

vance to archeologists, Quaternary geologists and geomorphologists. The treatment varies from reconnaissance survey to in-depth field and laboratory investigations. Better labelling of maps and figures, in places, would improve the book.

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The Common Tern. Its Breeding Biology and Social Behavior, J. Burger and M. Gochfeld, 1991. New York: Columbia University Press, xvii + 413p. \$65.00.

The Common Tern (*Sterna hirundo*) is unusual in that the populations of the northeastern United States have been treated monographically twice, 40 years apart. Thus, this modern text can be compared with the earlier treatment of R. S. Palmer (1941, A behavior study of the Common Tern., *Proc. Boston Soc. Natur. Hist.*, Vol. 42). This comparison permits an unusual perspective on intellectual progress in the field of natural history.

Palmer addressed the environmental "requirements" of Common Tern colony sites, and then presented a detailed descriptive account of tern behavior "during the breeding cycle." In the first section he addressed colony site requirements in terms of isolation from disturbance and predators, availability of food, and the condition of the substrate and vegetation. He also addressed influences of temperature and weather on colony siting, colonial associates (other birds nesting in and around tern colonies), kleptoparasites, and predators. The behavior section is arranged chronologically, from arrival at and occupancy of the colony site through courtship and bonding, nest establishment, incubation, hatching, and behavior of the young. Several more specific aspects of adult behavior (up flights, social attack, fishing, bathing, flocking and preening) are then treated outside the chronological framework.

Burger and Gochfeld also describe the breeding biology of Common Terns, but from the perspective of theoretical questions about the advantages and disadvantages of coloniality, and the costs and benefits of habitat shifts. They present a variety of graphical and numerical models to explain aspects of tern behavior. An introductory chapter

briefly describes terns as a group and as colonial species, reviews some of the theoretical literature on coloniality in birds, and gives a brief treatment of food and feeding behavior, with extensive reference to work done by a former student, Carl Safina. Chapter two describes study sites and methods.

The authors' results are presented in seven chapters. In chapter three they briefly review the breeding biology of Common Terns, touching on arrival, courtship, mating, egg-laying, incubation, the "chick stage," fledging, and post-fledging. A section on phenology follows, treating superficially the variation among colonies and years, and between salt-marsh and beach colonies. Next is a section on clutch size, followed by a very brief one on activity patterns, and then a more substantial one on synchrony, including the (Fraser) Darling effect. Habitat selection and territoriality are discussed in chapter four. Burger and Gochfeld examine habitat selection at two scales—colony site selection in the regional landscape, and nest site selection within the colony. Banding studies determined that Common Terns readily moved between beach and marsh colony sites. In general, if they returned to a beach colony where they had previously nested, they usually nested very near the same location in the colony, and if they moved, they were as likely to move to a different colony as to a distant part of the original colony. Nest site selection studies indicated that in marsh colonies terns tended to select wrack mats for nest sites, but also used other habitats. They often shared mats with Black Skimmers, and using experiments with artificial mats, the authors found that the tern nests were distributed differently on the mats in the presence versus absence of skimmers.

Aggressive behavior is treated in Chapter five. The authors document differences in frequency of aggressive interactions associated with crowding, with position within the colony (center vs. edge), with habitat structure, and with stage of the nesting cycle. The most interesting part of this chapter is the discussion of aggression from the perspective of frequency of intrusion. Chapter six covers predation, vigilance, and antipredator behavior. Burger and Gochfeld noted seven mammalian predators, and eleven avian predators. They also discussed depredation by ants, and noted mobbing of diamondback terrapins. They described the types and intensity of response to predators appearing at the colonies they observed,

and also conducted "experiments" involving the introduction of injured (nonflying) avian predators to colonies. Chapter seven deals with piracy (food stealing). The authors concentrated on avoidance behavior rather than behavior of the pirates. They developed models of fish availability to pirates, and provided extensive descriptions of piracy avoidance behavior.

Chapter eight discusses the effects of floods, heavy rains, and human disturbance on breeding success. Terns on supratidal portions of beaches and dunes, and on upland areas of islands nested in scrapes in the substrate, while terns nesting in saltmarshes sometimes build tall nests of grass to raise the eggs above high water. Human disturbance is rare in the salt-marsh colonies but can be frequent in the beach and dune colonies. The terns vigorously mob human intruders, and the authors suggest that "periodic reruns of (Hitchcock's motion picture) *The Birds* would contribute substantially to protecting tern colonies from human intrusion." In chapter nine the authors discuss reproductive success and colony dynamics. They note that the huge Common Tern colonies of the past have pretty much disappeared, and that tern populations now tend to be split into numerous small colonies.

Clearly, natural history has become much more quantitative over the last half century, and more concerned with scientific methodology. Palmer's text consists mostly of descriptions of behavior without direct reference to sample size, observational conditions, methods, hypotheses, or assumptions. His statistical analyses did not extend beyond the occasional reporting of averages. Burger and Gochfeld devote considerable space to hypotheses, explicit discussion of the adaptive values and costs of the behaviors they describe, data presentation, and a variety of statistical analyses. Even so, their work is not exhaustively quantitative by current standards: numerous conclusions are presented only by reference to figures and tables without statistical tests (Figures 4.5, 5.7, 5.10, 5.16, 5.17, 6.8, 6.12, 6.13, 7.6, 9.4, 9.5). Many of these figures are graphs showing means \pm one standard deviation: this presentation is a bit misleading, as these graphs resemble more typical displays of means with confidence intervals.

Burger and Gochfeld's book reads as if it was hastily written, with inadequate attention to organization. Some organizational problems are obvious (e.g. the two discussions in section 3.6 SYN-

CHRONY), while others are less definite: transitions are abrupt and sections seem out of place (e.g. "Turnstones in Colonies," pp. 180-182; and section 7.3). The subject index is poorly designed and mistakes in page numbers are so common that we wonder if parts of the book were repaged after the index was completed. In numerous cases the taxonomic index includes entries of Latin names of birds and other organisms but the listed pages mention these species only by English names, or merely group names (e.g. the index includes the entry "*Lamna nasus*, 249" but on p. 249 I find reference only to "sharks").

In a few places the logic also seems superficial and hasty. In section 4.2 Burger and Gochfeld reported Black Skimmers nesting on 24 of the islands in Barneget Bay, always accompanied by Common Terns (terns often nested without skimmers), and concluded "skimmers are strongly influenced by the presence of Common Terns, but not vice versa." We find this logic deficient, for alternatively, presence of skimmers could be one of several cues, individually sufficient to attract terns. In section 4.7 the authors note that territory size changes through the nesting season, with initially larger territories, decreasing to minimum size during incubation, and expanding during the chick phase (p. 114). They explain this adaptively, suggesting larger territories are needed in the chick phase to reduce piracy by neighbors, and trespassing by chicks. We find this argument unconvincing, as the density of a colony would be expected to follow this same pattern in the absence of any adaptive advantage: density increases (hence territory size decreases) through incubation because later nesters carve territories out of the interstices among the established birds, and territory size would be expected to increase subsequently, as soon as the rate of attrition of nests and broods exceeds the rate of arrival of new pairs to nest. We were also a little disappointed that they did not mention human exploitation of bait-fish stocks in their discussion of the disappearance of the huge colonies of the past (pp. 332-333).

Although Palmer's monograph is written in an undocumented expository manner that would be unacceptable for publication today, his results have weathered well, and the book remains a standard, widely-cited reference. It remains to be seen of course whether Burger and Gochfeld's effort will have similar lasting power. We are pessimistic on this point, for we find neither major new in-

sights into colonial bird biology, nor exemplary methodology to serve as a model for future studies.

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The Beaches are Moving, VCR tape available from Environmental Media, P.O. Box 1016 Chapel Hill, NC 27514 (Copyright NCPTV 1990). 60 min.

This videotape, prepared by Orrin H. Pilkey in conjunction with NCPTV in Chapel Hill, North Carolina, presents an interesting overview of man's attempt to live with beaches, particularly those associated with barrier islands. Pilkey focuses on natural environments and processes that are associated with these unique islands in the Carolinas and elsewhere along the northeastern coast of North America. From the prologue, it immediately becomes clear that barrier islands are dynamic shoreline features that respond in rather specific ways to storms, sea-level rise, longshore sediment supply, inlet formation and migration, as well as to human activity. Because these islands respond to a variety of factors, both natural and human induced, that can affect their dynamic stability, it is emphasized that great care and forethought is required to make effective human use of these habitats. Pilkey goes to great lengths to emphasize that early settlers in the Carolinas appreciated the fragile nature of these littoral barriers, especially their dynamic response to hurricanes and northeasters. Early inhabitants of these barrier islands, for example, learned to live on the backside (bay, lagoon or marsh side) of the islands, to build structures on stilts above flood or surge levels, or to construct dwellings in such a manner that they could easily be moved farther inland as conditions warranted.

This early appreciation and respect for barrier island "rollover" was gradually replaced by wanton disregard for 'lessons learned from the past' when developers and homeowners began to build on coastal dunes fronting the open sea. Instead of retreating landward as the barrier island moved

toward the coast, the new breed of islanders chose to fight the natural processes associated with shoreward island migration by constructing shore stabilization features, *e.g.* seawalls, revetments, groins, jetties, etc. The result of much of this coastal armoring was aesthetically displeasing when beaches and dunes eroded away and the protective structures themselves were degraded by wave activity. The process of creating fortified coasts composed of massive hard structures is sometimes referred to as "New Jerseyisation," named after sections of New Jersey's stabilized barrier island shoreline. Pilkey strives to emphasize the disadvantages of hard stabilization on barrier islands and actively encourages a shoreline management policy that features retreat, the landward removal of dwellings to barrier back-sides as the seashore erodes (transgresses shoreward).

The presentation of these points of view is entirely one-sided, in favor of a "do nothing" approach or construction of temporary dwellings that can be easily moved inland. The video is expertly prepared and masterfully executed by the star, Dr. O. H. Pilkey, James B. Duke Professor of Geology at Duke University in Durham. It is difficult to fault the videotape and unlikely, even unfair, that Pilkey should be chastised for honestly presenting his own views. As an instructional warning to the general public and a directed study for students (both undergraduate and graduate), this videotape merits attention. Pilkey is to be congratulated for a superb, first-class effort that will, no doubt, attract the attention of other researchers who deal with barrier-island processes, management, and policy. Can we look forward to a response which features alternative points of view? Representation of the other side of the coin would balance Pilkey's position.

In sum, Pilkey's tape is a masterful production that will be appreciated by a wide audience. As a teaching tool, it is heartily endorsed as thought-provoking, constructive, interesting, and entertaining.

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