines, mercury and selenium. Livers of embryos were analyzed for hepatic microsomal ethoxyresorufin-O-dealkylase (EROD) activity. Brains were measured for asymmetry. Egg-laying began in early April and the mean clutch size was 4.2 eggs per clutch. Organochlorine concentrations were generally low (geometric mean p,p'DDE = 1.6 µg/g wet weight; polychlorinated biphenyl [PCB] = 4.9 µg/g); however, one egg had elevated concentrations of p,p'DDE (13 µg/g) and PCBs (56 µg/g). EROD activity in the embryos analyzed from INDU was not elevated. The frequency (11%) of brain asymmetry was low. Eggshells on the average were 3.4% thinner than eggshells collected prior to the use of DDT. Mercury (geometric mean = 0.9 µg/g dry weight) concentrations in GBH eggs were within background levels. Selenium (4.0 µg/g dry weight) concentrations in eggs were above background levels, but below a concentration threshold associated with reproductive impairment.

Droege, S. 1999. Birds and landscape changes in Northeastern forests. Pages 185-186 *in* M. J. Mac, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran, editors. Status and trends of the nation's biological resources. Volume 1. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

Eisler, R. 1998. Copper hazards to fish, wildlife and invertebrates: a synoptic review. Biological Science Report USGS/BRD/BSR--1997-0002, Contaminant Hazard Reviews Report 33, U.S. Department of the Interior, Geological Survey. iv, 99 pp.

Selective review and synthesis of the technical literature on copper and copper salts in the environment and their effects primarily on fishes, birds, mammals, terrestrial and aquatic invertebrates, and other natural resources. The subtopics include copper sources and uses; chemical and biochemical properties; concentrations of copper in field collections of abiotic materials and living organisms; effects of copper deficiency; lethal and sublethal effects on terrestrial plants and invertebrates, aquatic organisms, birds and mammals, including effects on survival, growth, reproduction, behavior, metabolism, carcinogenicity, matagenicity, and teratogenicity; proposed criteria for the protection of human health and sensitive natural resources; and recommendations for additional research.

Eisler, R. 1998. Nickel hazards to fish, wildlife and invertebrates: a synoptic review. Biological Science Report USGS/BRD/BSR--1998-0001 and Contaminant Hazard Reviews Report 34 . U.S. Department of the Interior, Geological Survey. 76 pp.

This account is a selective review and synthesis of the technical literature on nickel and nickel salts in the environment and their effects on terrestrial plants and invertebrates, aquatic plants and animals, avian and mammalian wildlife, and other natural resources, The subtopics include nickel sources and uses; physical, chemical, and metabolic properties of nickel; nickel concentrations in field collections of abiotic materials and living organisms; nickel deficiency effects; lethal and sublethal effects, including effects on survival, growth, reproduction, metabolism, mutagenicity, teratogenicity, and carcinogenicity; currently proposed nickel criteria for the protection of human health and sensitive natural resources; and recommendations for additional research.

Eisler, R. 1998. Contaminant hazard reviews. [Reports No. 1-28 on CD-ROM.]. U.S. Department of the Interior, U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD.

This compact disc (CD) contains the first 28 reports in the Contaminant Hazard Reviews (CHR) that were published originally between 1985 and 1994 in the U.S. Department of the Interior Biological Report series. The CD was produced because printed supplies of these reviews--a total of 84,000--became exhausted and demand remained high. Each review was prepared at the request of environmental specialists of the U.S. Fish and Wildlife Service and each contained specific information on mirex, cadmium, carbofuran, toxaphene, selenium, chromium, polychlorinated biphenyls, dioxins, diazinon, mercury, polycyclic aromatic hydrocarbons, arsenic, chlorpyrifos, lead, tin, index issue, pentachlorophenol, atrazine, molybdenum, boron, chlordane, paraquat, cyanide, fenvalerate, diflubenzuron, zinc, famphur, or acrolein. Each report reviewed and synthesized the technical literature on a single contaminant and its effects on terrestrial plants and invertebrates, aquatic plants and animals, avian and mammalian wildlife, and other natural resources. The subtopics include contaminant sources and uses; physical, chemical, and metabolic properties; concentrations in field collections of abiotic materials and living organisms; deficiency effects, where appropriate; lethal and sublethal effects, including effects on survival, growth, reproduction, metabolism, mutagenicity, teratogenicity, and carcinogenicity; proposed criteria for the protection of human health and sensitive natural resources; and recommendations for additional research.

Eisler, R., D. R. Clark, Jr., S. N. Wiemeyer, and C. J. Henny. 1999. Sodium cyanide hazards to fish and other wildlife from gold mining operations. Pages 55-67 *in* José M. Azcue, editor. Environmental impacts of mining activities: emphasis on mitigation and remedial measures. Environmental Science Series. Springer-Verlag, Berlin. xx, 300 pp.

Ellis, D.H. and R.L. Bunn. 1998. Caribou antlers as nest materials for golden eagles in northwestern Alaska. Journal of Raptor Research 32(3):268.

There are few published records of antlers in golden eagle (*Aquila chrysaetos*) nests. This note reports extensive use of caribou (*Rangifer tarandus*) antlers in three golden eagle nests in the Cape Kruzenstern region of northwestern Alaska. The importance of antlers to this population of eagles can be explained at least in part by (1) the lack of suitable woody vegetation on the open tundra, (2) the similarity of antlers to sticks, and (3) the abundance of antlers, especially cow caribou antlers, in the region.

Ellis, D. H., B. Clauss, T. Watanabe, C. Mykut, M. Kinloch, and C. H. Ellis. 1997. Results of an experiment to lead cranes on migration behind motorized ground vehicles. Pages 114-122 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska. ix, 262 pp.

Ten greater sandhill cranes (*Grus canadensis tabida*), trained to enter and ride in a specially equipped truck, were transported at 80± days of age from their rearing site at Patuxent Wildlife Research Center (Patuxent), Maryland, to a reintroduction site located within the species' former breeding range in northern Arizona. After 5 additional weeks of training, these juvenile cranes were led south ca 600 km to a wintering area on the Arizona/Mexico border. Nine of the 10 survived the trek, 495 km of which was flown, although only a few cranes flew every stage of the route. Their longest flight was 77 km. Major problems during the migration were power line collisions (three, one fatal), eagle attacks (none fatal), and overheating (when air temperatures exceeded ca 25°C). All cranes that entered training quickly learned to follow the truck, and their tenacity when following under unfavorable conditions (e.g., poor light, extreme dust, or heat) showed that cranes could consistently be led over long distances. We cannot predict if the cranes will retrace their route unassisted when adults, but 2 cranes returned 130 km to the starting point of the migration after the flock was scattered by an eagle during our migration south. Three other cranes were recovered 55 km from the attack site and on course toward the starting point.

Ellis, D.H., M.H. Ellis, and P. Tsengeg. 1997. Remarkable saker falcon (*Falco cherrug*) breeding records for Mongolia. Journal of Raptor Research 31(3):234-240.

During 1994 and 1995 surveys, we located over 80 Saker Falcon (*Falco cherrug*) breeding sites in Mongolia. Over half of the eyries had features that were in some way remarkable or previously undescribed in the scientific literature. Ten were on utility poles, two on bridges, three on

abandoned buildings, and one was on a truck tire on a pole. Seven sites were very near buzzard nests, and two more were in buzzard nests that were used the same season. Five sites were on cliff tops accessible by walking. Four were on very short cliffs, two were on broken/sloping cliffs, and one was at the base of a cliff. Five were on the tops of stone pillars. Six were in very short elm trees. Eyrie composition was also sometimes remarkable: one was a suspended uric acid (excrement) platform without underlying support, three were trash nests, and two were composed largely of bones.

Ellis, D.H., D. Hjertaas, B.W. Johns, and R.P. Urbanek. 1998. Use of a helicopter to capture flighted cranes. Wildlife Society Bulletin 26(1):103-107.

Using a helicopter, we pursued 12 sandhill cranes *(Grus canadensis)* and captured 6. In forested habitat, cranes could be forced down, but we were unable to deploy the pursuit team, so cranes could not be captured. In open habitat, every crane we pursued was captured. Target cranes were forced to the ground in 0.3-14 minutes. Adjusting pursuit distance (50-150 m) was essential in promoting fatigue and in preventing escape of target cranes.

Ellis, D.H., S.R. Swengel, G.W. Archibald, and C.B. Kepler. 1998. A sociogram for the cranes of the world. Behavioural Processes 43:125-151.

The behavioral repertoire for the world's 15 species of cranes includes over 100 behavioral acts with clear social significance. Each species performs at least 60 discrete social postures, vocalizations, displays, and activities. Because all but a handful of the stereotyped social displays are common to all species, the presence or absence of social displays was useful only to a limited degree in comparing the relatedness of established crane taxonomic groups. However, the breadth of the repertoire for each species and for the family Gruidae tentatively places cranes at the apex of social complexity (at least for stereotyped displays) in the animal world.

Ellis, D.H., P. Tsengeg, and P.L. Whitlock. 1998. Saker falcon research and conservation efforts in Mongolia, 1997. Falco : The Middle East Falcon Research Group No. 11:7.

Erwin, R. M. 1997. Enhancing waterbird habitat with dredged materials: Some suggestions for improvement. Pages 106-108 *in* Proceedings of the Second Marine and Estuarine Shallow Water Science and Management Conference : April 3-7, 1995, Atlantic City, New Jersey. EPA/903/R/97009 United States Environmental Protection Agency, Philadelphia, PA. ii, 331 pp.

Erwin, R.M., J.D. Nichols, T.B. Eyler, D.B. Stotts, and B.R. Truitt. 1998. Modeling colony site dynamics: a case study of gull-billed terns (*Sterna nilotica*) in coastal Virginia. Auk 115:970-978.

We developed a Markov process model for colony site dynamics of Gull-billed Terns (*Sterna nilotica*) in coastal Virginia. We used the model and data on colony site occupation from 1993 to 1996 to estimate model parameters. Each year, we monitored the breeding numbers of Gull-billed Terns and their frequent colony associates, Common Terns (*Sterna hirundo*) and Black Skimmers (*Rynchops niger*) at colony sites along about 80 km of the barrier island region of Virginia. We also monitored flooding events and renesting. We developed the model for colony survival, extinction, and recolonization at potential colony sites over the four-year period. We then used data on annual site occupation by Gull-billed Terns to estimate model parameters and test between different structures reflecting competing hypotheses. Results revealed a dynamic system, but provided no evidence that the dynamics were Markovian , i.e. the probability of occupancy of a site in one year was not influenced by whether it had been occupied the previous year. Nor did the colony-level reproductive success the previous season seem to affect the probability of site occupancy. Site survival and recolonization rates were similar, and the overall annual probability of a site being occupied over the course of the four-year period was estimated to be 0.59 Of the total of 25 sites that were used during the four-year period, 16 were used in only one or two years while only three were used all four years.. Flooding and renesting were frequent in both habitat types in all years. The frequent flooding of nests on shellpiles argues for more effective management; augmentation with shell and sand to increase elevations as little as 20 cm could have reduced flooding at a number of sites. The low colony-site fidelity we demonstrate suggests that an effective management approach is to provide a large number of alternative sand and/or

shellpile sites that the terns may use. Sites not used one year may still be used in subsequent years.

Farrell, T.A. and J.L. Marion. 1998. An evaluation of camping impacts and their management at Isle Royale National Park. Research/Resources Management Report . U.S. Department of the Interior, National Park Service, Isle Royale National Park, Houghton, MI. 98 pp.

Results from the development and application of a monitoring program to assess visitor impacts on back-country campsites at Isle Royale National Park are presented. Survey staff assessed conditions on 244 sites within 36 back-country campgrounds, including 113 individual campsites, 43 group campsites, and 88 shelters. Site conditions are generally quite good. Site size and other areal measures of disturbance are exceptionally small attributed to the placement of most sites on cut-and-fill constructed “benches” within sloping terrain. Relational analyses revealed that campsites in Spruce and Fir forests and under more open forest canopies have significantly lower areal measures of disturbance. Areal disturbance is also reduced on sites where shelters and picnic tables are present, suggesting that these facilities act to concentrate visitor use. Site locational attributes, such as intersite visibility and proximity to trails, indicate a low potential for solitude within some campgrounds. Recommendations regarding site number, distribution, arrangement, facilities, maintenance, and monitoring are offered for management consideration.

Federoff, N.E. 1998. Cranial and dental abnormalities of the endangered red wolf (*Canis rufus*). Acta Theriologica 43(3):293-300.

Three skulls of captive-raised female endangered red wolves *(Canis rufus)* exhibited severe malocclusion of the jaws. Cranial and dental abnormalities (including crowding of upper toothrows, and an extra tooth behind the lower left M3 in one of the three mandibles) were also evident. Ratios of alveolar length of maxillary toothrow to maximum width across the outer sides of crowns of P4 were significantly different ($p=0.008$) compared to unaffected skulls. Significant differences were also evident when ratios of maximum width across inner edges of alveoli of P1 to alveolar length of maxillary toothrow and maximum width across outer sides of crowns of P4 were compared between the two groups. Although the three skulls all exhibited malocclusion, the abnormality expressed itself differently in relation to the effects to each skull. Captive inbreeding may increase the probability and frequency of expressing these anomalies, although inbreeding coefficients calculated for the wolves expressing malocclusion were not considered high (0.0313-0.0508). A wild female red wolf specimen captured in 1921 in Arkansas also exhibited the malocclusion, although not as severely as in the captive females. This demonstrates that this trait was present in wild populations prior to, and not a result of, the captive breeding program.

Foster, M. S. 1997. Evolution of lek social systems in manakins: alternative models and proofs . Pages 7-8 *in* Anais V. Congresso Brasileiro de Ornitologia. UNICAMP, Campinas, Brasil

Foster, M.S. and L.S. DeLay. 1998. Dispersal of mimetic seeds of three species of *Ormosia* (Leguminosae). Journal of Tropical Ecology 14(4):389-412.

Seeds with "imitation arils" appear wholly or partially covered by pulp or aril but actually carry no fleshy material. The *mimetic seed hypothesis* to explain this phenomenon proposes a parasitic relationship in which birds are deceived into dispersing seeds that resemble bird-dispersed fruits, without receiving a nutrient reward. The *hard-seed for grit hypothesis* proposes a mutualistic relationship in which large, terrestrial birds swallow the exceptionally hard "mimetic" seeds as grit for grinding the softer seeds on which they feed. They defecate, dispersing the seeds, and abrade the seed surface, enhancing germination. Any fruit mimicry is incidental. Fruiting trees of *Ormosia* spp. (Leguminosae: Papilionoideae) were observed to ascertain mechanisms of seed dispersal and the role of seemingly mimetic characteristics of the seeds in that dispersal. Seed predation and seed germination were also examined. *Ormosia isthamensis* and *O. macrocalyx* (but not *O. bopiensis*) deceived arboreally-foraging frugivorous birds into taking their mimetic seeds, although rates of seed dispersal were low. These results are consistent with the *mimetic seed hypothesis*. On the other hand, the rates of disappearance of seeds from the ground under the

Ormosia trees, hardness of the seeds, and enhancement of germination with the abrasion of the seed coat are all consistent with the *hard-seed for grit hypothesis*.

Foster, M.S. and J. Terborgh. 1998. Impact of a rare storm event on an Amazonian forest. Biotropica 30(3):470-474.

Francis, C.M., J.R. Sauer, and J.R. Serie. 1998. Effect of restrictive harvest regulations on survival and recovery rates of American black ducks. Journal of Wildlife Management 62(4):1544-1557.

Gardner, A.L. and C.B. Robbins. 1998. Generic names of northern and southern fur seals (Mammalia: Otariidae). Marine Mammal Science 14(3):544-551.

We have resolved a nomenclatural problem discovered during research on the northern fur seal that concerns the correct generic name for this taxon and for fur seals of the Southern Hemisphere. The unfortunate practice by some 19th century authors to use names in their Latinized form, but to date them from their first appearance as French common names led to the use of *Arctocephalus* for southern fur seals when the name correctly applies to the northern fur seal, known today as *Callorhinus ursinus.* However, *Arctocephalus* and *Callorhinus* are antedated by *Otoes* G. Fischer, 1817, which is the earliest available generic for the fur seal of the northern Pacific. The earliest available generic name for southern fur seals is *Halarctus* Gill, 1866. To avoid the confusion that would result from replacing the currently used generic names with those required by strict adherence to the Principle of Priority, we have petitioned the International Commission on Zoological nomenclature to preserve *Arctocephalus* and *Callorhinus* for the southern and northern fur seals, respectively.

Gee, G. F. 1997. Evaluation of semen from non-domestic birds. Pages 68-71 *in* M. R. Bakst and H. C. Cecil, editors. Techniques for semen evaluation, semen storage, and fertility determination. Poultry Science Association, Inc., Savoy, IL. ix, 97 pp.

Ginsberg, H.S., K.E. Hyland, R. Hu, T.J. Daniels, and R.C. Falco. 1998. Tick population trends and forest type. Science 281:349-350 (letter).

Gould, W.R. and J.D. Nichols. 1998. Estimation of temporal variability of survival in animal populations. Ecology 79(7):2531-2538.

Grossman, G.D., R.E. Ratajczak, Jr., M. Crawford, and M.C. Freeman. 1998. Assemblage organization in stream fishes: effects of environmental variation and interspecific interactions. Ecological Monographs 68(3):395-420.

We assessed the relative importance of environmental variation, interspecific competition for space, and predator abundance on assemblage structure and microhabitat use in a stream fish assemblage inhabiting Coweeta Creek, North Carolina, USA. Our study encompassed a ten year time span (1983-1992) and included some of the highest and lowest flows in the last 58 years. We collected 16 seasonal samples which included data on: 1) habitat availability (total and microhabitat) and microhabitat diversity, 2) assemblage structure (i.e., the number and abundances of species comprising a subset of the community), and 3) microhabitat use and overlap. We classified habitat availability data on the basis of year, season, and hydrologic period. Hydrologic period (i.e., pre-drought [PR], drought [D], and post-drought [PO]) represented the temporal location of a sample with respect to a four-year drought that occurred during the study. Hydrologic period explained a greater amount of variance in habitat availability data than either season or year. Total habitat availability was significantly greater during PO than in PR or D, although microhabitat diversity did not differ among either seasons or hydrologic periods. There were significantly fewer high-flow events (i.e., $\geq$ 2.1 m^3/s) during D than in either PR or PO periods. We observed a total of 16 species during our investigation, and the total number of species was significantly higher in D than in PR samples. Correlation analyses between the number of species present (total and abundant species) and environmental data yielded limited

results, although the total number of species was inversely correlated with total habitat availability. A cluster analysis grouped assemblage structure samples by hydrologic period rather than season or year, supporting the contention that variation in annual flow had a strong impact on this assemblage. The drought had little effect on the numerical abundance of benthic species in this assemblage; however, a majority of water-column species increased in abundance. The increased abundances or water-column species may have been related to the decrease in high flow events observed during the D. Such high flow events are known to cause mortality in stream fishes. Microhabitat use data showed that species belonged to one of three microhabitat guilds: benthic, lower water-column, and mid-water-column. In general, species within the same guild did not exhibit statistically distinguishable patterns of microhabitat use, and most significant differences occurred between members of different guilds. However, lower water-column guild species frequently were not separable from all members of either benthic or mid-water-column guilds. Variations in the abundance of potential competitors or predators did not produce strong shifts in microhabitat use by assemblage members. Predators were present in the site in only 9 of 16 seasonal samples and never were abundant (maximum number observed per day was 2). In conclusion, our results demonstrate that variability in both mean and peak flows had a much stronger effect on the structure and use of spatial resources within this assemblage than either interspecific competition for space or predation. Consequently, we suspect that the patterns in both assemblage structure and resource use displayed by fishes in Coweeta Creek arose from the interaction between environmental variation and species-specific evolutionary constraints on behavior, morphology and physiology.

Hadidian, J., J.R. Sauer, C. Swarth, P. Handly, S. Droege, C. Williams, J. Huff, and G. Didden. 1997. A citywide breeding bird survey for Washington, DC. Urban Ecosystems 1(2):87-102.

`DC Birdscape' was initiated in 1993 to systematically count the birds occurring throughout Washington D.C. during the breeding season. It involved a coordinated planning effort and partnership between the Audubon Naturalist Society, the National Park Service, and the National Biological Survey, and engaged the participation of more than 100 volunteers. A method for rapidly assessing the status of bird populations over a large area was developed and incorporated into a Geographic Information System to allow a multidimensional analysis of species presence and abundance across a variety of urban land use areas. A total of 91 species were observed, with an estimated total number of 115, making Washington D.C. almost as `bird rich' as nearby suburban counties. Data from the study clearly indicate that avian species are not randomly distributed throughout the Washington D.C. metropolitan area, and show affinity, at least in part, to some of the most broadly recognized land use patterns that are commonly used to zone and classify urban areas under development schemes. This study represents a prototype that will allow efficient and economical monitoring of urban bird populations.

Heinz, G. H. 1998. Contaminant effects on Great Lakes' fish-eating birds: a population perspective. Pages 141-154 *in* Ronald J. Kendall, Richard L. Dickerson, John P. Giesy, and William P. Suk, editors. Principles and Processes for Evaluating Endocrine Disruption in Wildlife. SETAC Technical Publication. SETAC Press, Pensacola, FL. xxiv, 491 pp.

Preventing environmental contaminants from reducing wildlife populations is the greatest concern in wildlife toxicology. In the Great Lakes, environmental contaminants have a history of reducing populations of many species of fish-eating birds. Endocrine effects may have contributed to declines in fish-eating bird populations, but the overriding harm was caused by DDE-induced eggshell thinning. Toxic effects may still be occurring today, but apparently they are not of a sufficient magnitude to depress populations of most fish-eating birds. Once DDE levels in the Great Lakes declined, eggshells of birds began to get thicker and reproductive success improved. Populations of double-crested cormorants *(Phalacrocorax auritus)* and ring-billed gulls *(Larus delawarensis)* have increased dramatically since the bans on DDT and other organochlorine pesticides. Bald eagles *(Haliaeetus leucocephalus)* are still not reproducing at a normal rate along the shores of the Great Lakes, but success is much improved compared to earlier records when eggshell thinning was worse. Other species, such as herring gulls *(Larus argentatus)* and black-crowned night-herons *(Nycticorax nycticorax)*, seem to be having improved reproductive success, but data on Great Lakes'-wide population changes are incomplete. Reproductive success of common terns *(Sterna hirundo)*, Caspian terns *(Sterna caspia)*, and Forster's terns *(Sterna forsteri)* seems to have improved in recent years, but, again, data on population changes are not very

complete, and these birds face many habitat related problems as well as contaminant problems. Although contaminants are still producing toxic effects, and these effects may include endocrine disfunction, fish-eating birds in the Great Lakes seem to be largely weathering these effects, at least as far as populations are concerned. A lack of obvious contaminant effects on populations of fish-eating birds in the Great Lakes, however, should not be equated with a lack of any harm to these birds or with a conclusion that certain contaminants do not need additional control.

Heinz, G.H. and D.J. Hoffman. 1998. Methylmercury chloride and selenomethionine interactions on health and reproduction in mallards. Environmental Toxicology and Chemistry 17(2):139-145.

Adult mallards *(Anas platyrhynchos)* were fed a control diet or diets containing 10 ppm mercury as methylmercury chloride, 10 ppm selenium as seleno-DL-methionine, or 10 ppm mercury plus 10 ppm selenium. One of 12 adult males fed 10 ppm mercury died and 8 others suffered from paralysis of their legs by the time the study was terminated. However, when the diet contained 10 ppm selenium in addition to the 10 ppm mercury, none of 12 males became sick. In contrast to the protective effect of selenium against mercury poisoning in males, selenium plus mercury was worse than selenium or mercury alone for some measurements of reproductive success. Both selenium and mercury lowered duckling production through reductions in hatching success and survival of ducklings, but the combination of mercury plus selenium was worse than either mercury or selenium alone. Controls produced an average of 7.6 young per female, females fed 10 ppm selenium produced an average of 2.8 young, females fed 10 ppm mercury produced 1.1 young, and females fed both mercury and selenium produced 0.2 young. Teratogenic effects also were worse for the combined mercury plus selenium treatment; deformities were recorded in 6.1% of the embryos of controls, 16.4% for methylmercury chloride, 36.2% for selenomethionine, and 73.4% for the combination of methylmercury chloride and selenomethionine. The presence of methylmercury in the diet greatly enhanced the storage of selenium in tissues. The livers of males fed 10 ppm selenium contained a mean of 9.6 ppm selenium, whereas the livers of males fed 10 ppm selenium plus 10 ppm mercury contained a mean of 114 ppm selenium. However, selenium did not enhance the storage of mercury. The results show that mercury and selenium may be antagonistic to each other for adults and synergistic to young, even within the same experiment.

Heusmann, H. and J.R. Sauer. 1997. A survey for mallard pairs in the Atlantic flyway. Journal of Wildlife Management 61(4):1191-1198.

During 1989-1992, spring surveys of randomly selected, 1-km2 plots, stratified by physiographic strata, were conducted in the Atlantic flyway from New Hampshire to Virginia, to estimate mallard (*Anas platyrhynchos*) pairs. All potential waterfowl habitat in each plot was checked by ground crews. The adjusted mean mallard pair estimate over the 4-year period was 300,849 (range 271,193-320,642, mean SE 22,455) for the region surveyed. Ground plot checks are a practical way to survey mallard pairs in the upper Atlantic flyway.

Hoffman, D.J. and G.H. Heinz. 1998. Effects of mercury and selenium on glutathione metabolism and oxidative stress in mallard ducks. Environmental Toxicology and Chemistry 17(2):161-166.

Earlier studies reported on the toxicity and related oxidative stress of different forms of Se, including seleno-D,L-methionine, in mallards (*Anas platyrhynchos*). This study compares the effects of Se (seleno-D,L-methionine) and Hg (methylmercury chloride) separately and in combination. Mallard drakes received one of the following diets: untreated feed (controls), or feed containing 10 ppm Se, 10 ppm Hg, or 10 ppm Se in combination with 10 ppm Hg. After 10 weeks, blood, liver, and brain samples were collected for biochemical assays. The following clinical and biochemical alterations occurred in response to mercury exposure: hematocrit and hemoglobin concentrations decreased; activities of the enzymes glutathione (GSH) peroxidase (plasma and liver), glutathione-S-transferase (liver), and glucose-6-phosphate dehydrogenase (G-6-PDH) (liver and brain) decreased; hepatic oxidized glutathione (GSSG) concentration increased relative to reduced glutathione (GSH); and lipid peroxidation in the brain was evident as detected by increased thiobarbituric reactive substances (TBARS). Effects of Se alone included increased hepatic GSSG reductase activity and brain TBARS concentration. Se in combination with Hg partially or totally alleviated effects of Hg on GSH peroxidase, G-6-PDH, and GSSG. These findings are compared in relation to field observations for diving ducks and other aquatic birds.

It is concluded that since both Hg and excess Se can affect thiol status, measurement of associated enzymes in conjunction with thiol status may be a useful bioindicator to discriminate between Hg and Se effects. The ability of Se to restore the activities of G-6-PDH, GSH peroxidase, and glutathione status involved in antioxidative defense mechanisms may be crucial to biological protection from the toxic effects of methyl mercury.

Hoffman, D.J., M.J. Melancon, P.N. Klein, J.D. Eisemann, and J.W. Spann. 1998. Comparative developmental toxicity of planar polychlorinated biphenyl congeners in chickens, American kestrels and common terns. Environmental Toxicology and Chemistry 17(4):747-757.

The effects of PCB congeners, PCB 126 (3,3',4,4',5-pentaCB) and PCB 77 (3,3'4,4'-tetraCB), were examined in chicken (*Gallus gallus*), American kestrel (*Falco sparverius*), and common tern (*Sterna hirundo*) embryos through hatching, following air cell injections on day 4. PCB 126 caused malformations and edema in chickens starting at 0.3 ppb, in kestrels at 2.3 ppb, but in terns only at levels affecting hatching success (44 ppb). Extent of edema was most severe in chickens and least in terns. Defects of the beak were common in all species, but with crossed beak most prevalent in terns. Effects on embryo growth were most apparent for PCB 126 in chickens and kestrels. The approximate LD_{50} for PCB 126 in chickens was 0.4 ppb, in kestrels was 65 ppb, and in terns was 104 ppb. The approximate LD_{50} for PCB 77 in chickens was 2.6 ppb and in kestrels was 316 ppb. Induction of cytochrome P450 associated monooxygenase activity (EROD activity) by PCB 126 in chick embryo liver was about 800 times more responsive than in tern and at least 1000 times more responsive than in kestrel. High concentrations of PCB 126 found in bald eagle eggs are nearly 20-fold higher than the lowest toxic concentration tested in kestrels. Concentrations of PCB 126 causing low level toxic effects in common tern eggs are comparable to highest levels in common terns and Forster's terns in the field, suggesting additional involvement of other compounds in the Great Lakes.

Hoffman, D.J., H.M. Ohlendorf, C.M. Marn, and G.W. Pendleton. 1998. Association of mercury and selenium with altered glutathione metabolism and oxidative stress in diving ducks from the San Francisco Bay region. Environmental Toxicology and Chemistry 17(2):167-172.

Adult male greater scaup (*Aythya marila*) (GS), surf scoters (*Melanitta perspicillata*)(SS), and ruddy ducks (*Oxyura jamaicensis)* (RD) were collected from Suisun Bay and coastal Tomales Bay in the greater San Francisco Bay area to assess exposure to inorganic contaminants. Hepatic selenium (Se) concentrations were highest in GS (geometric mean = 67 ppm, dw) and SS (119 ppm) in Suisun Bay, whereas hepatic mercury (Hg) was highest (19 ppm) in GS and SS from Tomales Bay. Hepatic Se and Hg were lower in RD and did not differ between locations. Hepatic supernatants were assayed for enzymes related to glutathione metabolism and antioxidant activity including: glucose-6-phosphate dehydrogenase (G-6-PDH), glutathione peroxidase (GSH-peroxidase), glutathione reductase (GSSG-reductase), and glutathione-S-transferase (GSH-transferase). GSH-peroxidase activity was higher in SS and RD, and G-6-PDH higher in GS and SS from Suisun Bay than Tomales Bay. GSSG-reductase was higher in SS from Suisun Bay. The ratio of oxidized glutathione (GSSG) to reduced glutathione (GSH) was greater in all species from Tomales Bay. The following significant relationships were found in one or more species with increasing hepatic Hg concentration: lower body, liver and heart weights; decreased hepatic GSH concentration, G-6-PDH and GSH-peroxidase activities; increased ratio of GSSG to GSH, and increased GSSG-reductase activity. With increasing hepatic Se concentration, GSH-peroxidase increased but GSH decreased. It is concluded that measurement of associated enzymes in conjunction with thiol status may be a useful bioindicator to discriminate between Hg and Se effects. Concentrations of mercury and selenium and variable affected have been associated with adverse effects on reproduction and neurological function in experimental studies with mallards.

Huang, Y.-W., M.J. Melancon, R.E. Jung, and W.H. Karasov. 1998. Induction of cytochrome P450-associated monooxygenases in northern leopard frogs, *Rana pipiens,* by 3,3',4,4',5-pentachlorobiphenyl. Environmental Toxicology and Chemistry 17(8):1564-1564.

Northern leopard frogs (*Rana pipiens*) were injected intraperitoneally either with a solution of polychlorinated biphenyl (PCB) 126 in corn oil at a concentration of 0.2, 0.7, 2.3 and 7.8 mg/kg body weight or with corn oil alone. Appropriate assay conditions with hepatic microsomes were

determined for four cytochrome P450-associated monooxygenases: ethoxyresorufin-*O*-dealkylase (EROD), methoxy-ROD (MROD), benzyloxy-ROD (BROD) and pentoxy-ROD (PROD). One week after PCB administration, the specific activities of EROD, MROD, BROD and PROD were not elevated at doses ¼ 0.7 mg/kg ($p > 0.05$), but were significantly increased at doses ¾ 2.3 mg/kg compared to the control groups ($p < 0.05$). The increased activity of these four enzymes ranged from 3to 6.4fold relative to control levels. The increased activities were maintained for at least four weeks. Due to a lack of induction at low doses of PCB 126, which were still relatively high compared to currentlyknown environmental concentrations, we suspect that EROD, MROD, BROD, and PROD activities are not sensitive biomarkers for coplanar PCB exposure in leopard frogs.

Jagoe, C.H., B. Arnold-Hill, G.M. Yanochko, P.V. Winger, and I.L. Brisbin, Jr. 1998. Mercury in alligators *(Alligator mississippiensis*) in the southeastern United States. Science of the Total Environment 213:255-262.

Mercury methylation may be enhanced in wetlands and humic-rich, blackwater systems that crocodiles and alligators typically inhabit. Given their high trophic level and long life-spans, crocodilians could accumulate significant burdens of Hg. Our objectives were to survey Hg concentrations in alligators from several areas in the southeastern United States to test their utility as sentinels of Hg contamination, to examine relationships among Hg concentrations in various tissues and to look for any differences in tissue Hg concentrations among locations. We measured total Hg concentrations in alligators collected in the Florida Everglades (n = 18), the Okefenokee National Wildlife Refuge, Georgia (n = 9), the Savannah River Site (SRS), South Carolina (n = 49) and various locations in central Florida (n = 21), sampling tissues including blood, brain, liver, kidney, muscle, bone, fat, spleen, claws and dermal scutes. Alligators from the Everglades were mostly juvenile, but Hg concentrations in tissues were high (means: liver 41.0, kidney 36.4, muscle 5.6 mg Hg/kg dry wt.). Concentrations in alligators from other locations in Florida were lower (means: liver 14.6, kidney 12.6, muscle 1.8 mg Hg/kg dry wt.), although they tended to be larger adults. Alligators from the Okefenokee were smallest and had the lowest Hg concentrations (means: liver 4.3, kidney 4.8, muscle 0.8 mg Hg/kg dry wt.). At some locations, alligator length was correlated with Hg concentrations in some internal organs. However, at three of the four locations, muscle Hg was not related to length. Tissue Hg concentrations were correlated at most locations; however, claw or dermal scute Hg explained less than 74% of the variation of Hg in muscle or organs, suggesting readily-obtained tissues, such as scutes or claws, have limited value for nondestructive screening of Hg in alligator populations.

Johnson, D. H and W. L. Kendall. 1997. Modeling the population dynamics of Gulf Coast sandhill cranes. Pages 173-180 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. . North American Crane Working Group, Grand Island, Nebraska. xi, 262 pp.

The Midcontinental population of sandhill cranes (*Grus canadensis*) has a large geographic range, contains nearly 500,000 birds, and is hunted in much of its range. The population includes three subspecies; the numbers of two of these are uncertain, and they should be afforded protection from hunting that would be detrimental to their population. The two subspecies of concern tend to concentrate in the eastern part of the Great Plains during fall and spring and to winter along the Gulf Coast in Texas. This paper uses the limited information available about the Gulf Coast subpopulation in a model. We included in the model five input parameters: population size, annual survival rate in absence of hunting, the number of birds taken by hunters, the extent of additivity of hunting mortality, and recruitment rate, measured as the fraction of juveniles in the winter population. Using three widely ranging estimates of each parameter, we examined the general behavior of the simulated population. Realistic population projections occurred with medium (60,000) or large (166,000) population sizes, low (2000) or moderate (4000) harvests, and recruitment rates of 0.07 and 0.11. All values of survival in the absence of hunting and additivity of hunting yielded some realistic projections. Results of modelling suggest that the variables warranting closer monitoring are population size and recruitment rate.

Karanth, U. and J.D. Nichols. 1998. Estimation of tiger densities in India using photographic captures and recaptures. Ecology 79(8):2852-2862.

Previously applied methods for estimating tiger (*Panthera tigris*) abundance using total counts based on tracks have proved unreliable. In this paper we use a field method proposed by Karanth (1995), combining camera-trap photography to identify individual tigers based on stripe patterns, with capture-recapture estimators. We developed a sampling design for camera-trapping and used the approach to estimate tiger population size and density in four representative tiger habitats in different parts of India. The field method worked well and provided data suitable for analysis using closed capture-recapture models. The results suggest the potential for applying this methodology for estimating abundances, survival rates and other population parameters in tigers and other low density, secretive animal species with distinctive coat patterns or other external markings. Estimated probabilities of photo-capturing tigers present in the study sites ranged from 0.75 - 1.00. The estimated mean tiger densities ranged from 4.1 (SE hat= 1.31) to 11.7 (SE hat= 1.93) tigers/100 km^2. The results support the previous suggestions of Karanth and Sunquist (1995) that densities of tigers and other large felids may be primarily determined by prey community structure at a given site.

Kearns, G.D., N.B. Kwartin, D.F. Brinker, and G.M. Haramis. 1998. Digital playback and improved trap design enhance capture of migrant soras and Virginia rails. Journal of Field Ornithology 69(3):466-473.

We used playback of rail vocalizations and improved trap design to enhance capture of fall migrant Soras (*Porzana carolina*) and Virginia Rails (*Rallus limicola*) in marshes bordering the tidal Patuxent River, Maryland. Custom-fabricated microchip message repeating sound systems provided digitally recorded sound for long-life, high-quality playback. A single sound system accompanied each 30-45 m long drift fence trap line fitted with 1-3 cloverleaf traps. Ramped funnel entrances improved retention of captured rails and deterred raccoon (*Procyon lotor*) predation. Use of playback and improved trap design increased trap success by over an order of magnitude and resulted in capture and banding of 2315 Soras and 276 Virginia Rails during September and October 1993-1997. The Sora captures more than doubled the banding records for the species in North America. This capture success demonstrates the efficacy of banding large numbers of Soras and Virginia Rails on migration and winter concentration areas.

Keller, C.M.E. and J.T. Scallan. 1999. Potential roadside biases due to habitat changes along breeding bird survey routes. Condor 101(1):50-57.

Breeding Bird Surveys (BBS) are conducted along roadside routes to enable a large geographic area to be surveyed. Yet the potential biases of sampling populations only from roadsides have received little attention. We sampled aerial photography of BBS routes taken in the mid-1960s and late-1980s to evaluate whether habitat changes that occurred along roadsides were also occurring in the surrounding area, and whether the frequency of habitats encountered along roadsides were similar to that off-route. We examined 28 routes in Maryland and 25 routes in Ohio, and defined roadside area as within 200 m of the road, and off-route as 200-1,600 m from the road. Most habitat changes that occurred along BBS roadsides also were occurring in the off-route areas. However, increases in urban cover was significantly greater along the road in Maryland where urbanization of farmland was the predominant habitat change. The small increase in urban cover in Ohio was not significantly greater along the road. Construction of single family homes was greater along BBS roadsides in both states. In Ohio, the greatest change in habitat was the conversion of farmland back to forest, which was not significantly greater along the road. Changes associated with urbanization were more biased towards roadsides than the reforestation of farmland. Within one time period, roadside areas had less forest and more agricultural and urban cover types than occurred off-route.

Kendall, W. L., D. H. Johnson, and S. C. Kohn. 1997. Subspecies composition of sandhill crane harvest in North Dakota, 1968-94. Pages 201-208 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska. xi, 262 pp.

North Dakota is a major fall staging area for the Midcontinent Population of sandhill cranes (*Grus canadensis*), which is composed of three subspecies: the greater (*G. c. tabida*), Canadian (*G. c. rowani*), and lesser (*G. c. canadensis*). The number of cranes killed by hunters in North Dakota averaged 6,793 during 1990-94 seasons, ranking second highest among crane-hunting states.

The distribution of harvest among subspecies is important, due to concerns about the poorly known status of these subspecies, especially the greater. We estimated subspecies composition of the harvest in North Dakota using morphometric data collected from field samples of birds harvested since 1968. Subspecies composition varied both spatially (across counties from east to west) and temporally (among 3 periods of distinct harvest regulations and within season). Lessers predominated in the west and Canadians and greaters in the east. For the 1990-94 period we estimated that mortality due to hunting in North Dakota averaged at least 1,085 (18%) greaters, 2,138 (36%) Canadians, and 2,716 (46%) lessers.

Kinney, E.H. and C.T. Roman. 1998. The response of primary producers to nutrient enrichment in a shallow estuary. Marine Ecology Progress Series 163:89-98.

Shallow coastal systems worldwide are exhibiting increased algal growth in response to nutrient enrichment. This study evaluates primary production patterns in an estuarine system (Bass Harbor Marsh, Maine) receiving low levels of anthropogenic nitrogen. Biomass, areal coverage and *in situ* oxygen production of green macroalgae, *Ruppia maritima*, and phytoplankton were measured over a growing season to determine net ecosystem production. Macroalgae and *Ruppia* exhibited strong seasonal biomass curves with early summer peaks; however, peak biomass of macroalgae (150 g dwt m^{-2}) was substantially greater than *Ruppia* (33 g dwt m^{-2}). Phytoplankton biomass, measured as chlorophyll *a*, was low (<1 ug l^{-1}) early in the season and peaked (11 ug l^{-1}) following a mid-summer decline in macroalgal biomass, suggesting a competitive interaction with macroalgae. Instantaneous net production rates varied over the growing season for all three primary producers. *Ruppia* net production ranged from near zero to 3.7 mg C g dwt^{-1} h^{-1}, with higher rates during summer and much of the seasonal variability explained by temperature. Macroalgal (0.88 - 5.0 mg C g dwt^{-1} h^{-1}) and phytoplankton (0 - 28 mg C m^{-3} h^{-1}) net production did not exhibit any clear seasonal signal. Net primary production calculated on an areal basis demonstrated macroalgae's dominance in the lower basin of Bass Harbor Marsh, with peak summer rates (400 mg C m^{-2} h^{-1}) greatly exceeding maximum rates for both *Ruppia* (70 mg C m^{-2} h^{-1}) and phytoplankton (12 mg C m^{-2} h^{-1}). When compared to other New England estuarine sites with short residence times, nutrient loading and peak green macroalgal biomass in Bass Harbor Marsh is relatively low; however, the strong dominance of opportunistic green macroalgae is a pattern that is characteristic of shallow coastal systems undergoing eutrophication.

Kizirian, D.A. and R.W. McDiarmid. 1998. A new species of *Bachia* (Squamata: Gymnophthalmidae) with pleisomorphic limb morphology. Herpetologica 54(2):245-253.

We describe a new species of *Bachia* from the upper Río Negro drainage of southeastern Colombia and southern Venezuela. The new taxon is diagnosed by a complement of phalanges that is unique among gymnophthalmid lizards and intermediate relative to other *Bachia* and closely related genera. Variation in limb osteology among the species of *Bachia* and close relatives is reported. We discuss the distribution of *B. panoplia* and the taxonomic status of *B. flavescens.*

Klein, P. N. and D. Thompson. 1997. Long bone fracture management in a sandhill crane: a case report. Pages 232-236 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska. ix, 262 pp.

Krementz, D.G. and J.B. Berdeen. 1997. Survival rates of American woodcock wintering in the Georgia Piedmont. Journal of Wildlife Management 61:1328-1332.

We estimated survival rates of wintering American woodcock. We found no age- or sex-specific differences in period survival rates. The survival rate for the period 25 December 1994 - 7 February 1995 for all age and sex classes combined (0.72) was not different from a similarly derived estimate for woodcock wintering along the Atlantic Coast. Survival rates of wintering woodcock are relatively low compared to other seasons.

Lasier, P.J., P.V. Winger, and R.E. Reinert. 1997. Toxicity of alkalinity to *Hyalella azteca*. Bulletin of Environmental Contamination and Toxicology 59(5):807-814.

Toxicity testing and chemical analyses of sediment pore water have been suggested for use in sediment quality assessments and sediment toxicity identification evaluations. However, caution should be exercised in interpreting pore-water chemistry and toxicity due to inherent chemical characteristics and confounding relationships. High concentrations of alkalinity, which are typical of sediment pore waters from many regions, have been shown to be toxic to test animals. A series of tests were conducted to assess the significance of elevated alkalinity concentrations to *Hyalella azteca*, an amphipod commonly used for sediment and pore-water toxicity testing. Toxicity tests with 14-d old and 7-d old animals were conducted in serial dilutions of sodium bicarbonate ($NaHCO_3$) solutions producing alkalinities ranging between 250 to 2000 mg/L as $CaCO_3$. A sodium chloride (NaCl) toxicity test was also conducted to verify that toxicity was due to bicarbonate and not sodium. Alkalinity was toxic at concentrations frequently encountered in sediment pore water. There was also a significant difference in the toxicity of alkalinity between 14-d old and 7-d old animals. The average 96-h LC_{50} for alkalinity was 1212 mg/L (as $CaCO_3$) for 14-d old animals and 662 mg/L for the younger animals. Sodium was not toxic at levels present in the $NaHCO_3$ toxicity tests. Alkalinity should be routinely measured in pore-water toxicity tests, and interpretation of toxicity should consider alkalinity concentration and test-organism tolerance.

Lebreton, J.D. and J.D. Nichols. 1997. Ecology and management of subdivided animal populations. Bulletin of the Ecological Society of America 78:285-288.

Leirs, H., N.C. Stenseth, J.D. Nichols, J.E. Hines, R. Verhagen, and W. Verheyen. 1997. Stochastic seasonality and nonlinear density-dependent factors regulate population size in an African rodent. Nature 389(6647):176-180.

Leung, Y.F. and J.L. Marion. 1998. A survey of whitewater recreation impacts along five West Virginia rivers. U. S. Department of Interior, Geological Survey, Virginia Tech Cooperative Park Studies Unit, Blacksburg, Va. 106 pp.

Results are reported from an assessment of whitewater river recreation impacts at river accesses and recreation sites along five West Virginia rivers: the New, Gauley, Cheat, Tygart, and Shenandoah. Procedures were developed and applied to assess resource conditions on 24 river access roads, 68 river accesses, and 151 recreation sites. The majority of river accesses and recreation sites are located on the New and Gauley rivers, which account for most of the state's whitewater recreation use. Site conditions are variable. While some river accesses and sites are situated on resistant rocky substrates, many are poorly designed and/or located on erodible soil and sand substrates. Recreation site sizes and other areal measures of site disturbance are quite large, coincident with the large group sizes associated with commercially outfitted whitewater rafting trips. Recommendations are offered for managing river accesses and sites and whitewater visitation and the selection of indicators and standards as part of a Limits of Acceptable Change management process. Procedures and recommendations for continued visitor impact monitoring are also offered.

Link, W. A. 1998. Unbiasedness. Pages 4648-4650 *in* Peter Armitage and Theodore Colton, editors-in-chief. Encyclopedia of Biostatistics, v. 6. John Wiley and Sons, Chichester, U.K. 6 volumes. lxii, 4898 pp.

Unbiasedness is probably the best known criterion for evaluating the performance of estimators. This note describes unbiasedness, demonstrating various failings of the criterion. It is shown that unbiased estimators might not exist, or might not be unique; an example of a unique but clearly unacceptable unbiased estimator is given. It is shown that unbiased estimators are not translation invariant. Various alternative criteria are described, and are illustrated through examples.

Link, W.A. and J.R. Sauer. 1997. New approaches to the analysis of population trends in land birds: Comment. Ecology 78(8):2632-2634.

James et al. (1996, *Ecology* **77**:13-27) used data from the North American Breeding Bird Survey (BBS) to examine geographic variability in patterns of population change for 26 species of wood warblers. They emphasized the importance of evaluating nonlinear patterns of change in bird populations, proposed LOESS-based non-parametric and semi-parametric analyses of BBS data, and contrasted their results with other analyses, including those of Robbins et al. (1989,

Proceedings of the National Academy of Sciences 86: 7658-7662) and Peterjohn et al. (1995, Pages 3-39 in T. E. Martin and D. M. Finch, eds. Ecology and management of Neotropical migratory birds: a synthesis and review of critical issues. Oxford University Press, New York.). In this note, we briefly comment on some of the issues that arose from their analysis of BBS data, suggest a few aspects of the survey that should inspire caution in analysts, and review the differences between the LOESS-based procedures and other procedures (e.g., Link and Sauer 1994). We strongly discourage the use of James et al.'s completely non-parametric procedure, which fails to account for observer effects. Our comparisons of estimators adds to the evidence already present in the literature of the bias associated with omitting observer information in analyses of BBS data. Bias resulting from change in observer abilities should be a consideration in any analysis of BBS data.

Link, W.A. and J.R. Sauer. 1998. Estimating population change from count data: application to the North American Breeding Bird Survey. Ecological Applications 8(2):258-268.

For birds and many other animal taxa, surveys that collect count data form a primary source of information on population change. Because counts are only indices to population size, care must be taken in using them in analyses of population change. Temporal or geographic differences in the proportion of animals counted can be misinterpreted as differences in population size. Therefore, temporally or geographically varying factors that influence the proportion of animals counted must be incorporated as covariables in the analysis of population parameters from count data. We describe the North American Breeding Bird Survey (BBS) for illustration. The BBS is a major, landscape-level survey of birds in North America; it is typical of many count surveys, in that the same sample units (survey routes) are sampled each year, and change is modeled on these routes over time. We identify covariables related to observer ability, the omission of which can bias estimation of population change from BBS data. Controlling for observer effects or other potential sources of confounding requires the specification of models relating counts to population size. We begin with a partial model specification relating expected counts to population sizes; we describe estimators currently in use in relation to this partial specification. Additional assumptions lead to a class of over-dispersed multinomial models, for which we describe estimators of population change and procedures for parsimonious model selection. We illustrate the use of over-dispersed multinomial models by an application to data for Carolina Wren *(Thryothorus ludovicianus)*.

Link, W.A. and J.R. Sauer. 1998. Estimating relative abundance from count data. Austrian Journal of Statistics 27(1):83-97.

Much of the available information on large-scale patterns of animal abundance is based on count surveys. The data provided by such surveys are often influenced by nuisance factors affecting the numbers of animals counted, but unrelated to population size. Temporal and spatial patterns in nuisance factors may exist, causing simple summaries of counts to give a misleading view of patterns in population size. We develop models for count data that allows the incorporation of such factors, and describe methods for estimating spatial patterns of relative abundance from counts. We carry out spatial analyses of North American Breeding Bird Survey data, in which observer ability is a nuisance parameter nested within sites. In light of evidence that new observers tend to count more birds than the observers they replace, we model observer ability as a random effect with mean depending on observer initiation year.

Long, R.A., A.F. O'Connell, Jr., and D.J. Harrison. 1998. Mortality and survival of white-tailed deer *Odocoileus virginianus* fawns on a north Atlantic coastal island. Wildlife Biology 4(4):237-247.

Mortality and survival of white-tailed deer *Odocoileus virginianus* fawns (n=29) were studied from birth to 1 year of age during 1991-95 on Mount Desert Island (MDI), Maine where deer hunting is prohibited, coyotes *Canis latrans* have become recently established, and protected U. S. National Park lands are interspersed with private property. Rate of predator-caused mortality was 0.52, with coyote predation (*n*=8) accounting for at least 47% of mortalities from all causes (*n*=17). Mortality rate from drowning was 0.24 (*n*=3), and from vehicles was 0.14 (*n*=3). Of fawns radio-collared as neonates, 10 of 14 mortalities occurred during the first 2 months of life. Annual rate of fawn survival was 0.26. Survival rate from 6 months to 1 year was 0.65 and 4 mortalities (2 predation, 2 drowning) were observed during this interval. A subgroup of fawns (*n* = 11) captured

near a residential area and along the edge of a coyote territory had a higher (*P* = 0.002) rate of survival to 1 year of age (*S* = 0.67) than did fawns from all other areas (*n* = 18, *S* = 0.00). Recruitment to 1 year of age was lower than has been observed in other deer populations in the northeastern United States. Low recruitment associated with coyote predation and mortality sources influenced by humans appears to be limiting white-tailed deer populations in this insular landscape.

Longcore, J.R. 1998. [Book review] Natural History of the Waterfowl, by Frank S. Todd, 1996; Handbook of Waterfowl Identification, by Frank S. Todd, 1996. Birding 30(3):255-256.

Longcore, J. R. and D. A. Clugston. 1999. American black duck. Pages 196-198 *in* M. J. Mac, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran, editors. Status and trends of the nation's biological resources. Volume 1. U.S. Department of the Interior, U.S. Geological Survey, Reston, Va.A brief summary of the annual cycle of the American Black duck (*Anas rubripes*) is presented. The history of the American black duck population is tracked by the Mid-Winter Index (MWI) and related to annual harvest. Previous to effective restrictions in the United States in 1982 and later in Canada, the MWI was declining significantly at about 4% annually. Since restrictions were established the black duck population has stabilized, but to reach the goal of 260,000 wintering black ducks in the Atlantic Flyway continued or even more restrictions will be necessary. If the number of breeding pairs can be increased from current levels the black duck population is expected to increase.

Longcore, J.R., D.A. Clugston, and D.G. McAuley. 1998. Brood sizes of sympatric American black ducks and mallards in Maine. Journal of Wildlife Management 62(1):142-151.

The long-term decline of the American black duck (*Anas rubripes*) population has been attributed to lower productivity of black ducks that might have been excluded from fertile agricultural wetlands by mallards (*Anas platyrhynchos*). We monitored broods on 53 wetlands in 1993 and on 58 wetlands in 1994 to determine mean brood sizes of black ducks and mallards in forested and agricultural landscapes. Study wetlands were moderately to highly fertile. We monitored 94 black duck broods each year and 46 (1993) and 52 (1994) mallard broods until they reached Class IIc-III (near fledging). No differences existed (*P* = 0.71) in mean brood size between black ducks (1993, 3.95 ñ 0.23; 1994, 4.59 ñ 0.24) and mallards (1993, 3.96 ñ 0.35; 1994, 5.00 ñ 0.43) either year. Brood size for species; however, was different between years (*P* = 0.014) and among wetland sites (*P* = 0.001). Mean sizes of broods were larger (*P* < 0.05) on 2 large impoundment complexes (Lake Josephine and Lake Christina) compared with brood sizes on other wetlands in forested or agricultural landscapes. No differences (*P* 0.41) existed between mean Class IIc-III, brood sizes of black ducks and mallards whether species were alone or together on wetlands. Our data document that mallard productivity is similar to that of black ducks where they breed sympatrically in Maine.

Longcore, J. R., D. G. McAuley, and J. K. Ringelman. 1997. Characteristics of some black duck nest sites in Maine. Page 30 (abstract) *in* P. Kehoe, editor. American Black Duck Symposium. Merritt Press Ltd., Grand Falls, New Brunswick

Longcore, J. R. and J. K. Ringelman. 1997. Densities of breeding American black ducks in southcentral Maine: 1958-60 and 1978-80. Page 23 (abstract) *in* P. Kehoe, editor. American Black Duck Symposium. Merritt Press Ltd., Grand Falls, New Brunswick

Marion, J. L. 1998. Recreation ecology research findings: Implications for wilderness and park managers. 188-196 *in* Hannah Kirchner, editor. National Outdoor Ethic Conference Proceedings, April 18-21, 1996, St Louis, Missouri, New directions for responsible outdoor recreation. Izaak Walton League of America, Gaithersburg, Maryland. 308 pp.

Recreationists unintentionally trample vegetation, erode soil, and disturb wildlife. Such human-related impacts present a dilemma for managers charged with the dual objectives of providing recreational opportunities and preserving natural environments. This paper presents some of the principal findings and management implications from research on visitor impacts to protected areas, termed recreation ecology research. This field of study seeks to identify the type and

extent of resource impacts and to evaluate relationships between use-related, environmental, and managerial factors. The capabilities and managerial utility of recreation impact monitoring are also described.

Marion, J. L. and T. A. Farrell. 1998. Managing ecotourism visitation in protected areas. 155-181 *in* Kreg Lindberg, Megan Epler Wood, and David Engeldrum, editors. Ecotourism: A guide for planners and managers, Volume 2. Ecotourism Society, North Bennington, Vermont. 244 pp.

Ecotourism management seeks to integrate and balance several potentially conflicting objectives: protection of natural and cultural resources, provision of recreation opportunities and generation of economic benefits. In the absence of effective planning and management, ecotourism can lead to significant negative impacts on vegetation, soil, water, wildlife, historic resources, cultures, and visitor experiences. This chapter reviews visitor-related natural resource and experience impacts associated with ecotourism within protected areas. The influence of factors that control the nature and extent of impacts are also reviewed, including type and amount of use, the variable resistance and resilience of environmental attributes such as vegetation and soil types, and the role of management in shaping visitation, resources and facilities to support visitation while minimizing associated impacts. Implications for managing the effects of protected area visitation are highlighted, including carrying capacity decision frameworks and selecting management strategies and tactics.

Marion, J. L. and Y. Leung. 1998. International impact research and management. Pages 328-346 *in* William E. Hammitt and David N. Cole, editors. Wildland Recreation: Ecology and Management. 2nd edition. John Wiley & Sons, New York. xii, 361 pp.

To be sustainable, ecotourism requires the protection of natural environments and processes both from development and operation of the tourism infrastructure, and from the activities of ecotourists within protected areas. This book chapter reviews the international literature on the study of visitor or recreation-related resource impacts with special reference to ecotourism. Four case examples are presented to characterize the geographic scope, focus, and principal findings of this recreation ecology literature and its relevance to ecotourism management. Case examples include the Cairngorms National Nature Reserve, Scotland; the Great Barrier Reef, Australia; the Central American tropics; and wildlife viewing in Kenya's protected areas. Implications for the management of international protected areas and ecotourism resources are discussed.

Markowski, D., H.S. Ginsberg, K.E. Hyland, and R. Hu. 1998. Reservoir competence of *Microtus pennsylvanicus* (Rodentia: Cricetidae) for the Lyme disease spirochete, *Borrelia burgdorferi*. Journal of Medical Entomology 35(5):804-808.

The reservoir competence of the meadow vole, *Microtus pennsylvanicus* Ord, for the Lyme disease spirochete, *Borrelia burgdorferi* Johnson, Schmid, Hyde, Steigerwalt & Brenner was established on Patience Island, RI. Meadow voles were collected from 5 locations throughout Rhode Island. At 4 of the field sites, *M. pennsylvanicus* represented only 4.0% (*n* = 141) of the animals captured. However, on Patience Island, *M. pennsylvanicus* was the sole small mammal collected (*n* = 48). Of the larval *Ixodes scapularis* Say obtained from the meadow voles on Patience Island, 62% (*n* = 78) was infected with *B. burgdorferi*. Meadow voles from all 5 locations were successfully infected with *B. burgdorferi* in the laboratory and were capable of passing the infection to xenodiagnostic *I. scapularis* larvae for 9 wk. We concluded that *M. pennsylvanicus* was physiologically capable of maintaining *B. burgdorferi* infection. However, in locations where *Peromyscus leucopus* (Rafinesque) is abundant, the role of *M. pennsylvanicus* as a primary reservoir for *B. burgdorferi* was reduced.

McAuley, D.G., D.A. Clugston, and J.R. Longcore. 1998. Outcome of aggressive interactions between American black ducks and mallards during the breeding season. Journal of Wildlife Management 62(1):134-141.

Black duck (*Anas rubripes*) numbers have declined during the past several decades, while mallards (*Anas platyrhynchos*) have expanded their range eastward. Competitive exclusion of black ducks from wetlands by mallards has been proposed as a principal cause of the decline. We studied a sympatric population of black ducks and mallards in Maine during the early breeding season

to document behavior and interactions. We observed 832 aggressive interactions; most (72%) were between members of the same species. When a choice was available, both species interacted more often with conspecifics than with the other species ($P < 0.028$). On wetlands that both species occupied simultaneously, numbers of interspecific interactions initiated by each species were similar ($P = 0.47$). The proportion of won (initiator displaces recipient of attack), lost (initiator displaced), and "no change" outcomes of these interactions were different ($P < 0.0001$). Black ducks displaced mallards during 87.2%, lost none, and no change occurred during 12.8% of the interactions they initiated with mallards. Mallards displaced black ducks during 63.3%, were displaced by the black duck during 15%, and no change occurred during 21.7% of the interactions they initiated with black ducks. Displacement from wetlands was rare (38 of 229 interspecific interactions) and was equal between species. Mallards were neither more aggressive than nor behaviorally superior to black ducks.

McAuley, D. and D. Clugston. 1999. American woodcock. Pages 191-193 *in* M. J. Mac, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran, editors. Status and trends of the nation's biological resources. Volume 1. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

McShea, W. J., H. B. Underwood, and J. H. Rappole. 1997. Deer management and the concept of overabundance. Pages 1-7 *in* W. J. McShea, H. B. Underwood, and J. H. Rappole, editors. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, DC. xiv, 402 pp.

McShea, W.J., H.B. Underwood, and J.H. Rappole, editors. 1997. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, DC. xiv, 402 pp.

Mirande, C. M., J. W. Carpenter, and A. M. Burke. 1997. The effect of disturbance on the reproduction and management of captive cranes. Pages 56-61 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. . North American Crane Working Group, Grand Island, Nebraska. xi, 262 pp.

Mossman, M. J., L. M. Hartman, R. Hay, J. R. Sauer, and B. J. Dhuey. 1998. Monitoring long-term trends in Wisconsin frog and toad populations. Pages 169-198 *in* M. J. Lannoo, editor. Status and conservation of midwestern amphibians. University of Indiana Press, Bloomington, IN. xviii, 507 pp.

Musser, G.G., M.D. Carleton, E.M. Brothers, and A.L. Gardner. 1998. Systematic studies of Oryzomyine rodents (Muridae, Sigmodontinae): diagnoses and distributions of species formerly assigned to *Oryzomys "capito"*. Bulletin of the American Museum of Natural History No. 236:1-376.

We describe the morphological species-boundaries and geographic distributions of ten Neotropical *Oryzomys* based on analyses of museum specimens (skins and skulls, examples preserved in fluid, chromosomal spreads, and information about collection sites from skin tags, field catalogs, and other sources). These species have been regarded as members of an *Oryzomys capito* complex and for a long time were consolidated into a single entity identified as *O. capito*. Our study documents the following:

1. Defining the limits of species within the *O. capito* complex first requires a comprehensive review and rigorous definition of *O. capito* itself. We consider Fischer's (1814) *Mus megacephalus* to be valid and available, designate a neotype to bear the name, and reinstate it as a senior synonym of *capito* Olfers (1818). We then provide a working definition of *O. megacephalus* and its close relative, *O. laticeps*, derived from analyses of morphometric variation, estimates of geographic distributions, and evaluations of synonyms. In our view, *O. megacephalus* occurs in Amazonia but also extends into eastern Paraguay; its synonyms are *capito* Olfers (1818), *cephalotes* Desmarest (1819), *velutinus* Allen and Chapman (1893), *goeldi* Thomas (1897), *modestus* Allen (1899), and *perenensis* Allen (1901). *Oryzomys laticeps* Lund (1840) occurs in the Atlantic Forest region of eastern Brazil. We designate a lectotype for *laticeps* and allocate the names *saltator* Winge (1887) and *oniscus* Thomas (1904) as synonyms.

2. We provide the first comprehensive taxonomic revision of *Oryzomys yunganus* Thomas (1902). Its range covers tropical evergreen rainforest formations in the Guiana region and the Amazon Basin where, as documented by voucher specimens, it has been collected at the same localities as *O. megacephalus, O. nitidus,* and *O. tern* of carotid arterial circulation, occlusal patterns of second upper and lower molars, cranial proportions, and chromosomal features. Appreciable intraspecific geographic variation occurs in diploid number of chromosomes and frequency of occurrence of the hypothenar plantar pad, but sampling inadequacies obscure the significance of this variation. Large body size is characteristic of populations in the western Amazon Basin and in the tepui region of eastern Venezuela; smaller size characterizes populations in the Guianas and along the eastern margin of the Amazon Basin. No other scientific name has been correctly associated with the species. Samples from Mirador, Palmera, and Mera in the western Andean foothills of central Ecuador possess a combination of pelage, cranial, and dental traits that distinguish them from all samples of *O. yunganus*. These specimens are the basis for a new species we describe here, one that is more closely related to *O. yunganus* than to any other member of the former *O. "capito*" complex.

3. We redescribe *Oryzomys bolivaris* (reviewed by Pine, 1971, under the name *O. bombycinus*), amplify its geographic range, and contrast it with *O. talamancae* and *O. alfaroi*, two sympatric congeners often confused with it. A distinctive set of morphological traits allows unambiguous identification of specimens belonging to *O. bolivaris*. It is a trans-Andean species recorded from very wet tropical evergreen rainforests extending from eastern Honduras and Nicaragua through Costa Rica and Panamá to western Colombia and Ecuador. Allen's (1901) *bolivaris* is the oldest name for this species; *castaneus* Allen (1901), *rivularis* Allen (1901), *bombycinus* Goldman (1912), *alleni* Goldman (1915), and *orinus* Pearson (1939) are synonyms.

4. We revise the definition of *Oryzomys talamancae* Allen (1891) provided by Musser and Williams (1985), document additional specimens, describe karyotypes from Ecuadoran and Venezuelan samples, and contrast its morphology, chromosomes, and distribution with those of *O. alfaroi* and *O. megacephalus.* The geographic distribution of *O. talamancae* is also trans-Andean, but it inhabits a wider variety of habitats than *O. bolivaris*. We also provide a new synonymy and identify the following scientific names as synonyms of *O. talamancae: mollipilosus* Allen (1899), *magdalenae* Allen (1899), *villosus* Allen (1899), *sylvaticus* Thomas (1900), *panamensis* Thomas (1901), *medius* Robinson and Lyon (1901), and *carrikeri* Allen (1908).

5. We present hypotheses of species-boundaries of four morphologically similar species that we identify as members of the *Oryzomys nitidus* group: *O. nitidus* Thomas (1884), *O. macconnelli* Thomas (1910), *O. russatus* Wagner (1848), and a species described as new. We recognize the four species by morphological and chromosomal traits, and contrast characteristics of each species with one another. One synonym, *boliviae* Thomas (1901), is associated with *O. nitidus,* and two scientific names, *incertus* Allen (1913) and *mureliae* Allen (1915), are allocated to *O. macconnelli.* Synonyms of *O. russatus* are *physodes* Brants (1827), *intermedia* Leche (1886), *coronatus* Winge (1887), *lamia* Thomas (1901), *legatus* Thomas (1925), *kelloggi* Ávila-Pires (1959), and *moojeni* Ávila-Pires (1959). We designate lectotypes for *russatus* and *intermedia* and identify the holotype of *coronatus.*

Based on voucher specimens, the geographic distribution of *O. nitidus* is mainly along the Andean foothills and adjacent lowlands in Perú, Bolivia, and nearby western Brazil, but scattered records document its eastward extension through southcentral Brazil to Paraguay and northeastern Argentina. *Oryzomys macconnelli* inhabits the tropical evergreen rainforests of Amazonia. Its distribution partially overlaps that of *O. nitidus* in western Amazonia, where the two species have been collected together at one locality in Perú, and is sympatric with the new species, which is recorded only from the lower regions of Rios Xingu and Tocantins in northern Pará, Brazil. The distribution of *O. russatus* is documented by specimens from southeastern and southcentral Brazil, southern Bolivia, and northern Argentina; its range is allopatric to those of *O. macconnelli*, the new species, and *O. nitidus* except in southern Bolivia where the latter was collected at the same site with *O. russatus.* We also examined types and descriptions of taxa associated with *Oryzomys subflavus* and *O. ratticeps* to determine if any of those names actually reference members of the *O. nitidus* group. Although the original description of *subflavus* Wagner (1842) is vague, the holotype clearly represents an example of that very distinctive species; *vulpinus* Lund (1840), for

which we designate a lectotype, and *vulpinoides* Schinz (1845) are synonyms of *O. subflavus.* The oldest name for the species currently known as *Oryzomys ratticeps* is *Mus angouya* Fischer (1814), a name not based on a specimen but on Azara's (1801) description of "RAT TROISIÈME OU RAT ANGOUYA." Azara's account is so general in its characterization of the designate a neotype for *Mus angouya* Fischer (1814) and treat the following scientific names as synonyms: *buccinatus* Olfers (1818), *leucogaster* Wagner (1845), *ratticeps* Hensel (1872), *rex* Winge (1887), *tropicius* Thomas (1924), and *paraganus* Thomas (1924). We also designate lectotypes for *leucogaster* and *ratticeps.*

We have not analyzed phylogenetic relationships among the species in the former *O. "capito"* complex discussed here. Documenting morphological and distributional boundaries of other biological species now grouped in the genus *Oryzomys (alfaroi* and and its close relatives, for example) must precede, in our view, attempts at phylogenetic reconstruction.

Nelson, J.T., G.F. Gee, and R.D. Slack. 1997. Food consumption and retention time in captive whooping cranes *(Grus americana)*. Zoo Biology 16(6):519-531.

Nesbitt, S. A., M. J. Folk, M. G. Spalding, J. A. Schmidt, S. T. Schwikert, J. M. Nicolich, M. Wellington, J. C. Lewis, and T. H. Logan. 1997. An experimental release of whooping cranes in Florida -- the first three years. Pages 79-85 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska . ix, 262 pp.

Nichols, J.D., T. Boulinier, J.E. Hines, K.H. Pollock, and J.R. Sauer. 1998. Inference methods for spatial variation in species richness and community composition when not all species are detected. Conservation Biology 12(6):1390-1398.

Inferences about spatial variation in species richness and community composition are important both to ecological hypotheses about the structure and function of communities and to community-level conservation and management. Few sampling programs for animal communities provide censuses, and usually some species present. We present estimators useful for drawing inferences about comparative species richness and composition between different sampling locations when not all species are detected in sampling efforts. Based on capture-recapture models using the robust design, our methods estimate relative species richness, proportion of species in one location that are also found in another, and number of species found in one location but not in another. The methods use data on the presence or absence of each species at different sampling occasions (or locations) to estimate the number of species not detected at any occasions (or locations). This approach permits estimation of the number of species in the sampled community and in subsets of the community useful for estimating the fraction of species shared by two communities. We provide an illustration of our estimation methods by comparing bird species richness and composition in two locations sampled by routes of the North American Breeding Bird Survey. In this example analysis, the two locations (an associated bird communities) represented different levels of urbanization. Estimates of relative richness, proportion of shared species, and number of species present on one route but not the other indicated that the route with the smaller fraction of urban area had greater richness and a larer number of species that were not found on the more urban route than vice versa. We developed a software package, COMDYN, for computing estimates based on the methods. Because these estimation methods explicitly deal with sampling in which not all species are detected, we recommend their use for addressing questions about species richness and community composition.

Nichols, J.D., T. Boulinier, J.E. Hines, K.H. Pollock, and J.R. Sauer. 1998. Estimating rates of local species extinction, colonization and turnover in animal communities. Ecological Applications 8(4):1213-1225.

Species richness has been identified as a useful state variable for conservation and management purposes. Changes in richness over time provide a basis for predicting and evaluating community responses to management, to natural disturbance, and to changes in factors such as community composition (e.g., the removal of a keystone species). Probabilistic capture-recapture models have been used recently to estimate species richness from species count and presence-absence data. These models do not require the common assumption that all species are detected in sampling efforts. We extend this approach to the development of estimators useful for studying

the vital rates responsible for changes in animal communities over time; rates of local species extinction, turnover, and colonization. Our approach to estimation is based on capture-recapture models for closed animal populations that permit heterogeneity in detection probabilities among the different species in the sampled community. We have developed a computer program, COMDYN, to compute many of these estimators and associated bootstrap variances. Analyses using data from the North American Breeding Bird Survey (BBS) suggested that the estimators performed reasonably well. We recommend estimators based on probabilistic modeling for future work on community responses to management efforts as well as on basic questions about community dynamics.

Nisbet, I. C. T., J. A. Spendelow, J. S. Hatfield, G. Gough, and J. M. Zingo. 1997. Early growth of roseate terns chicks as an index of parental quality. Page 22 *in* L. R. Monteiro, editor. Proceedings of the Seventh Roseate Tern Workshop held in Horta, Azores, Portugal, 26-27 April 1997. 46 pp.

Nisbet, I.C.T., J.A. Spendelow, J.S. Hatfield, J.M. Zingo, and G.A. Gough. 1998. Variations in growth of roseate tern *(Sterna dougallii)* chicks: II. Early growth as an index of parental quality. Condor 100(2):305-315.

We measured growth of Roseate Tern (*Sterna dougallii)* chicks at a colony in Connecticut in 10 successive years. Data on body mass during the first three to four days of life were fitted to a quadratic regression model, yielding three parameters of early growth for each of 1,551 chicks: mass at hatching (Mo), linear growth (a) and quadratic growth (b). First chicks in each brood (A-chicks) exceeded second chicks (B-chicks) in each of the three growth parameters; A-chicks from broods of two grew faster than single chicks during the first three days. Mo depended on egg mass, hatch order, hatch date, and year. The linear coefficient (a) depended on hatch date, hatch order, and year, but not on egg mass or Mo. The quadratic coefficient (b) depended on a, hatch date, Mo, and hatch order. Subsequent growth and survival of chicks were predicted well by these parameters of early growth, with b contributing more to these predictions than Mo or a. After controlling for effects of early growth, none of the other variables measured (hatch date, egg mass, parental age, hatch interval between chicks, mass difference between chicks, female-female pairing, or trapping) contributed significantly to explaining later growth and survival. Year effects were substantial in only two of the 10 years of study. Individual pairs were consistent in performance (as indexed by chick growth) in successive years. These results suggest that growth and survival of Roseate Tern chicks are determined primarily by parental quality; much of the information about parental quality is expressed by the time the eggs are laid, and most of it is expressed by the time the chicks are three days old.

Nowak, R.M. and N.E. Federoff. 1998. The validity of the red wolf: a response to Roy et al. (1996). Conservation Biology 12(3):722-725.

"Red wolf" is a name commonly given to a kind of wild *Canis* historically found from central Texas to the Atlantic. Since first recorded in colonial times, it variously has been treated as a full species or as a subspecies of the Holarctic gray wolf. Recent genetic research presented by Roy et al. (1996) is one of a series of papers suggesting, through analysis of mitochondrial and nuclear DNA, that the red wolf is not a valid species or subspecies, but instead originated as a hybrid of *C. lupus* and *C. latrans*. That there has been hybridization between the red wolf and coyote is not in dispute. The occurrence of hybridization has long has been recognized by all who have looked into the issue and is a major reason that the red wolf is endangered. And, since hybridization did occur, it would not be unexpected to find that genetic material from one species has spread through the other. However, to accept this process of hybridization and consequent decline of the red wolf within the last century, is very different from accepting that the red wolf had a hybrid origin hundreds or thousands of years ago. It requires some effort to comprehend the fundamental difference between the two positions. One argues that the red wolf is an ancient and natural component of its ecosystem but has nearly disappeared, in part because of a hybridization process induced and perhaps controllable by humans. This interpretation demands priority work to save the animal. The other position holds that the red wolf may actually have been a modern creation of a process brought on by human environmental modification, and hence that the animal is nothing more than an artifact that can be discarded. The salvation of the red wolf may hinge upon the effort that is made to grasp this distinction. Hopefully, all parties who have investigated

this complex issue will yet reach a consensus, thus allowing the systematic controversy to be put aside in favor of conservation efforts.

Olsen, G. H. and G. F. Gee. 1997. Causes of Mississippi sandhill crane mortality in captivity 1984-1995. Pages 249-252 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska. ix, 262 pp.

Olsen, G. H., J. A. Taylor, and G. F. Gee. 1997. Whooping crane mortality at Patuxent Wildlife Research Center, 1982-1995. Pages 243-248 *in* R. P. Urbanek and D. W. Stahlecker, editors. Proceedings of the seventh North American Crane Workshop. North American Crane Working Group, Grand Island, Nebraska. ix, 262 pp.

Olsen, J.A. and M.C. Perry. 1997. Watershield use by ring-necked ducks. Northeastern Naturalist 4(3):197-204.

During 1993-94 and 1994-95, the amount of watershield *(Brasenia schreberi)* in selected Maryland wetlands was determined to see if a relationship existed between the amount of watershield on a wetland and the number of ring-necked ducks *(Aythya collaris)* observed on that wetland. Data were collected for two years from eight different wetlands on the Patuxent Research Refuge in Laurel, Maryland. Results indicate there was no significant correlation between the amount of watershield in a wetland and the number of ring-necked ducks observed on that wetland.

Parker, G. R. and J. D. Nichols. 1997. Mortality workshop. Pages 50-54 *in* P. Kehoe, editor. American Black Duck Symposium. Merritt Press Ltd., Grand Falls, New Brunswick

Perry, M. C. 1998. Wetland habitats for wildlife of the Chesapeake Bay. Pages 332-349 in *in* S.K. Majumdar, E. W. Miller, and Fred J. Brenner. Ecology of wetlands and associated systems. Pennsylvania Academy of Science, Easton, Pa. 685 p pp.

The wetlands of Chesapeake Bay have provided the vital habitats that have sustained the impressive wildlife populations that have brought international fame to the Bay. As these wetland habitats decrease in quantity and quality we will continue to see the decline in the wildlife populations that started when European settlers first came to this continent. These declines have accelerated significantly in this century. As the human population continues to increase in the Bay watershed, one can expect that wetland habitats will continue to decline, resulting in declines in species diversity and population numbers. Although federal, state, and local governments are striving for "no net loss" of wetlands, the results to date are not encouraging. It is unrealistic to believe that human populations and associated development can continue to increase and not adversely affect the wetland resources of the Bay. Restrictions on human population growth in the Chesapeake area is clearly the best way to protect wetland habitats and the wildlife that are dependent on these habitats. In addition, there should be more aggressive approaches to protect wetland habitats from continued perturbations from humans. More sanctuary areas should be created and there should be greater use of enhancement and management techniques that will benefit the full complement of species that potentially exist in these wetlands. The present trend in wetland loss can be expected to continue as human populations increase with resultant increases in roads, shopping malls, and housing developments. Creation of habitat for mitigation of these losses will not result in "no net loss". More innovative approaches should be employed to reverse the long-term trend in wetland loss by humans.

Perry, M. C., P. C. Osenton, F. W. Fallon, and J. E. Fallon. 1997. Optimal management strategies for biodiversity within a powerline right-of-way. Pages 133-139 *in* James R. (Randy) Williams, John W. Goodrich-Mahoney, Jan R. Wisniewski, and Joe Wisniewski, editors. Sixth International Symposium on Environmental Concerns in Right-of-Way Management: 24-26 February 1997, New Orleans, Louisiana. Elsevier Science, New York, NY. x, 511 pp.

Management techniques used to control vegetation along a new 8.5 km- (5.3 mile) long powerline right-of-way located at Patuxent Research Refuge are being evaluated to identify changes in habitat that affect wildlife. Techniques include: complete mow, strip mow, low volume foliar spray,

selective basal spray, and tree topping. One hundred and one bird species were recorded during line transect sampling along the right-of-way. The eastern towhee had the highest frequency of occurrence followed by the field sparrow and the common yellowthroat. The field sparrow had the highest numbers per visit followed by the eastern towhee and eastern bluebird. Fifteen species were recorded in numbers greater than ten individuals per visit in at least one season of the year. Nine species of mammals were trapped in live traps during the study and four other mammal species were observed but not captured. Twelve species of amphibians and six species of reptiles were trapped in pitfall or funnel traps. Differences in the distribution of species seemed to be related to the physical and hydrological features of the right-of-way. Although no major differences in the distribution of wildlife species resulted from the vegetation management, differences are expected in the future as vegetation differences become more pronounced. Data from this study will be of value to resource managers attempting to provide optimal habitat for biodiversity.

Perry, M. C., S. B. Pugh, and A. S. Deller. 1995. Forested wetlands constructed for mitigation of destroyed natural wetlands. Pages 257-262 *in* ECOSET '95: International conference on ecological system enhancement technology for aquatic environments. Sixth International Conference on Aquatic Habitat Enhancement Japan International Marine Science and Technology Federation, Tokyo

Forested wetlands constructed for mitigation were evaluated at six sites in Maryland to determine the success of these areas for providing suitable wildlife habitat. Natural forested wetlands were used as reference sites. Initial mortality of planted woody shrubs and trees was high (avg. 55%) and mostly attributed to excessive moisture. The number of woody seedlings from natural regeneration was inversely proportional to the amount of grass cover on the site, which was planted for erosion control. The number of volunteer woody seedlings was also inversely proportional to the distance from adjacent natural forests. Preliminary data indicate that cost does not support use of transplants and that enhancement of soil with organic supplements, followed by widespread and heavy seeding of woody plants would be more efficient and effective. Wildlife use of areas measured by avian surveys and trapping of mammals, reptiles, and amphibians showed that in general wildlife species were more representative of open grassland areas than forested habitats. Natural succession of the sites probably will take at least 20-30 years before typical values and functions of forested wetlands are obtained.

Peterjohn, B.G. and J.R. Sauer. 1997. Population trends of black terns from the North American Breeding Bird Survey, 1966-1996. Colonial Waterbirds 20(3):566-573.

Data from the North American Breeding Bird Survey indicate a survey-wide decline in Black Terns (*Chlidonias niger*) at an average rate of 3.1% annually during 1966-1996. Black Terns in Canada decreased at an average annual rate of 3.5% during this interval, while the United States population showed no significant trends. The long-term declines largely reflect trends prior to 1980, when the continental, Canadian, and United States populations decreased at average annual rates of 7.5%, 5.6%, and 11.9%, respectively. Most population trends were reversed during the 1990s, causing trend estimates over the 1980-1996 interval to become more positive. Associations between patterns of change in Black Terns, Mallards (*Anas platyrhynchos*), and numbers of ponds in the northern Great Plains suggest some relationships exist between habitat availability and the population trajectories.

Portnoy, J.W., B.L. Nowicki, C.T. Roman, and D.W. Urish. 1998. The discharge of nitrate-contaminated groundwater from developed shoreline to marsh-fringed estuary. Water Resources Research 34(11):3095-3104.

As residential development, onsite wastewater disposal and groundwater contamination increase in the coastal zone, assessment of nutrient removal by soil and sedimentary processes becomes increasingly important. Nitrogen removal efficiency depends largely upon the specific flow paths taken by groundwater as it discharges into nitrogen-limited estuarine waters. Shoreline salinity surveys, hydraulic studies and thermal infrared imagery indicated that groundwater discharge into the Nauset Marsh estuary (Eastham, MA) occurred in high-velocity seeps immediately seaward of the upland-fringing salt marsh. Discharge was highly variable spatially and occurred through permeable, sandy sediments during low tide. Seepage chamber monitoring showed that dissolved

inorganic nitrogen (principally nitrate) traversed nearly conservatively from the aquifer through shallow estuarine sediments to coastal waters at flux rates of 13 mmoles m^2 h^1. A significant relationship found between porewater NO_3N concentrations and NO_3N flux rates may provide a rapid method of estimating nitrogen loading from groundwater to the water column.

Powell, D.C., R.J. Aulerich, J.C. Meadows, D.E. Tillitt, M.E. Kelly, K.L. Stromborg, M.J. Melancon, S.D. Fitzgerald, and S.J. Bursian. 1998. Effects of 3,3',4,4',5-pentachlorobiphenyl and 2,3,7,8-tetrachlorodibenzo-p-dioxin injected into the yolks of double-crested cormorant *(Phalacorcorax auritus)* eggs prior to incubation. Environmental Toxicology and Chemistry 17(10):2035-2040.

Double-crested cormorant *(Phalacorcorax auritus)* eggs were injected with either 3,3',4,4',5-pentachlorobiphenyl (polychlorinated biphenyl [PCB] 126; 70-698 µg/kg egg) or 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD; 1.3-11.7 µg/kg egg) prior to incubation. These compounds were injected into the yolks of cormorant eggs collected from incomplete clutches at isolated colonies on Lake Winnipegosis, Manitoba, Canada. Eggs were incubated for approximately 26 to 28 d. After hatching the brain, bursa, heart, liver, and spleen were dissected and weighed. Torsos were preserved in formalin for examination of the gonads. Median lethal doses (LD50s) calculated from mortality data at hatching were 177 and 4.0 µg/kg egg for PCB 126 and TCDD, respectively. No significant differences were found in the incidence of developmental abnormalities in any of the treatment groups. Bursa weights were significantly less in the greatest (11.7 µg/kg egg) TCDD group compared to the vehicle control group. Spleen weights were significantly less in the 349 µg PCB 126/kg egg and the 5.4 and 11.7 µg TCDD/kg egg groups when compared to the vehicle control group. No histological alterations of the gonads were found. Hepatic ethoxyresorufin-*O*-deethylase activity in all PCB 126 and TCDD dose groups was significantly greater compared to the control activity. The toxic equivalency factor for PCB 126 was 0.02

Powell, L.A., D.G. Krementz, J.D. Lang, and M.J. Conroy. 1998. Effects of radio transmitters on migrating wood thrushes. Journal of Field Ornithology 69(2):306-315.

We quantified the effects of radio transmitters on Wood Thrushes (*Hylocichla mustelina*) using 4 yr of banding and telemetry data from Piedmont National Wildlife Refuge, Georgia. Flight performance models suggest that the 1.6-g transmitter shortens the migratory range of Wood Thrushes by only 60 km, and the estimated migratory range is adequate to accomplish migration even with limited fat stores. We used two strengths of line, 5- and 9-kg test-strength braided Dacron, to attach the transmitters using the thigh-harness method. We recaptured 13 returning radio-marked Wood Thrushes, seven of which were still marked. Six of the seven birds marked with the 5-kg test harnesses lost their transmitters within 1 yr while all six of the 9-kg test harnesses were still attached up to 21 mo later. Radio-marking did not reduce the return rates of adults and immatures, and the transmitters did not cause radio-marked birds to lose more mass than banded-only birds. Wood Thrushes can successfully carry a transmitter during migration with no detectable negative effects. We recommend continued use of the thigh-harness method, but we encourage the use of 5-kg cotton line.

Rattner, B.A. and J.R. Jehl, Jr. 1997. Dramatic fluctuations in the liver mass and metal content of eared grebes *(Podiceps nigricollis)* during autumnal migration. Bulletin of Environmental Contamination and Toxicology 59(3):337-343.

Adult eared grebes exhibit threefold fluctuation in body mass and up to a fivefold variation in liver weight during the course of their annual breeding and migratory cycle. Concentrations of 20 metals or metalloids were quantified in the liver from eared grebes obtained at three phases of their annual cycle: newly arrived migrants (July-August-September), staging (October-November), and immediate post-migration (December-January). Values for twelve elements (Al, B, Cd, Cr, Cu, Fe, Hg, Mg, Mn, Ni, Se, and Zn) that were detected in more than one-half of the samples were low. Hepatic concentrations of elements known to be toxic to free-ranging birds (e.g., Cd, Hg, Pb, Se) were well below known effect thresholds. No differences in metal concentrations were observed between newly arrived migrants and staging birds despite the large increases in body and liver mass. However, in the immediate post-migration period after body and liver mass have rapidly declined, Al values decreased, whereas Se and Zn concentrations actually increased.

Total liver burdens of elements tended to be greatest in staging grebes compared to other collection periods, and paralleled changes in body and liver mass. The need for temporally- and physiologically-matched reference birds, and at least knowledge of circannual organ mass fluctuations, appears to be a requirement for ecotoxicological exposure assessments in species such as the eared grebe. Generation of additional avian toxicity data from controlled dosing studies during potentially vulnerable phases of their annual cycle (e.g., molt, post-migration) seems warranted. Although it is commonly accepted that hepatic metal concentrations are principally affected by contaminant exposure, we have shown differential alterations related to the stage of the annual cycle. Our findings may be of broad significance, as well as of immediate importance in resolving the cause of the die-off of approximately 150,000 eared grebes (perhaps 7% of the North American population) at the Salton Sea in 1991-1992.

Rattner, B.A., M.J. Melancon, C.P. Rice, W. Riley, Jr., J. Eisemann, and R.K. Hines. 1997. Cytochrome P450 and organochlorine contaminants in black-crowned night-herons from the Chesapeake Bay region. Environmental Toxicology and Chemistry 16(11):2315-2322.

Black-crowned night-heron (*Nycticorax nycticorax*) offspring were collected from a relatively uncontaminated coastal reference site (next to Chincoteague National Wildlife Refuge, VA, USA) and two sites in the Chesapeake Bay watershed (Baltimore Harbor, MD and Rock Creek Park, Washington, D.C., USA). Hepatic microsomal activities of benzyloxyresorufin-*O*-dealkylase and ethoxyresorufin-*O*-dealkylase were significantly elevated (up to sixfold and ninefold induction, respectively) in pipping embryos from the Baltimore Harbor colony compared to the reference site, whereas values in embryos from the Rock Creek Park colony were intermediate. Concentrations of organochlorine pesticides and metabolites in pipping embryos from both sites in the Chesapeake watershed were greater than at the reference site, but below known threshold for reproductive impairment. However, concentrations of 10 arylhydrocarbon-receptor active PCB congeners and estimated toxic equivalents were up to 37-fold greater in embryos collected from these two sites in the Chesapeake Bay region, with values for toxic congeners 77 and 126 exceeding those observed in pipping heron embryos from the Great Lakes. Monooxygenase activity of pipping embryos was frequently associated with concentrations of organochlorine contaminants and toxic equivalents (r = 0.30 to 0.59), providing further evidence of the value of cytochrome P450 as a biomarker of organic contaminant exposure. Organochlorine contaminant levels were greater in 10-d-old nestlings from Baltimore Harbor than the reference site, but had no apparent effect on monooxygenase activity or growth. These findings demonstrate induction of cytochrome P450 in *pipping* black-crowned night-heron embryos in the Chesapeake Bay region, probably by exposure to PCB congeners of local origin, and the accumulation of organochlorine pesticides and metabolites in *nestling* herons from Baltimore Harbor.

Remsen, J.V., Jr., J.A. Kushlan, and B.A. Loiselle. 1998. History and tradition, or contemporary ornithology? Why ornithological journals should not have bird names. Auk 115(1):252-253.

Risenhoover, K. L., H. B. Underwood, W. Yan, and J. L. Cooke. 1997. A spatially-explicit modelling environment for evaluating deer management strategies. Pages 366-379 *in* William J. McShea, H. Brian Underwood, and John H. Rappole, editors. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, DC. xiv, 402 pp.

Rodda, G. H., E. W. Campbell, III, and S. R. Derrickson. 1998. Avian conservation research in the Mariana Islands, Western Pacific Ocean. Pages 367-381 *in* John M. Marzluff and Rex Sallabanks, editors. Avian Conservation: Research and Management. Island Press, Washington, DC. xii, 563 pp.

Rodda, G.H., T.H. Fritts, and D. Chiszar. 1997. The disappearance of Guam's wildlife: new insights for herpetology, evolutionary ecology, and conservation. BioScience 47(9):565-574.

The wealth of data generated from intensive study of the brown tree snake as a result of the need to control introduced populations of this pest species allow several important conclusions. First, that the snakes on Guam are extraordinary in terms of their absolute abundance and in terms of their ability to exploit a broad prey base. Our data suggest an exceptionally high reproductive success on Guam for a snake with an otherwise unnoteworthy reproductive capability and life history (i.e. small clutch size, typical ontogenetic shift from small heterothermic prey to larger

homeotherms). Especially important was the snakes versatility in taking advantage of extremely common prey on islands; population expansion was slow but survival was maximal, ultimately leading to high population levels. The brown tree snake shares many attributes with other snakes that could cause similar biodiversity crises in a wide variety of contexts in which they lack coevolutionary histories (especially formerly snake-free island environments). As opposed to their relatively poor history as over-water dispersers, snakes may be especially problematic as travelers in increasing ship and air traffic between widely separated geographic regions of the world.

Rodda, G.H., T.H. Fritts, G. Perry, and E.W. Campbell, III. 1998. Managing island biotas: Can indigenous species be protected from introduced predators such as the brown treesnake? Transactions of the North American Wildlife and Natural Resources Conference 63:95-108.

Roman, C.T., J.A. Peck, J.R. Allen, J.W. King, and P.G. Appleby. 1997. Accretion of a New England (U.S.A.) salt march in response to inlet migration, storms, and sea-level rise. Estuarine, Coastal and Shelf Science 45:717-727.

Sediment accumulation rates were determined at several sites throughout Nauset Marsh (Massachusetts, U.S.A.), a back-barrier lagoonal system, using feldspar marker horizons to evaluate short-term rates (1 to 2 year scales) and radiometric techniques to estimate rates over longer time scales (^{137}Cs, ^{210}Pb, ^{14}C). The barrier spit fronting the *Spartina*-dominated study site has a complex geomorphic history of inlet migration and over-wash events. This study evaluates sediment accumulation rates in relation to inlet migration, storm events, and sea-level rise. The marker horizon technique displayed strong temporal and spatial variability in response to storm events and proximity to the inlet. Sediment accumulation rates of up to 24 mm year $^{-1}$ were recorded in the immediate vicinity of the inlet during a period that included several major coastal storms, while feldspar sites remote from the inlet had substantially lower rates (trace accumulation to 2.2 mm year $^{-1}$). During storm-free periods, accumulation rates did not exceed 6.7 mm year $^{-1}$, but remained quite variable among sites. Based on ^{137}Cs (3.8 to 4.5 mm year $^{-1}$) and ^{210}Pb (2.6 to 4.2 mm year $^{-1}$) radiometric techniques, integrating sediment accumulation over decadal time scales, the marsh appeared to be keeping pace with the relative rate of sealevel rise from 1921 to 1993 of 2.4 mm year $^{-1}$. At one site, the ^{210}Pb-based sedimentation rate and rate of relative sea-level rise were nearly similar and peat rhizome analysis revealed that *Distichlis spicata* recently replaced this once S.*patens* site, suggesting that this portion of Nauset Marsh may be getting wetter, thus representing an initial response to wetland submergence. Horizon markers are useful in evaluating the role of short-term events, such as storms or inlet migration, influencing marsh sedimentation processes. However, sampling methods that integrate marsh sedimentation over decadal time scales are preferable when evaluating a systems response to sea-level rise.

Seagle, S. W. and S-Y. Liang. 1997. Bottomland forest composition and seedling diversity. Pages 346-365 *in* W. J. McShea, H. B. Underwood, and J. H. Rappole, editors. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, DC. xiv, 402 pp.

Sheffield, S. R., J. M. Matter, B. A. Rattner, and P. D. Guiney. 1998. Wildlife species as sentinels of environmental endocrine disruption. Pages 369-430 *in* Ronald J. Kendall, Richard L. Dickerson, John P. Giesy, and William P. Suk, editors. Principles and Processes for Evaluating Endocrine Disruption in Wildlife. SETAC Special Publication. SETAC Press, Pensacola, FL. xxiv, 491 pp.

This chapter provides an overview of the history and criteria for use of captive and free-ranging fish and wildlife (amphibians, reptiles, birds, and mammals) species as sentinels of potential environmental endocrine disruption. Biochemical, behavioral, physiological, immunological, genetic, reproductive, developmental, and ecological correlates of endocrine disruption in these sentinels are presented and reviewed. In addition, data needs to promote better use of sentinel species in the assessment of endocrine disruption are discussed.

Smith, W.P., D.J. Twedt, P.B. Hamel, R.P. Ford, D.A. Wiedenfeld, and R.J. Cooper. 1998. Increasing point-count duration increases standard error. Journal of Field Ornithology 69(3):450-456.

We examined data from point counts of varying duration in bottomland forests of west Tennessee and the Mississippi Alluvial Valley to determine if counting interval influenced sampling efficiency. Estimates of standard error increased as point count duration increased both for cumulative number of individuals and species in both locations. Although point counts appear to yield data with standard errors proportional to means, a square root transformation of the data may stabilize the variance. Using long (>10 min) point counts may reduce sample size and increase sampling error, both of which diminish statistical power and thereby the ability to detect meaningful changes in avian populations.

Sparling, D.W. 1998. Deformities in southern leopard frogs linked to common pesticides. People, Land & Water 5(9):11.

Sparling, D.W. and N.E. Federoff. 1997. Secondary poisoning of kestrels by white phosphorus. Ecotoxicology 6(4):239-247.

Since 1982, extensive waterfowl mortality due to white phosphorus (P_4) has been observed at Eagle River Flats, a tidal marsh near Anchorage, Alaska. Ducks and swans that ingest P_4 pellets become lethargic and may display severe convulsions. Intoxicated waterfowl attract raptors and gulls that feed on dead or dying birds. To determine if avian predators can be affected by secondary poisoning, we fed American kestrels (*Falco sparverius*) 10-day-old domestic chickens that had been dosed with white phosphorus. Eight of 15 kestrels fed intact chicks with a pellet of P_4 implanted in their crops died within seven days. Three of 15 kestrels fed chicks that had their upper digestive tracts removed to eliminate any pellets of white phosphorus also died. Hematocrit and hemoglobin in kestrels decreased whereas lactate dehydrogenaseL, glucose, and alanine aminotransferase levels in plasma increased with exposure to contaminated chicks. Histological examination of liver and kidneys showed that the incidence and severity of lesions increased when kestrels were fed contaminated chicks. White phosphorus residues were measurable in 87% of the kestrels dying on study and 20% of the survivors. This study shows that raptors can become intoxicated either by ingesting portions of digestive tracts containing white phosphorus pellets or by consuming tissues of P_4 contaminated prey.

Sparling, D.W. and T.P. Lowe. 1998. Metal concentrations in aquatic macrophytes as influenced by soil and acidification. Water, Air, and Soil Pollution 108:203-221.

Bioavailability of metals to aquatic plants is dependent on many factors including ambient metal concentration, pH of soil or water, concentration of ligands, competition with other metals for binding sites, and mode of exposure. Plants may be exposed to metals through water, air, or soil, depending on growth form. This paper examines the influence of soil type under two regimens of water acidification on metal uptake by four species of aquatic macrophytes: smartweed *(Polygonum sagittatum)*, burreed *(Sparganium americanum)*, pondweed *(Potamogeton diversifolius)*, and bladderwort *(Utricularia vulgaris)* in constructed, experimentally acidified wetlands. Soil types consisted of a comparatively high-metal clay or a lower-metal sandy loam. Each pond was either acidified to pH ca. 4.85.3 or allowed to remain circumneutral. Metal concentrations tended to be higher in the submerged bladderwort and pondweed than in the emergent burreed and smartweed. Soils were important to plant metal concentrations in all species, but especially in the emergents. Acidification influenced plant concentrations of some metals and was especially important in the submerged pondweed. Bioaccumulation of metals occurred for Mn, B, Sr, Ba, and Zn, compared to soil concentrations.

Sparling, D.W., S. Vann, and R.A. Grove. 1998. Blood changes in mallards exposed to white phosphorus. Environmental Toxicology and Chemistry 17:2521-2529.

White phosphorus (P4) has been extensively used by the military for various purposes including marking artillery impacts and as an obscurant. Target practice in an Alaskan tidal marsh during the last four decades has deposited large amounts of P4 particles in sediments and water which have resulted in die-offs of several waterfowl species. Because the toxicity of P4 in birds has not been well documented and because it is quickly excreted or metabolized in living animals, we sought to determine the effects of experimental dosing on blood characteristics in game farm mallards *(Anas platyrhynchos)*. In two experiments, one employing single doses of 5.4 mg P4/kg

body weight in corn oil and the other using daily repeated doses of pelletized P4 at either 0.5 or 1.0 mg/kg, there were significant changes in AST, ALT, LDH, inorganic P, hematocrit and hemoglobin. Other indications of exposure included changes in uric acid, creatinine, and total protein which were consistent with reported liver and kidney damage due to this contaminant. Changes in white blood cells included a greater frequency of thrombocytes and fewer lymphocytes in dosed birds compared to controls. A biomarker of exposure based on LDH activity and hemoglobin is proposed.

Spendelow, J.A. and J.M. Zingo. 1997. Female roseate tern fledges a chick following the death of her mate during the incubation period. Colonial Waterbirds 20(3):552-555.

Despite the death of her mate during the incubation period and a shortage (or lack of availability) of food in nearby waters, a female Roseate Tern (*Sterna dougallii*) nesting at the Falkner Island Unit of the Stewart B. McKinney National Wildlife Refuge in Connecticut was able to raise a chick to fledging in 1995 without human assistance. The growth and development of this chick was slower than that of other single chicks in the colony; it never weighed more than 90 g and did not fledge until 32 days of age. Despite this exceptional female's ability to rear a chick on her own, this observation supports the idea that bi-parental care is important in Roseate Terns, particularly during years of food shortage.

Spendelow, J. A., J. M. Zingo, and J. S. Hatfield. 1997. Reproductive strategies for coping with poor conditions: responses of roseate terns to low food availability during the egg-laying period at Falkner Island, Connecticut. Pages 34-36 *in* L. R. Monteiro, editor. Proceedings of the Seventh Roseate Tern Workshop held in Horta, Azores, Portugal, 26-27 April 1997. 46 pp.

Spendelow, J. A., J. M. Zingo, DA. Shealer, and G. W. Pendleton. 1997. Growth and fledgling of roseate terns in exceptionally "good" and "poor" years of overall productivity. Pages 31-33 *in* L. R. Monteiro, editor. Proceedings of the Seventh Roseate Tern Workshop held in Horta, Azores, Portugal, 26-27 April 1997. 46 pp.

Swicker, S.M. 1998. Frog force enlists public in national monitoring campaign. People, Land & Water 5(9):12.

Sykes, P.W., Jr. and M.H. Clench. 1998. Winter habitat of Kirtland's warbler: an endangered nearctic/neotropical migrant. Wilson Bulletin 110(2):244-261.

Habitats of Kirtland’s Warbler (*Dendroica kirtlandii*) on the wintering grounds in the Bahama Archipelago are presented based upon data from 29 specimens, two bandings, and 67 sightings of at least 61 individuals on 13 islands scattered through the region. Major emphasis is placed on a study site in central Eleuthera, with additional information on sites on Grand Turk, North Caicos, and Crooked Island. The warblers used upland habitats that have a low shrub/scrub component with a patchiness of small openings and openings within the vegetation at the ground level. Six broad habitats were identified as being used: Natural Shrub/Scrub, Secondary Shrub/Scrub, Low Coppice, Pineland Understory, Saline/Upland Ecotone, and Suburban; High Coppice is not used. The structure and floristic composition of the habitats are described. Observations (N=451) of a Kirtland’s Warbler male (uniquely color banded) and female over three months indicated the birds generally stayed on or near the ground, generally < 3 m (98% of observations), and used a territory of 8.3 ha. A crude estimate of potential winter habitat suggests that there is more than an adequate amount in the Bahama Archipelago for the currently small warbler population (733 singing males in 1997) and allows for a considerable population increase. No serious future threat to the amount of that habitat is foreseen.

Sykes, P.W., Jr. and D.W. Sonneborn. 1998. First breeding records of whooping swan and brambling in North America at Attu Island, Alaska. Condor 100(1):162-164.

We document the first breeding records of Whooper Swan (*Cygnus cygnus*) and Brambling (*Fringilla montifringilla*) in Alaska and North America on Attu Island in the Western Aleutians in the spring of

1996. Five cygnets were seen with adults and the nest located, and a territorial pair of Bramblings was observed and a nest with eggs found.

Twedt, D.J., C.O. Nelms, V.E. Rettig, and S.R. Aycock. 1998. Shorebird use of managed wetlands in the Mississippi Alluvial Valley. American Midland Naturalist 140(1):140-152.

We assessed shorebird densities on managed wetland habitats during fall and winter within the primarily agricultural landscape of the Mississippi Alluvial Valley. From November through March, shorebird densities were greater on soybean fields than on rice or moist-soil fields. Killdeer (*Charadrius vociferus*) and Common Snipe (*Gallinago gallinago*) were common throughout winter, whereas Yellowlegs (*Tringa* spp.) and "peep" sandpipers (*Calidris* spp.) were present but less abundant. During fall, Dowitchers (*Limnodromus* spp.), Pectoral Sandpipers (*Calidris melanotos*), Killdeer, and peep sandpipers were the most abundant species on managed shorebird habitat units. Although shorebird densities were consistently greater on habitats managed by drawing down existing water, we were unable to detect a significant difference in densities from areas managed by flooding previously dry habitat.

Twedt, D.J. and J. Portwood. 1997. Bottomland hardwood reforestation for neotropical migratory birds: are we missing the forest for the trees? Wildlife Society Bulletin 25(3):647-652.

Reforestation of bottomland hardwoods on lands managed for wildlife or timber production has historically emphasized planting heavy-seeded oaks (*Quercus* spp.). Although techniques have been developed for successful oak establishment, these plantings often require 5 or more years before establishing a 3-dimensional forest structure. We suggest that lands planted to fast-growing early-successional species, in combination with oaks, provide: (1) more expedient benefits to Neotropical migratory birds; (2) greater forest diversity; (3) more rapid economic return to landowners; and (4) enhanced public relations. Under good growing conditions, and with effective weed control, some fast-growing species can develop a substantial 3-dimensional forest structure in as few as 2 or 3 years. Forest-breeding Neotropical migratory birds use stands planted with early successional species several years before sites planted solely with oaks. Where desirable, succession to forests with a high proportion of oak species can be achieved on sites initially planted with fast-growing species through silvicultural management.

Underwood, H. B. and W. F. Porter. 1997. Reconsidering paradigms of overpopulation in ungulates: white-tailed deer at Saratoga National Historical Park. Pages 185-198 *in* William J. McShea, H. Brian Underwood, and John H. Rappole, editors. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, DC. xiv, 402 pp.

Williams, M., A. Lunsford, D. Ellis, J. Robinson, P. Coronado, and W. Campbell. 1998. Satellite tracking of rare birds. Argos Newsletter No. 53:16-17.

In 1990, a joint effort of two U.S. federal agencies, NASA Goddard Space Flight Center (GSFC) and the Patuxent Wildlife Research Center, began. We initially joined forces in a project that used satellite telemetry to discover the winter home of a tiny dwindling population of Siberian Cranes. Since then several projects have emerged, and a web site was created to follow some of these activities. This web site is called the Satellite Tracking of Threatened Species and its location is http://sdcd.gsfc.nasa.gov/ISTO/satellite_tracking. It describes the overall program, and links you to three subsections that describe the projects in more detail: Satellite Direct Readout, Birdtracks, and Birdworld.

Wilson, K.A., M.H. Wilson, and R. Field. 1997. Behavior of Puerto Rican parrots during failed nesting attempts. Wilson Bulletin 109(3):490-503.

Wilson, R.R. and R.J. Cooper. 1998. Acadian flycatcher nest placement: Does placement influence reproductive success? Condor 100(4):673-679.

We located 511 Acadian Flycatcher (*Empidonax virescens*) nests in bottomland hardwood forest of eastern Arkansas. Microhabitat characteristics were measured and their relationship with nest

success evaluated. Fifty-two percent of all nesting attempts resulted in predation. Attributes of nest placement were similar between successful and unsuccessful nests, although successful nests were placed higher. Similarly, non-parasitized nests were typically higher than parasitized nests. Nests initiated late in the breeding season were placed in larger trees with higher canopy bases resulting in increased vegetation around the nest. Fifteen different tree species were used for nesting. Acadian Flycatchers chose nest trees in a nonrandom fashion, selecting Nuttall oak (*Quercus nuttallii*) and possumhaw (*Ilex decidua*) in greater proportions than their availability. However, there was no relationship between tree species used for nesting and nest success. Nest height was positively correlated with concealment at the nest site, supporting the predator-avoidance theory. No other attribute of nest placement differentiated successful nest sites, suggesting that nest predation is likely a function of random events in space and time.

Wilson, R.R. and R.J. Cooper. 1998. Breeding biology of Acadian flycatchers in a bottomland hardwood forest. Wilson Bulletin 110(2):226-232.

From 1993-1995, we located and monitored 601 Acadian Flycatcher (*Empidonax virescens*) nests in a large contiguous tract of bottomland hardwood forest on the White River National Wildlife Refuge, Arkansas. Annual reproductive success was significantly different among years; ranging from 10-25% (Mayfield estimate) over the three years of the study. There was no significant difference in nest success among study plots, with nesting success showing a trend of increasing late in the breeding season. Clutch size for non-parasitized nests averaged 2.9 ± 0.02 (SE) eggs with a mode of 3. Rates of Brown-headed Cowbird (*Molothrus ater*) parasitism were low (21%), accounting for 7% of all nest failures. However, parasitism by cowbirds resulted in a reduction of clutch size for nests initiated early (i.e., first nests and replacements) in the breeding season. Predation was the leading cause of nest failures, accounting for 75% of all failures. Snakes and avian predators were thought to be the leading cause of nest failures. Although additional factors must be investigated, preliminary results indicate that nest predation is a major influence on this population, despite the size of the forest tract.

Winger, P.V. and P.J. Lasier. 1997. Fate of airborne contaminants in Okefenokee National Wildlife Refuge. Final report submitted to U.S. Fish and Wildlife Service, Region IV., Atlanta, GA. 131 pp.

Designation of Okefenokee National Wildlife Refuge as a Class I Air Quality Area (given the highest level of protection possible from air pollutants under the Clean Air Act Amendments of 1977) affords mandatory protection of the Refuge's airshed through the permit-review process for planned developments. Rainfall is the major source of water to the swamp, and potential impacts from developments to the airshed are high. To meet management needs for baseline information, chemical contributions from atmospheric deposition and partitioning of anions and cations, with emphasis on mercury and lead, in the various matrices of the Swamp were determined between July 1993 and April 1995. Chemistry of rainfall was determined on an event basis from one site located at Refuge Headquarters. Field samples of surface water, pore water, floc and sediment were collected from four locations on the Refuge: Chesser Prairie, Chase Prairie, Durden Prairie, and the Narrows. A sediment core sample was collected from the Refuge interior at Bluff Lake for aging of mercury deposition. Rainfall was acidic (pH 4.8) with sulfate concentrations averaging 1.2 mg/L and nitrate averaging 0.8 mg/L. Lead in rainfall averaged 1 µg/L and total and methylmercury concentrations were 11.7 ng/L and 0.025 ng/L, respectively. The drought of 1993 followed by heavy rains during the fall and winter caused a temporary alteration in the cycling and availability of trace-elements within the different matrices of the Swamp. Surface water was acidic (pH 3.8 to 4.1), dilute (specific conductance 35-60 µS/cm), and highly organic (DOC 35-50 mg/L). Sediment and floc were also highly organic (>90%). Total mercury averaged 3.6 ng/L in surface water, 9.0 ng/L in pore water and about 170 ng/g in floc and sediments. Mercury bioaccumulated in the biota of the Refuge: fish fillets (*Centrarchus macropterus, Esox niger, Lepomus gulosus and Amia calva*) had >2 µg/g dry weight, alligators (*Alligator mississippiensis*) >4 µg/g dry weight in liver and kidney, and raccoons (*Procyon lotor*) >16 µg/g dry weight in the liver and kidney. Lead averaged 1 µg/L in rainfall, 6.6 µg/L in surface water, 9.8 µg/L in pore water, 12.3 µg/g in floc and 12.5 µg/g in sediments. Lead in fish muscle was ~0.1 µg/g and >1.2 µg/g in bone, alligator kidney had 1.5 µg/g lead and liver had 3.8 µg/g; raccoon kidney and liver averaged about 1 µg/g.

Historical patterns of mercury deposition based on ^{210}Pb aging of the core sample showed mercury increased from pre-1800 concentrations of <250 ng/g to >500 ng/g in the 1950s, with a subsequent decline to current levels. Lead concentrations in the core sample followed a similar pattern as that of mercury. Okefenokee Swamp serves as a sump for the cations and anions deposited through rainfall. Although mercury and lead levels in the biota are not currently acutely hazardous, concentrations are high enough to cause adverse chronic effects on behavioral, physiological or reproductive functions of resident biota, especially piscivorous species. To protect trust resources associated with the Refuge, activities and developments in the airshed that have the potential to increase atmospheric contamination, especially for lead and mercury, should be curtailed.

Winger, P.V. and P.J. Lasier. 1998. Toxicity of sediment collected upriver and downriver of major cities along the lower Mississippi River. Archives of Environmental Contamination and Toxicology 35:213-217.

The Lower Mississippi River contributes significantly to the biodiversity and ecological stability of the alluvial valley. Agricultural, industrial and municipal developments have historically impacted environmental quality of the river. Toxicity of sediment and sediment pore water was used to assess the current effects of major cities on sediment quality along the Lower Mississippi River. Composite sediment samples were collected from four sites upriver and four sites downriver of five major cities: Cairo, IL; Memphis, TN; Vicksburg, MS; Baton Rouge, LA; and New Orleans, LA. Following EPA's standard methods for acute toxicity testing of freshwater solid-phase sediment, *Hyalella azteca* were exposed to the sediments for 10 d with two water renewals per day. *Hyalella azteca* were also exposed for 96 h to pore water extracted from the sediments. After the initial tests, the animals were exposed to ultraviolet light for 12 h. Sediments were analyzed for organics (organochlorine pesticides, PCBs, organophosphate insecticides, and PAHs) and metals (Cr, Cu, Pb, Mn, Ni, Zn). With the exception of upriver from Memphis, solid-phase sediments were not toxic to *H. azteca.* Pore water from sediments collected upriver of Memphis showed slight toxicity. Exposure of *H. azteca* to ultraviolet light did not increase the toxicity of the sediment or pore-water samples, indicating a lack of PAH toxicity. Chemical analyses did not reveal any contaminant levels of concern in the sediments. Based on toxicity testing and chemical analyses, quality of sediments collected from the Lower Mississippi was good, with the exception of sites sampled upriver of Memphis.

Winger, P.V., P.J. Lasier, and B.P. Jackson. 1998. The influence of extraction procedure on ion concentrations in sediment pore water. Archives of Environmental Contamination and Toxicology 35(1):8-13.

Sediment pore water has the potential to yield important information on sediment quality, but the influence of isolation procedures on the chemistry and toxicity are not completely known and consensus on methods used for the isolation from sediment has not been reached. To provide additional insight into the influence of collection procedures on pore water chemistry, anion (filtered only) and cation concentrations were measured in filtered and unfiltered pore water isolated from four sediments using three different procedures: dialysis, centrifugation and vacuum. Peepers were constructed using 24-cell culture plates and cellulose membranes, and vacuum extractors consisted of fused-glass air stones attached with airline tubing to 60cc syringes. Centrifugation was accomplished at two speeds (2,500 and 10,000 x g) for 30 min in a refrigerated centrifuge maintained at 4°C. Only minor differences in chemical characteristics and cation and anion concentrations were found among the different collecting methods with differences being sediment specific. Filtering of the pore water did not appreciably reduce major cation concentrations, but trace metals (Cu and Pb) were markedly reduced. Although the extraction methods evaluated produced pore waters of similar chemistries, the vacuum extractor provided the following advantages over the other methods: (1) ease of extraction, (2) volumes of pore water isolated, (3) minimal preparation time and (4) least time required for extraction of pore water from multiple samples at one time.

Wood, K.V., J.D. Nichols, H.F. Percival, and J.E. Hines. 1998. Size-sex variation in survival rates and abundance of pig frogs, *Rana grylio,* in northern Florida wetlands. Journal of Herpetology 32(4):527-535.

During 1991-1993, we conducted capture-recapture studies on pig frogs, *Rana grylio,* in seven study locations in northcentral Florida. Resulting data were used to test hypotheses about variation in survival probability over different size-sex classes of pig frogs. We developed multistate capture-recapture models for the resulting data and used them to estimate survival rates and frog abundance. Tests provided strong evidence of survival differences among size-sex classes, with adult females showing the highest survival probabilities. Adult males and juvenile frogs had lower survival rates that were similar to each other. Adult females were more abundant than adult males in most locations at most sampling occasions. We recommended probabilistic capture-recapture models in general, and multistate models in particular, for robust estimation of demographic parameters in amphibian populations.

Zhioua, E., M. Browning, P.W. Johnson, H.S. Ginsberg, and R.A. LeBrun. 1997. Pathogenicity of entomopathogenic fungus *Metarhizium anisopliae* (Deuteromycetes) to *Ixodes scapularis* (Acari: Ixodidae). Journal of Parasitology 83(5):815-818.

The entomopathogenic fungus *Metarhizium anisopliae* is highly pathogenic to the black-legged tick, *Ixodes scapularis*. Spore concentrations of 10^8/ml for engorged larvae and 10^7/ml for engorged females resulted in 100% tick mortality, 2 wk post-infection. The LC_{50} value for engorged larvae (concentration to kill 50% of ticks) was 10^7 spores/ml. *Metarhizium anisopliae* shows considerable potential as a microbial control agent for the management of *Ixodes scapularis*.

Zingo, J. M., R. Field, and J. A. Spendelow. 1997. Impacts of trapping adult roseate terns on their reproductive success. Pages 37-39 *in* L. R. Monteiro, editor. Proceedings of the Seventh Roseate Tern Workshop held in Horta, Azores, Portugal, 26-27 April 1997. 46 pp.

Presentations of the

USGS Patuxent Wildlife Research Center

September 1997 — February 1999

Albers, P., G. Heinz, and R. Hall. 1998. Biological approaches for assessment of terrestrial vertebrate responses to contaminants: moving beyond individual organisms. "Environmental contaminants and terrestrial vertebrates: effects on populations, communities, and ecosystems," a symposium sponsored by USGS Patuxent Wildlife Research Center, SETAC, The Wildlife Society and EPA, held at the University of Maryland, College Park, October 19-21.

Alvarez-Cordero, E., M. W. Collopy, D. H. Ellis, and P. E. Küng. 1998. A conservation model for the harpy eagle and its habitat. 5th World Conference on Birds of Prey and Owls, Midrand near Johannesburg, South Africa, August 4-11.

Since 1989, an ongoing international effort to learn how to conserve the Harpy Eagle (*Harpia harpyja*) integrates individuals and institutions in creative interdisciplinary collaboration. The emerging model combines conventional natural history observations with a wide array of information technology and remote sensing tools at multiple levels of involvement including scientific, political, biological, and socio-cultural aspects. Broad spatial scaling ranges from locating the first active nest sites in Venezuela and Panama to conducting regional nest and habitat surveys. Temporal scope varies from documenting nesting cycle to monitoring dispersal of fledglings until adulthood (45 years of age). Networking with local informants in these two countries has been the most practical means to find nests (N = 47) of this large but inconspicuous Neotropical raptor. Satellite-based applications are invaluable in mapping for the first time the layout of breeding pairs (Global Positioning System), and for the long-term tracking of young and adult eagles (system ARGOS transmitters). A Geographic Information System (GIS) merging regional and detailed views of the species distribution with the human encroachment on its habitat serves to design and evaluate practical alternatives to current forest management policy.

Barboza, P. S. and D. G. Jorde. 1998. Restricted foraging in wintering black duck. The Wildlife Society 5th Annual Conference : Wildlife Toxicology in Northeastern North American Ecosystems, September 22-26, Buffalo, NY.

Waterfowl are prevented from feeding by adverse weather and other disturbances. American black duck (*Anas rubripes)* have a high risk of winter mortality and low spring production in their first year. Does feeding time constrain body condition and production in these young birds? Birds hatched in 1996 were segregated by sex in groups of three and housed in identical pens and ponds at the Patuxent Waterfowl Facility. An extruded formulation (Mazuri #5642) was fed to 20 pens for nine weeks from January to March 1997. Feed was provided in three regimes each week: daily (control; 9 male : 9 female), for five consecutive days (2d fast; 9 male: 9 female), or for three consecutive days (4d fast; 11 male : 12 female). Birds fasted for four days consumed less than the controls after one week of treatment (male 129 vs. 333; female 116 vs. 185g.kg$^{-0.75}$.7d1) but matched the intake rates of controls by weeks three and five (230 460 g.kg$^{-0.75}$.7d1). Drakes lost 8-13% of their initial body mass (1460g) over nine weeks on all regimes. Although hens were 1260g at the start of the experiment, restricted hens were heavier (2d fasted 1046g; 4d fasted 1135g) than controls (996g; $P<0.05$) at pairing in March. Birds were paired according to treatment and provided with a breeding formulation (Mazuri #5640) on the same feeding regimes. Restricted hens were still heavier than controls at eight weeks after pairing but had laid fewer eggs (1 vs. 6 vs. 11 eggs/clutch for 4d fasted, 2d fasted & controls respectively). Laying resumed in 4d fasted hens within five days of restoring daily feeding at eight weeks from pairing. Clutch fertilities were similar between groups (41%) and unaffected by restriction. Wintering black duck can increase daily intake and digestion to overcome a 56% reduction in feeding time while using their body reserves. Although hens modulate this loss and attain greater mass at spring, they are sensitive to feeding disruptions at pairing even though they may have established the body mass and reserves to reproduce.

Beyer, W. N., D. D. Day, A. Morton, and Y. Pachepsky. 1998. Relation of lead exposure to sediment ingestion in mute swans: A Chesapeake Bay risk assessment. Conference on Federally Supported Science and the Chesapeake Bay Program, Laurel, MD - December 9-10 [poster].

Although wildlife risk assessments are generally based on the accumulation of environmental contaminants through food chains, wildlife may also ingest contaminants incidentally with sediment. Fortytwo mute swans (*Cygnus olor*) were collected from unpolluted portions of central Chesapeake Bay in spring 1995, and their intestinal digesta were analyzed for 13 metals (Al, B, Ba, Cd, Cu, Fe, Mg, Mn, Ni, Pb, Sr, V, Zn) and for acidinsoluble ash, a marker of sediment. Swan livers and sediment samples also were analyzed for the same metals. Group method of data handling demonstrated that the digesta Al, which is associated with clays, was the best predictor of digesta Pb. Adding concentrations of other metals as predictors did not improve the accuracy of the estimates of Pb concentrations from Al concentrations. The r^2 of the equation relating the log of digesta Pb to the log of digesta Al was 0.86, whereas the r^2 of the equation relating the log of digesta Pb to the log of digesta acidinsoluble ash was 0.50. Accounting for the sediment ingested was critical to determining the exposure of mute swans to Pb, as well as to some of the other metals, and sediment ingestion should be considered in ecotoxicological risk assessments of waterfowl. The mean of 7.4% acidinsoluble ash in the digesta corresponded to an estimated 3.2% sediment in the diet. The Pb concentrations in the digesta were 23 times the concentration that would have been predicted from sediment Pb concentrations; presumably the swans had ingested clays high in Pb that had settled on the vegetation. The swans were probably not exposed to high Cu concentrations but nevertheless had hepatic Cu concentrations that would be considered very high if found in other species.

Brawn, J. D., J. R. Karr, J. D. Nichols, and W. D. Robinson. 1998. Demography of forest birds in Panama: How do transients affect estimates of survival rates. International Ornithological Congress, symposium on "Demography of Tropical Birds", Durban, South Africa, August 19-22.

Cam, E., J. D. Nichols, J. E. Hines, J. R. Sauer, and C. Flather. 1998. Geographic analyses of species richness and community attributes of forest birds from survey data in the Mid-Atlantic Integrated Assessment (MAIA) Region. EPA Mid-Atlantic Integrated Assessment Working Conference, November 30-December 2, Baltimore.

Coffman, C. J., J. D. Nichols, and K. H. Pollock. 1998. The effects of corridor-linked fragments on metapopulation dynamics of *Microtus pennsylvanicus*. Ecological Society of America Meeting, Baltimore, August 3.

Dawson, D. 1997. Avian research and conservation at Rancho Sandoval, Campeche, Mexico. University of Maryland, Appalachian Ecological Laboratory at Frostburg State University, October 30.

Day, D. D. 1998. History of an introduced species in the Chesapeake Bay ecosystem: The mute swan. Exotic Species Workshop, PWRC, Laurel, MD - August 20.

Day, D. D. 1998. The role of sediment ingestion in exposure of wildlife to environmental contaminants. Seminar presented to Department of Animal and Avian Sciences, University of Maryland, College Park, May 12.

The analysis of intestinal digesta and scat from wildlife is a promising means of estimating the exposure of wildlife to those environmental contaminants and nutrients that, like lead, are poorly absorbed in the digestive tract. Digesta may be collected from carcasses available from hunters, and scat may be collected either from wild or trapped animals. The results are directly relevant to wildlife, apply strictly to recent local exposure, and may be easier to interpret than are concentrations in wildlife tissues or in soils, sediments or water. Current risk assessment models can severely underestimate wildlife exposure to contaminants, such as lead, that don't biomagnify in the food chain, yet pose significant ecotoxicological consequences. This situation is further exacerbated by traditional food habits techniques which discard intestinal soil as unimportant in the determination of dietary content. Soil ingestion by wildlife may be deliberate, as is the case with many ungulates seeking to supplement mineral intake by frequenting salt licks, or may be

incidental to obtaining fossorial food items. Several species of waterfowl have been documented to intentionally consume sediment containing course grit, presumably as an abrasive.

Beyer, et al. (1994) described an equation to estimate the percentage of soil in the diet based on the acidinsoluble ash content of digesta or scat. This model relies on assumptions that soil contains >90% acidinsoluble ash and that the ratio of acid-insoluble ash to dry mass of diets without soil for wildlife are <2%. The model requires an estimate of digestibility of the diet based on published values. Experimental tests with white-footed mice (*Peromyscus leucopus*) closely approximated the theoretical soil-ingestion curve. This model has subsequently been applied to several waterfowl species inhabiting highly contaminated sites to help explain high mortality rates that could not otherwise be explained by traditional risk assessment models. The ability to accurately predict contaminant exposure based on an estimated soil ingestion rate, allows for a much more precise characterization of site-specific contaminant hazards in the development of risk assessments.

Day, D. D., W. N. Beyer, D. J. Hoffman, L. Sileo, D. J. Audet, and M. A. Ottinger. 1998. Toxicity of lead-contaminated sediment to mute swans. 19th Annual SETAC meeting, Charlotte, NC, Nov. 15-19. [poster].

Day, D. D., W. N. Beyer, A. Morton, and P. Frederick. 1998. Elevated mercury concentrations in eggs of piscivorous birds from south Florida. 12th Annual Symposium, Department of Animal and Avian Sciences, University of Maryland, College Park, June 2.

Douglas-Stroebel, E., G. L. Brewer, and D. J. Hoffman. 1998. Toxicity of lead-contaminated sediment to mallard duckling behavior. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

Ingestion of lead-contaminated sediment, related to past mining activity in the Coeur d'Alene River Basin (CDARB) in Idaho, was evaluated for effects on behavior of mallard ducklings, using time-activity budgets over a five-week period. Day-old ducklings received untreated control diet, clean sediment (24%) supplemented control diet, or CDARB sediment (3449 ug/g lead) supplemented diets at 12% or 24%. Also, the effect of nutrition was evaluated with a less than optimal diet (two thirds corn and one third standard diet), and the form of lead in the sediment compared with lead acetate. The incidence and duration of ten behaviors was recorded (resting, standing, moving, drinking, dabbling, feeding, pecking, preening, bathing, and swimming). Contaminated sediment significantly affected the proportion of time spent swimming, yet did not significantly affect any of the other recorded behaviors. There were also signs of disruption of balance and mobility observed in the 24% contaminated sediment groups and the lead acetate group. Nutrient level affected the amount of time spent in water-related behaviors, the growth rate, and the initial time of molt. Although the proportion of time spent in behaviors other than swimming was not markedly affected by ingestion of the contaminated sediment, the observed problems with balance and mobility coupled with decreased time spent swimming illustrate a potential threat of the contaminated sediment to the survival of mallard ducklings in the wild.

Droege, S. and P. Eagle. 1998. Large scale amphibian monitoring in the Mid-Atlantic: Power to the people. EPA Mid-Atlantic Integrated Assessment Working Conference, November 30-December 2, Baltimore.

Ellis, D. H. 1998. Of eagles and falcons. North American Falconer's Association Annual Meeting, Vernal, Utah, November.

The talk will provide scientific findings and adventures with: (1) pallid falcons in Tierra del Fuego country, (2) altay falcons in Siberia and Mongolia, (3) peregrine falcons in Arizona and Peru, (4) saker falcons in Mongolia, and (5) gyrfalcons in Siberia. I will also include footnotes on remarkable experiences with the golden eagle in the same places. I will end with a request for stories for the anthology section of the upcoming golden eagle book.

Ellis, D. H., P. Tsengeg, and P. L. Whitlock. 1998. Eyrie enhancement measures to bolster saker falcon populations in Mongolia. Raptor Research Foundation Annual meeting, September 30 - October 4, Ogden, Utah.

Because the massive harvest of saker falcons (*Falco cherrug*) in Central Asia has already impacted local populations at least in Kazakhstan, because falcon smuggling has recently become rampant in China, and because a government-authorized harvest has begun in Mongolia, we sought measures to bolster numbers in Mongolia before the population can decline there. In three expeditions (1994, 1995, and 1997), we located over 120 saker falcon eyries in Mongolia. Over 20% of these were on manmade structures. Because so many falcons were already nesting on artificial supports, we decided that the creation of artificial eyries on manmade supports would be the most efficient means of expanding saker populations. Two other factors also recommended the creation of artificial eyries. First, most of Mongolia is open steppe with good prey populations but without trees or cliffs that might support falcon eyries. Second, in the open habitat, manmade supports are often available but nests are often absent. In 1997, we created 65 new nest sites and enlarged or modified another 15 previously used falcon eyries. This paper reports the extreme variety in sites used by saker falcons in Mongolia, and occupancy rates on artificial eyrie supports.

Erwin, R. M. and J. Gill. 1998. Dredged material, wetland creation, and beneficial uses to wildlife: Poplar Island restoration. [poster]. "Federally supported Science in Chesapeake Bay," a conference held, at Patuxent, Dec 9-10.

Fabrizio, M. C., J. D. Nichols, J. E. Hines, B. L. Swanson, and S. T. Schram. 1998. Modeling data from double-tagging experiments to estimate heterogeneous rates of tag shedding in lake trout. 128th Annual Meeting of the American Fisheries Society, Hartford, CT, August.

Freeman, M. C. 1998. Conservation Challenges in Fragmented Rivers of the Southeast. Invited Lecture, Furman University, 30 April, Greenville, SC.

Freeman, M. C. 1998. Integrating ecology with river management: Tales from the heart of Dixie. Seminar,Texas A&M University, Department of Wildlife and Fisheries Sciences, March 5.

River management increasingly is shifting from questions of minimum flow requirements to what elements of natural flow regimes are essential for sustaining system function and native biodiversity. The current interstate study and negotiations involving management of the Apalachicola-Chattahoochee-Flint (ACF) and Alabama-Coosa-Tallapoosa (ACT) river systems by the states of Alabama, Georgia and Florida well illustrate the challenges to identifying ecologically-sound management alternatives. The ACT and ACF systems support riverine communities rich in native species diversity (e.g., > 130 fishes), but with high levels of species imperilment primarily as a result of habitat loss and system fragmentation. To address flow regime needs to sustain biological integrity in the remaining fluvial portions of these systems, the Riverine Community Habitat Assessment and Restoration Concept (RCHARC) has been used to develop habitat-flow models for selected locations in the two basins. Initially developed for application in the Missouri River system, RCHARC rests on the assumption that “managing modified, regulated streams to mimic the spatial and temporal variability of natural streams will promote and protect the diversity of organisms characteristic of natural stream communities”. This application of RCHARC has resulted in a tool by which basin managers can evaluate alternative water management strategies in terms of similarity of instream habitat regimes to unimpaired conditions, in a currency compatible with measures of effects on other water uses such as navigation, hydropower, or municipal consumption. The extent to which the habitat models will be used to negotiate management regimes and water-sharing among the states remains to be seen. However, in any outcome, completely natural flow regimes will assuredly not prevail in the flow-regulated segments of these systems. This emphasizes the critical importance of understanding functional links between characteristic elements of natural flow regimes and the dynamics of riverine communities. Ongoing research and monitoring downstream from selected hydropower facilities in the ACT system is elucidating effects of diminished or rapidly fluctuating flows, and stable-flow periods on instream habitat and assemblages of native fishes. The primary goal is to identify those elements of the predevelopment flow and habitat regimes that are most essential to sustaining river communities and that can be incorporated in future river management strategies.

Freeman, M. C., Z. H. Bowen, K. D. Bovee, and E. R. Irwin. 1997. Habitat bottlenecks and windows of opportunity for fishes in a regulated flow regime. Instream and Environmental Flows: 17th

International Symposium of the North American Lake Management Society, December 2, Houston, TX.

Freeman, M. C. and M. C. Freeman. 1998. Native fishes in unnatural flows. Invited Lecture, Furman University, 30 April, Greenville, SC.

Our research on fishes downstream from a peaking hydropower facility in a southeastern U. S. river focuses on identifying flow-mediated habitat conditions that may limit or promote persistence of native fishes. The upstream-most hydropower project on the Tallapoosa River, central Alabama, is a peak-load generation facility completed in 1982. The dam regulates flows through a 75 km Piedmont-reach of the river that historically support at least 61 native fishes. Operation of the hydropower facility results in rapid flow fluctuations, for example from less than 4.5 m3/s to over 340 m3/s in less than 2 h at our study site located 22 km downstream from the dam, on most days. In some years, however, low rainfall restricts summertime power generation, resulting in prolonged periods of stable flows. The fish assemblage (38 species total) at the regulated-flow site is dominated (77% of all sampled individuals) by species capable of spawning through at least mid-summer. Spring-spawning species are disproportionately less abundant compared to assemblage composition in an upstream, unregulated Tallapoosa River site. We have also observed increased abundances of young-of-year of summer-spawning fishes at the regulated-flow site following late-summer stable flow periods of at least 10 days in duration. We hypothesize that the severe reduction in duration of stable low- or high-flow periods caused by the hydropeaking operation diminishes opportunities for successful young-of-year recruitment. Protecting or restoring communities in regulated rivers depends on identifying components of the flow regime that may critically limit reproduction, growth or survival of riverine fauna. We hypothesize that providing stable-flow releases during spring and earlier in the summer, so as to mimic pre-regulation periods of habitat stability, could restore a feature of the natural flow regime with potential benefit to the native fish fauna.

Freeman, M. C. and E. R. Irwin. 1998. Fishes at the edges of the lower Alabama River. Alabama Fisheries Association Annual Meeting, February 11-13, Gulf Shores, AL.

The edge habitats of many southeastern Coastal Plain rivers are not what they were. Improvement of channels for navigation has included pulling and removing snags, construction of wingdams and training structures, channel dredging and ultimately isolation of main-channel from backwater habitats. Sand and gravel bars, and dredge spoil bars, are prominent present-day habitat features in large Coastal Plain rivers. Bars provide relatively homogenous littoral habitat, but previous studies have documented use of bars by a variety of fishes. We have initiated a five-year study to quantify littoral fish abundance and assemblage dynamics on sand and gravel bars in the lower Alabama River. In first-year samples we found over 30 fish species using bars, and overwhelmingly large nighttime aggregations of minnows and juvenile channel catfish. Our long-term investigation will seek to relate fish abundances on bars to differences in bar habitat, including substratum, edgeslope, and water depth and current velocity because these features may be strongly influenced by management of flow regimes and dredging practices.

Freeman, M. C. and E. R. Irwin. 1998. Flow regime and habitat effects on fishes in southeastern rivers: the science of regulated systems [poster]. USGS, Biological Resources Division, National Program Review, Fisheries and Aquatic Resources, Madison WI, August 10-14.

Gabor, T. S., J. R. Longcore, and H. R. Murkin. 1997. Visibility bias of helicopter waterfowl brood surveys on beaver pond habitat in eastern Ontario. 59th Midwest Fish and Wildlife Conference, December 7-10, Milwaukee, WS.

Helicopter surveys are commonly used to estimate waterfowl densities over large areas or inaccessible habitats. Wetlands with extensive emergent vegetation or forested wetlands can be difficult to survey due to reduced visibility. The objectives of the study were to determine the survey efficiency of helicopter-based waterfowl brood counts on beaver pond habitat in eastern Ontario, Canada to develop appropriate visibility correction factors. The study was conducted on the southern fringe of the Canadian Shield in the Great/St. Lawrence Lowland Biome. Wetlands in the area are predominantly beaver pond complexes (approximately 3.2 ponds/km^2) surrounded by mixed hardwood/conifer forest. During 1996 we conducted simultaneous helicopter and ground

observations, as well as replicate helicopter surveys on 57 wetlands. The helicopter crew located 59% of the broods observed by the ground crews (19 of 32). When broods were observed by helicopter crew, >80% were correctly aged and >90% were correctly enumerated. The helicopter crew located 79% (11 of 14) and 43% (6 of 14) of the single and multiple (>1) broods observed by the ground crews, respectively. There was a trend for lower sightability of all brood species combined on forested and scrub-shrub wetlands. Visibility correction factors for all species combined using aerial and ground surveys was 1.78. The improvement in the VCF by adding a second helicopter survey was minimal (1.60). As well, the VCF developed by using repeated helicopter surveys resulted in higher VCFs (2.05) than when a single helicopter survey (1.78) was used. Additional surveys will be conducted in 1997.

Golden, N. H., J. L. Pearson, M. A. Ottinger, B. A. Rattner, and R. M. Erwin. 1998. Biological and ecotoxicological characteristics of terrestrial vertebrate species residing in estuaries. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

The threat of contaminants to terrestrial vertebrates residing in Atlantic coast estuaries is being examined by the Department of the Interior's Biomonitoring of Environmental Status and Trends program. Twenty-two species (2 reptiles, 18 birds, 2 mammals) that breed in proximity to estuaries were evaluated for potential suitability as sentinels of environmental contamination. Species were selected based upon documented or suspected contaminant exposure and effects, or because they are valued or protected natural resources. The morphology, status in estuaries, abundance and range, site fidelity, ease of census, feeding habits, and a summary of published contaminant exposure and response data for each species was compiled by review of extant data. Data are being nonparametrically analyzed to rank the suitability and sensitivity of the select species for monitoring various classes of contaminants and estuarine health. Preliminary findings indicate substantial chlorinated hydrocarbon exposure data for 10 of the 22 candidates, most of which are piscivorus and colonial breeding waterbirds that readily bioaccumulate these compounds. Based on reproductive effects (population declines and recoveries), the bald eagle, brown pelican and osprey appear to be the most sensitive to chlorinated hydrocarbons. There are considerably less metal exposure data, and almost no associated effects data. The most substantial metal data (lead shot and sinker ingestion) are for mute swan and black duck, species that feed by grazing or dabbling. Despite numerous incidences of organophosphorus and carbamate poisoning in birds, published reports fail to reveal any single estuarine vertebrate species or group as an outstanding sentinel of anticholinesterase intoxication. Limited field data are available for petroleum hydrocarbons, although vulnerability studies suggest diving ducks are most susceptible.

Guntenspergen, G. 1998. Decision support models to prioritize wetland restoration at the landscape scale. Symposium: "Use of Natural Resource Information in Wetland Creation and Restoration" of the Soil Science Society of America meeting, Baltimore, October 19-23.

Wetland conservation and restoration programs have been implemented in response to the large-scale loss and impairment of the Nation's wetlands. These programs require tools which will identify areas having the greatest potential for restoration and where restoration will have a significant impact in maintaining environmental quality. Three case studies are presented which outline the use of GIS and environmental data bases in developing screening tools which prioritize areas for wetland restoration. These models link soils, hydrology, landuse, and geomorphic data to identify and rank potential restoration sites for bottomland hardwood wetlands in the southeastern United States and depressional wetlands in the Prairie Pothole Region of the north central United States. The use of STATSGO and SSURGO soils information is compared in one case study, a biological rule based model is used in a second study, and an integrated spatial decision support model is presented in the final study.

Hahn, Caldwell. 1998. The spatial and genetic basis of host selection in cowbirds. International Society of Behavioral Ecologists' bi-annual meeting, Monterey, CA, July 29.

Molecular genetics makes it possible to measure basic, but long elusive parameters of the breeding biology of the Brown-headed Cowbird (*Molothrus ater*). We examined cowbird fecundity and host selection behavior using a combination of molecular genetic techniques to link female cowbirds to the eggs they lay, radiotelemetry techniques to track female cowbirds's daily movements, and geographic information systems (GIS) to integrate these genetic and spatial data.

Our study site lies within a forested 1300 ha landscape in New York composed primarily of mature forest with adjacent old fields. We found that female cowbirds used their home ranges as principal egg-laying areas. Individual females used characteristic individual home ranges throughout the breeding season, and they returned to the same home range every breeding season. Over one-half (54%) of females laid all their eggs in host nests inside or close to their home range. Proximity to a female's home range was the only significant ecological or biological feature affecting a cowbird's host selection. Neither host species identity, nest height, adult mass, egg size, incubation period, nor host taxonomic classification predicted which nests would be parasitized. Eggs laid outside the home range were frequently found in multiply-parasitized nests located along common flyways or in conspicuous sites that a cowbird could discover opportunistically. We also found that female cowbirds avoided laying more than one egg in a particular host nest, even though multiple parasitism characterized over one-third of parasitized nests in the study. Finally, we estimated that effective cowbird fecundity lies between a minimum of 1.72 eggs per female and an upper bound of 8.16 eggs per female. Effective cowbird fecundity is defined as the actual number of cowbird eggs laid in appropriate host nests and not ejected; it is lower than raw fecundity or the physiological egg production capacity of cowbirds. We suggest that the female cowbird's use of home range is a critical element in its breeding behavior, enabling cowbirds to use a known host selection strategy. Experienced female cowbirds selectively parasitize the host pairs that nested in their home ranges in previous breeding seasons and were most successful. The three elements of cowbird breeding behavior reported here challenge the stereotype of the Brown-headed Cowbird as an r-selected species that produces a large number of young and invests no parental care. Instead, these results suggest that cowbirds lay fewer eggs in host nests than has been speculated and that they do invest parental care. Two examples of parental care we discuss are observing a host's parental behavior and nest success before parasitizing it; and laying each egg in a different host nest, even though that requires females to search longer and to find a larger number of host nests. Current cowbird trapping programs should be evaluated for their effect on age structure of cowbird populations and resulting parasitism patterns. Yearling females may be associated with higher rates of multiple parasitism and higher rates of parasitism on more conspicuous hosts. Conspicuous hosts such as the Black-capped (*Vireo atricapillus*) and Least Bell's (*Vireo bellii pusillus*) vireos are probably most at risk from cowbird populations with disproportionately high numbers of immigrant yearling female cowbirds such as those created by trapping programs.

Hahn, D. C. 1997. Closing Remarks: The Future for Cowbird Management. Partners In Flight symposium on Cowbird Parasitism in Eastern and Western Landscapes in Sacramento, CA, September 23-26.

Hahn, D. C. 1997. Combining genetic and radiotelemetry data to document cowbird parasitism patterns in forest communities. Partners In Flight symposium on Cowbird Parasitism in Eastern and Western Landscapes in Sacramento, CA, September 23-26.

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

Hahn, D. C. 1997. Summary of the Partners in Flight conference on Research and Management of the Brown-headed Cowbird in Eastern and Western Landscapes. American Bird Conservancy Policy Council, quarterly meeting, December 9, Washington, D.C.

The content and outcome of the recent PIF symposium on research and management of cowbirds in all parts of the continental United States were reviewed. The western Research Working Group of Partners in Flight had hosted a national meeting in October, 1997, in Sacramento, CA, for a wide range of scientists and land managers with expertise in brood parasitism. Experts presented technical findings on cowbird behavior and impacts on host species in the full range of cowbird

habitats and host bird communities nationally. The meeting also scheduled discussion groups and workshops where experts began to integrate individual findings into broad national and regional patterns. Particular emphasis was placed on distilling knowledge about cowbird management for use in the large new > $1 million initiative to protect the newly listed southwestern Willow Flycatcher that is being undertaken in 5 southwestern states by the Bureau of Reclamation in conjunction with the Fish and Wildlife Service and the Bureau of Land Management. The Partners in Flight Symposium closed with the recommendation that a cowbird advisory council be formed to maintain the momentum achieved in integrating expertise about cowbird impacts and to serve as a focal point for providing guidance in ongoing and future cowbird control programs.

Haramis, G. M. and R. Colona. 1998. The effect of nutria (Myocastor coypus) on marsh loss in the lower eastern shore of Maryland: an exclosure study. Conference on Federally Supported Science and the Chesapeake Bay Program, Laurel, MD - December 9-10 [poster].

Haramis, G. M. and G. D. Kearns. 1998. Length of stay, survival, habitat use and migration characteristics of fall migrant soras on the Patuxent Rriver marsh as determined by radio telemetry. Conference on Federally Supported Science and the Chesapeake Bay Program, Laurel, MD - December 9-10 [poster].

Harshbarger, J. C., E. B. May, A. E. Pinkney, and M. J. Melancon. 1998. Prevalence and histology of liver neoplasms in brown bullhead, *Ameiurus nebulosus,* from the Anacostia River. 23rd Annual Fish Health Workshop, Leetown, WV.

Henshell, D. S., S. Sobiech, D. W. Sparks, C. A. A. Mayer, and M. Melancon. 1997. PCB effects on passerine productivity, reproductive success, growth and development: A multispecies comparison. SETAC 18th annual meeting: Bridging the Global Environment: Technology, Communication, and Education, November 16-20, San Francisco, CA.

In order to assess relative ecotoxicologic effects of *in ovo* posthatching exposure to PCBs, we compared multiple effects endpoints in five passerine species nesting at PCB-contaminated sites versus at a *control* site. The five species examined include tree swallows, carolina chickadees, bluebird, redwinged blackbird, and house wren. Nest boxes were placed around the sludge lagoon, and in a relatively clean *control* pond in a different watershed on the other side of the county. Nest boxes were observed daily, and productivity measures were recorded, including number of nests per site, number of eggs per nest, percentage of eggs hatched, nestling survival to just before fledgling (8 14 days, depending on the species). After collection, the nestlings were weighed, sacrificed, necropsied, and assessed for gross abnormalities and individual and organ growth. Livers were weighed and used for EROD analysis, and the rest of the organs were weighed and archived for future histological analysis. Initial assessment indicates that significant differences were detectable between sites. The tree swallow nestlings at the contaminated site had significantly smaller mean weights of heart, lung, kidney, and spleen (corrected for body weight), compared to those at the *control* site. Gross abnormalities included: abnormal hearts (house wren was the most frequent), abnormal beaks (especially tree swallow), and gonadal abnormalities in several of the species. We will compare the biochemical, reproduction, productivity and necropsy data between species to determine relative sensitivity.

Hoffman, D. J., G. H. Heinz, H. H. Obrecht, L. Sileo, D. J. Audet, J. K. Campbell, and L. J. LeCaptain. 1998. Toxicity of lead- contaminated sediment to goslings. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

The toxicity of lead-contaminated sediment, related to past mining activity in the Coeur d'Alene River Basin (CDARB) in Idaho, was examined on posthatching development of Canada geese (*Branta canadensis*) for 6 weeks. Day-old goslings received an untreated control diet, a clean sediment (48%) supplemented control diet, or CDARB sediment (3449 ug/g lead) supplemented diets at 12%, 24%, or 48%. The 12% CDARB diet resulted in a geometric mean blood lead concentration of 0.68 ppm (ww), greater than 90% depression of red blood cell ALAD activity, and over four-fold elevation of free erythrocyte protoporphyrin concentration. The 24% CDARB diet resulted in blood lead of 1.61 ppm, decreased hematocrit, hemoglobin, and plasma protein in addition to the above effects. The 48% CDARB diet resulted in blood lead of 2.52 ppm with 22% mortality, decreased growth and elevated plasma LDH-L activity. In this group the liver lead

concentration was 6.57 ppm (ww) with two-fold increases in hepatic lipid peroxidation (TBARS) and glutathione concentration, elevated glutathione reductase activity, and lower protein-bound thiols concentration and G-6-PDH activity. The kidney lead concentration in this group was 14.93 ppm with subacute renal tubular nephrosis in one of the surviving goslings. Lead from CDARB sediment accumulated less readily in gosling blood and tissues than reported in ducklings, but at given concentrations was generally more toxic to goslings. These findings confirm the toxicity of this exposure route as reported in wild geese and mallards within the CDARB.

Hoffman, D. J., G. H. Heinz, H. H. Obrecht, L. Sileo, D. J. Audet, J. K. Campbell, and L. J. LeCaptain. 1998. Toxicity of lead- contaminated sediment to mallard ducklings. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

The toxicity of lead-contaminated sediment, related to past mining activity in the Coeur d'Alene River Basin (CDARB) in Idaho, was examined on posthatching development of mallards (*Anas platyrhynchos*) for 6 weeks. Day-old ducklings received untreated control diet, clean sediment (24%) supplemented control diet, or CDARB sediment (3449 ug/g lead) supplemented diets at 12% or 24%. The 12% CDARB diet resulted in a geometric mean blood lead concentration of 1.41 ppm (ww) with over 90% depression of red blood cell ALAD activity and over three-fold elevation of free erythrocyte protoporphyrin concentration. The 24% CDARB diet resulted in blood lead of 2.56 ppm with over six-fold elevation of protoporphyrin. In this group the liver lead concentration was 7.92 ppm (ww) and there was a 40% increase in hepatic reduced glutathione concentration. The kidney lead concentration in this group was 7.97 ppm and acid fast inclusion bodies were present in the kidneys of 4 of 9 ducklings. When ducklings were on a less than optimal diet (two thirds corn and one third standard diet), CDARB sediment was more toxic; blood lead levels were higher, body growth and liver biochemistry (TBARS) were more affected, and prevalence of acid fast inclusion bodies increased. Lead from CDARB sediment accumulated more readily in duckling blood and liver than reported in goslings, but at given concentrations was generally less toxic to ducklings. These findings confirm the toxicity of this exposure route as reported in wild geese and mallards within the CDARB.

Hoffman, D., C. Marn, K. Marois, E. Sproul, M. Dunne, and J. Skorupa. 1997. Sublethal effects in avocet and stilt hatchlings from selenium-contaminated sites. SETAC 18th annual meeting: Bridging the Global Environment: Technology, Communication, and Education, November 16-20, San Francisco, CA.

Excess selenium (Se) in the aquatic food chain is embryotoxic and teratogenic to avocets, stilts, and other waterbirds. American avocet (*Recurvirostra americana*) and black-necked stilt (*Himantopus mexicanus*) eggs were collected from three sites in the Tulare Lake Basin of California in 1992 and hatched in the laboratory. These sites included the Tulare Lake Drainage District-north (TLDD-N, water 2.5 ppb Se), TLDD-south (TLDD-S, water 8.6 ppb Se) and Westfarmers (WF, water 190 ppb Se). Highest egg Se concentrations occurred at WF (geometric mean 31.4 ppm, dw for avocets and 20.5 for stilts). Mean egg Se concentrations were 6.7 ppm for avocets and 8.4 for stilts at TLDD-S, and 3.3 ppm for avocets and 2.3 for stilts at TLDD-N. Liver samples were collected from day-old hatchlings for biochemical assays. Hatching success, incidence of malformations, body and organ weights and bone lengths did not differ significantly among locations. However, ratio of liver to body weight was greater for avocets from WF. With increasing Se concentration, oxidative stress was most apparent in avocet hatchlings from WF: hepatic glutathione (GSH) peroxidase activity increased, glucose-6-phosphate dehydrogenase (G-6-PDH) decreased, and oxidized glutathione (GSSG) concentration as well as the ratio of GSSG to reduced glutathione (GSH) increased. In stilts hepatic GSH was lower in WF hatchlings. These findings are compared to other Se studies where oxidative stress was reported in adult American coots in the field and mallard ducklings in the laboratory.

Hoffman, D., M. Spalding, and P. Frederick. 1997. Subchronic effects of methylmercury in great egret nestlings. SETAC 18th annual meeting: Bridging the Global Environment: Technology, Communication, and Education, November 16-20, San Francisco, CA.

In recent years high concentrations of mercury have been found in wading birds in Florida. Great egret (*Ardea alba*) chicks (two weeks old) were orally dosed daily with the equivalent of 0, 0.5 ppm

or 5 ppm mercury (Hg) as methylmercury chloride in the diet for up to 12 weeks. Weakness of the legs or paralysis occurred in all high dosed birds. Geometric mean blood Hg concentrations were 0.17, 10.3, and 78.5 ppm (ww), respectively. Hg concentrations for organs (ppm, ww), including brain (0.22, 3.4, and 35), liver (0.34, 15.1, 138), and kidney (0.28, 8.1, and 120), increased in a dose-dependent manner. Glutathione (GSH) peroxidase activity was significantly lower in the plasma of Hg-treated groups, but only lower in the brain, liver, and kidney of the high-dosed group. Other plasma enzymes increased in activity following Hg exposure and included AST, ALT, and CK. Concentrations of the following plasma constituents decreased in response to Hg: total protein, albumen, inorganic phosphorus, and calcium. Lipid peroxidation (TBARS) increased in liver (low and high dose) and brain (high dose). Tissue changes in concentrations of reduced thiols included decreased total thiols and protein-bound thiols in liver, decreased protein-bound thiols in kidney, and increased GSH in kidney and brain. Activities of GSH transferase and GSH reductase increased in liver. In kidney GSH transferase and glucose-6-phosphate dehydrogenase activities increased with mercury dose. These findings are compared to other Hg studies where oxidative stress was reported in adult diving ducks in the field and mallards in the laboratory.

Irwin, E. R. and M. C. Freeman. 1998. Definition of critical habitat for juvenile channel and flathead catfish in lotic systems. First International Ictalurid Symposium: Catfish 2000, June 23-28, Davenport, Iowa.

Amount of nursery habitat may regulate recruitment of fishes, yet few data are available on critical habitat requirements of juvenile catfishes. We analyzed quantitative fish samples collected in streams of the southeastern U.S. to describe habitat use of channel Ictalurus punctatus and flathead catfish Pylodictis olivaris < 150mm total length. Daytime samples were taken in five distinct habitat types with a barge-mounted electrofisher. In addition, prepositioned area electrofishers (PAEs) were used to document daytime and nighttime habitat use for both species. Few juvenile flathead catfish were collected in relation to channel catfish. The hand-held electrofisher captured 716 age-0 channel catfish and 95 age-0 flathead catfish. Only 3 age-0 flathead catfish were captured in over 1790 daytime PAE samples; 5 were captured in the 310 nighttime PAEs. However, 290 and 200 age-0 channel catfish were collected in day and night PAEs, respectively. These data suggest diel shifts in habitat use for both species. Juvenile channel catfish exhibited a distinct nearshore distribution in shallow habitats with slow velocities at night and occupied main channel habitats with variable depth and velocities during day. Juvenile flathead catfish were collected almost exclusively (86%) in habitats that were shallow with fast velocities or had coarse substrata. Both species displayed evidence of size specific habitat use. Over 90% of the smallest individuals (< 35mm total length, present from May-July), occupied shallow riffle habitats; whereas, mean juvenile lengths were greatest in deep-fast habitat, during August-November. The limited number of flathead catfish collected indicates that either they are not available to our gears or that they occur in low numbers in the study system. Because juveniles of both species may be "riffle dependent", impacts of flow modification in regulated systems may limit recruitment by decreasing nursery habitat.

Irwin, E. R., M. C. Freeman, and J. J. Isely. 1998. Effects of flow regime on recruitment and growth of juvenile bass (*Micropterus* spp.) in flow-regulated rivers. Annual Meeting, Southern Division, American Fisheries Society, February 26-March 1, Lexington, KY.

Jorde, D. G., D. B. Stotts, and A. J. Vecchio. 1998. Atlantic Coast Black Duck Habitat Project: Status report. Atlantic Flyway Council, Absecon, NJ., Feb.23-27.

Land use databases are being examined to detect changes in wetland habitat along the Atlantic Coast in areas where wintering black ducks have been surveyed during the past 40 years. The Mid-winter Waterfowl Survey (MWS) provides the best long-term index of changes in distribution and number of black ducks in the Atlantic Flyway. However, MWS data have not been verified and compiled by zone and segments into one database needed for the habitat change analyses. In addition, changes in zone and segments for each of the 17 States in the Atlantic Flyway have not been compiled into a useful database. Currently, we have verified MWS data files from 1955/56 to 1982/83 for North Carolina, Virginia, Maryland, Delaware, and New Jersey, although some years are still missing for several States, particularly Virginia and North Carolina (zone or state totals only). We are standardizing old data to conform to the new GIS zone-segment identifiers. Previous grouping of segments and shifts in survey boundaries are being noted

(segment by segment; year by year) in verified State data files. Conversion charts for 1955 to present are being developed for each State to document changes in zone and segments, and have been completed for Virginia (1955-1973), New Jersey (1956-1972), Maine (1955-1973, Delaware (1956-1966 sub-segments), Massachusetts (1955-1983); New York (1956-1973); Connecticut (1956-1981), and Rhode Island (1958-1997). GIS land use databases being used for habitat change analyses include: GIRAS-LULC (1972-1982; 40 hectare resolution), MRLC (grid only; 0.9 hectare resolution; not avail. for ME, NH, VT, FL), NALC geo-rectified LANDSAT MSS (1970,1980,1990; 3.6 hectare resolution); LANDSAT TM (about 20% of east coast); REACH file ver. 3 (1:24,000 scale), NWI wetlands database (not complete for entire east coast), and State agency GIS databases (e.g. MASSGIS). In addition, a Patuxent web site questionnaire has been put on-line (http://www.mbr-pwrc.usgs.gov/geotech/ducks/) for State waterfowl biologists, habitat managers, and wetland experts to identify changes in State wetland habitats based on MWS zone/segment polygons.

Jung, R., S. Droege, and J. R. Sauer. 1998. Terrestrial and streamside salamander monitoring at Shenandoah National Park. EPA Mid-Atlantic Integrated Assessment Working Conference, November 30-December 2, Baltimore.

Kendall, W. L., M. Lindber, and J. E. Hines. 1998. Combining capture-recapture and band-recovery data to simultaneously estimate permanent and temporary emigration. Ecological Society of America Meeting, Baltimore, August 3.

Kendall, W. L., M. S. Lindberg, and J. E. Hines. 1998. On the use of capture-recapture and band recovery data to simultaneously estimate permanent and temporary emigration. North American Arctic Goose Conference, Victoria, BC, Jan. 7-11.

Dispersal is an important component of the dynamics of arctic goose populations, affecting metapopulation demography, breeding probability, social behavior, and gene flow. When birds are captured at all sites of interest, this dispersal can be monitored using multistate capture-recapture models (Brownie et al. 1993). When birds are captured at only one site, and hunter-recovered bands are also available, permanent emigration can be estimated using the method of Burnham (1993). When breeding birds are captured using Pollock's robust design, where there are multiple capture or resighting occasions within a short period of time, the methods of Kendall et al. (1997) permit the estimation of the proportion of the entire population that is present at the study site (e.g., breeding). We present a methodology whereby both permanent and temporary emigration probabilities are estimated simultaneously for a single-site study. This temporary emigration can be modeled as a Markovian process. Given the fact that arctic goose studies often entail multiple capture or resighting occasions for breeding geese within a season, we anticipate that this methodology will prove useful for estimating both the probability of dispersing to other breeding colonies, and the probability of moving between breeding and nonbreeding status. An additional benefit is the ability to test hypotheses about variability in these phenomena, including modeling the probabilities of permanent and/or temporary emigration as a function of pertinent predictor variables. Although developed for single-site studies, this methodology can be extended for the case where multiple sites are monitored but some parts of the metapopulation are not.

Kendall, W. L. and J. D. Nichols. 1998. Management experiments versus adaptive resource management: is there a difference? The Wildlife Society 5th Annual Conference : Wildlife Toxicology in Northeastern North American Ecosystems, September 22-26, Buffalo, NY.

Kendall, W., J. D. Nichols, J. Hines, J. Dubovsky, F. Johnson, C. Moore, and G. Smith. 1997. Beyond 'Compensation versus additivity': modeling survival of midcontinent mallards. 4th Annual Conference of The Wildlife Society, September 21-27, 1997, Snowmass Village, CO.

Knutson, M. G., J. R. Sauer, D. A. Olson, M. J. Mossman, L. M. Hemesath, and M. J. Lannoo. 1998. Effects of landscape composition and wetland fragmentation on frog and toad abundance and species richness in Iowa and Wisconsin, USA. Midwest Declining Amphibians Conference, March 20-21.

Lasier, P. J. and P. V. Winger. 1998. Ammonia toxicity to *Hyalella azteca*. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

The amphipod, *Hyalella azteca*, is a recommended test organism for toxicity assessments of freshwater sediments and pore waters. However, these media often contain ammonia concentrations that elicit a toxic response. Reported tolerances of *H. azteca* to ammonia vary from 20 mg/L to over 70 mg/L. The effects of age, feeding during testing and different ammoniumanion compounds on ammonia toxicity were determined in 96h static toxicity tests. Known-age animals (1, 3, 7, 14, and 21 d) and mixed-age animals (7 to 10 d) were exposed to dilutions of ammonium chloride. One block of these animals were fed at test initiation and after 48 h. In nonfed exposures, ammonia was significantly more toxic to 1 and 3d old animals (LC_{50}s of 29 and 30 mg NH_4^+/L) compared to older animals (LC_{50}s between 64 and 72 mg NH_4^+/L). Within the fed treatment, ammonia was significantly more toxic to 1 and 3d old animals than 14 and 21d old animals; LC_{50}s ranged from 58 to 88 mg NH_4^+/L. Coefficients of variation for survival among replicates were greatest for 1and 3d old animals in nonfed treatments and lowest for mixed-age animals in both fed and nonfed treatments. Effects of different anions (Cl, CO_3^{2}, SO_4^{2} and CH_3COO) on ammonia toxicity was evaluated using mixed-age animals. Toxicity of $(NH_4)_2CO_3$ was significantly greater than that of the other ammonium salts due to an additive toxic effect of unionized ammonia produced by the greater solution pH. These tests indicate that multiple factors can influence the toxicity of ammonia to *Hyalella azteca*. Animals 3d old or less are the most sensitive and require feeding to reduce survival variability to levels similar to the older ages.

Link, W. A. 1998. Empirical Bayes for meta-analysis: Bayes for doubters. The Wildlife Society 5th Annual Conference : Wildlife Toxicology in Northeastern North American Ecosystems, September 22-26, Buffalo, NY.

Link, W. A. 1998. The roles of model selection and hypothesis testing in natural resource studies. The Wildlife Society 5th Annual Conference : Wildlife Toxicology in Northeastern North American Ecosystems, September 22-26, Buffalo, NY.

Link, W. A. and J. R. Sauer. 1997. Estimation of relative abundance from count data. International Conference on Quantitative Methods for the Environmental Sciences, Innsbruck, Austria, August 4 to 8, 1997.

This paper illustrated recently developed methods that will be applied in summary analyses of North American Breeding Bird Survey data; data for Loggerhead shrike were used for illustration.

Melancon, M. J. and A. L. Yorks. 1998. Tree swallows as bioindicators for PCB exposure. Wildlife Society 1998 Annual Conference : Wildlife Toxicology in Northeastern North American Ecosystems, September 22-26, Buffalo, NY.

Tree swallows (*Tachycineta bicolor*) are widespread, are easily attracted to nestboxes, and feed extensively on aquatic insects. As such, they may conveniently serve as a non-fisheating sentinel species for the accumulation and impact of contaminants from the aquatic environment. Hepatic cytochromes P450 (monooxygenase activities) were studied as part of a project that included assessment of reproductive success, growth and development, selected biomarkers and tissue PCB concentrations in tree swallows at two reference sites and at five sites with differing concentrations of PCBs. PCB concentrations were measured in up to 8 eggs and 20 nestlings from each site. Controlled studies involved administration of benchmark inducers of cytochromes P450 to eggs and nestlings. Ethoxyresorufin-*O*-dealkylase (EROD) and benzyloxyresorufin-*O*-dealkylase (BROD) activities were assayed in hepatic microsomes using a fluorescence microwell plate reader. PCBs were found in field-collected eggs and nestlings and hepatic microsomal monooxygenase activity correlated to nestling PCB concentrations, however results with controlled administration of PCBs raise questions as to whether the observed monooxygenase activities were really due to the PCBs. There were no consistent major impacts on reproduction, growth, or development.

Meyers, J. M., L. K. Duncan, and E. G. Springborn. 1998. Reproductive survival of white-eyed vireos and painted buntings in unmanaged shrub-scrub, managed pine-oak forest, and old growth maritime forest habitats of Sapelo Island, GA. North American Ornithological Conference, April 6-12, St. Louis, MO.

Comparisons of reproductive survival of breeding bird populations that are stable and declining in the southeastern United States may provide clues to causes for population declines. We studied the nesting success of a stable population White-eyed Vireo (*Vireo griseus*) and a "species at risk" population Painted Bunting (*Passerina ciris*) on Sapelo Island, GA, in 1996 and 1997. Nests were located in three 64ha sites: unmanaged shrub-scrub, managed pine-oak forests, and old growth maritime forests. We calculated daily egg and nestling survival using Mayfield's method and tested for survival differences using program CONTRAST (chi-square). White-eyed Vireo's daily survival was higher in 1996 than in 1997 (0.984 and 0.961, P=0.05). The vireo's daily survival was higher in old growth maritime (0.996) than in managed pine-oak forests (0.925, P= 0.05) in 1996 and similar (0.9560.967, P=0.86) in all habitats in 1997. Mean clutch sizes decreased for vireos from 1996 to 1997 (3.9 to 3.4 eggs, *t*test, P=0.002). Painted Bunting's daily survival was similar between years (0.951 and 0.975, P=0.17) and also similar among habitats (0.9630.975, P=0.82). The vireo's daily survival (0.985) surpassed the bunting's survival (0.951, P=0.06) only during 1996. Cowbird nest parasitism was relatively low for buntings (8% of 50) and higher for vireos (23% of 52). Record long-term cold weather during the spring of 1997 may have affected the vireo's survival and clutch sizes, but had little effect on later nesting buntings.

Mossman, M. J., L. Hartman, J. R. Sauer, B. Hay, and B. Dhuey. 1998. The Wisconsin Frog and Toad Survey: update and 1984-97 trends. Midwest Declining Amphibians Conference, March 20-21.

Nichols, J. D. 1997. Statistical inference in community ecology [seminar]. Department of Biological Sciences, Simon Fraser University, September 29.

Nichols, J. D. Hinz R. L. and J. E. Hines. 1998. Effects of habitat fragmentation on dynamics of meadow vole populations: a field experiment. Ecological Society of America Meeting, Baltimore, August 3.

Nichols, J. D. and U. Karanth, leaders. 1999. Indo-U.S. Workshop on Monitoring Tiger and Prey Populations, held 12-17 January at Nagarahole National Park, India.

Lectures dealt with topics ranging from the conceptual basis for monitoring programs, to presence-absence distribution mapping methods, to index-based monitoring methods, to estimation-based methods. There was also substantial field work with field exercises every morning and afternoon on topics ranging from line transect estimation of ungulate and monkey densities, to camera-trapping, to scat and track identification for possible use in presence-absence surveys.

Nisbet, I. C. T., J. A. Spendelow, J. S. Hatfield, G Gough, and J. M. Zingo. 1997. Early growth of roseate tern chicks an index of parental quality. 21st Annual Meeting of the Colonial Waterbird Society, Lafayette, LA., Oct. 29 - Nov. 2.

We measured mass growth of Roseate Tern chicks at a colony in Connecticut in 10 successive years. Data on growth during the first 3-4 days of life were fitted to a quadratic regression model, yielding three parameters of early growth for each of 1,551 chicks: mass at hatching, linear growth and quadratic growth. First chicks in each brood (A-chicks) exceeded second chicks (B-chicks) in each of these three growth parameters; A-chicks from broods of two grew faster than single chicks. Early growth parameters were predicted by hatch order, hatch date, and egg mass. Subsequent growth and survival of chicks were predicted by all three parameters of early growth. After controlling for effects of early growth, parental age and other parameters contributed little to variance in subsequent growth and survival. However, individual parents and pairs showed consistency in performance in successive years. These results suggest that breeding success in Roseate Terns is determined primarily by parental quality, but that parental quality is almost fully expressed by the time the first egg is laid.

Nisbet, I. and J. A. Spendelow. 1997. "Bird Science and Conservation - A View from Ireland", The British Ornithologists' Union and Royal Society for the Protection of Birds Autumn Conference, 5-7 September, Stanmillis College, Belfast, Ireland.

The Roseate Tern (*Sterna dougallii*) is the bird species most characteristic of Ireland. In North America, it is similarly characteristic of the northeastern coast of the USA between 40^{o} and 42^{o}N. The North American population comprises about 3,800 breeding pairs and has been increasing slowly since 1987, except for a sharp decline by about 17% in 1992 which was probably

attributable to a hurricane in August 1991. In 1988-1994, about 85% of the breeding population in the northeastern USA nested on two islands and about 95% on five. 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 occupied by large gulls between 1930 and 1972; many of the terns are now nesting at less suitable sites near the mainland, where they are subject to predation by mainland-based predators. Despite this, Roseate Terns breed with generally high success at most sites. The sex-ratio is skewed towards females; about 12% of nests are attended by female-female pairs. The annual adult survival rate is about 0.83, unusually low for a seabird. Most mortality appears to occur away from the breeding grounds, but the winter quarters remained unknown until one roost site was found in Brasil in 1995-1997. The population has been studied intensively since 1987, using a more "hands-on" approach than that favoured in Europe. Research has yielded important information about the biology and demography of the species, but has not yet provided the key to restoring the population. The major management projects have involved restoring former colony-sites by eliminating nesting gulls; these have been successful in some cases but not in others. Sites for restoration must be chosen carefully to ensure that birds are not attracted to less suitable sites. Some of the experience gained from research projects in North America may be useful for planning research and management activities in Ireland.

Pattee, O. H., B. A. Rattner, and R. Eisler. 1998. Species decline: Contaminants and other contributing factors [poster]. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

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. Identification of critical limiting factors may result in management actions that stabilize vulnerable populations and insure their perpetuation. 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 synoptic review of all recovery plans (n=479) with listing packages (n=1134) 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 all of the recovery plans for reptiles (n=26) and amphibians (n=6). 188 causes are defined, falling into 6 major categories: habitat alteration/availability (47.8%); exploitation/harvest (19.7%); introduction of exotic species (10.1%); contaminants (9.0%); miscellaneous others (6.9%); pollution (6.4%). 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 (69.7%) are based on poorly documented expert opinion and/or guesswork. This is particularly true of the contaminant/pollution categories where only 13.8% of the incidents are documented in the literature as true causes of decline.

Pinkney, A. E., E. B. May, J. C. Harshbarger, and M. J. Melancon. 1997. Relationships between tumor prevalences in brown bullheads (*Ameiurus nebulosus*) and contaminant exposure in the Potomac and Anacostia Rivers. SETAC 18th annual meeting: Bridging the Global Environment: Technology, Communication, and Education, November 16-20, San Francisco, CA.

Three surveys of the prevalence of neoplasms (oral, cutaneous, and internal organs) and other lesions in brown bullhead (*Ameiurus nebulosus*) were conducted. The prevalences of skin neoplasms (squamous carcinomas and papillomas) increased in three Potomac River tributaries about 30-40 km downstream of Washington, DC in the same manner as the average sediment concentration of carcinogenic PAHs. Prevalences of skin neoplasms were 3.4% in Farm Creek, 16.6% in Marumsco Creek, and 33.3% in Neabsco Creek. Liver carcinoma prevalences were 0% in Farm, 3.3% in Marumsco, and 10% in Neabsco. Carcinogenic PAHs in sediments averaged 0.34 ppm in Farm, 0.63 ppm in Marumsco, and 1.37 ppm in Neabsco, where the highest concentration (2.70 ppm) was found near a complex of marinas. The second study was a

preliminary survey of neoplasms and other lesions in 20 bullheads collected from the Anacostia River, a Chesapeake Bay Region of Concern due to sediment and fish contamination. A 75% prevalence of liver carcinomas and a 10% prevalence of heart mesotheliosis were found. The third study, in progress, is examining associations between tumor prevalences and liver cytochrome P450 activity, PAH bile metabolites, and tissue and sediment organochlorine pesticide/PCB concentrations in bullheads collected from 2 Potomac River sites (Neabsco and Quantico), one Anacostia site (collected in spring and fall), and an Eastern Shore control site. Cytochrome P450 activity is significantly elevated in the spring collection from the Anacostia and in the Neabsco collection. Histopathological results and possible relationships with contaminant exposure will be discussed.

Powell, D., R. Aulerich, M. Kelly, S. Fitzgerald, S. Bursian, J. Meadows, D. Tillitt, K. Stromborg, and M. Melancon. 1997. Effects of PCB 126 and TCDD injected into double-crested cormorant eggs prior to incubation. SETAC 18th annual meeting: Bridging the Global Environment: Technology, Communication, and Education, November 16-20, San Francisco, CA.

Double-crested cormorant (*Phalacrocorax auritus*) eggs were injected with either 3,3',4,4',5-pentachlorobiphenyl (PCB 126) or 2,3,7,8-tetrachlorobiphenyl- -dioxin (TCCD). These compounds were injected into the yolks of cormorant eggs collected from incomplete clutches from an isolated colony on Lake Winnipegosis, Manitoba, Canada. The brain, bursa, heart, liver, and spleen were dissected and weighed. Torsos were preserved for examination of the gonads. LD50s were calculated from mortality data at hatching. The LD50 for PCB 126 was 177 µg/kg egg based on actual doses. The LD50 for TCDD was 6.4 µg/kg egg based on targeted doses. There were no significant increases in the incidence of developmental abnormalities in any of the treatment groups. Bursa weights were significantly less in the 32 µg TCDD/kg egg group compared to the vehicle control group. Spleen weights were significantly less in the 349 µg PCB 126/kg egg and 8 and 32 µg TCDD/kg egg groups when compared to the vehicle control group. There were no histological alterations of the gonads. Hepatic EROD induction in all PCB 126 (70 - 698 µg/kg egg) and TCDD (2 - 32 µg/kg egg) dose groups was significantly greater compared to control activity. Toxic equivalency factors for PCB 126 calculated on the basis of LD50 values, the lowest dose to cause a significant increase in EROD activity, and the lowest dose to cause a significant decrease in spleen weights were 0.04, 0.03, and 0.02, respectively.

Pringle, C. M. and M. C. Freeman. 1998. Regional effects of hydrologic alterations on the biotic integrity of river ecosystems in the New World: tropicaltemperate comparisons. Annual Meeting, Ecological Society of America/ American Society of Limnology and Oceanography, June, St Louis MO.

Hydrologic alterations have destroyed or are threatening major linkages between ecosystems throughout the New Word. Here we evaluate regional effects of hydrological modifications on the biotic integrity of riverine systems in the New World, with emphasis on temperate-tropical comparisons. Just as anadromous salmonid migrations create an ecological connection between the Pacific Ocean and headwater tributaries on central North America (through their reproductive cycles and foodweb relationships), catfish migrations connect a large portion of the Amazon basin from the Atlantic estuary to the base of the Andes. In North America, our ability to evaluate effects of dams in constrained by a lack of preimpoundment data and information on the distribution/ecology of biota in river networks before extensive hydrologic alterations occurred. While the era of hydropower development is just beginning in the neotropics (with seventy-nine large dams either planned or already existing in the Brazilian Amazon alone), our limited understanding of how tropical rivers function has contributed to uncertainty regarding environmental effects. The potential of dams to negatively affect biodiversity in the neotropics is perhaps greater than in any other region of the world; there are >2000 fish taxa in the Amazon alone, with 90% endemism and a diversity of migratory biota that undergo extensive longitudinal and/or lateral migrations. In North America, while much attention has focused on salmonids, dams are also responsible for the reduced abundance and restricted distribution of many migratory and resident large-river fauna. For example, at least six of nine sturgeon taxa are imperiled, and at least three quarters of all unionid mussel species are rare, in decline, or extinct. Impoundments have restricted many smaller-bodied fishes to unregulated headwaters, where populations can become genetically isolated and vulnerable to other anthropogenic alterations. Hydropower development often enhances the success of introduced species at the expense of native species;

the Colorado River has over twice as many fish taxa today as it did prior to the arrival of European settlers as a result of exotic species which thrive in the altered flow and thermal regimes above and below the 44 large dams along the river. While the interrelated effects of river fragmentation, faunal impoverishment, and replacement of native species by exotics remains to be evaluated, the sheer magnitude of hydrological modifications in the New World promises to have negative consequences on regional patterns of biodiversity and ecosystem stability on an evolutionary time frame.

Rattner, B. A., J. B. Cohen, and N. H. Golden. 1998. Contaminant effect endpoints in terrestrial vertebrates at and above the level of the "individual". "Environmental contaminants and terrestrial vertebrates: effects on populations, communities, and ecosystems," a symposium sponsored by USGS Patuxent Wildlife Research Center, SETAC, The Wildlife Society and EPA, held at the University of Maryland, College Park, October 19-21.

Scores of measurement endpoints have been used to make ecotoxicological assessments in free-ranging wild terrestrial vertebrates. At and below the level of the individual organism, biomarker and bioassay response patterns have been associated with contaminant exposure. Although such molecular, cellular level, organ and organismal measurement endpoints may constitute excellent "early warning" systems of contaminant exposure, rarely are such responses causally linked to effects at the population level. Few contaminant concentration thresholds, guidelines or standards in matrices such as water, soil, sediment, and foods, have been developed for the protection of wild terrestrial vertebrates. This overview critiques biotic measurement endpoints and toxicant criteria that are utilized to assess contaminant exposure and effects at or above the level of the individual, and suggests areas of potential research, development, application, and extrapolation to potentially improve ecological risk assessment.

Rattner, B. A., R. M. Erwin, J. Pearson, A. Walz, and M. A. Ottinger. 1997. Development of a retrospective regional database for the Biomonitoring of Environmental Status and Trends Program. SETAC 18th annual meeting: Bridging the Global Environment: Technology, Communication, and Education, November 16-20, San Francisco, CA.

The Biomonitoring of Environmental Status and Trends (BEST) program of the Department of the Interior is focused to identify and understand effects of contaminant stressors on biological resources under their stewardship. Despite the desire of many to continuously monitor the environmental health of our estuaries, much can be learned by summarizing existing temporal, geographic, and phylogenetic contaminant information. To this end, retrospective contaminant exposure and effects data for amphibians, reptiles, birds, and mammals residing within 30 km of North-Atlantic coast estuaries are being assembled through searches of published literature (e.g., Fish and Wildlife Review; BIOSIS) and databases (e.g., US EPA Ecological Incident Information System; USGS Diagnostic and Epizootic Databases), and compilation of summary data from unpublished reports of government natural resource agencies, private conservation groups, and universities. These contaminant exposure and effect data for terrestrial vertebrates (CEE-TV) are being summarized using Borland dBASE in a 92- field format, including species, collection time and site coordinates, sample matrix, contaminant concentration, biomarker and bioindicator responses, and source of information (N>1500 records). This CEE-TV database has been imported into the ARC/INFO geographic information system (GIS), for purposes of examining geographic coverage and trends, and to identify critical data gaps. A preliminary risk assessment will be conducted to identify and characterize contaminants and other stressors potentially affecting terrestrial vertebrates that reside, migrate through or reproduce in these estuaries. Evaluations are underway, using specific measurement and assessment endpoints, to rank and prioritize estuarine ecosystems in which terrestrial vertebrates are potentially at risk for purposes of prediction and focusing future biomonitoring efforts.

Rattner, B. A., D. J. Hoffman, M. J. Melancon, G. H. Olsen, K. C. Parsons, and S. R. Schmidt. 1998. Organochlorine contaminant exposure and effects in pipping black- crowned night-herons in Delaware Bay. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

Pea Patch Island in Delaware Bay is the site of the largest heronry north of Florida. From 198993, the population of 9 species of wading birds numbered approximately 12,000 pairs, but has recently declined to 7,000 pairs. Because Delaware Bay is a major shipping channel, and

receives anthropogenic releases of toxic substances from agricultural, industrial and municipal point and nonpoint sources, contaminant exposure and effects to the heronry have been an ongoing concern. In 1997, pipping black-crowned night-herons (BCNHs) were collected from separate nests at Pea Patch Island (N=15), and from a coastal reference site, Middle Island (N=9), in Rehoboth Bay, DE. There was neither evidence of malformation nor hepatic histopathological lesions, and body and liver weights did not differ between sites. Biomarkers of petroleum hydrocarbons, polyhalogenated contaminant and metal exposure (cytochrome P450 induction and oxidative stress responses) did not differ ($P>0.05$) between sites, however, activities of benzyloxy- and ethoxyresorufin-O-dealkylase were greater in 3 of 15 embryos from Pea Patch Island compared to Middle Island. Concentrations of 21 organochlorine pesticides and metabolites were relatively low at both sites, with *p,p'*DDE values well below the threshold associated with eggshell thinning. Although total PCB concentration was modestly elevated ($P<0.05$) in Pea Patch Island BCNH embryos, levels of arylhydrocarbon-receptor active PCB congeners, dioxins, dibenzofurans and toxic equivalents were low and did not differ between sites. Surprisingly, organochlorine contaminant exposure and effects in Delaware Bay BCNHs appear to be considerably less than that observed and recently reported (ETC 16:2315-2322, 1997) for herons residing in the Chesapeake Bay.

Rattner, B. A., J. L. Pearson, N. H. Golden, J. B. Cohen, R. M. Erwin, and M. A. Ottinger. 1998. An assessment of contaminant trends and data gaps for terrestrial vertebrates residing within Atlantic coast estuaries. EPA Mid-Atlantic Integrated Assessment Working Conference, November 30-December 2, Baltimore.

The Biomonitoring of Environmental Status and Trends (BEST) program of the Department of the Interior is focused to identify and understand effects of contaminant stressors on biological resources under their stewardship. One BEST program activity involves evaluation of retrospective data to assess and predict the condition of biota in Atlantic coast estuaries. A "Contaminant Exposure and Effects Terrestrial Vertebrates" database (CEETV) has been compiled through computerized literature searches of AGRICOLA, Aquatic Sciences and Fisheries Abstracts, BIOSIS, Fish and Wildlife Reviews, and TOXLINE, review of existing databases (e.g., US EPA Ecological Incident Information System, USGS Diagnostic and Epizootic Databases), and solicitation of unpublished reports from conservation agencies, private groups, and universities. Summary information has been entered into the CEETV database, including species, collection date (1965-present), site coordinates, sample matrix, contaminant concentrations, biomarker and bioindicator responses, and reference source, utilizing a 96-field dBase format. Currently, the CEETV database contains 3500 geo-referenced records representing >200 vertebrate species and >100,000 individuals residing in estuaries from Maine through Florida. This relational database can be directly queried, imported into the Geographic Information System to examine spatial tendencies, and used to identify "hotspots", generate hypotheses, and focus ecotoxicological assessments. An overview of temporal, phylogenetic, and geographic contaminant exposure and effects information, trends, and data gaps will be presented for terrestrial vertebrates residing in estuaries in the mid-Atlantic region of the United States.

Rattner, B. A., J. L. Pearson, N. H. Golden, R. M. Erwin, and M. A. Ottinger. 1998. Identification of contaminant trends and data gaps for terrestrial vertebrates residing in northeastern estuaries of the United States. The Wildlife Society 5th Annual Conference : Wildlife Toxicology in Northeastern North American Ecosystems, September 22-26, Buffalo, NY.

The Biomonitoring of Environmental Status and Trends (BEST) program of the Department of the Interior is focused to identify and understand effects of contaminant stressors on biological resources under their stewardship. One BEST program activity involves evaluation of retrospective data to assess and predict the condition of biota in Atlantic coast estuaries. A "Contaminant Exposure and EffectsTerrestrial Vertebrates" database (CEETV) has been compiled through computerized literature searches of Fish and Wildlife Reviews, BIOSIS, AGRICOLA, and TOXLINE, review of existing databases (e.g., US EPA Ecological Incident Information System, USGS Diagnostic and Epizootic Databases), and solicitation of unpublished reports from conservation agencies, private groups, and universities. Summary information has been entered into the CEETV database, including species, collection date (1965-present), site coordinates, sample matrix, contaminant concentrations, biomarker and bioindicator responses, and reference source, utilizing a 96-field dBase format. Currently, the CEETV database contains 3500 geo-

referenced records representing >200 vertebrate species and >100,000 individuals residing in estuaries from Maine through Florida. This relational database can be directly queried, imported into the ARC/INFO geographic information system (GIS) to examine spatial tendencies, and used to identify “hotspots”, generate hypotheses, and focus ecotoxicological assessments. An overview of temporal, phylogenetic, and geographic contaminant exposure and effects information, trends, and data gaps will be presented for terrestrial vertebrates residing in estuaries in the northeast United States.

Rattner, B. A., J. L. Pearson, A. Walz, R. M. Erwin, and M. A. Ottinger. 1997. A new look at contamination of north Atlantic estuarine ecosystems through retrospective terrestrial vertebrate exposure and effects data. Estuarine Research Federation, 14th International Conference, October 12-16, Rhode Island. Abstracts, p. 151.

Although the tendency of many is to continually collect specimens for pollution biomonitoring, valuable predictive information can be gleaned on The State of Our Estuaries by review of existing temporal, geographic, and phylogenetic contaminant data. Retrospective contaminant exposure and effects data for terrestrial vertebrates (CEE-TV) are being compiled for North Atlantic estuaries through searches of published literature, existing databases, and unpublished reports of conservation agencies, private groups, and universities. Summary information is entered into the CEE-TV database, which utilizes a 71-field dBase format, including species, collection time, coordinates, sample matrix, contaminant concentrations and toxic equivalents, biomarker/bioindicator responses, and reference source (N>1500 records). These records are then imported into the ARC/INFO geographic information system (GIS) to examine spatial distribution and trends, and to identify critical data gaps to focus future biomonitoring efforts. A risk assessment will identify contaminants that pose a hazard to resident and migratory terrestrial vertebrates, and also rank and prioritize estuaries in which these biota are potentially threatened.

Robbins, C. S. 1997. Birds, conservation and politics in the land of the Maya. Alaska Bird Conference, Anchorage, Alaska, Migratory Bird Management, U.S. Fish and Wildlife Service, December 3.

Described how BRD's migratory bird research program in Guatemala assisted in the passing of legislation by the Guatemalan government to protect 119,000 acres of rain forest at Cerro San Gil, the largest protected area in Guatemala.

Robbins, C. S. 1997. Mapping neotropical migrants in Belize. Boreal Working Group of Partners in Flight, Anchorage, Alaska, December 4.

Described BRD's research program on habitat use by migratory and resident birds in Belize, including the use of GIS and satellite imagery to map their distribution throughout the country.

Robbins, C. S. 1997. Methodology; and Data Management and Interpretation (two sessions). Training Workshop, "Bird Conservation, from Techniques to Application, Rio Bravo Conservation and Management Area, Programme for Belize, November 8-15.

These two sessions included introduction to sampling techniques for song birds, field demonstrations of mist netting, banding, and point counts, preparation of charts and maps, and use of bird data to promote conservation objectives.

Russell, J., R. Halbrook, M. Melancon, and J. French. 1997. Hepatic monooxygenase induction and pentobarbital induced sleeping-times in mice and shrews. SETAC 18th annual meeting: Bridging the Global Environment: Technology, Communication, and Education, November 16-20, San Francisco, CA.

Hepatic cytochrome P450 induction and corresponding reductions in pentobarbital induced sleep times were evaluated and compared among 4 dose groups of white-footed mice (*Peromyscus leucopus*) and short-tailed shrews (*Blarina brevicauda*) exposed to dietary doses of a PCB mixture (Aroclor 1254 and 1242, 1:2) for 31 days. Dose concentrations for mice and shrews were 0.1, 1.6, and 25 ppm and 0.6, 9.6, and 150 ppm, respectively. Sleep times of exposed animals dosed with sodium pentobarbital were measured on day 31 prior to necropsy. Liver microsomes of shrews

and mice were prepared and assayed for ethoxyresorufin-, methoxyresorufin-, pentoxyresorufin-, and benzyloxyresorufin-O-dealkylase activity (EROD, MROD, PROD, and BROD). EROD was the monooxygenase most readily induced by exposure to PCBs in both species. In shrews and mice, PCB ingestion increased hepatic microsomal enzyme activity in all but the low dose group and pentobarbital induced sleep times were reduced in the highest dose group in mice. A trend towards reduction in pentobarbital induced sleep times in the highest dose group occurred in shrews, however the difference was not significant. Results indicate hepatic enzyme activity and decrease in pentobarbital induced sleep time can be useful biomarkers of contaminant exposure in mice and shrews. However, hepatic microsomal activity appears to be a more sensitive indicator of contaminant exposure than sleep time reduction. Dietary exposure to PCBs resulted in a greater induction of monooxygenase activity in mice than in shrews at all dose concentrations indicating that mice may be more readily induced by PCB exposure than shrews.

Sauer, J. R. 1997. Estimating population change and relative abundance from the North American Breeding Bird Survey. Chesapeake Chapter of the American Statistical Association, September 30.

Sauer, J. R. 1998. Landscape analysis of remotely-sensed habitat data and the North American Breeding Bird Survey: Sense or nonsense? A seminar presented at the Appalachian Laboratory, University of Maryland Center for Environmental Science, Frostburg, Maryland, December 10.

Seaman, B. D. and D. G. Krementz. 1998. Bachman's sparrows in response to growing season prescribed burns in South Carolina. Fire and Forest Ecology: Innovative silviculture & vegetation management symposium, sponsored by Tall Timbers, April 14-16, Tallahassee, FL.

Sparling, D. W. 1998. Field evidence for linking Altosid applications with increased amphibian deformities in southern leopard frogs. Joint meeting of the Great Lakes and Central Division Working Groups of the Declining Amphibian Populations Task Force, March 20 & 21, Milwaukee Public Museum, Milwaukee, Wisconsin.

During the summer of 1997 we repeatedly sprayed Altosid, a formulation of 4% methoprene used for mosquito control, on six constructed macrocosms. Six additional macrocosms were sprayed with Abate-4E, containing the organophosphate pesticide temephos, and six were sprayed with water (controls). The wetlands were created on an impermeable foundation for research purposes and averaged 215 m^2 in area and 0.5 m deep. Application rates and frequency of Abate-4E and Altosid followed label directions and mimicked procedures for mosquito control in National Wildlife Refuges. In early September juvenile frogs and metamorphing tadpoles were collected with dip nets from each pond and examined for deformities. In all, 91 juveniles and metamorph southern leopard frogs (*Rana utricularia*) were collected from Altosid sprayed wetlands with 14 (15%) demonstrating deformities. Seventy-seven juveniles and metamorphs were collected from control wetlands with three (4%) showing deformities. Only six juveniles and metamorphs were collected from Abate-4E wetlands and none showed deformities. Deformities included missing or deformed hind limbs (9 of 10 involving only the right hind limb), missing eyes, and abnormal color. The differences in rate of deformities was dependent on treatment (X^2=6.44, p< 0.02). The number of leopard frogs caught per unit effort (tadpoles and juveniles) differed among treatments (p=0.032) with Abate-4E wetlands producing fewer individuals per capture effort than either Altosid or control wetlands.

Sparling, D. W., C. Bishop, and G. Linder. 1998. Where should we be headed in the study of ecotoxicology of amphibians and reptiles? The Wildlife Society 5th Annual Conference : Wildlife Toxicology in Northeastern North American Ecosystems, September 22-26, Buffalo, NY.

Compared to fish, birds, and reptiles, the ecotoxicology of amphibians and reptiles has not been well studied. This is despite the occurrence of several contaminant-related events among herps including apparent global declines of amphibian populations, deformed amphibians in parts of North America, feminization of alligators in Florida, and severely reduced populations of many sea turtles. To stimulate research interest in the area of herp ecotoxicology, the authors solicited experts in the field to contribute to a compendium of review and synthesis articles. Topics such as effects of pesticides, metals, organic contaminants, and acidification on herps; current theories of amphibian deformities, endocrine disruption, declining amphibian populations; and discussions

of using herps in risk assessment, laboratory studies and field investigations were presented in the book. This paper gleans the most salient research needs from each of these topics and aspects of each topic and discusses them in relation to ongoing research in the field.

Spendelow, J. A., I. C. T. Nisbet, J. J. Hatch, H. Hays, G. D Cormons, J. Burger, M. Gochfeld, C. Safina, M. England, J. D. Nichols, and J. E. Hines. 1997. Recent major changes in overwinter survival and metapopulation dynamics of the endangered western north Atlantic roseate tern breeding population. 21st Annual Meeting of the Colonial Waterbird Society, Lafayette, LA., Oct. 29 - Nov. 2.

Multistratum capture-recapture models were used to examine geographic and temporal variation in survival and movement probabilities of breeding adult Roseate Terns from 1988-1996 at 6 of the largest nesting colonies of this endangered population in the Massachusetts-Connecticut-New York area. During this period the regional breeding population showed an increasing trend except between the 1991-1992 breeding seasons when it decreased about 15%. The drop in breeding population size between these two years is believed primarily due to the effect of Hurricane Bob which passed through this area in August 1991 near the beginning of the migration period. The average annual overwinter survival rate of adults for all years except 1991-1992 was 0.83 and the average overwinter survival rate of adults for 1991-1992 was 0.67; the loss (mortality) rate of breeding adults from 1991-1992 (0.33) was almost twice the typical (0.17) loss rate.

Springborn, E. G., J. M. Meyers, and L. K. Duncan. 1998. Home range and movements of painted buntings in managed pineoak forest and shrubscrub habitat on Sapelo Island, GA. North American Ornithological Conference, April 6-12, St. Louis, MO.

The Painted Bunting (*Passerina ciris*) population of the southeastern United States has declined 2.8% annually from 1966 to 1994 (Breeding Bird Survey). Important source breeding habitat for this species exists along the Atlantic coast, especially on undeveloped coastal islands. We radiotracked 20 Painted Buntings on Sapelo Island, GA, from April to July, 1997, to determine home range and movements in managed and unmanaged habitats. After-hatching-year female and after-second-year male buntings were studied in managed pine-oak forest (age 60 yr) and unmanaged shrub-scrub habitat by homing to radio-marked birds and recording GPS locations. We calculated home ranges (95% volume) using the fixed kernel method with a smoothing parameter chosen by least squares cross validation. Males and females occupied similar-sized home ranges (1.95 ha for males, 2.10 ha for females, $P = 0.68$). Buntings occupied larger home ranges in managed pine-oak forest (2.38 ha) than in shrub- scrub habitat (1.73 ha, $P = 0.10$) and traveled 75 m further (mean square distance from center of home range) in managed pineoak forest. Birds of managed pineoak forest flew long distances (>300 m) to coastal marshes, to freshwater marshes, and to moist forest clearings. In shrub-scrub habitat, buntings occupied a compact area and rarely moved long distances. We observed evidence of polygamy and possibly polyandry. Painted Bunting home ranges for the first year of our twoyear telemetry study suggest that for successful nesting, buntings may require more habitat and travel longer distances in managed forests than in unmanaged shrub-scrub habitat.

Teets, M. J., J. J. Hatch, J. A. Spendelow, and J. M. Zingo. 1997. Post-fledging parental care in roseate terns. 21st Annual Meeting of the Colonial Waterbird Society, Lafayette, LA., Oct. 29 - Nov. 2.

Almost nothing is known about parental care in seabirds once the chick has left the nest. The allocation of post-fledging parental care in the Roseate Tern was quantified at the breeding colony on Falkner Island, Connecticut, during the 1997 breeding season. Differences in the number of feeds per hour delivered by parents to one-fledgling versus two-fledgling broods were examined. Brood splitting occurred upon the fledging of the first (A) chick in two-chick broods. Male parents provided most of the feeds to the first fledger with occasional feeds to the second (B) fledger. Female parents provided most of the feeds to the B-fledgers with very occasional feeds to the A-fledger. Usually, the A-fledger disappeared from the island several days before the B-fledger disappeared. The male adult disappeared at the same time as the A-fledger; female adults continued to feed the B-fledger either until the B-fledger disappeared or was abandoned. Single-fledge broods' parental care was not allocated differentially by the sex of the parent. More information is needed to find out how long these associations last.

Twedt, D. J., A. B. Elliot, R. R. Wilson, D. A. Grossuesch, J. L. Henne-Kerr, L. M. Gericke, D. L. Mackey, and R. B. Hamilton. 1998. Avian densities in reforested habitats of the Mississippi Alluvial Valley. Warren County Forestry Association.

Twedt, D. J., R. R. Wilson, R. Hamilton, and J. Henne-Kerr. 1998. Avian nest success in relation to forest type and silvicultural treatment in the Mississippi Alluvial Valley. North American Ornithological Conference, April 6-12, St. Louis, MO.

We estimated daily survival rates, predation rates, and brood parasitism rates for 526 opencup nests in mature, bottomland hardwood forests at Tensas River National Wildlife Refuge, LA and 455 opencup nests in young, managed cottonwood forests at Fitler Managed Forest, Fitler, MS from 1994 to 1997. Daily nest survival was higher ($P<0.01$) in bottomland forest ($S=0.95$; nest success=30.4) than in managed cottonwood forest ($S=0.93$; nest success=7.2). However, the species assemblages differed between forest habitats. Separate analyses of 5 species common to both forest types revealed no difference ($P>0.14$) in daily nest survival. Within bottomland hardwood forests, we found no difference ($P=0.91$) in daily nest survival between pre- and post-treatment years in forest stands subjected to single-tree harvests, but survival was higher ($P<0.01$) in uncut bottomland hardwood forests than in harvested forests. Harvest impacts varied by species; post-harvest nest survival declined for Acadian Flycatcher but was unchanged for Northern Cardinal. Daily nest survival rates were similar ($P=0.93$) in planted and coppiced cottonwood forests. Rates of brood-parasitism and nest predation were higher ($P <0.01$) in managed cottonwood forests (0.24 parasitized; 0.65 predated) than in bottomland forests (0.08; 0.39). Timber harvest in bottomland hardwood forests tends to shift avian species assemblages, nest survival, brood parasitism, and nest predation rates closer to those of young, managed cottonwood forests.

Warren-Hicks, W. J., K. R. R. Solomon, J. H. Gentile, J. Butcher, B. A. Rattner, W. G. Landis, and R. Wenger. 1998. Linking stressors and ecological responses. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

Wilson, R. R., A. B. Elliot, and D. J. Twedt. 1998. Spring migrants in forested wetlands of the Mississippi Alluvial Valley. North American Ornithological Conference, April 6-12, St. Louis, MO.

We compared 400 m long line-transects and three 5-min point counts to assess avian richness and abundance in mixed species bottomland hardwood forests at Tensas River National Wildlife Refuge, LA and managed cottonwood forests at Filter Managed Forest, MS. In 218 paired surveys conducted in 11 forest stands between 24 March and 3 June, 1996 and 1997, we detected more species and total number of individuals using line-transects than point counts. Differences were most pronounced in bottomland hardwood stands recently subjected to single-tree harvest. Species richness did not differ between forest types but number of individuals detected was greater in bottomland hardwoods than in cottonwoods. Despite similarity in species richness, detrended correspondence analysis of avian abundances revealed marked differences in the bird communities using these two forest types during migration. Indicator species analysis detected 27 species indicative of bottomland hardwood forests, including Acadian Flycatcher, Prothonotary Warbler, Red-bellied Woodpecker, and White-throated Sparrow, whereas 15 species were indicative of managed cottonwood forests, including Yellow-breasted Chat, Indigo Bunting, Eastern Towhee, and Eastern Bluebird. Temporal changes in the species composition was also revealed by detrended correspondence analysis. Six clusters of bird species, identified through cluster analysis, depicted short-distance migrants, year-round residents, and long-distance migrants within each forest type.

Winger, P. V. and P. J. Lasier. 1998. Effects of dredge-spoil runoff in the Savannah River. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

The lower Savannah River distributary, consisting of Front, Middle and Back rivers, encompasses the city of Savannah, GA, Savannah Harbor and the Savannah National Wildlife Refuge. Harbor activities (maintenance and expansion), in conjunction with municipal and industrial discharges, have adversely affected habitat quality and indigenous fish and wildlife resources. The objectives of this study were to ascertain the effects of dredge-spoil runoff on habitat quality in the river. Sediments from 35 river sites and 6 dredge-disposal sites were collected for analysis of metal and

organic contaminants (organochlorine and organophosphate pesticides, PAHs and PCBs) and toxicity testing of solid-phase sediment and sediment porewater using *Hyalella azteca*. Bioaccumulation of contaminants from 6 dredge-spoil sediments was determined using *Lumbriculus variegatus.* Metal residues were measured in livers of marsh ducks (*Anas creca*), wading birds (*Tringa flavipes*) and raccoons (*Procyon lotor*). Most sediments were not toxic, and for those showing toxicity, water quality characteristics (ammonia, alkalinity, salinity) were generally responsible. However, dredge-spoil runoff or pointsource discharge may have contributed to the toxicity shown at 14 sites. Organic contaminants in sediments were at or below detection limits. *Lumbriculus* bioaccumulated arsenic, copper, mercury, selenium and zinc from dredge-spoil sediments. Cadmium, mercury, molybdenum and selenium residues were higher in livers of birds and raccoons than in sediment, and these metals were significantly higher in livers of raccoons living near the river than those living in an upland control area. Evidence of bioaccumulation from laboratory and field evaluations, toxicity of sediments from some areas receiving dredge-spoil runoff and concentrations in sediments demonstrated that some metals present in the dredge spoils are mobile and biologically available and have the potential to impact habitat quality in the lower Savannah River.

Yorks, A. L., M. J. Melancon, and D. J. Hoffman. 1998. Nestling tree swallow (*Tachycineta bicolor*) PCB body burdens and their effects on reproduction and growth. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

Tree swallows (*Tachycineta bicolor*) were monitored during three consecutive breeding seasons at eight sites in Maryland, Pennsylvania, and New York representing a range of polychlorinated biphenyl (PCB) contamination in order to evaluate if there were any effects on reproductive or growth parameters. Eggs were collected and analyzed to determine contamination due to the females' body burden and establish a baseline PCB level. Composite sediment samples and pooled stomach contents were also analyzed to characterize each site and quantify PCBs from local food sources. Reproductive success was assessed by clutch size, and embryo and nestling survival. Clutch sizes at the two most contaminated sites near Philadelphia PA were generally smaller than at other sites. Nine-day nestlings were ligatured and insects in the food samples were identified to order (suborder for Dipterans), categorized as aquatic or non-aquatic, and analyzed for total PCBs. Growth parameters examined for twelve-day nestlings included body, liver, and heart weights, and bone, culmen, and brain symmetry measurements. A subset of carcasses were cleared and skeletons were stained in order to observe growth and bone structure. Body weights at two contaminated sites were lower than those at control or less contaminated sites. There were no consistent differences between liver and heart weights that related to contamination. While there were only subtle differences between reproductive and growth parameters from nestlings at various sites, body burdens of PCBs correlated strongly with levels in sediment, eggs, and food sources.

Yorks, A. L., M. J. Melancon, C. S. Hulse, J. J. Stegeman, and B. R. Woodin. 1998. Cytochrome P450 monooxygenase activities as a biomarker for PCB exposure and effect in field collected and manually dosed tree swallow (*Tachycineta bicolor*) nestlings. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

The utility of measuring protein and catalytic function of cytochrome P450s of the CYP1A and CYP2B subfamilies as biomarkers for environmental polychlorinated biphenyl (PCB) exposure in upland birds was examined using Tree swallows (*Tachycineta bicolor*). From 1995 to 1997, nests and nestlings were monitored at eight sites in Maryland, Pennsylvania, and New York. Additionally, eggs and nestlings from one site were dosed with the model cytochrome P450 inducers, ÿnaphthoflavone, 3methycholanthrene, PCB 126, and various Aroclors. Hepatic microsomes were prepared from twelveday old nestlings and analyzed for EROD (CYP1A) and BROD (CYP2B) activities. A subset of microsomal samples were also examined by protein immunoblotting using polyclonal antibodies specific for the CYP1A and CYP2B subfamilies. Heart and skin samples from the nestlings were examined immunohistochemically to determine relative amounts and cellular location of CYP1A. Although BNF induced cytochrome P450s as assessed by enzyme activity and protein immunoblotting, PCBs were ineffective. A range of PCB contamination was seen in composite sediment (0.0216ppm) and egg (0.709.7ppm) samples from the field sites. BROD and EROD activities correlated significantly with each other ($r>0.8$) and with PCB concentrations. Contaminant levels and CYP1A and CYP2B antibody responses of the

nestlings also were correlated. Differences between sites and treatments show that there is a cytochrome P450 biomarker response in nestling Tree swallows which is indicative of contaminant exposure and effects. However, lack of enzyme activity after dosing with PCBs indicates that induction at field sites may be due to other contaminants.

Yorks, A. L., B. A. Rattner, and M. J. Melancon. 1998. Investigations of potential endocrine disruption and sexual dirmorphism in nestling tree swallows (*Tachycineta bicolor*) with a range of PCB body burdens. 19th Annual SETAC meeting, Nov. 15-19, Charlotte, NC.

Polychlorinated biphenyls (PCBs) elicit endocrine disruptive effects in many species, including birds. Tree swallows (*Tachycineta bicolor*) were studied at eight sites, located in Maryland, Pennsylvania, and New York, with a range of PCB contamination to determine effects on gender and gonadal development of nestling offspring. Blood samples were collected from nestlings and genetic sex was determined by polymerase chain reaction amplification of sex chromatin in nucleated red blood cells. Gonads were excised and fixed for subsequent gross and histologic examination. PCB analyses of twelve-day old nestlings indicated that residue concentrations varied considerably among the eight sites. Of the 145 nestlings examined anatomically, the phenotypic sex ratio was 53% female and 47% male. No intersexes were observed. Histological observations revealed some variation such as numbers of spermatogonia and stages of follicular development among individuals. Genotypic evaluation of the 145 nestlings revealed complete concordance with phenotypic observations. Although there were significant differences in PCB exposure among study sites, there was no evidence of abnormal gonadal development or anatomical gender alteration in nestling tree swallows.

Zingo, J. M., J. A. Spendelow, and J. S. Hatfield. 1997. Does the trapping of adult roseate terns adversely affect chick growth? 21st Annual Meeting of the Colonial Waterbird Society, Lafayette, LA., Oct. 29 - Nov. 2.

We evaluated the effects of trapping adult Roseate Terns on chick growth at the Falkner Island colony site in Connecticut, USA, from 1987-1996. We calculated five parameters of chick growth which collectively represent the entire growth curve: linear (*a*) and quadratic (*b*) components of early growth, mass on Day 5 (*Mass5*), linear growth rate (*LGR*), and asymptotic or prefledging mass (*AM*). Trapping significantly reduced *a*, *b*, and *Mass5* compared to untrapped controls. However, effect sizes were much smaller for *Mass5* than for *a* and *b*, suggesting that trapped parents had already begun to compensate. *LGR* and *AM* were not adversely affected by trapping, except for a small but statistically significant reduction in *LGR* if both parents were trapped during late incubation. These results suggest that while trapping adult terns can affect early chick growth and should be taken into account during research, the effects are short-lived and the parent birds compensate. Trapping had little or no effect on later growth (indices of fledgling quality) and thus is unlikely to affect postfledging survival.