BOWDOIN COLLEGE

BOWDOIN SCIENTIFIC STATION BRUNSWICK, MAINE 04011

1993 Annual Report

Since the Last Annual Report

The Bowdoin Scientific Station was awarded several important grants and donations in 1993. The Norcross Wildlife Foundation provided a grant of $8600 for the purchase of a much-needed boat. Built by Dana Hunter Boat Building Ltd. in Tatamagouche, Nova Scotia, the 23-foot fiberglass work boat has green sides and an orange roof. Its name, naturally, is the *Ernest Joy*, in memory of Kent Island's legendary caretaker. The National Science Foundation has just notified us that it will fund a proposal entitled "Facilities improvements for research in marine biology." Among other things, the $25,000 grant will provide solar power for the lower lab and cover the cost of an inflatable boat for landing on islands and ledges, radar for the *Ernest Joy*, aquaria, computers, and cabinets for storing chemicals and reference collections of marine invertebrates, plants, and insects. For the third year in a row, the New England Consortium for Undergraduate Science Education (NECUSE) provided funds to support student research on Kent Island. Daniel Smith (Harvard University) was selected to conduct research on the pollination biology of larger blue flag (Iris versicolor) and Debbie Rudnick (Brown University) was chosen to work with Corey Freeman ('91, currently a graduate student at Cornell University) on his study of paternal care in Savannah Sparrows. A generous bequest by Grace Hand (wife of James Hand, Jr., '34) allowed us to purchase a VHF radio, Loran system, and other equipment for safe navigation in the unpredictable Bay of Fundy.

John Kent's ghost was quiet last summer, although Corey swears that one foggy morning he heard a gull cry, just once but distinctly, plaintively, "Help me...." Things were also quiet with the U.S. Fish and Wildlife Service, thankfully. However, the repercussions of last year's battle and subsequent incidents involving other ornithologists have mobilized professional biologists to demand changes in the agency's regulatory policies, which are widely seen as interfering with essential research and education on the conservation of birds (see editorials in the latest volumes of Condor and the Newsletter of the Pacific Seabird Group).

The Summer of 1993

Boats and island exploration were a theme of 1993. Our fleet now includes not only the *Ernest Joy*, but also the dinghy found washed up on the southern end of the island last summer. Gunwales freshly painted barn red, seats sanded and varnished, the dinghy has been christened *The Frank* in honor of its discoverer, Frank Pierson. The aging skiff *Streaker* continues to provide good service, as does the little "arse-wetting coracle," which has finally been given a formal name: *Chuck*. The whaler -- an accident waiting to happen -- has been sold. Caretaker Russell Ingalls turned in the *Fundy Girl* and bought a bigger boat from Nova Scotia called the *Misty Maid*, which has made the trip between Seal Cove and Kent Island safer, faster, and more comfortable.

Carpentry was a familiar summer theme. Mark Murray, the station's terrestrial caretaker, instructed his apprentices, Ian Stewart ('96) and Laurel Matey ('95), in the art of outhouse architecture and construction. Visitors and residents of the lower lab can now sit in comfort overlooking the Basin or, if they find themselves between the caretaker's cottage and the Hodgson House, take their choice of either side of a new double outhouse. Inspired perhaps by Marko's early religious training, it is designed sort of like a confessional. The Captain Gillett has been stabilized and reshingled, with the first floor and one wall completely rebuilt. Corey beautified the second story with matching twin beds salvaged from the Bowdoin campus, wall posters, and, yes, an oriental rug. Even the cow barn (the decaying structure west of the dorm) was rolled onto a new floor and foundation, where it will be used for storage.

Seven miles to the south of Kent Island lie the Murre Ledges, an arc of rocks strung like jewels on a necklace between Machias Seal Island and Gannet Rock. The site of numerous shipwrecks, most of the ledges are visible only at low tide, but the highest, Yellow Murre, has a crown of granite boulders that rises above all but the highest winter tides. Beneath these boulders breeds the southernmost colony of Common (Thin-billed) Murres in the western Atlantic, a small population isolated by more than 500 miles from the nearest colony, in Newfoundland. As

part of Steve Kress's (Cornell Laboratory of Ornithology) Puffin Project, which is dedicated to reestablishing and protecting seabird colonies, we helped Peter Duley census the population. (Bill Gross, the first Field Director of the Bowdoin Scientific Station, undertook one of the earliest scientific surveys in 1935.) Grand Manan fisherman Leslie "Beaver" Mullen piloted us through the ledges. The population appears to have grown since it was last censused by Bill Drury; we estimated 110-150 pairs of murres now breed there, with an equal number of Razorbills. Lang Elliott, a specialist in making digital binaural recordings of natural history sounds, captured the breeding brouhaha on a tape which will be used to "lure" murres to colonize other islands. Besides seabirds, we recorded just a single terrestrial plant species (sea spurrey, Spergula marina) and two species of flies.

Fraser and Lillian Shepherd picked us up in the *Kittiwake* one sunny day and gave us a guided tour of Wood Island, where Fraser lived as a child. We found the old schoolhouse, still covered with the brick-motif asphalt siding that once adorned the garage on Kent Island; we looked unsuccessfully for the gravestone of Carrie Chase, Ernest Joy's housekeeper, who died in the Warden's House in 1948. Only the foundation of Ernest's Wood Island home remains. Once a thriving fishing village with its own town square, Wood Island's population has dwindled to three. One of them is Gene Harvey, who told us that his great-grandfather John once farmed on Kent Island and lived in the north field.

The tradition of squeezing cod livers to chum for seabirds was revived after a decade's dormancy when Russell and the *Misty Maid* took us east of Kent Island to the Old Proprietor Ledge. Dusting off Doug Gill's 1965 hoop net, we captured and banded ten Greater Shearwaters plucked out of a swirl of gulls, Wilson's Storm-Petrels, and Sooty Shearwaters, while minke whales surfaced nearby.

The Kent Island hand rash reappeared on schedule, targeting its usual victims, those who handle Savannah Sparrows in late May or early June. This year we tried Lydex, a powerful (and expensive) cortisone cream, with good results. Trematodes transmitted by sparrows still seem the best explanation for the itchy rash.

Research in 1993

- Leach's Storm-Petrels

With the help of Kerry Bacher ('94) and Holly Wagner (Ohio State University '94), Bob Mauck (Ohio State University) continued his PhD dissertation research on Leach's Storm-Petrels. By checking nest burrows each day for cold eggs, Bob and his assistants quantified parental absences, or egg-neglect. Taking advantage of Chuck's long-term study, Bob predicts that individuals paired with the same mate for many years will coordinate their incubation shifts more efficiently than pairs with less experience together. A subset of birds were electronically marked to allow daily identification of the attending parents without having to handle them. With the station's Campbell Datalogger and Bob Ricklefs' (University of Pennsylvania) burrow monitors, Bob recorded parental feeding activity at four burrows during the months of August and September. Preliminary results show no differences between the sexes in parental care, in contrast to last year's findings that females are more likely than males to abandon the nest. Bob's group also monitored chick growth and net energy expenditure through the use of ptilochronology. Combined with the 1991 and 1992 field seasons, Bob has accumulated measures of parental investment by age and sex for almost 200 nests. When the costs of raising young were experimentally elevated, parents showed no decline in nutritional condition compared to control birds, but treatment chicks were fed on fewer nights and grew more slowly than the chicks of unmanipulated parents. Faced with the burden of increased parental care, storm-petrels apparently shunted that cost to their offspring.

After 40 years of studying storm-petrels, Chuck Huntington outlasted Santiago, a male banded in 1961 when he was about four years old (the storm-petrel, that is; Chuck was about 41 years old at the time). Santiago failed to return in 1993, as did Ishmael, the oldest known-aged storm-petrel in the world. Banded as a chick in 1963, Ishmael returned to breed in his natal burrow from 1969 through 1992. Ishmael's widow re-paired with a new male in the same burrow in 1993. Chuck's former field assistants will be pleased to learn that the nest location information that was laboriously recopied onto index cards each year has been computerized. Nocturnal mist-netting of storm-petrels was very successful in 1993, as Chuck attracted the birds with recordings blasted from a powerful amplified speaker.

Matthias Starck (Universität Tübingen,

Tübingen, Germany) began his postdoctorate with Bob Ricklefs by visiting Kent Island for a study of endocrine development and cell proliferation in nestling storm-petrels using newly-developed immunohistochemical techniques.

• Herring Gulls

Debbie Jeffrey (Canadian Wildlife Service) returned to Kent Island for several days in July. Kent Island was selected as a "clean" reference site for a collaborative study of contaminant-induced mutations in Great Lakes Herring Gulls directed by Jim Quinn (McMaster University, Hamilton, Ontario), and Glen Fox (National Wildlife Research Centre, Hull, Quebec). Assisted by Azra Ali and Jan Neuman, Debbie collected blood samples from 25 pairs of Herring Gulls and their chicks. The samples will be used to perform multi-locus DNA fingerprinting to estimate the mutation rate in local populations as a function of food-chain contamination by polycyclic aromatic hydrocarbons. In addition, the study will compare the absolute measure of mutation rates to the results of a DNA strand breakage assay, which assesses DNA damage in individuals.

Nev Garrity (Canadian Wildlife Service) collected Herring Gull eggs again as part of a long-term investigation of seabirds as indicators of marine pollution. The Canadian Wildlife Service plans to compare carbon and nitrogen isotopes in the eggs of gulls breeding in Lake Ontario with those of Atlantic Canada.

• Savannah Sparrows

Assisted by Debbie Rudnick (Brown University '94), Corey Freeman (Cornell University) completed the second season of his PhD dissertation research on the effect of paternal care on male fitness. After months of difficult and often frustrating lab work, his multi-locus DNA fingerprinting has produced some extremely interesting results. Having fingerprinted all nestlings and both adults in 10 different nest-pairs (including first and second broods), Corey finds that the frequency of extra-pair fertilizations (EPFs or, in common parlance, cuckoldry) is nearly 70% in the first brood. Only 40% of the offspring in second broods are the product of EPFs. Intriguingly, females whose mates provided relatively little parental care to the first brood were more likely to be unfaithful during the second. Given that male parental care seems to have little effect on offspring survival, Corey suspects that paternal care is maintained by female choice through its effect on female fidelity rather than traditional direct fitness. Corey's other project deals with genetic differences between island and mainland sparrow populations. That provided a good excuse to visit Black's Harbour, Outer Wood Island, and Outer Green Island in order to take blood samples and measure birds. The genetic analysis is still incomplete, but morphological features prove to be significantly different between island and mainland populations, which suggests some degree of reproductive isolation. Between islands, however, there are no morphological differences and there are several documented cases of inter-island dispersal: while on Outer Green, Corey netted a Savannah Sparrow originally banded as a juvenile on Kent Island, and later we recaptured on Kent Island one of the juveniles he had banded on Outer Green.

I worked with Ralph Rynning ('94) on the population biology of Savannah Sparrows. During the frantic early part of the season, we were thankful to have Geoff Trussell's ('91) skilled nest-finding help. A big breakthrough for that project came when Bob Mauck designed a relational database. The computer program, which is similar to one Bob wrote for Chuck's voluminous data set, allows us to make sense of masses of information, locating individuals' relatives, determining lifetime reproductive success, etc. (I've been duly warned that, intoxicated by this new toy, I risk taking on the bad habit of driving my field assistants all day and keeping them up late at night to enter data.) The program uncovered one particularly interesting sparrow family tree: a grandfather, son, and grandson simultaneously defended south field territories, with two of them sharing the same mate between broods. We also discovered that one six-year-old female has so far fledged 23 offspring; the lifetime fecundity record for a single male is 39. Bob and I have begun to analyze dispersal distances between a bird's birthplace and its first nesting attempt (an average of about 200 meters for both males and females), and Ralph is quantifying territory size (50-5000 m^2, with a pronounced increase in size between a male's first and second breeding season). We attempted an experiment exchanging eggs between Savannah and Song Sparrow nests, but our sample sizes were low because the latter were maddeningly difficult to find, and nest predation rates were high. We discovered only late in the project that Song

Sparrows preferentially nest in white spruces early in the season and on the ground later on. Finally, we started a library of Savannah Sparrow recordings with the aim of measuring the heritability of vocalizations using new software developed by the Cornell Laboratory of Ornithology.

• Tree Swallows

Pete Johnston ('94) studied Tree Swallows for his honors thesis. Part of the project involves a collaborative study with Raleigh Robertson (Queens University, Kingston, Ontario), the authority on the species. Having already isolated the DNA from blood samples of 13 complete families, Pete will spend a week in Robertson's laboratory learning how to use DNA fingerprinting to determine paternity, which Pete will then relate to his observations of parental care and the frequency of non-territorial "floating" males. Tree Swallows were color-banded in 1993 to make it easier to identify males with particular nest boxes without having to capture them at the nest. Besides Merlins, which daily raided the colony in 1993, the main predators of Tree Swallows on Kent Island are Herring Gulls. Frustrated by newly designed roofs and wire guards which prevent them from perching on the swallow boxes, some gulls have turned to a new method of hunting their prey, waiting in ambush below the boxes and leaping to capture them out of the air. But the swallows gain at least some benefits by nesting among gulls. Gull feathers are used to insulate their nests, and some swallows weave the long white feathers into their own tails or wings and fly in a conspicuous display throughout the colony.

• Bird Populations

There were no extraordinary ornithological sightings in 1993. The most notable was a Eurasian Wigeon on Hay Island in early May. The daily presence of two Bald Eagles in the Three Island Harbor suggested that they may have bred on Hay; a pair definitely nested on nearby Outer Wood Island. Four Double-crested Cormorants nested unsuccessfully at the south end, losing all of their eggs to gull predation. Ralph recaptured a Black Guillemot that was at least 20 years old, the oldest known individual of its species. The annual woodland census revealed relatively high densities of Red-breasted Nuthatches, American Redstarts, Black-throated Green Warblers, Blackpolls, and Boreal Chickadees; other species, common in certain years, were rare (Parula Warblers) or absent (White-throated Sparrows, Eastern Wood Peewee).

• Insects

Monarchs were abundant in 1993 (in contrast to the previous year), whereas there were few red admirals and painted ladies. In addition to her other jobs as chef and carpenter's apprentice, Laurel Matey ('95) censused beetles in different habitats across the island and put together a useful reference collection which will soon be sent to the USDA Systematic Entomology Laboratory (SEL) for identification. The SEL recently completed the identification of most of the specimens collected by Justin Schuetz ('94) in 1992, as follows:

COLEOPTERA: Buprestidae: Chrysobothris sp.// Cantharidae spp.// Carabidae spp.// Coccinellidae: Anatis labiculata, Coccinella septempunctata// Cerambicidae: Callidium sp. prob. violaceum, Evodinus monticola, Stictoleptura canadensis// Chrysomelidae: Altica bimarginata, Syneta ferruginea// Elateridae: Limonius quercinus, Agriotes fucosus, Melanotus castanipes, Dalopius vagus, Ctenicera tarsalis, C. triundulata, C. appressa, C. resplendens, C. spinosa, Eanus maculipennis// Hydrophilidae spp.// Lampyridae spp.// Scarabaeidae spp.// Silphidae spp.// Staphylinidae spp.

DIPTERA: Bombyliidae: Villa fulviana// Calliphoridae: Calliphora vicina, C. terraenovae, Cynomya cadaverina, Lucilia illustris // Culicidae: Aedes vexans// Hippoboscidae: Ornithomya anchineuria// Sarcophagidae: Sarcophaga sp. near sarraceioides, Sarcophaginae sp. // Stratiomyidae: Stratiomys badia // Syrphidae: Platycheirus (Carposcalis) obscurus, Toxomerus geminatus, T. marginatus, Didea fuscipes Loew, Erizona (Megasyrphus) laxa , Eupeodes americanus, Melangyna umbellatarum, Meliscaeva cinctella,

Parasyrphus semiinterruptus, Sphacrophoria contiqua, S. sp., Syrphus torvus, Sericomyia chrysotoxoides, S. militarsis, Helophilus lapponicus, H. latifrons, Lejops (Polyontoenyua) curvipes, Eristalis anthophoria, E. arbustorum, E. dimidiata, E. flavipes, E. tenax, E. transversa, Tropidia quadrata, Xylota quadrimaculata // Tachinidae: Parchytas decisus, Cryptomeigenia sp.// Tephritidae: Paroxyna albiceps, Euleia fratria// Tipulidae: Dolichopeza americana, Ctenophora frontalis, Tipula (Pterelachisus) entomophthorae, T. (P.) trivittata, T. (Beringotipula) sp. near borealis, T. (Triplicitipula) triplex, Limonia tristigma, Limnophila rufibasis

HEMIPTERA: Acanthosomatidae: Elasmostethus cruciatus // Cydnidae: Sehirus cinctus albonotatus // Lygaeidae sp. // Miridae: Calocoris norvegicus, Megaloceroea recticornis, Orthops scutellatus// Pentatomidae sp.

HOMOPTERA: Aphalaridae: Aphalara sp. // Cercopidae: Philaenus spumarius, Neophilaenus lineatus // Cicadellidae: Agallia sp., Deltocephalinae sp., Evacanthus sp. // Delphacidae: Delphacodes pellucida // Psyllidae spp. // Psylloidea sp. // Triozidae: Trioza sp.

HYMENOPTERA: Formicidae: Formica glacialis, F. neorufibarbis, F. podzolica, Camponotus herculeanus, Lasius sp. // Pamphiliidae: Onycholyda nigritibialis, O. luteicornis // Tenthredinidae: Tenthredo verticalis

LEPIDOPTERA: Crambidae: Crambinae sp.

NEUROPTERA: Chrysopidae: Chrysopa oculata

ODONATA: Aeschnidae: Anax junius, Pantala hymenea, Libellula pulchella, Sympetrum internum, Leucorrhinia frigida, L. intacta // Coenagrionidae: Nehalennia irene, Enallagma boreale, E. hageni // Corduliidae: Tetrogoneuria spinigera

ORTHOPTERA: Acrididae: Melanoplus differentialis, M. sp., Gomphocerinae sp., Oedipodinae sp., Camnula pellucida // Rhaphidophoridae: Centhophilus sp.

TRICHOPTERA: Limnephilidae: Limnophilus ornatus, L. muestus

- Fungi and Lichens

During the September Ecology field trip to Kent Island, 20 species of mushrooms were collected and identified by John Cowden ('95), Ian Stewart ('95), and Andy Zink ('94), with assistance from Sam Ristich, an expert on the fungi of the northeast. On the same trip, Zoe Amos ('94) gathered 10 species of lichens and classified them with help from James and Patricia Hinds.

FUNGI Amanita porphyria, Cantharellus tubaeformis, Clavulina cinerea, C. cristata, Collybia sp., Coriolis versicolor, Cortinarius sp. (?), Fomitopsis pinicola, Gymnopilus sp. (?), Hydnum umbilicatum (repandum?), Lactarius deceptivus, Lycoperdon perlatum, Mycena sp. (?), Phellinus pini, Phylloporus rhodoxanthis, Pleurotus porrigens, Russula emetica, R. fragrantissima, R. sp., Tricholoma vaccinum

LICHENS Bryoria trichodes, Cladonia cholorophaea, C. squamosa, Hypnogymnia physodes, Parmelia sulcata, Platismatia glauca, Ramalina roesteri, Usnea subfloridiana, Xanthoria parietina, X. polycarpa

- Plant ecology

Tim Smith ('94) examined the pollination systems of four plant species, three blueberry relatives (Labrador tea, Ledum groenlandicum; rhodora, Rhododendron canadense; sheep-laurel, Kalmia angustifolia) and one orchid (one-leaf rein orchis, Habenaria obtusata). Island plant populations, if isolated from their normal mainland insect pollinators, might be expected to have relatively low fruit set. As a partial compensation

for "pollinator limitation," such plants may have evolved the ability to fertilize their ovules with their own pollen ("self-compatibility"). Tim tested both hypotheses with a series of hand-pollination and pollinator-exclusion experiments. Returning to count mature fruits in September, Tim discovered that, compared to natural pollination and self-pollination, hand pollination using pollen from a different plant tended to result in the highest fruit set. In rhodora, however, self-pollination was as effective as cross-pollination.

Daniel Smith (Harvard University '95, no relation to Tim) chose the common iris, larger blue flag, for his study of the timing of flowering in sunny and shaded habitats. He introduced us to an elegantly simple way to quantify light levels by placing small tight stacks of light sensitive photographic paper in different microhabitats. After several days, the paper stacks are developed; the depth of exposed sheets reflects a measure of light intensity. Iris flowers last 3.1 days on average, regardless of microhabitat. Preliminary observations suggested that reproductive ramets (that is, flowering shoots within a clone) suffered greater herbivory than non-flowering ramets, possibly because investments in reproduction diverted energy ordinarily used in defense against herbivores.

• Meteorology

Bob Cunningham reports that summer temperatures were normal in 1993, but precipitation in July and August was a record low. July had only 4.5 cm of rain, August only 1.1 cm. In the last 43 years, even the dry summer of 1939 had more rainfall in those months. Kent Island took on its brown fall hues prematurely. Fog was relatively uncommon and, interestingly, much less acidic than in recent years. Bob suspects that there may be a positive correlation between precipitation and local fog acidity, perhaps generated by biological activity. Working with Dick Jagels and Jobie Carlisle (University of Maine), Steve Beauchamp (Canadian Atmospheric Environmental Service, Bedford, Nova Scotia), and Roger Cox (Forest Canada, Fredericton, New Brunswick), Bob continued to monitor short-term changes in fog chemistry in an effort to relate "pollution plumes" to trajectories of air masses.

Kent Island Life

In early May, nine students from my advanced Ornithology class spent the weekend on Kent Island. We happened to hit an old-fashioned "migrant fall-out," as from out of the fog dropped scores of warblers, particularly Yellow-rumped and Blackpoll Warblers. Laboratory Instructor Tulle Frazer lead a few hearty souls for a dip in the 4.5° C water. That event started a swimming tradition which continued throughout the summer, culminating in late July in a midnight group plunge lit by bioluminescent marine organisms.

Various Bowdoin faculty made visits during the summer, including David and June Vail and Karin Dillman, bringing family, fresh fruit, news of the outside world, and, in Karin's case, a wonderful reading of the poems of Elizabeth Bishop. Physical Plant Director David Barbour returned with his wife, Barbara, to find the buildings in much better shape than during his last visit. Once again, there were birding tours led by Field Guides and Victor Emanuel Nature Tours, and a visit by the Grand Manan Nature Society. Other visitors included Wayne Guptill, who had brought Grand Manan high school groups out during the 1960s, Peter and Lisa Cunningham, Ginny Rynning, the Johnston family, and Dorcas Miller. Louise Huntington brought her violin and teamed up with Marko and Ian's guitars for some inspired concerts in the Club Dingleberry. Incidentally, Marko has caught the attention of the folk music world beyond Kent Island with a recording entitled "Up the Winding River" (Whistler's Music No. 9870, with Kevin McElroy and Sarah Bauhan). Cassettes ($10 US) and CDs ($15) are available from Mark at RR2 Box 98A, South Harpswell, ME 04079.

The social pinnacle of 1993, though, was an extraordinary picnic that brought together Myhron and Eunice Tate, virtually the entire Ingalls clan, Bob and Claire Cunningham -- in short, a collection of people whose association with Kent Island is measured not in years but in decades, and whose affection for and knowledge of the place run deep. Chuck's slides of Kent and Hay Islands taken in the 1950s capped a wonderful day, which ended with a group photograph on the wharf of the 40 of us.

For the final trip of the season, 15 Ecology students ventured to Kent Island for a field trip in mid-September, camping out in Oak Bay, New Brunswick, on the way. Crossing the Bay of Fundy we saw harbor porpoises, minke whales, a fin whale, terns, Razorbills, and peregrine falcons.

Ian Stewart and Laurel Matey were our "tag-team" cooks, alternating at two-week intervals.

Ian's speciality was vegetarian casseroles, Laurel's was Kent Island-style continental fare. At the annual 4th of July beach clean-up, the winning entry in multiple categories was a sculpture entitled "Susannah Kent's tanning salon." Our parting song was "I've got Lydex/for my itchy skin" (performed to the tune of "My Girl").

Addenda to the List of Publications from the Bowdoin Scientific Station

More than 115 articles have been published in peer-reviewed journals based on research on Kent Island. Those authored by students are indicated by asterisks. Numbers in parentheses represent Contribution Numbers from the Bowdoin Scientific Station.

Houghton, H.G. 1955. On the chemical composition of fog and cloud water. Journal of Meteorology 12: 355-357.

Dunn, E.H., and I.L. Brisbin, Jr. 1980. Age-specific changes in the major body components and caloric values of Herring Gull chicks. Condor 82: 398-401.

Jagels, R., J. Carlisle, R. Cunningham, S. Serreze, and P. Tsai. 1989. Impact of acid fog and ozone on coastal red spruce. Water, Air, and Soil Pollution 48: 193-208.

Jagels, R., J. Carlisle, C. Cronan, R. Cunningham, et al. 1987. Coastal red spruce health along an acidic fog/ozone gradient. Proceedings of the U.S./FRG research symposium: Effects of atmospheric pollution on the spruce-fir forests of the eastern U.S. and the Federal Republic of Germany. Pp. 229-233.

Wheelwright, N.T., and J.D. Rising. 1993. Savannah Sparrow (Passerculus sandwichensis). In The Birds of North America, No. 45 (A. Poole and F. Gill, eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union. (109)

* Wheelwright, N.T., and C.B. Schultz. Age and reproduction in Savannah sparrows and tree swallows. Journal of Animal Ecology 64. In press. (110)

* Wheelwright, N.T. , G.C. Trussell, J.P. Devine, and R. Anderson. Sexual dimorphism and population sex ratios in juvenile Savannah Sparrows. Journal of Field Ornithology. In press. (111)

R. E. Ricklefs and W. A. Schew. Foraging stochasticity and lipid accumulation by nestling petrels. Functional Ecology. In press. (112)

Mauck, R.A., and T.C. Grubb, Jr. Parent petrels shunt all experimentally-increased reproductive cost to their offspring. Animal Behavior. In review. (117)

As part of the College's Bicentennial, the Bowdoin Alumni Science Symposium will be held March 4 and 5, 1994 in Brunswick. If you are interested in delivering a 20-minute research presentation or participating in other ways in the celebration, please contact the Bicentennial Committee, Bowdoin College (207-725-3038).

Nathaniel T. Wheelwright
Director, Bowdoin Scientific Station
December 22, 1993

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Kent Island Cards

Justin Schuetz's ('94) dramatic black-and-white photographs of Kent Island have been made into 4 1/2 x 6 inch cards that are blank on the inside. If you would like to buy one or more sets of 12 cards depicting four different scenes (pictured on the last page of this report), please send $4 US for each set to: Bowdoin Scientific Station, Dept. of Biology, Bowdoin College, Brunswick, ME 04011.

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Kent Island cards (set of 12: $4; see p. 7)