

BOWDOIN COLLEGE

BOWDOIN SCIENTIFIC STATION

BRUNSWICK, MAINE 04011

1994 Annual Report

Since the Last Annual Report

The Annual Report of the Bowdoin Scientific Station first appeared in 1934, but this is undoubtedly the first time that it has been composed on a laptop computer in southern Africa. Thanks to a Fulbright Lecturing and Research Fellowship, I am spending the year at the University of Botswana in Gaborone. Recent Kent Islanders will remember heated philosophical debates around the dinner table about the classiest way to die: peacefully rusting in a rocking chair on the back porch, or (as I argued) going out with all neurons firing, "mano a mano" with a lion. Well, after a 200-kilogram lion shook our thin-walled tent in the Kalahari Desert last month with a roar of terrifying hugeness and a blast of meaty breath, I confess that I am rethinking my position.

Oddly, the feeling that night of being totally at the mercy of nature untamed made me recall an instance or two when we got caught in rough water in the inadequately equipped whaler off Kent Island. Now, in the second year of a National Science Foundation grant to the Bowdoin Scientific Station, our new boat, the *Ernest Joy*, has additional safety gear. With radar supplementing our other navigational equipment, we can cross the Bay of Fundy safely under a wide range of weather conditions, although we still depend on Russell Ingalls and the *Misty Maid* to carry large groups or heavy loads, or to venture out during storms. To land on islands and ledges in the Grand Manan archipelago, we purchased a nine-foot inflatable raft. Our 30-year-old skiff, the *Streaker*, had aged to the point where we could no longer delay replacing it, so we commissioned Mark Murray ('76) to design and build a custom craft, an elegant 16-foot high-sided wooden boat which we call *Susannah Kent*, in honor of John Kent's wife, who outlived her husband by three decades (and, according to some, still wanders the island). The grant also provided solar panels, storage batteries, regulators, and an inverter to produce electricity for the lower lab by the basin, which we are upgrading to facilitate research in marine biology. Other purchases included a hot, six-burner commercial stove and a trailer for hauling supplies from Brunswick.

A grant from the New England Consortium for Undergraduate Science Education (NECUSE) supported two non-Bowdoin students at the Bowdoin Scientific Station in 1994. Devavani Chatterjea (Mt. Holyoke College, '96) worked with Corey Freeman ('91) on his PhD dissertation research project on paternal care in Savannah Sparrows. Pamela Yeh (Harvard University, '96) assisted Chuck Huntington on his study of Leach's Storm-Petrels while carrying out her own research on the breeding biology of Black Guillemots.

The Summer of 1994

Mark Murray and Russell Ingalls put in another productive summer as the station's caretakers. Besides outfitting and tending the boats, piloting the *Ernest Joy* weekly to Grand Manan to fetch supplies and visitors, and installing the lower lab's photovoltaic system, Mark rebuilt two more sections of the wharf with the assistance of his apprentice, Andy Zink ('94). In the Captain Gillett, a double-door facing the basin was cut and a ramp was added to make use of the building for boat storage and maintenance. During a winter gale, "Fog Heaven," Bob Cunningham's weather hut, had literally exploded from the fierce winds and scudded out of sight across the south field, leaving just a chair standing behind, so Mark built a handsome, sturdy replacement at the same site. The new 6 x 6 foot cedar-shingled building houses the station's meteorological data logger and even a bed for Bob. Russell and his family, particularly his father, Junior, and his uncles, Howard and Jack, transported students, researchers and visitors back and forth, took us out fishing on several occasions, and watched over the island and its occupants throughout the year.

On the 5th of June, we received a majestic visitor to Kent Island, one that recalled the voyages of Admiral MacMillan sixty years ago. Propelled by a jib, two stay sails, two high sails, and a main sail, the 125-foot *Westward* glided out of the fog like a pirate schooner and anchored for a night just north of the Moustache. Its skipper, Phil Sacks, piloting 22 Sea Education Association college students from Nova Scotia to Massachusetts, had arranged a stopover at Kent

Island. In exchange for giving them a tour ashore, we were treated to a barbecue on board and a short sail in the magnificent vessel. Bob Cunningham joined the ship's faculty for the trip between Grand Manan and Woods Hole, during which he taught meteorology while the boat fought 40-knot winds.

Research in 1994

• Leach's Storm-Petrels

Chuck Huntington added another year to his long-term population study of Leach's Storm-Petrels. In this, the 41st year of his study, he and Pamela filled in some of the few remaining gaps in his knowledge of the biology of the species in preparation for completing a monograph which will be published in the American Ornithologists' Union's The Birds of North America series. Chuck's co-author on that paper, Bob Mauck (Ohio State University), finished the fourth and final field season of his PhD dissertation research on Leach's Storm-Petrels. In August Bob and Chuck, together with Tom Grubb, Jr., presented a joint poster entitled "Sex-specific reproductive effort in Leach's Storm-Petrel (*Oceanodroma leucorhoa*)" at the International Ornithological Congress in Vienna, Austria. The Congress provided an excuse for a Kent Island reunion attended by Glen Woolfenden, Bob Ricklefs, Sandy Gaunt, Helmut Mueller, Jamie Smith, and other alumni/ae of the field station. After so many years of study, Chuck finds few surprises among Kent Island's storm-petrels, but a pleasant one this year involved Santiago, the "old man of the sea." It turns out that Santiago's obituary in the 1993 Annual Report was premature. Santiago, first mist-netted and banded in 1961 on Petrel Path, probably while breeding (and therefore at least four years old), was not seen in 1993 and was presumed missing in action. However, he reappeared in 1994. Over the course of his long life, Santiago has fledged at least 24 chicks.

• Herring Gulls

Debbie Jeffrey (Canadian Wildlife Service) returned in 1994 to gather additional data for a study of the effect of environmental pollutants on mutation rates in Herring Gulls directed by Glen Fox (National Wildlife Research Centre, Hull, Quebec) and Jim Quinn (McMaster University, Hamilton, Ontario). With the assistance of several McMaster students, she collected blood

samples from 20 Herring Gull pairs and their chicks. The results of multi-locus DNA fingerprinting conducted last year suggested that mutation rates (as evidenced by the frequency of novel bands among chicks) on Kent Island are significantly lower than in three Great Lakes gull populations exposed to contamination by polycyclic aromatic hydrocarbons.

Although it was hardly a rigorous study, we gathered informal observations about diet and digestion in gulls. In mid-June, gulls supplemented their normal catholic diet of marine animals, Savannah Sparrow eggs, and ground and click beetles with an unusual behavior. Taking advantage of dense midge mating swarms, the gulls snapped copulating pairs out of the air by the dozens. Donnair was less popular. We tried to resuscitate a sickly gull by feeding it the New Brunswick specialty. It ate some but then died, confirming our worst suspicions about the meat. Corey monitored defecation rates throughout the summer, using his sweatshirt as a sampling quadrat. Andy must have set a record by leaving the island unscathed by a single gull dropping.

• Savannah Sparrows

With Devavani's assistance, Corey Freeman (Cornell University) added a third year of data to his PhD dissertation research on the evolution of paternal care in Savannah Sparrows. His DNA fingerprinting continues to show a high frequency of extra-pair fertilizations (EPFs), with females apparently rewarding males who care for the first brood with increased fidelity during the second. Some females, however, have a short memory, are constrained in their choice of mates, or are quick to forgive: a female whose mate had been removed and held in an aviary early the previous year, unable to help out with either brood, nonetheless paired with him again in 1994. To test his hypothesis about female fidelity, Corey attempted experimentally to reduce male parental care by trimming their flight feathers. With elevated flight costs, he reasoned, males would not be able to feed young as frequently, which would allow an experimental evaluation of the relationship between paternal care and the proportion of offspring actually sired by the resident male. However, he and Devavani found that "handicapped" males fed and sang at rates comparable to those of control males. Corey is also investigating the population genetics of the species. Using DNA fingerprinting, he has uncovered surprisingly large genetic differences between populations

separated by relatively short distances. For instance, birds from the Green Islands a mere three kilometers away, are genetically distinct. Such a finding is consistent with Bob Mauck's and my discovery that the median dispersal distance between a sparrow's natal nest and its first nest as a one-year-old is only about 200 meters.

Brooke McKnight ('94) was my field assistant during the eighth year of my study of the population dynamics and behavioral ecology of Savannah Sparrows. The aims of the study are to understand the "fabric" of an animal population under natural conditions: patterns of dispersal and "philopatry," or site-faithfulness; the relationship between reproductive success and behaviors such as mate, food or habitat choice; longevity and age-specific fecundity; and fluctuations in population size between years. The study has finally lasted long enough to start to shed light on the demography of the population. Of more than 3000 sparrows banded on Kent Island, only four have lived to the age of seven years, and one of those returned lame from spring migration and quickly disappeared. These results call into question the dogma of "age-independent mortality" in birds. In 1994 we began to look more closely at song in Savannah Sparrows, in collaboration with Don Kroodsma, a University of Massachusetts-Amherst professor (who, incidentally, was inspired to choose his career because of a Bowdoin graduate, the renowned ornithologist Olin Pettingill, '30) and Jamie Smith, a professor, at the University of British Columbia. Don is well-known for his work on song-learning and repertoire diversity in a variety of bird species, and Jamie for his long-term study of Song Sparrows on an island off the coast of Vancouver. Compared to mainland populations, Kent Island birds have a dramatic predawn chorus. Birds started to sing at 0440, more than an hour before sunrise, during which they sang about 8 songs/minute, but by 0515 most birds had eased singing. During the rest of the day, singing was sporadic and unpredictable. Following up on the study, Brooke found substantial variation between individual males and between reproductive phases. Song rates were highest when females were receptive (during egg-laying and incubation), and diminished sharply when males were busy feeding nestlings and fledglings. Males appeared to direct their song to their mates as the females approached the nest to begin incubation; males also sang briefly after feeding young, as if to call attention to the quality of their parental care.

This year we tried another experiment to

combat the infamous Kent Island hand rash, which we think is caused by trematodes present in Savannah Sparrow feces or on their feathers. For the first time, those who wore latex gloves while handling birds through mid-June escaped the rash completely. Those who didn't....

• Tree Swallows

For Tree Swallows on Kent Island, 1994 was not a good year. A female Merlin hunted the colony daily: we witnessed at least six kills. Other Tree Swallows were last seen in gull castings. Nonetheless, as of late June, 37 of 100 boxes had active nests, 34 of them with nestlings. But in early July, after three days of thick fog which happened to coincide with a trough in the bimodal midge population cycle, the entire colony abandoned their nests and disappeared. The sky over the island was eerily vacant for the rest of the summer. Not one Tree Swallow fledged from Kent Island in 1994. Bank Swallows and, to a lesser degree, Cliff Swallows, faced a similar fate. Only Barn Swallows rode out the harsh weather, presumably because their preferred diet, flies larger than midges, were available during the worst of the weather. Deprived of Tree Swallows, the merlin turned to Barn Swallows and brazenly entered their breeding colony above the shop to capture nesting birds. Mosquitoes were noticeably more common in 1994, perhaps due to the scarcity of predatory swallows.

The total reproductive failure of the Tree Swallow colony forced Dan Harrington ('95) to modify his honors thesis research, which was designed to test a prediction of life history theory, namely that older swallows should behave more "altruistically," as measured by their nest defense against model predators. Dan managed to collect observations of Tree Swallows during the incubation period, then switched to Savannah Sparrows during July. Although he found behavioral differences between the sexes, there was no obvious increase in nest defense with age in either Tree Swallows or Savannah Sparrows. One of the model predators that Dan used was a life-like rubber snake. Intriguingly, neither the sparrows nor the swallows showed any fear of the snake, perhaps because birds on Kent Island have never been exposed to snakes during the breeding season. (Alternatively, birds may react to snakes more because of their movement than their shape or coloration.) In his spare time, Dan organized the field station's insect collection, which for flies alone includes more than 300 identified specimens representing 89 species and

30 families.

- Bird Populations

Red-breasted Nuthatches and Boreal Chickadees, common in last year's annual woodland census, were scarce in 1994, while American Redstarts, Black-throated Green Warblers, and Blackpolls were as abundant as ever. In general, the number of individual breeding forest birds was high but the species diversity was low. The only unusual avian visitor recorded in 1994 was a Grasshopper Sparrow captured in a mist-net in mid-May. En route to Machias Seal, where we visited the breeding colonies of Common Puffins, Razorbills, and Arctic and Common Terns, we noticed much larger numbers of Sooty and Manx Shearwaters than normal. No Double-crested Cormorants attempted to breed on Kent Island, but many young fledged from a colony of about 45 nests on nearby Inner Green Island. This year in late July, after a disastrous shorebird migration a year ago, Semipalmated Sandpipers, Semipalmated Plovers, Short-billed Dowitchers, and Ruddy Turnstones passed through in flocks numbering in the thousands.

- Insects

Alex Wild ('95) undertook the challenge of investigating the ant fauna of Kent and nearby islands. On Kent Island alone he found 14 species of ants, whose tentative identifications are: *Camponotus herculeanus*, *C. novaeboracensis*, *Formica fusca*, *F. glacialis*, *F. neorufibarbis*, *F. podzolica*, *F. subnuda*, *Lasius pallitarsus*, *L. subumbratus* (?), *L. umbratus* (?), *Leptothorax muscorum*, *Myrmica emeryana*, *M. incompleta*, and *M. lobicornis*. Based on preliminary samples of ants on Sheep, Hay, Outer and Inner Green, West Green, and Grand Manan Islands, Alex noted a positive correlation between island size and ant species richness, as predicted by the theory of island biogeography, although habitat diversity was a possible confounding factor.

Among butterflies, monarchs and painted ladies were unusually abundant in 1994, whereas red admirals seemed less common.

- Marine Ecology

Glyn Sharp led a team from Fisheries and Oceans Canada to sample "canopy invertebrates" at Kent Island. To a terrestrial ecologist, that conjures up images of exploring tree tops for

insects and spiders, but Sharp's group aimed instead to learn more about the diversity of marine animals inhabiting the dense kelp stands in the subtidal zone as part of a larger project assessing the ecological importance of kelp "forests."

On July 7, three days after the annual beach clean-up, Alex stumbled upon an item on Kent Island's southwest shore which would have taken the honors in all categories on July 4: most artistic, biggest, most disgusting, and most valuable. It was a 12-meter-long male right whale, its skin completely worn off except for a rubbery black patch above one eye. Its exposed back muscles and relatively thin fat layer indicated that it may have been injured by a boat and subsequently starved. Once we anchored it to the shore by ropes around its jaw and tail, the reeking carcass attracted dozens of gulls and crows which crowded around to pick at the orange fat. John Wang, a McMaster University graduate student working at the Grand Manan Whale and Seabird Research Station, sampled tissues for biochemical analysis. As he left, he warned us that whale carcasses, insulated by a foot-thick layer of fat, quickly rot from the inside, build up pressure, and can actually explode. Fortunately, before Corey's study area was littered with whale fat, Don McAlpine and Tim Fletcher of the New Brunswick Museum appeared with flensing knives. Aided by Russell and several other brave volunteers, they reduced the "most glorious fish" to neat stacks of gigantic bones, which will one day be exhibited at the Provincial museum.

- Fungi and Lichens

Betsy Carter ('95) undertook the job of establishing a systematic photographic collection of Kent Island's fungi and lichens. The specimens are currently being identified, but they include a surprising diversity of mushrooms, mostly in the family Tricholomataceae, as well as some spectacular boletes, ruselas and amanitas.

- Plant ecology

Following up on Tim Smith's ('94) earlier work on rhodora (*Rhododendron canadense*), an ericaceous shrub whose flowers are pollinated mainly by bees and flies, Andy Zink ('94) found no evidence that rates of natural fruit set increased as spring advanced and insects became more abundant. Furthermore, the likelihood of accepting pollen from the same plant (autogamy) remained high and constant throughout the

flowering season. Andy documented an apparent "cost of reproduction" in one-leaf rein orchis (*Habenaria obtusata*): plants that had been hand-pollinated and forced to reproduce in 1993 tended to produce fewer flowers, shorter inflorescences, and smaller leaves in 1994. The main thrust of Andy's study was an experimental exploration of the ability of plants to set fruit in the absence of insects, which one might expect among island populations isolated from their normal mainland pollinators. Eleven of 16 species set fruit even when their inflorescences were shielded by insect netting; in eight of the species, fruit set in experimental plants was at least 80% as high as in controls. In blue flag (*Iris versicolor*), which Daniel Smith (Harvard '95) had studied in 1993, Andy described an unusual mechanism for self-fertilization. In flowers that were denied pollinators, the stigmas actually reflexed downwards to contact their own anthers.

Dominated by just five tree species (red spruce, white spruce, balsam fir, heart-leaf birch, mountain ash), Kent Island's forest is floristically and structurally simple compared to mainland forests. Its dynamics, on the other hand, are complicated by physical factors (fog, salt spray, high winds, low temperatures, shallow acidic soils), biological factors (spruce budmoth larvae, gulls, snowshoe hares), and human disturbance (logging and fires as recently as the 1940s). Jenna Barbour (Oberlin College '95) set out to understand the island's forest ecology by establishing nine 10m x 10m permanent plots representing different habitat types. In each plot she identified, labeled, measured, and mapped every tree. Using an increment borer to extract cores from trees, she estimated their ages based on annual growth rings. The oldest tree, a white spruce, was at least 120 years old. Most trees were 60-80 years old. To determine the impact of hares on forest regeneration, she set up replicate 1m² plots protected by wire fence. In half of the plots all vegetation was removed to compare seedling establishment on bare versus vegetated soil. Preliminary measurements of soil pH ranged from 3.9 to 4.7. Finally, Jenna described and mapped 35 habitat types around the island, recruiting her father, David Barbour, former Director of Bowdoin's Physical Plant, as her field assistant during his visit.

- Meteorology

Bob Cunningham continued his long-term research on Kent Island's climate, accumulating data around the clock with a data logger and sophisticated meteorological sensors in

collaboration with researchers from the University of Maine in Orono, Forest Canada in Fredericton, New Brunswick, and Canadian Atmospheric and Environmental Sciences in Halifax, Nova Scotia. Like Chuck, Bob is not easily surprised after so many years of research. Nonetheless, 1994 produced some unexpected weather. Thick fog enveloped the island on 52 summer days, 12 days more than average. In 48 years of observations, only 1967 had more fog, 63 days of it. Equally remarkable were the summer's record warm temperatures: June was 1.2°C higher than the 30-year average, July 2.6°C higher, and August 1.3°C higher. In late summer a nor'easter crossed the island, bringing 110-km/hr winds (134-km/hr winds were recorded at Gannet Rock). One night Bob's collectors netted five gallons of fog water, enough for chemical samples, cool drinks, and a bath. Typical fog pH values ranged from 3.6 to 4.3, although they occasionally dropped as low as 3.1.

- Geology

Bowdoin professor Art Hussey spent several days conducting a preliminary geological survey of Kent Island. All around the island's shore are granite outcrops dating from the Paleozoic and showing irregular fractures and alterations due to pressure generated by episodic volcanic eruptions. The bluish diabase dikes that cut across the granite may be related to Grand Manan's spectacular basalt cliffs, which date from the Triassic. Art pointed out that while many of the cobbles and boulders on Kent Island's beaches were transported by glaciers from formations as distant as St. George, New Brunswick, the angular granite rocks found on the beaches, and even many of the smooth ones, originated locally. The action of powerful waves and dramatic tides can apparently round rocks within as little time as a few decades.

Kent Island Life

The spring class expedition (May 11-14) combined students from two classes, my upper-level Evolution course and my nonmajors Ecology course. We spent our time mist-netting birds and exploring the island. During the trip Bob Cunningham showed off his legendary forecasting prowess. Scrutinizing the damp sky and the thermometer, which read a balmy 7.2°C (45°F), he was heard to mutter, "I think it's going to snow...." An hour later great white

flakes floated down, blanketing the island.

Rebecca Stanley orchestrated the planting of the best garden I've ever seen on Kent Island. The secret was to fertilize and mulch an area south of the dorm, plant in early May, and pamper the seedlings in a large cold frame until the beginning of June. We enjoyed unlimited mixed salad greens, broccoli, spinach, and even zucchinis by the end of July.

Bob Mauck brought with him a collapsible two-person kayak, a *Klepper Aerius*, which we put to good use. With Bob in the stern, I fulfilled a long-time ambition, to re-enact Ernest Joy's paddle from Kent Island to Seal Cove. (As a safety measure, we were escorted at a discrete distance -- by the *Ernest Joy*, appropriately enough.) With the help of a rising tide and gentle westerly wind, the trip took an hour and 40 minutes. After looking out at the Moustache (Eastern Ledges), wondering for years what was on it, a number of us had the opportunity to paddle there as well. Bob and Susie Mauck circumnavigated the island in the craft, a feat matched only by the dulse-picker who periodically pushed her luck by paddling her canoe around the island during the summer of 1986.

Betsy Carter, our cook for the summer, fed us wonderfully. Thanks to her connections in Brunswick's health food stores and to NAFTA, we were able to bring exotic supplies with us and ate more healthily and economically than ever. Like Alex Wild, she turned 21 on the island, and her parents, brother and sister came out to celebrate the rite of passage. Several visitors, including the Elsaessers, Louise Huntington, Choi Soo and Maeve Corish, and the Maucks, brought us music, fresh fruit, and an occasional *Time* magazine. Reading about the O.J. Simpson trial and other mainland "news" served to remind us how lucky we all were to spend the summer in the Bay of Fundy.

Promising that "the dock will rock," Corey hosted his third annual extravaganza at the wharf on the very night that a shower of comets collided with Jupiter. From somewhere, clean shirts, ties (Mark's made of orange plastic flagging), and evening dresses appeared. Andy read fortunes at "Bobby's Little Table of Wisdom." Pamela taught us how to hula, which inspired the end-of-the-season song cum dance, entitled (after the hula classic) "Little Brown Gal."

Seri Rudolph, teaching Ecology this year in my absence, led 11 students on a weekend field trip to Kent Island in mid-September. Despite fog and wind, the group established transects to estimate the abundance of intertidal organisms,

banded storm-petrel chicks, and explored the island before Mark Murray closed the station for the season.

Addenda to the List of Publications from the Bowdoin Scientific Station

At least 118 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.

* Wheelwright, N.T., and C.B. Schultz. Age and reproduction in Savannah sparrows and tree swallows. *Journal of Animal Ecology* 63: 686-702. (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* 65: 520-529. (111)

R. E. Ricklefs and W. A. Schew. Foraging stochasticity and lipid accumulation by nestling petrels. *Functional Ecology* 8: 159-170. (112)

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

Mauck, R.A., and T.C. Grubb, Jr. Monogamy in Leach's Storm-Petrels: DNA fingerprinting evidence. *Auk*. In press. (118)

Nathaniel T. Wheelwright
Director, Bowdoin Scientific Station

November 2, 1994
