Massachusetts
Tern and Piping Plover Handbook:

a manual for stewards

First Edition
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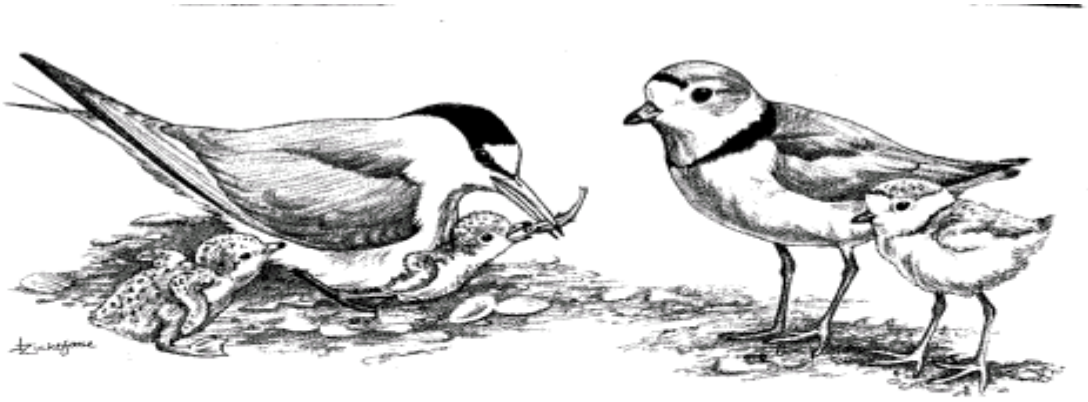
by

Bradford G. Blodget
State Ornithologist

and

Scott M. Melvin
Rare Species Zoologist



MASSACHUSETTS DIVISION OF FISHERIES AND WILDLIFE
Natural Heritage and Endangered Species Program
Field Headquarters, Route 135
Westborough, Massachusetts 01581-3337

Table of Contents

Chapter 1
Introduction

Welcome! We are extremely pleased to bring to fruition this handbook as a guide for tern and piping plover management here in Massachusetts. For the first time, down-to-earth practical information and technical guidance documents have been brought together in one manual to provide an information source for persons at all levels of involvement in tern and piping plover management.

In Massachusetts we share a rich natural heritage of coastal waterbirds, including terns and piping plovers. However, we know this heritage is extremely fragile and the outlook for these birds in Massachusetts has never been secure. Unrelenting increases in human pressure on coastal areas for residential and recreational uses presents all of us as scientists, landowners, managers and monitors with a formidable challenge. That challenge is to be responsible stewards of tern and plover populations in the Commonwealth and to do everything in our power to assure these resources continue to maintain their place in the coastal ecosystem.

As the network of tern and plover managers has grown over the last 20 years, our jobs have assumed added complexities with the passage of the federal and state endangered species acts and the addition of rare wetland wildlife as a consideration of the Massachusetts Wetlands Protection Act. The piping plover and roseate tern are listed by both the state and federal government as "Threatened" and "Endangered" species respectively. Our other 3 nesting tern species--the common, Arctic and least--are all listed as "Special Concern" species by the state.

We know, from what you--our cooperators and volunteers--have told us, that a manual of this type has been sorely needed. Management of terns and piping plovers in Massachusetts is undertaken by multiple organizations and agencies and by many seasonal, part-time employees. Information provided in this manual responds to many of the questions you have asked and provides guidance that we hope will make your tasks not only easier, but more enjoyable as well.

The intent of this manual is to improve communications in all aspects of tern and plover management and to foster implementation of good management practices at all sites. Our dual goals are to: 1) maximize the effectiveness and efficiency of management and 2) to maximize the precision and accuracy of monitoring.

The looseleaf format of this first "edition" manual was

selected with the intent of making it easier to periodically update. Issues surrounding tern and plover management in Massachusetts will continue to change and recommended conservation measures for terns and plovers will always be subject to revision as new information becomes available through research and ongoing management experience. We welcome your continued thoughts and suggestions for future "editions".

Acknowledgements

We would like to take this opportunity to thank the scores of cooperators from whom we have learned and who have contributed so much time, energy, creativity, and commitment to tern and plover conservation in Massachusetts. We would particularly like to extend our appreciation to the following individuals who critically reviewed key sections of the manual and shared with us their thoughts: Henry Barbour, Pat Bosco, Chris Dowd, Tom French, Scott Hecker, Kyle Jones, Laurie MacIvor, and Ian Nisbet. We are indebted to Matthew Burne for pen and ink artwork, Julie Zickefoose for the cover art, and to Jeanne Livingston for various word processing and editing assistance, production of graphs, and development of the tern and plover census forms.

Chapter 2
History and Overview of Tern and Piping Plover Management in Massachusetts

Terns

Historical In the Commonwealth of Massachusetts, laws regulating the taking of terns and plovers were enacted as early as 1886. Chapter 276 of the Acts of 1886 closed the hunting season on plovers from May 1 to July 15 and on terns from May 1 to October 1. Chapter 524 of the Acts of 1897 prohibited the use of feathers of protected birds for ornamental purposes. It appears that these early statutes were not particularly well-enforced.

The first efforts at formal protection and management of nesting colonial waterbirds, including terns, appear to have been undertaken about 1908 by the Commissioners of Fisheries and Game, a precursor agency of today's Division of Fisheries and Wildlife. These actions, carried out by game wardens and conservation agents, were initiated as a response to rising public concern about unregulated commercial hunting of nongame birds. Edward H. Forbush, State Ornithologist (1908-1929), was very active during this period--in concert with the efforts of many individuals and organizations throughout the nation--to secure stronger laws to protect wild birds.

These efforts culminated in the passage of the federal Migratory Bird Treaty Act of 1918. From that point onward into the early 1930's, efforts were initiated to enforce the new law--which was considered very novel at the time--by putting a stop to poaching of seabirds and shorebirds. Considerable effort, as evidenced by copies of old signs from the Division's archives, was directed at seabirds, including herring gulls, which were then considered "endangered species!" Starting in 1918, special deputies were appointed to guard the more important tern colonies, including North Beach, Simpson's Island (a former site in Pleasant Bay), Nauset, Monomoy, and Katama. It would appear these efforts peaked in 1919 and continued with somewhat diminished enthusiasm well into the 1920's. Details of these early efforts to census and manage the state's seabird colonies are contained in the Annual Reports of the Commissioners of Fisheries and Game.

Terns entered a period of great prosperity from about 1925 on through the 1940's. An extensive tern banding program on Cape Cod--principally at Tern Island, Chatham--was begun by C.B. Floyd in 1927. Floyd's early work was continued by Dr. Oliver L. Austin

from 1929 through 1956. Based in Wellfleet at the Austin Ornithological Research Station, Austin and his associates conducted a massive banding study of Cape Cod terns and at the same time directed efforts to protect and manage Cape Cod terns. Though limited in geographic extent, these efforts were quite involved and even included habitat management. Work was focused at Tern Island, which was disc harrowed annually to thin the vegetation for the benefit of common terns.

As the activities of the Austin Station waned in the 1950's, the Massachusetts Audubon Society assumed an increasing presence in the Cape Cod terneries and at Plymouth Beach, starting about 1954. Onward through the 1960's, the Society soldiered on alone, hiring seasonal wardens and attempting to protect the most important colonies. In 1967, the Society launched a pilot project that for the first time attempted to learn the numbers and distribution of all terneries in the state. Colonies of 50+ pairs were posted. Slowly and by degrees, annual efforts at censusing terns throughout the state became more rigorous and in 1972, for the first time, it became possible to hazard reasonably accurate estimates of the state's nesting tern populations.

When in 1968 it became apparent that the large gulls presented a serious menace to the state's terneries, the Society launched a program to check the gull population at important terneries. Alpha-chloralose was tested at Tern Island, Chatham and Ram Island, Mattapoisett. In 1969-70, the Society requested the assistance of the United States Fish & Wildlife Service and DRC-1339 gull toxicant was tested at Tern and Ram Islands.

Present (1977-1996) Starting in 1977, the Division--under the flag of its developing "nongame" program,--became more proactive in seabird management, exercising long-dormant statutory authorities. The Division and its Board recognized an important and increasingly important role that needed to be filled. The tasks of censusing and posting tern colonies along the coast were becoming larger and more complex, and, importantly, there were more cooperators involved. The Division assumed a coordinating role, encouraging and streamlining the efforts of numerous individuals and agencies.

More recently, the Division and the Department of Environmental Protection have assumed added responsibilities as a result of the passage of landmark legislation. Chapter 262 of the Acts of 1986 made fundamental changes in the way wildlife was treated under the state's Wetland Protection Act (MGL, Ch. 131, §40). For the first time, specific legal protection was afforded the habitat of terns and the piping plover. The Massachusetts Endangered Species Act (MGL, Ch. 131A) was signed into law in January, 1991 affording additional protection for terns and piping plovers and their habitat.

Piping Plover

Although there was some early official concern for the protection of plovers as evidenced by Ch. 276 of the Acts of 1886, the first really important efforts to protect piping plovers followed in the wake of the Migratory Bird Treaty Act of 1918 and were directed mainly at stopping poachers. However, no effort was made to census or manage piping plovers from historical times through the mid-1970's, when, as was the case with terns, many of their nesting sites were remote and transportation relatively primitive. Until relatively recently, management of piping plovers could be accurately characterized as "benign neglect."

As census and management efforts on behalf of terns increased, more information on plover numbers and productivity was collected from some sites. An early estimate of the Massachusetts plover population of 140 pairs was made in 1980 from data collected incidental to the annual tern census (Blodget, unpubl. file data).

During the early 1980's, suspicions grew that the piping plover was in trouble both in Massachusetts and elsewhere throughout North America. A meeting of concerned biologists hosted by The Nature Conservancy and the Division in Boston in March, 1984, highlighted the need for increased monitoring and management of this species. During the next few years the Division worked with cooperators throughout the state to develop a statewide program of population monitoring and management.

Listing of the piping plover as a "Threatened" species by the Division (1985) and the U.S. Fish and Wildlife Service (1986) especially helped to catalyze increasing census and protection efforts. Long-term studies of piping plover life history and demographics begun in the early or mid-1980's at places such as Sandy Neck (Barnstable), outer Cape Cod, Crane Beach (Ipswich) and Bristol County have provided essential information on which to base management decisions. Standardized surveys have estimated numbers of breeding pairs and reproductive success at most sites statewide since 1986. Efforts to protect breeding habitat, nests and chicks have steadily increased over the past 12 years, as have the number and diversity of cooperators involved in these efforts. In August each year, plover and tern cooperators gather for a day-long meeting to compile the year's census data and to review and discuss management issues.

Tern and piping plover census and protection activities overlap at many sites. In fact, nearly 75 percent of all piping plovers nest on beaches where least tern colonies occur. In 1989, in the interests of greater efficiency, the Division took steps to merge tern and plover census and management efforts under one

project. During the 1990 season, paid professionals and volunteers involved in tern and plover management contributed an estimated 2,000 person-days (A. Hecht, pers. comm.). In 1993, paid staff effort alone directed at piping plover management in Massachusetts was estimated at 2,900 person-days and total estimated expenditures approached a half million dollars (U.S. Fish and Wildlife Service 1995).

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Chapter 3
Population Trends

Breeding terns are difficult to count accurately or precisely. Apart from the difficulty of estimating large numbers of birds, the numbers of terns attached to any colony vary continuously throughout the season as pairs variously settle and relocate.

Trend information is further clouded by differences in observer methods and accuracy and, in the case of the larger terns, difficulties in differentiating between species in large mixed-species colonies. Historical estimates (pre-1970) reported in the literature for many sites vary wildly and there is virtually no way to ascertain their accuracy. Historical trend information offers, at best, a very general assessment of past abundance and distribution. Nisbet (1973) undertook an exhaustive review of historical estimates of tern abundance and distribution (pre-1973) and his analysis forms the basis for the following discussion.

Unlike terns, estimates of numbers of breeding plovers are relatively easy to ascertain. Unfortunately however, no disciplined efforts were made to gather accurate statewide data on abundance and distribution until the mid-1980's.

Estimated annual abundance of the four species of terns and the piping plover from 1970 through 1995 are shown in Table 3-1. Annual estimates for the black skimmer and laughing gull, which are censused in the same time windows as terns, are also shown in Table 3-1.

Common, Roseate, and Arctic Terns

Common Tern (Fig. 3-1). Data from the 19th Century are extremely fragmentary, but common terns were apparently quite abundant about 1850. In response to relentless human persecution, numbers plunged in the 1870's and 1880's. Only 3-4 sizable colonies survived during this period. At the low point, numbers were probably close to 5,000 pairs, but had recovered to near 10,000 pairs by 1896.

Under legal protection afforded by the Migratory Bird Treaty Act of 1918, numbers continued to increase, reaching 30-40,000 pairs by 1920. These numbers apparently were maintained through about 1935-40, after which numbers deteriorated, largely because various islands were occupied by gulls and the terns

systematically replaced. The low point was apparently reached in 1977 and 1978 (4,507 and 4,119 pairs respectively) when numbers dipped alarmingly to (or even below) the historical lows of the 1870-1890 period.

Since the 1977-78 lows, estimated numbers have rebounded slowly. Estimated numbers briefly exceeded the 10,000 pair level in 1989 (10,199 pairs), 1990 (10,226 pairs) and 1995 (10,323 pairs). The most recent 10-year (1986-1995) mean is 9,347 pairs (range=7,643-10,323) at an average of 30 stations (range=20-36).

Trends in common tern abundance and distribution since 1900 have been influenced by increased legal protection, offset by natural erosion and loss of nesting islands, usurpation of nesting islands by large gulls and heightened predation.

Roseate Tern (Fig. 3-2). Although available data are vague, persecution of terns in the late 19th Century likely depressed the population of roseate terns to the 2,000 pair level. In the first half of the 20th Century numbers increased, reaching a high point of about 5,000 pairs in the 1930-1940 period. Thereafter, numbers slowly declined, reaching very low levels in 1977 (1,322 pairs) and 1994 (1,339). Over the last quarter century (1971-95) numbers have, in fact, fluctuated in a rather narrow range (1,322 to 2,300 pairs) averaging 1,669 pairs. Numbers have not exceeded the 2,000 pair level since 1979.

The roseate tern is more specialized and is much more locally distributed than the common tern. However, nesting groups are invariably embedded within common tern colonies. In the 20th Century, significant nesting groups (50+ pairs) have been recorded at only 12 stations, only 2 of which--Bird and Ram Islands in Buzzards Bay--were occupied in 1995 and contained about 98% of the birds.

Trends in roseate tern abundance and distribution since 1900 have been influenced by increased legal protection offset by the loss of nesting stations due to natural erosion, usurpation of nesting stations by large gulls and heightened predation. The long-term declining trend in the roseate tern's abundance in the Northeast generally, extremely low numbers, and an increasingly restricted distribution were all factors leading to federal and state listing of the roseate tern as "Endangered" in 1987.

Trends toward lower abundance and increasingly restricted distribution have occurred in spite of consistently high productivity reported from most of the major roseate tern colonies. The reasons for this seeming paradox are poorly understood, but seem to be related to high juvenile mortality resulting from predation, storms, and likely unknown factors.

Arctic Tern (Fig. 3-3). Massachusetts lies at the extreme southern fringe of the extensive global range of this species. The difficulty of distinguishing Arctic terns within large heterogeneous colonies makes historical information scant, even doubtful. Arctic terns seem to have declined, along with the preceding species, to a low point around 1890. A gradual increase occurred during the first half of the 20th century evidenced by estimates of 250 pairs in 1937-38 and a peak estimate of 400 pairs around 1945-47.

Estimated pairs declined thereafter, to about 250 pairs in 1954 and 110 pairs in 1968-72. A steady decline has continued to the present, with only a trace population of 4 pairs remaining in 1995. The 10-year mean (1986-95) is 14 pairs (range=4-29) at an average of 4 stations (range=2-6).

The Arctic tern's fortunes in Massachusetts appear to have

benefitted from increased legal protection in the first half of the century. However, the various benefits increased posting and protection of colonies have brought to other species of terns in the last 25 years do not seem to have had a corresponding benefit to the Arctic tern. The actual factors controlling the southern limit of the range of the Arctic tern are not well understood and hence it has been difficult to effect management to increase this peripheral population. The relatively small, isolated Arctic tern population in Massachusetts may be relatively more sensitive to heightened predation and other stochastic events. Classically, such small populations have less resilience to limiting factors and low probabilities of persistence.

Least Tern

More than other species of terns, least tern numbers probably vary over time in response to cycles of storms and overwash along barrier beaches. Least terns were probably abundant, at least at certain times in the 19th Century, but precise data are lacking. It is clear that least terns suffered from human persecution in the late 19th Century and that estimated numbers fell as low as 100-300 pairs in the 1900-1920 period.

Under strict protection, numbers slowly rebuilt to 1,500 pairs by 1950, but then declined again to 800-1,000 pairs by 1970-75, possibly as a consequence of increased recreational use of beaches. Thereafter, in response to storm-related improvement in habitat conditions and increasingly aggressive protection of nesting grounds, numbers rebounded markedly. Estimated numbers exceeded the 2,000 pair level for the first time in 1980 and reached 2,756 pairs in 1995 (Fig. 3-4).

The least tern, nesting as it does along mainland beaches and

barrier beaches, is the most widespread nesting tern in Massachusetts. The 10-year mean (1986-95) is 2,487 pairs (range=2,109 to 2,756) at an average of 46 sites (range=41-57).

Piping Plover

Although little historical information is available, several lines of evidence suggest that prior to European settlement, the piping plover may have been a common nester wherever suitable sandy beach and dune habitat was available throughout coastal Massachusetts. In his description of piping plovers along the Atlantic Coast, Audubon (1840) states that in suitable habitat, "many pairs may be found, with nests thirty to forty yards apart". Townsend (1920) describes the piping plover during the 1860's and 70's as "breeding very plentifully in the Ipswich sandhills" (Crane Beach). Shorebird gunning in the late 19th and early 20th centuries likely reduced numbers, but to what extent is conjectural. Numbers recovered after protection was afforded by the Migratory Bird Treaty Act of 1918.

The first comprehensive statewide surveys, conducted during the mid-1980's, revealed a statewide population of between 126 and 140 pairs. Comparison of these data with several site-specific censuses conducted during the 1970's suggested that numbers at these sites had declined by 50-100 percent.

After a decade of intensive management, piping plover numbers have rapidly increased in Massachusetts, from a low of 126 pairs in 1987 to the 1995 estimate of 441 pairs (Fig. 3-5). Throughout the state, we are seeing increasing densities of nesting plovers and colonization of nearly every beach where suitable habitat is available and levels of human disturbance and predators/competitors are tolerable. Increasingly, pairs are observed nesting ≤100 yards apart in all types of habitat, lending support to the suggestion that historically this was a relatively common and widely distributed breeding bird all along the Massachusetts coast.

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Table 3-1. Estimated numbers of pairs of four species of terns, black skimmer, laughing gull and piping plover nesting in Massachusetts, 1970-1995.

Year	LETE	COTE	ARTE	ROST	BLSK	LAGU	PIPL
1970	n/a	9,000	80	2,200	0	200	n/a
1971	n/a	8,310	75	2,045	0	n/a	n/a
1972	950	7,500	105	2,300	0	135	n/a
1973	n/a	n/a	n/a	n/a	0	n/a	n/a
1974	1,000	5,600	45	1,700	0	n/a	n/a
1975	800	4,900	52	1,400	0	n/a	n/a
1976	1,450	5,650	66	1,400	0	n/a	n/a
1977	1,383	4,507	31	1,322	0	200	n/a
1978	1,434	4,119	53	1,609	0	n/a	n/a
1979	1,734	6,168	45	2,023	0	500	n/a
1980	2,040	7,299	39	1,868	0	800	n/a
1981	1,856	5,625	31	1,851	0	1,000	n/a
1982	1,812	7,577	23	1,986	0	602	n/a
1983	2,112	7,909	17	1,502	0	930	n/a
1984	2,415	6,953	16	1,820	3	1,054	n/a
1985	2,338	7,548	16	1,618	1	768	n/a
1986	2,306	7,643	24	1,746	4	542	139
1987	2,109	8,869	29	1,697	4	1,278	126
1988	2,681	9,533	17	1,657	2	1,129	134
1989	2,233	10,199	15	1,576	1	1,356	137
1990	2,546	10,226	21	1,585	4	1,073	140
1991	2,356	9,835	11	1,776	5	1,285	160
1992	2,642	8,601	8	1,412	6	943	213
1993	2,622	8,957	7	1,355	3	885	289
1994	2,617	9,288	5	1,339	5	864	352
1995	2,756	10,323	4	1,480	5	828	441

Chapter 4
Natural History

In this chapter, brief synopses of the life histories of terns and piping plovers in Massachusetts are presented. Only the briefest of descriptions for field identification purposes are included, as many excellent field guides to birds are readily available. Numerous published natural history materials for terns and piping plovers exist and a selection of these are suggested at the end of the chapter for further reading.

Common, Roseate, and Arctic Terns

Common Tern The common tern (Sterna hirundo) is a light gray and white colored, medium-sized (14½") seabird, which, during the nesting season, has a black cap and a black-tipped reddish-orange bill. Legs of breeding adults are orange. The familiar call of the common tern is a drawn-out "*Kee-arrrr*".

This seabird breeds over a broad area of northern interior North America from Alberta to Newfoundland, southward to the Great Lakes area and southward locally along the Atlantic Seaboard to North Carolina. It also nests at a few stations further southward and in the Old World. In Massachusetts, the common tern is indeed the commonest of our four species of nesting terns.

Common terns prefer to establish colonies on offshore islands, both rocky islands and sandy barrier islands, but also nest in dunes at remote tips of barrier beaches. Unfortunately for these terns, most of the optimal offshore nesting stations were gradually usurped by gulls from the 1950's onward. As a result, the terns have been forced to settle in a limited number of suboptimal inshore sites that are more exposed to disturbance by a variety of factors including human activity and a host of land-based predators.

This species nests on rocky substrate with scant vegetation, or, more frequently in Massachusetts, sandy dune areas with moderate stands of beach grass and other dune vegetation. They also nest on cobble beaches, deposits of sandy dredged material, on small raised areas in salt marshes comprised of sand, rock or matted vegetation and sometimes, usually where no natural sites remain, on artificial structures such as old wooden docks or piers.

Birds arrive from the south in early May. Colony sites are selected by the end of May. An elaborate and highly ritualized

courtship including aerial displays, body posturing and fish offerings eventually lead to the formation of pairs and copulation. This activity spills over onto the rocky shore or the sandy beaches and flats about the colony site. Pairs do not mate for life, but remate each year. Colonies range from just a few to 4,000 or more pairs. Adults in colonies rise in mutual defense to aggressively mob, strike on the head and defecate upon intruders.

Nests are crude assemblages of grasses placed along crevices in the rocks or shallow "scrapes" in the sand often lined with beach grass and seaweed. Clutches of 2 to 3 brownish-olive eggs are produced. In Massachusetts, egg dates are May 4 to August 15. Nesting activity usually peaks around the time of first hatch in mid-June. Both parents share incubation duties for a term of 23-27 days. Common terns are single-brooded. Young seek the shade of vegetation and are brooded by the adults. Although precocial, young are completely dependent on adults for food. Diet is almost exclusively small fish, which in Massachusetts includes sand launce (Ammodytes americanus), menhaden (Brevoortia tyrannus) and alewives (Alosa pseudoharengus) as important components. Adults commute up to 12-15 miles to favorite fishing grounds. Birds hunt by hovering over the water and plunging suddenly downward to surprise and seize small fish with their bills.

As the young grow, they run progressively further and further away from the shelter of dune vegetation. The bare sandy berm areas proximate to dune colonies assume importance as rearing or nursery areas for the young. Some of these nursery areas may contain thousands of young, which are sought-out and tended by their parents. Young fledge at about 28 days, but continue to be highly dependent on adults for food as their fishing skills take time and practice to develop. Most young have fledged by mid-August. Adults and young gather on "staging areas", where birds build body reserves and the young continue to practice fishing skills prior to departure for winter quarters. Most birds have departed southward by mid-September, although stragglers may be seen into mid-December. The wintering grounds include the Atlantic Coast from South Carolina southward throughout the Caribbean to northern Ecuador and Brazil.

Roseate Tern The roseate tern (S. dougallii) is a medium-sized (15½") seabird, that is overall a very white-appearing, black-capped tern with a very light gray mantle. Adults have a subtle pinkish cast on the breast, sometimes visible in strong light, and a notably long, deeply forked tail. The bill of a breeding adult is mostly black, but with a variable amount of red at the base; however, after June, the bill becomes reddish-orange with a black tip in many individuals, resembling that of the common tern. The legs are bright orange. The diagnostic call most often heard is "*chi-vee*". The alarm note, a rasping "*zaaaaaaap*" likened to the sound of tearing cloth, is also heard.

The roseate tern has a fragmented global distribution with important metapopulations in northeastern North America, the Caribbean, northwestern Europe, West Africa, East Africa and Madagascar, the Indian Ocean, the Philippines and northern Australia. In North America, breeding is currently restricted to just a handful of stations from Nova Scotia and Maine southward to Long Island, New York. The species' extremely restricted range coupled with declining numbers in the Northeast led to the listing of the northeastern population as "Endangered" by both the Division and the U.S. Fish and Wildlife Service in 1987.

Roseate terns feed mainly on fish, which are captured by diving forcibly into the water. Roseates hover less and dive from greater heights than the common tern. Sand launce (Ammodytes americanus) are the dietary staple, with fewer Clupeidae and other fish taken as available. They may also glean small invertebrates from the surface of the water.

Nesting groups of roseates are invariably found embedded within large common tern colonies, usually on islands but sometimes at the ends of long barrier beaches. Habitat usually is characterized by either very dense vegetation or jumbled rocks. Heavily man-altered substrates such as rip-rap and heavily vegetated spoil banks may also be utilized. Roseate nest sites are notably better concealed than those of other species and are usually "roofed", that is, hidden under debris, in rock cavities or

Fig. 4-1. A roseate tern incubating inside a nest box. Boxes are built to measure

approximately 8x6x3½".

"tunneled under" very dense vegetation. Roseates also readily accept "nest boxes" (Fig. 4-1). Actual nests are very shallow scrapes, unlined or scantily-lined with a few pieces of vegetation.

Egg dates reported in Massachusetts are May 12 to August 18. Clutches of 1-2 (rarely 3 or 4) eggs are usually produced, with a laying interval of 2-4 days. Roseates are single brooded; one replacement clutch may be produced. Incubation period is 23 days (range=21-26, rarely 31) with the time tending to lengthen in instances where a colony is repeatedly disrupted by predators. Incubation, shared by both sexes, commences with the first egg; hatching is asynchronous with hatch intervals of 2-5 days. As a result, the older chick (the "A-chick") is usually much larger than the younger chick and this disparity in size nearly always persists throughout the period of growth. Young are precocial and often remain by the nest for 15-20 days if cover is good, moving to better cover only if necessary. The chicks spend most of their time in tunnels under dense vegetation or rocks, emerging only to be fed. Chicks also readily use the "nest boxes" for shelter.

Young fledge at ages of 22-29 days, but continue to be very dependent for much longer. When 2 chicks are raised, the first to fledge is accompanied by one parent, while the other parent remains behind for up to 6 days to feed and attend the second chick. After birds have fledged, family units move to nursery areas and eventually to staging areas where young continue to be fed by adults. As fishing skills in roseates apparently take considerable time for development, time until complete independence is very long and may continue on the wintering grounds. Birds depart southward about mid-September, migrating at sea. First breeding usually occurs at 3 years of age. Subadult birds do not return north, but remain in the winter range. The winter range is not well known. Sparse early winter reports are chiefly from the eastern Caribbean and from the Atlantic Coast of South America to eastern Brazil; after mid-January, roseates are unaccounted for until they reappear at the nesting colonies in May. Some researchers believe the species may be chiefly pelagic in midwinter, possibly commingling with Old World populations somewhere in the mid-Atlantic.

Arctic Tern Of the 3 medium-sized terns nesting in Massachusetts, the Arctic tern (15½") is the darkest gray overall. Breeding adults sport a black cap and have a solid blood red bill and bright orange legs. Compared with the common tern, the legs are very short. Often, a white line separates the gray breast from the black crown. The call resembles the common tern's but is higher pitched.

The Arctic tern's range is circumpolar, extending as far north as there is land within range of open water. While Arctic terns are fairly common as far south as Maine, they reach their southernmost breeding limit in Massachusetts. As discussed in Chapter 3, the Arctic tern has been slowly abandoning its Massachusetts range since about 1950 and is the one tern species that has not responded well to management efforts.

Arctic terns are renowned for their epic migrations, with the longest round trips estimated at 22,000 miles between Arctic Canada and wintering grounds in Antarctic and subantarctic waters. Since individuals as old as 30 years have been documented, this means some individuals easily travel over a half million miles in a lifetime! Migration is over the sea.

This species nests typically on small sandy, rocky or grassy islands or barrier beaches. In Massachusetts, pairs are now restricted to sandy or gravelly areas, usually about the edges of common tern colonies or within colonies of least terns.

Arctic terns arrive in Massachusetts about May 15 and usually lay eggs from May 28 to June 15, generally after common terns have laid. Massachusetts egg dates are May 20 to July 27. Clutch size is 1-2 (rarely 3). Arctic terns are single brooded and often do not renest if a clutch or chicks are lost. Young fledge in 21-24 days. The Arctic tern is the first species to depart Massachusetts after nesting and is rarely seen in Massachusetts after August 7. Generally, the entire chronology of the Arctic tern's life is an accelerated one, with the emphasis being on breeding and returning to the Southern Hemisphere. Unlike common terns, Arctic terns defer the molt until after their southward migration.

Least Tern

Least terns (S. antillarum) are small (9"), whitish-colored, black-capped seabirds with a black-tipped yellow bill. Least terns are found along the Atlantic Coast from southern Maine to Florida and the Gulf states, in the interior along the Ohio and Mississippi River systems and on the Pacific Coast to central California. The United States Fish and Wildlife Service classified the California and interior populations as "Endangered" in 1970 and 1985 respectively. The Massachusetts Division of Fisheries and Wildlife has classified the least tern as a "Special Concern" species.

Least terns occupy nesting grounds similar in most respects to those of the piping plover and the two species commonly nest in close proximity to each other. Like the plovers, least terns have nested along the sandy eastern barrier beaches for thousands of

years, capitalizing opportunistically on the natural processes of beach erosion and rejuvenation. This species, by far the most widespread and adaptable of our nesting tern species, readily nests on deposits of sandy dredged material and, occasionally in the South, on gravelly rooftops. Least terns nest in their own colonies and do not join in mixed colonies with other species of terns.

Least terns arrive in Massachusetts in early May, quickly form colonies, engage in elaborate courtship rituals and mate. Egg dates extend from May 23 to July 28. Nesting groups range in size from just a few to 1,000 or more pairs. Nesting groups join in mutual defense to protect colonies and will mob and defecate upon intruders with great accuracy, earning them the apt nickname, "little striker."

Nests are formed as shallow "scrapes" in the sand or cobble, usually in areas devoid of vegetation, but sometimes in sparse beach grass, beach pea and other dune vegetation. Nests are frequently very close to the high tide line and almost always where incubating adults can view the sea. Clutches contain 2-3 eggs (occasionally 1 or 4). The average incubation period is 21-23 days. Incubating adults, clutches of eggs and the young are extremely cryptic. These terns are single-brooded, but will renest multiple times in response to nest loss.

Chicks are precocial. They will seek shade during the hot part of the day and are closely brooded by their parents. By the age of 1 week, chicks may run considerable distances along the beach. Fledging occurs at 20-22 days. Adults deliver fish caught in the surrounding waters to chicks. After the chicks have fledged, least terns waste no time in departing southward and in some years are scarce by mid-August.

Least terns suffer high rates of nest loss from storm tides, sand burial due to wind, and predation, notably that of fox and skunk.

Piping Plover

The piping plover (Charadrius melodus) is a small (6-7") whitish and sand-colored bird with distinctive black markings, notably a band above the forehead and an often incomplete necklace. It is so protectively colored that as it fleets ghost-like over the sand and suddenly stops, it seems to utterly disappear before your eyes. It feeds robin-like, deliberately running short distances, pausing to peer at the ground and then quickly snatching-up food items. Its diet consists exclusively of small invertebrates such as flies, sand worms, crustaceans and mollusks. The name "piping" plover derives from its clear, two-

noted whistle--often rendered, "peep-lo."

This plover is endemic to North America, with disjunct nesting populations found on the northern and central Great Plains, in the Great Lakes region and along the Atlantic Seaboard. Declining populations led to its classification in 1986 as "Endangered" in the Great Lakes region and "Threatened" elsewhere. Population declines have been attributed to numerous factors including degradation and loss of breeding and wintering habitat, human disturbance, direct mortality from off-road vehicles, disturbance and mortality caused by domestic and feral pets and heightened predation and competition from other species. An estimated 1,350 pairs (1995 census) now nest along barrier beaches from Newfoundland to South Carolina and winter along the Atlantic and Gulf coasts from North Carolina southward into the Caribbean.

Piping plovers are early harbingers of spring on the outer beach, arriving--sometimes amidst freezing and inclement weather--in mid-March. We now suspect birds continue to arrive at breeding sites in Massachusetts through mid or late May. Early arriving plovers spend much of their time foraging along the intertidal flats. Ritualized courtship behaviors of males and females, including nest scraping, pebble tossing and high step marching, may begin within a few days after arrival. Males display by flying over the nesting territory in an elliptical or "figure-8" pattern and calling with piping notes. Although courtship and territorial establishment may continue into July, many adults have formed monogamous pair bonds and established nesting territories by late April. Piping plovers typically remain with the same mate during the nesting season but usually change mates between years.

Following mating, the female selects a nest scrape and lays eggs. Nests are shallow scrapes in the sand, often lined with shell fragments. They may be found along the unvegetated beach berm, overwashed areas with scattered pebbles and shells, foredunes with sparse beach grass or in blow-out areas behind primary dunes. Piping plovers depend upon natural processes of beach erosion and accretion through wind and wave action to maintain suitable nesting habitat. They may also nest in areas where sandy dredged material has been deposited. Nests are frequently in or adjacent to least tern colonies.

Egg dates for Massachusetts run from April 19 to August 10, although nests initiated after July 1 are seldom successful. The number of active nests usually peaks June 1-10. Initial clutches usually contain 4 eggs, while clutches of re-nesters may contain 2 or 3. Initial clutches of 3 or 5 eggs are rare. Eggs are pale sandy with fine splotches of black or brownish-black and extremely cryptic. A clutch is completed over a 7-day period, usually with an egg laid every other day. Incubation begins after the clutch is complete. Both sexes participate in incubation duties. The

incubation period averages 27-28 days (range=25-39 days). If the clutch should be lost, renesting often will occur in 5-10 days. Pairs that repeatedly lose clutches may renest up to 5 times. Piping plovers are usually single brooded and do not relay after the loss of chicks, although rare exceptions have been reported.

Chicks typically hatch within a few hours of each other. One of the pair may continue to incubate a "late" egg for up to 48 hours before abandoning it. The chicks--about 2" high and weighing less than an ounce--are precocial. They are highly ambulatory and adept at finding and picking-up their own food within a few hours of hatching. Beach visitors who do not understand this sometimes "rescue" these "abandoned" chicks and carry them off the beach in a sand bucket or picnic basket to a very uncertain future. Adult plovers never feed the chicks but guide them to areas where food is plentiful. Chicks forage while the parents stand guard nearby. Broods may move hundreds of yards from the nest site at any time after hatching. Young chicks often seek warmth and shelter from rain, cold, or wind by being "brooded" under adults. The average age at first flight is 29 days (range=25-35 days). From late July onward, loose groups of adults and juveniles assemble and forage together. Most depart southward during late August and early September.

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Chapter 5
Factors Limiting Nesting Terns and Piping Plovers in Massachusetts

Common, Roseate and Arctic Terns

These "larger" tern species, because they nest on more remote sites such as offshore islands and the far ends of barrier beaches, and because they tend to nest in vegetative cover, are not as likely to be disturbed by human activities as are least terns and piping plovers. Nevertheless, human entry into nesting colonies is extremely disruptive, causing terns to rise into the air in alarm for extended periods, leaving eggs and chicks exposed to potentially lethal heat and cold or predators such as gulls or crows. These terns are also very disturbed by dogs.

As a result of the dramatic rise in herring and great black-backed gull populations since the 1940's, prime offshore tern nesting areas have been usurped by the gulls, forcing terns into less optimal sites closer to shore--and, unfortunately, closer to various land-based predators.

Predation is one of the major factors limiting this group of 3 mid-sized terns. Avian predators such as great horned owls and peregrine falcons may raid colonies taking adult birds and causing night desertions and delayed nesting activity. Eggs and chicks are, from time to time, heavily preyed upon by black-crowned night- herons, gulls, raccoons, red foxes, and striped skunks. Roseate tern eggs and chicks, because roseate nest sites are more cryptic, seem to be less vulnerable than those of the other two species. Recently fledged tern chicks just starting to fly may be preyed upon by gulls.

Weather events certainly play a limiting role. Marginal, low elevation nests at the periphery of colonies or situated in salt marshes may be inundated by storm or moon tides. Extended periods of cold rains or extreme heat take a toll. Ocassionally, weather events may play a devastating limiting role. For example, an early season hurricane, "Hurricane Bob", that swept through the roseate tern staging grounds in Chatham in 1991 is believed to have destroyed the entire year class due to the fact that fledglings, learning to forage and still dependent on adults for food, were separated from their family units and lost.

Other limiting factors such as food shortages, disease and poisoning from environmental contaminants may, from time to time be limiting. These terns may also face unknown mortality factors

during their extensive migrations and on their wintering grounds.

Least Tern

Least terns are extremely vulnerable to human disturbance during their nesting season from mid-May through July. These seabirds set up their nesting colonies on the open sandy berm, which is also a favored recreational area for people. Entry into nesting areas for any reason is extremely disruptive to nesting birds. During periods of courtship and territory establishment, the birds may be especially vulnerable to disturbance. Once clutches of eggs are on the beach, they are completely at the mercy of pedestrian and vehicle traffic, which inadvertently may crush eggs and chicks. Any human activity such as picnickers, sunbathers or campers, who are set up too close to nesting birds will keep birds agitated and away from their nests. When this occurs, eggs and chicks may be exposed to lethal heat or cold. Garbage--even in small amounts--left in the wake of human activity may lure predators to remote nesting areas. Dogs are also very disruptive in least tern colonies and may keep adults off nests or kill chicks.

ORV's degrade the habitat of least terns by creating tire ruts, into which least tern chicks may run and then be unable to climb out. Chicks are then vulnerable to the next approaching vehicle. The physical presence of vehicles driving or parked on the upper beach can prevent least terns from nesting there.

Unlike piping plover chicks which forage for themselves back and forth over the beach, least tern chicks are fed by their parents until they have fledged and acquired fishing skills. Their movements over the beach tend to be less extensive. Nevertheless, least tern chicks will, at times, run outside the post-and-string fencing, placing themselves at risk. This is especially likely to occur as chicks move into nursery areas nearer the water.

Inclement weather limits least tern productivity in some years. Least terns often nest only slightly above the mean high tide line and are extremely vulnerable to flooding events associated with astronomical and storm tides that periodically overwash their nesting grounds. Nests may also become "sanded-in" during high winds.

Least terns may be limited at different times by a host of mammalian predators including red fox and striped skunk and avian predators including gulls, crows and northern harriers that prey on eggs, young and adults. While not well-documented, food availability, disease and competition may, from time-to-time, play significant limiting roles.

Piping Plover

Sandy beaches that provide nesting habitat for piping plovers are also attractive recreational areas for people and their pets. Human recreational activities can be both a source of disturbance that discourages birds from nesting and a potential source of mortality to eggs, chicks, and adults. Barrier beaches that are physically suitable as nesting grounds and as feeding, chick rearing and migration staging areas may become functionally unavailable to the birds because of human activity and the resulting disturbance. People walking or driving on beaches may inadvertently crush eggs, cause nest abandonments, or disturb or displace adults and unfledged chicks. Unleashed dogs may chase adults, kill chicks or eat eggs. Garbage associated with human activities such as picnicking and camping may attract predators that feast on eggs and young. Kites are highly disturbing to piping plovers.

Motorized off-road vehicles (ORV's) adversely effect piping plover habitat, survival and productivity. Vehicles can crush cryptic eggs and chicks, even adult birds. In Massachusetts, 15 plover chicks and 2 adults were killed by vehicles in 11 separate incidents reported between 1989 and 1995.

Typical behaviors of piping plover chicks make them especially vulnerable to ORV's. Chicks frequently move back and forth between the upper beach or foredune and preferred feeding habitats in the wrack line and intertidal zone. These movements place chicks in the paths of vehicles moving along the berm or through the intertidal zone. Because piping plover chicks typically leave the nest within a day of hatching and run up and down the beach, wire fencing placed around nests to deter predators and "symbolic" post-and-string fencing placed around nesting habitat are ineffective in protecting chicks from vehicles. Chicks may stand in or walk and run along tire ruts, and young chicks sometimes have difficulty crossing deep ruts or climbing out of them. Chicks sometimes stand motionless or crouch, rather than flee, as vehicles pass by.

Piping plovers may be vulnerable to disturbance during periods of territory establishment, courtship, and nesting in spring and early summer. ORV's may also degrade piping plover habitat by crushing wrack (seaweed, shells and other organic material deposited on the beach by tidal action) into the sand and making it unavailable to plovers as cover or foraging substrate. Studies have shown wrack to be a preferred feeding habitat for piping plovers, especially chicks.

Efforts to close blow-outs or overwashes along primary dunes using discarded Christmas trees and/or sand fencing, although often well-intentioned, are especially damaging to piping plover nesting habitat. Formerly suitable nesting habitat may be degraded or destroyed by such activities if it is re-vegetated, blocked or occupied by fencing, or if the elevation and slope of foredunes is increased. Dense fencing may block movement of chicks from nest sites to feeding areas on the beach. Piping plovers depend upon natural cycles of beach erosion and accretion to create suitable nesting sites. When man intercedes to disrupt these natural processes, the habitat of the plover is destroyed or made inaccessible and therefore useless to the birds.

Piping plovers are also susceptible to a variety of biotic and abiotic natural limiting factors. Abiotic factors include the natural dune building process itself, which may over a period of years result in higher, steeper, narrower, or more densely vegetated beaches and dunes and correspondingly less suitable nesting habitat for the birds. Weather conditions can limit productivity of nesting birds in a variety of ways. Storm and or moon tides that overwash a beach can inundate low-lying nests. Under very windy conditions, nests may be buried by blowing sand. Storm erosion may temporarily eliminate suitable nesting habitat along sections of beach with narrow berms or steep foredunes.

Biotic factors limiting numbers include predation, injuries, disease, and competition. A variety of predators, notably red foxes, crows, skunks, and gulls prey upon plover eggs and young. Red fox and various birds of prey may also take adult plovers.

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Chapter 6
Terns, Plovers and the Law

This section provides a brief overview of provisions of the Massachusetts Wetlands Protection Act and both the federal and state endangered species acts that are pertinent to the management of terns, piping plovers and their habitats. The Massachusetts Division of Fisheries and Wildlife has developed more detailed guidelines to assist beach managers and property owners with protecting piping plovers, terns and their habitats in compliance with the Massachusetts Endangered Species Act and Wetlands Protection Act and their implementing regulations (Appendix A). Similarly, the U.S. Fish and Wildlife Service has developed guidelines for managing recreational activities in piping plover habitat to avoid violations of the Federal Endangered Species Act (Appendix B). Readers are strongly advised to review these guidelines thoroughly.

In addition to the state and federal laws that specifically address wildlife, most towns have various rules and bylaws governing activities on beaches under their jurisdiction. Enforcement of these local bylaws can also be important to protection of terns, piping plovers and their habitats.

Summary of Pertinent Laws

Massachusetts Endangered Species Act (MESA) (MGL, Chapter 131A)

1. Overview Regulations promulgated under this law became effective in 1992 and establish (a) procedures for the listing of "Endangered", "Threatened", and "Special Concern" species native to Massachusetts, (b) procedures for the determination of "Significant Habitat" for "Endangered" and "Threatened" species and (c) rules and prohibitions regarding activities which will result in take of such species or alter "Significant Habitat". The following species of terns and the piping plover are listed and classified at 321 CMR 10.60 as follows as of 1 January 1996:

Common Tern	Special Concern
Roseate Tern	Endangered
Arctic Tern	Special Concern
Least Tern	Special Concern
Piping Plover	Threatened

To date, "Significant Habitat" provisions of the law have not been exercised. "Significant Habitat" is defined as areas of the Commonwealth in which are found those physical or biological features important to the conservation of a "Threatened" or

"Endangered" species population and which may require special management consideration or protection.

2. Performance Standards Regulations pursuant to the MESA prohibit the take of any species listed as "Endangered", "Threatened", or "Special Concern" in Massachusetts. In specific reference to animals, "take" means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding or migratory activity or attempt to engage in any such activity, or to assist in such conduct. The regulations further state that, "All state agencies shall utilize their authorities in furtherance of the purposes of the MESA and these regulations; review, evaluate and determine the impact on "Endangered", "Threatened", and "Special Concern" species or their habitats of all works, projects or activities conducted by them; and use all practicable means and measures to avoid and minimize damage to such species or their habitats". This includes any work, project or activity either directly undertaken by a state agency or indirectly by other parties with funds provided by a state agency.

3. Penalties Section 6(a) of the MESA provides that any person found to be in violation of the "take" provisions are subject to punishment by a fine of not less than $500 or imprisonment for not more than 90 days or both such fine and imprisonment. Upon a second conviction, fines of $5,000 to $10,000, imprisonment for not less than 180 days or both such fine and imprisonment may be imposed. Also, it is noteworthy that the law provides that "the commission of a prohibited act with respect to each individual animal...., or part thereof, shall constitute a separate violation". In other words, breaking all 4 eggs in a piping plover nest, for example, would constitute 4 violations.

Massachusetts Wetlands Protection Act (MGL, Chapter 131, §40)

1. Overview Amendments to this act signed into law in 1986 and new regulations effective in 1987 recognized the importance of wetlands as wildlife habitat. Coastal beaches, dunes, and intertidal areas are included in the definition of "wetland". The law also defines "Rare Species Habitat" as those resource areas identified on the most recent Estimated Habitat Maps of state-listed vertebrate and invertebrate species prepared by the Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife. These maps define the estimated geographical extent of habitats utilized by the four species of terns and by the piping plover for which occurrences have been reported and documented to the satisfaction of the Natural Heritage and Endangered Species Program.

2. Performance Standards Proposed activities that will alter wetland resource areas and will occur within the actual habitats

of terns and piping plovers must not be permitted if they will have short or long-term adverse effects on the habitat of these species. The Massachusetts Division of Fisheries and Wildlife acts as the scientific authority in making this determination. A determination made by the Division is presumed to be correct, although it can be rebutted by a clear demonstration of contrary information before a town conservation commission. The Department of Environmental Protection has determined that use of off-road vehicles within wetland resource areas is an activity regulated under the Wetlands Protection Act.

3. Penalties Violations of the Wetlands Protection Act provisions are punishable by a fine of not more than $25,000 or imprisonment for not more than 2 years or both such fine and imprisonment.

Federal Endangered Species Act of 1973 (Federal ESA)

1. Overview This law and the regulations promulgated thereunder authorize the United States Fish and Wildlife Service (USFWS) to list--based on the best available biological data and other considerations--plants and animals determined to be "Endangered" or "Threatened" and to designate "Critical Habitat" for listed species. As of 1 January 1996, the Northeastern U.S. population of the roseate tern is listed as "Endangered" and the Atlantic Coast population of the piping plover is listed as "Threatened" on the federal list.

The Federal ESA also prohibits take of listed species, prohibits federal agencies (including activities funded by them) from having any adverse effects on listed species, and requires federal agencies to consult with the U.S. Fish and Wildlife Service where a proposed activity may have an adverse impact on a listed species.

2. Performance Standards Section 9 of the Federal ESA prohibits any person subject to the jurisdiction of the United States from harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting listed wildlife. Regulations implementing the Federal ESA (50 CFR 17.3) further define "harm" to include significant habitat modification or degradation that results in the killing or injury of wildlife by significantly impairing essential behavior patterns including breeding, feeding, or sheltering. "Harass" means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

The USFWS and the Division executed a Cooperative Agreement in 1979 under which the two agencies share management responsibilities for federally-listed species. Federally-listed species also occur on the "Massachusetts List of Endangered,

Threatened and Special Concern Species" found at 321 CMR 10.60. Compliance with the MESA and the Massachusetts Wetlands Protection Act normally will meet or exceed performance standards of the federal law relative to management of terns and plovers.

3. Penalties Fines for violation of the taking provisions of the Federal ESA include--for "Threatened" or "Endangered" species--fines of up to $100,000 per individual and $200,000 per organization and/or one year imprisonment or both.

United States Migratory Bird Treaty Act Terns and piping plovers, as well as most other migratory birds, their nests and eggs are also protected by another federal law, the Migratory Bird Treaty Act of 1918 (18 USC 703-712). Activities prohibited by this act include pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting such conduct toward migratory birds.

Local Ordinances Most municipalities have bylaws that govern activities on town lands, including beaches, under their jurisdiction. Individual beaches may have specific rules or bylaws that apply. Local bylaws and rules affecting beaches often regulate activities such as overnight camping, vehicles and dogs. It is important to obtain a copy of special town bylaws and rules that apply to a particular site and become familiar with them.

Enforcement of Laws

General Procedures Enforcement of the above laws is the job of enforcement officials trained in legally proper and appropriate procedures. State and federal wildlife laws are enforced by Environmental Police Officers ("EPO's") from the Department of Fisheries, Wildlife and Environmental Law Enforcement and by Special Agents from the U.S. Fish and Wildlife Service. Enforcement of local bylaws are the responsibility of town enforcement officials. While site owners, managers, monitors, and biologists may provide information to the public about the laws and serve a valuable educational role, they cannot enforce laws themselves.

You should know the names and telephone numbers of the appropriate law enforcement personnel assigned to your area. Try to network with the appropriate officers, establish dialogue and become personally acquainted with them. Then, should a serious enforcement problem arise, you will know who to turn to quickly and--just as important--you will be known by the officers.

In dealing with law enforcement officials, a complaint sometimes heard is that they seem disinterested or that issues dealing with terns or plovers do not seem to be a high priority. While getting their assistance may be very frustrating at times, bear in mind that they have many responsibilities and demands on their time and may not always be able to respond to your needs instantaneously.

At sites where chronic law enforcement violations are seen and expected, a radio or cellular phone may be an excellent investment. Sometimes, the officers themselves will loan portable communications equipment if you can demonstrate a need. If you do not have such equipment, take time to note locations of the nearest telephones.

If you do observe serious and/or chronic violations of the law, remain calm and methodically note down critical information. Such information should include careful descriptions of individuals and vehicles involved, plate numbers, the number of people in a vehicle, a description of the incident itself, the date, time of day, weather conditions and the names and addresses of any witnesses besides yourself. Photos or videos of observed violations can be very valuable, with the exact date and time noted for each frame. Then contact the appropriate law enforcement official or a state or federal wildlife biologist for assistance.

The following sections provide general guidance and suggest procedures for responding to certain specific situations you might encounter.

Birds Crushed by ORV's If ORV's have violated a closed area and you suspect that crushed eggs or chicks might be present, it is important to search the area for this type of evidence. Be aware that a chick run over by a vehicle on a beach may be quite difficult to find! Dead chicks may be buried by wind-blown sand or ground into the sand by other passing vehicles. If you discover egg or chick mortalities, make careful notes on the location and condition of the carcass(es), evidence of any vehicle use, and details of any apparent violation. Take photos or videos if possible. If dead chicks are found in vehicle tracks, note whether any chicks are also dead outside of vehicle tracks. Seek witnesses to the violation, or at least to confirm the presence of the dead chick(s).

If possible, send someone to contact an EPO or Special Agent or a state or federal wildlife biologist. Normally specimen evidence should only be handled by an EPO, Special Agent, or a state or federal wildlife biologist. However, if conditions at the site are such that biological evidence, such as a carcass, might disappear or be lost before assistance can arrive, then it

should be collected and held until help arrives. If it must be held until the next day, then it should be placed in a plastic bag, carefully labeled, and frozen.

Loose Dogs Most towns have "leash laws" that require dogs to be leashed or under the control of their owners at all times. Furthermore, individual beaches usually have rules that either outright prohibit dogs or require their owners to maintain them on a leash at all times. Despite beach rules and local ordinances, free running dogs are a continuing problem at many sites. Exercise care in approaching any dogs not known to you. However, free running dogs should be restrained if possible and an attempt made to locate their owner. Check for dog tags that may carry the name, address and phone number of the owner. Take photos or videos if possible. Place the dog on a leash and turn it over to the beach manager or take it to the local police station. Most police stations will place a dog in the "lock-up" and the owner must come in to retrieve the errant pet.

Unless you are familiar with a particular dog, it may be wiser to just chase dogs away from the vicinities of nests and eggs. Be persistent in seeking assistance from the town's animal control officer, beach manager or local police. If the problem persists, seek assistance from your supervisor, state or federal biologists or law enforcement personnel.

Dogs with Their Owners on "No Dog" Beaches Identify yourself and politely inform the owners that they are violating beach rules and, if their dogs should disturb nesting terns and plovers, they could be liable under the state and federal endangered species acts. Request that they remove their dog from the beach. If you get no cooperation, report the incident at once to the beach manager. Sometimes it may be possible to trace the dog to its owner's vehicle, in which case you should obtain the license number and turn it over to the beach manager or to the local police department. Don't be discouraged if you are ignored or treated rudely or encounter "repeat offenders". Sometimes persistence in approaching dog owners will become enough of a deterrent that they will walk their dogs elsewhere during the rest of the nesting season.

Dogs Killing Chicks or Damaging Eggs In these cases, the dog's owners may be liable for fines under the Migratory Bird Treaty Act of 1918 and/or the state and federal endangered species acts. If possible, take photos or videos of the dog causing damage, as well as close-up, identifiable photos of any of the dog's prey items. If safe to do so, try to restrain the dog on a leash and identify the owner. Take careful notes detailing the incident, including the date and time of day. Call an EPO or Special Agent or a state

or federal wildlife biologist for assistance.

Damage to Fencing and Predator Exclosures On heavily used recreational beaches, unfortunately, some vandalism to signs or symbolic fencing often occurs. Fencing may also be damaged by winds or wave action, and frequent maintenance may be necessary. Report flagrant or repeated acts of vandalism to the beach manager, your supervisor and state or federal biologists.

Vandalism of predator exclosures should also be reported to the above individuals. Law enforcement staff should be notified if eggs are damaged as a result of vandalism. Document as thoroughly as possible through detailed notes, photos, or videos the evidence at the scene.

Inadequate Beach Management Report management inadequacies to the beach manager or landowner with recommendations for correcting deficiencies. If problems are not resolved, discuss with your supervisor or contact a state or federal biologist.

For contacting state Environmental Police Officer:

dial 1-800-632-8075

For contacting a USFWS Special Agent:

dial 1-617-424-5750

Chapter 7
Managing Terns, Plovers, and Their Habitats

Overall Management Goals and Approaches

In Massachusetts, the public/private partnership for stewardship of nesting terns and piping plovers has as its overall goal the perpetuation and enhancement of nesting tern and piping plover populations and their habitats.

Management of terns and plovers in Massachusetts is actually accomplished by a unique mosaic of projects operated by many different agencies, both public and private. This partnership "network" has evolved slowly over many years and continues to evolve. It seems to work well because individual projects are locally-controlled (often by the landowner) and manageable in size. Cooperators take pride in their individual operations and are well acquainted with their particular sites. While government agencies have a strong interest and a legal mandate to see that tern and plover populations are conserved, private groups have adopted tern and plover conservation as important and visible parts of their missions.

Implementation of regulations promulgated under the Wetlands Protection Act in 1987 and the Massachusetts Endangered Species Act in 1992 has increased Division oversight and involvement in tern and plover conservation activities in Massachusetts. However, managers have great freedom to imaginatively customize protective strategies for sites under their stewardship. Such an eclectic approach encourages innovation and has resulted in many new ideas to advance tern and plover management in the state.

The Division attempts to: (a) coordinate monitoring and management at all nesting sites, (b) hold training workshops as needed, (c) facilitate information exchange between cooperators, (d) standardize methodologies where appropriate, (e) ensure adherence to performance standards established by state and federal laws and regulations, (f) coordinate the annual compilation of population data, and (g) serve as repository of information on abundance, distribution, productivity and the effects of management on the Commonwealth's tern and plover populations. Technical assistance for censusing, monitoring, and protecting nesting areas is provided as needed. In early August, a "reporting meeting" is customarily held, during which tern and plover census data for the season are compiled and management strategies are reviewed in an open forum. Census data are compiled and summarized in annual reports prepared by the Division and distributed to cooperators and are entered into the NHESP's Natural Heritage Database.

Locating Nesting Habitat

Central to all tern and plover protection strategies is the need to identify suitable nesting habitat and protect these areas from human disturbance. Trained biologists or experienced site monitors should be able to identify suitable habitat just by looking at it. Habitat likely to be occupied by nesting terns and plovers can sometimes be identified by noting the locations where birds nested in previous years. However, locations of least tern colonies and piping plover nests often change from year to year in response to changes in beach morphology and vegetation, past nesting success or other factors. As Massachusetts' piping plover population continues to grow, nesting occurs each year in areas that may have been unoccupied in recent years.

Locating Nesting Birds

Locating nesting terns and plovers is not always easy, for the birds are not always obvious. Success in locating nesting sites improves with experience and may become almost second nature. Several clues can be helpful in fixing the location of nesting birds, but the presence of nests and eggs or unfledged young is always the only verification of nesting. Some indicators of nesting activity include:

1. Continuous presence of breeding-plumaged adults in or near suitable nesting substrate.

2. Presence of terns or plovers anywhere above the wrack line.

3. Courtship behavior and/or copulations noted in and about a locale.

4. Agitated behavior; adult terns dive-bombing persons or animals when they enter certain areas offering suitable nesting substrate; adult plovers running and flying anxiously about in suitable habitat and giving the "peep-lo" call or performing "broken-wing" distraction displays.

5. Birds "nest scraping" in suitable habitat or walking to and actually settling on a nest.

Fencing

Ideally protected nesting habitat should consist of a fenced

area that completely restricts all access into the habitat from about the time that birds return in the spring until the last of any chicks have fledged.

The basic hardware used to protect nesting areas is simple post-and-string fencing, often referred to as "symbolic fencing." Symbolic fencing serves to: (a) alert the public to nesting or chick rearing areas and (b) temporarily keep people, pets, and vehicles from entering these areas. This prevents accidental destruction of nests and eggs and disturbance of incubating birds or unfledged chicks, and creates refugia where chicks can seek shelter during periods of heavy beach use.

Most nesting sites should be fenced every year to prevent entry of people in these areas. Fencing may not be required on small islands, where signs around the perimeter of the island may suffice, or on remote sections of beach that are closed to ORV use and receive little pedestrian use during the nesting season. The following guidelines should be followed:

1. Be sure to obtain the owner's consent before fencing off nesting habitat. In Massachusetts, many of the public beaches used by nesting terns and plovers are owned by towns. Seek permission from the beach manager, Parks Department or Board of Selectmen. While in most towns, such permission has traditionally been granted, approval should be renewed annually. In cases where owners are reluctant to cooperate, do not try to force the issue, but contact the Division of Fisheries and Wildlife for assistance.

   An exception may be made if an unexpected nest or chicks are found at a new location and are imminently threatened by disturbance or direct mortality. If the property owner is unknown or unavailable, erect a minimum amount of symbolic fencing; then notify the Division and make every effort to locate and advise the owner or beach manager as soon as possible!

2. Strong twine or nylon twist line should be strung between stakes or wooden posts set at 75-100 feet intervals. For safety reasons, do not use wire or monofilament line (it is difficult for both people and birds to see)! Set 5 or 6 foot-long wooden stakes or poles into the sand using a small sledge hammer or spade. In cobblestone areas, ¾" re-bar may be easier to drive into the substrate. Fence height should be about 4 feet. Affix line securely to the top of each post. One can improve the visibility of symbolic fencing by tieing short pieces of bright-colored flagging or surveyor's tape at intervals along the line. This may not be feasible at some sites where there may be hundreds of yards of symbolic fencing.

3. A buffer of at least 50 yards should be maintained between symbolic fencing and the nearest nest (Fig. 7-1; see state and federal guidelines: Appendices A and B). This buffer should be expanded if it is insufficient to prevent incubating birds from being constantly disturbed.

Fig. 7-1. A minimum 50-yard buffer should be maintained between the symbolic fencing and the nest or nearest nest.

4. When fencing a colony on a beach where vehicles are operated, make certain that there is room for vehicles to pass seaward of the fence at high tide! Where passage is narrow, it is extremely important to monitor the site closely during periods of spring or storm tides when vehicles and people may be forced into the colony by the high water. Anticipate tide and weather conditions. Discuss with the beach manager contingency plans to temporarily close the beach if conditions are such that intrusions into nesting habitat are likely. If the width of the beach is too narrow to adequately protect nesting habitat and maintain a narrow vehicle corridor, then it should be closed to vehicles.

5. Fences should be regularly monitored (daily on heavily trafficked sites) and maintained as required by tightening line, uprighting fallen stakes and replacing broken stakes or missing signs. Veteran tern and plover wardens are in agreement that well-maintained fencing with taut lines, sturdy erect posts, and frequent signs is more likely to be respected by the beach-going public. Conversely, sloppy fencing sends a message that you are not serious about the closure.

6. Fence plover nesting habitat by April 1; tern nesting habitat by May 15. As the season progresses, adjustments in the fence line should be made to accommodate any late nesting birds or expanding habitat area on the berm of accreting beaches. Fencing around habitat not being utilized by birds should be discontinued after July 31.

7. Delineate and fence all habitat and define travel corridors by April 1 on ORV beaches. Also fence nesting habitat on busy pedestrian beaches if the potential disturbance is such that nesting might otherwise be inhibited. Later nests discovered outside posted areas should be fenced as found, with the minimum 50 yard buffer, expanded if necessary to prevent disturbance. If the beach grows in width in late spring and early summer, fencing should be moved seaward so that the majority of nesting habitat is protected and vehicles are restricted to discrete travel corridors along the edge of suitable habitat.

8. Erection of fencing or signs while birds are present does create some disturbance and should not be done on cold, rainy, or windy days or in mid-day heat. Even on days of suitable weather, do not keep birds disturbed more than 30 minutes. One such "controlled disturbance" to install fencing and signs is preferable to many, later, uncontrolled disturbances by recreational beach users.

9. Fencing should be adjusted to accommodate "nursery areas." Plover family groups will sometimes vacate the nesting area proper and shift to a "nursery area" where food is abundant and the chicks can feed and grow. Young terns, as they become more mobile, tend to run out of the nesting area proper to congregate in adjacent "nursery areas" where they are fed by the adults. When such areas are identifiable, they should be fenced as generously as possible such that the birds can carry on their activities without disruption. NOTE WELL: Where unfledged tern and piping plover chicks are present, additional temporary restrictions on vehicle use should be implemented (see state and federal guidelines: Appendices A and B).

10. Remove all fencing promptly after the last chicks have fledged. This is important, especially on heavily-used public beaches lest credibility with the beachgoers suffer and the "symbolic fencing" loose its effectiveness.

Remove all equipment and store ready for use the next season. Do not stash posts and signs on the beach or in the dunes. They may be vandalized, stolen, buried in sand or washed away before the next spring and they detract from the esthetics of the beach.

Signs and Posting

Fig. 7-2. Clear and attractive signage at frequent intervals along symbolic fencing is important.

1. All nesting sites where disturbance is likely should be posted with signs that clearly communicate to beachgoers the presence of nesting habitat that should not be entered. Numerous signs have been designed over the years. In 1990, the Division of Fisheries and Wildlife developed a "Restricted Area" sign that includes artwork depicting least terns and piping plovers feeding chicks (Fig. 7-2). This sign also cites specific state and federal statutes that serve to make it enforceable by law enforcement personnel. At the bottom of the sign is a blank area in which the moniker or name of the posting organization and/or the name of the property owner can be placed.

The Division recommends the use of this sign for posting both tern and piping plover nesting areas. Limited numbers of these signs are available from the Division at no cost. Beach managers should budget and plan for adequate numbers of signs prior to each nesting season.

2. Signs should be attached to the posts at frequent intervals (≤50 feet) along the fence line. If no fence is used at a site, signs should be placed around the nesting grounds to include a buffer zone of at least 50 yards between the signs and the nearest nest.

3. Durable plastic, printed signs are expensive! Retrieve as many as possible for more than one year's use.

4. In addition to warning signs, informative or advisory signs may also be employed. Such signs, more educational in nature, can be very effective when placed at visitor's centers, parking lots or access routes to beaches.

The Division recommends a two-tiered signage system: (1) advisory signs at access points, informing and educating visitors about posted nesting areas ahead and (2) warning signs around the nesting areas themselves.

Vehicle Management

Please refer to **Appendix A**, Guidelines for Managing Recreational Use of Beaches to Protect Piping Plovers, Terns, and Their Habitats in Massachusetts prepared by the Massachusetts Division of Fisheries and Wildlife and to **Appendix B**, Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act prepared by the U.S. Fish and Wildlife Service.

Other Management Issues

Dogs In most towns, local ordinances prohibit dogs from beaches in summer or require that dogs must be leashed. Many dog owners, unaware of the damage they can inflict on nesting birds, seem unable to resist the temptation to let their dogs run free when at the beach. It is particularly important that dogs be leashed and under the control of their owners on all beaches where terns or plovers nest. Dogs riding in ORV's and boats can be very difficult to control and special attention should be paid to advising their owners of applicable laws, regulations and local ordinances.

Tern and plover wardens or their supervisors should make a concerted effort to elicit the assistance of beach managers and local dog control officers in dealing with dogs on nesting beaches. Be persistent in seeking enforcement of local dog ordinances. Request assistance from the Division if necessary.

If you encounter dogs running loose on the beach, try to chase them away from areas where nests or chicks are present. If the dog has a tag, you may want to try to catch the dog to read it, but use good judgement and don't get bitten. If you are able to identify a dog by reading its tag, notify the owner and the local dog officer or EPO.

Approach and talk with people that you encounter with unleashed or illegal dogs on beaches. Be polite but firm.

Explain the current situation with terns and plovers on the beach and the threat posed by dogs. For example, a plover chick was killed by a dog on South Beach in Chatham in 1994, shortly after its owners had unleashed it. Remind people if they are violating a local dog ordinance, and in all cases that they may be subject to prosecution under state and federal endangered species laws if their dog kills, injures or harasses terns, plovers, or their eggs or chicks. If people persist, remind them that: (1) it is your job to protect the birds and provide evidence of any violations to law enforcement officials; (2) they are taking a big risk; and (3) that you are carrying binoculars, camera, and notebook with which to record any potential violations.

Unfortunately, dealing with dog owners is often unpleasant. Although many are understanding and respond positively, expect others to either ignore you, be argumentative, or downright verbally abusive. Be polite and firm, but do not provoke a confrontation. Be persistent, however; your continued presence on the beach may be enough of a deterrent that people will seek other places to walk their dogs until the end of the nesting season.

Horses Horseback riding should be discouraged on or near the nesting grounds of least terns and piping plovers during the nesting seasons of these birds. Where piping plovers are present, horseback riding should be discouraged from April 1 onward until such time as all chicks have fledged or nesting has ended. Where least terns are present, the period should be from May 15 onward until all chicks have fledged or nesting has ended.

Bird Banders and Photographers No one should ever be allowed to enter a symbolically-fenced area for banding, scientific or photographic purposes unless they have been issued a state letter of authorization for this purpose. Should questions about a person's credentials arise, contact the Division of Fisheries and Wildlife.

Kite Flying Kite flying should be prohibited within 200 yards of adult and juvenile piping plovers.

All-terrain Vehicles Trail bikes, all-terrain vehicles and any other self-propelled vehicles not easily restricted to defined tracks should be totally banned from areas supporting nesting terns and plovers during the nesting season.

Beach Cleaning Cherrington machines should not be used on portions of beaches where plovers are nesting and raising chicks. Inorganic debris and materials considered hazardous to public health or safety should be removed by hand.

Techniques NOT Recommended

The following practices are not recommended under normal circumstances:

1. Moving nests or eggs that appear to be exposed or vulnerable (for example to high tides). In unusual, case-by-case situations where movement of nests or eggs might be warranted, consult with and obtain authorization from the Division.

2. Marking eggs.

3. Placing "stray" eggs in any nest or adding eggs to nests.

4. Handling young birds. For procedures in handling sick or injured birds, consult Chapter 10.

Suggested References

Massachusetts Division of Fisheries and Wildlife. 1993. Guidelines for Managing Recreational Use of Beaches to Protect Piping Plovers, Terns, and Their Habitats in Massachusetts. Natural Heritage and Endangered Species Program, Westborough, Mass. 14pp. (Appendix A)

Melvin, S.M., C.R. Griffin and L.H. MacIvor. 1991. Recovery strategies for piping plovers in managed coastal landscapes. Coastal Management 19:21-34.

United States Fish and Wildlife Service. 1994. Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take under Section 9 of the Endangered Species Act. USFWS Northeast Region, Hadley, Mass. 19pp. (Appendix B)

_____. 1995. Piping Plover (Charadrius melodus), Atlantic Coast Population, Revised Recovery Plan. Technical/Agency Draft. Hadley, Mass. 238pp.

Chapter 8
Monitoring Terns and Plovers

In order to monitor long-term trends, it is crucial to census populations of terns and plovers at periodic intervals. In Massachusetts, laughing gulls and black skimmers, which nest at relatively few sites in association with common terns, are censused at the same time as the common terns. Census data allow biologists to develop and implement protection and recovery efforts, to assess results and modify approaches. Using these data, population estimates are generated and trends are determined. The accuracy and precision of such estimates obviously depend on careful field work. Training and a certain amount of experience are essential to become proficient at counting or estimating numbers in the field.

In Massachusetts, the piping plover, all species of terns, the laughing gull and the black skimmer are censused annually. Other species of colonial nesting waterbirds that are not discussed in this manual, including the larger gulls, herons, egrets, ibises, and cormorants, are censused at 10-year intervals. The most recent census for the latter group was accomplished in 1994 and 1995.

Monitors should not be timid about seeking guidance from their supervisors or consulting with Division staff when general or site specific questions about census methodologies arise.

When censusing terns and plovers, the numbers are everything! Persons responsible for censusing these populations should use the utmost care in following procedures and standards outlined in this section as closely as possible. When any one census effort is nonconforming, the efforts of everyone are compromised and the final results correspondingly impaired.

Terns and plovers are relatively easy to count compared to most other species of birds. They are active in the daytime. Their nesting grounds are in open habitats. Census schemes are predicated on the fact that, by their nature, terns and plovers are temporally and spatially restricted during the nesting season to a finite number of nesting stations where their presence is relatively easy to detect.

In this chapter we discuss established procedures that should be employed in counting or estimating numbers of terns and plovers in the field in Massachusetts. The procedures are intended to provide as much accuracy and precision as possible in assessing a dynamic resource and should be adhered to exactly.

Getting Started

Monitoring nesting terns and plovers often involves long hours in the field. While the beaches and islands where these birds nest are usually very pleasant places to be, they can also prove to be harsh environments. This, coupled with the fact that many sites are quite remote, means that you should carry everything you need to be independent, to be able to do your job, and to be as safe and comfortable as possible. Remember that when working in the seashore and ocean environment, weather conditions can change suddenly and a change in wind direction may mean rapid temperature changes of 10-15 degrees.

The following checklist of personal items and equipment may be helpful:

Personal Items

1. Sunscreen
2. Sunglasses
3. Hat
4. Insect repellent
5. Windbreaker jacket
6. Shorts/long pants
7. Sturdy shoes; sandals may not be adequate if you are walking long distances or are traversing rough terrain
8. Water/plenty of fluids
9. Food

Equipment

1. Binoculars
2. Spotting scope
3. Lawn or beach chair
4. Camera/camcorder and film
5. Watch
6. Notebook and pen/pencil
7. Field Guide(s)
8. String, flagging and a small hammer
9. Portable radio/cellular phone; carry coins if you might have to use a pay telephone
10. List of emergency radio call signals or telephone numbers
11. Identification credentials
12. Tern and/or plover informational pamphlets
13. Burro or sherpa to help carry all the above!

Terns

Because pairs of terns do move between sites within a nesting season, it is essential to accomplish abundance estimates within proscribed time periods or census "windows". Movement from site to site within the nesting season occurs in response to various factors such as storms, predation, disturbance and social factors. Such movement may be considerable in some seasons. Without standardized "windows," that in effect take a "snap shot" of the distribution during a finite period of time, the true population size could be either overestimated by duplicating counts of pairs that have moved between sites or underestimated if sites are censused at times when the birds are not present.

Abundance estimates for all species of terns in Massachusetts, as well as for the laughing gull and black skimmer, are all taken in a standard "window" period of June 5-20 inclusive. This is known as the "A-count". Later counts known as "B-counts" may also be taken, but, as discussed below, these may have slightly different meanings depending on the species.

A standard tern census form for use in Massachusetts has been developed by the Division of Fisheries and Wildlife (Appendix E) and should be used for reporting purposes. Directions on the back of the census form explain exactly how to fill it out and what to report for the "A and B-counts" for each species. The form also asks for encoded entries giving: 1) the census method, 2) confidence level and 3) a qualitative estimate of productivity.

Regardless of which species of tern you are censusing, the following general protocol should be closely adhered to when working in and about terneries:

1. Do not attempt to census a colony unless you are trained and experienced or accompanied by an experienced person. Do not enter into fenced-off colonies unless authorized by your supervisor.

2. Try to work on calm mornings and before large numbers of people are about. Generally 5-10 a.m. (the earlier the better) is an optimal time. Weekday late afternoons and evenings in June have also proven to be good times with minimal human activity. Never disturb birds during the heat of the day or on windy, cold and/or rainy days.

3. Work alone or in small groups to minimize the area of disturbance.

4. Watch your step! Think carefully about where you place your feet. Cryptic eggs and chicks may be anywhere.

5. When censusing a colony, work along slowly but deliberately. No procrastinating! Do not keep the entire colony disturbed >30 minutes. If it requires several sessions to complete the count, allow 30 minute "rests" between sessions.

6. Plan all your activities within or about a colony carefully so as to accomplish the census in the shortest time possible and with the least amount of disturbance. The longer you remain in a colony, the greater the chances that you might tip off predators. Also, presence in a colony sends a mixed message to the public about "no entry" restrictions.

With the exception of colonies where banding studies are authorized, nests or eggs should not be individually marked in any way.

While being censused, terns will respond in an agitated manner. Expect to be "mobbed" by adult terns, which dive and strike at the head and defecate on intruders. Wearing a hat to which is taped a 6-8" upward protruding stick (such as a large tongue depressor) helps to deflect the angry terns and minimize pecks to the head.

Roseate Tern The endangered roseate tern nests at only a few scattered stations. Most of these sites are censused by experienced specialists. Nobody should enter an area where roseate terns are nesting without a letter of authorization from the Division of Fisheries and Wildlife. If nesting roseate terns are encountered unexpectedly, they should be reported immediately to the Division of Fisheries and Wildlife.

For the roseate tern, the censusing protocol follows that recommended by the Roseate Tern Recovery Team (Appendix D). The objective in censusing roseate terns is to estimate the maximum number of nests containing eggs or chicks located during the window period, with an effort made to time the census as closely as possible to the date of first hatch or approximately 23 days after the first eggs were laid. This usually falls on or about June 15-18 (the "A-count"). Count all nests containing at least 1 egg. Also, nests should be counted if the eggs have hatched and/or the chicks have moved away from the nest. Do not count empty scrapes or nests that are obviously abandoned.

A second nest count should be taken exactly 25 days after the first count to estimate the number of late-nesting pairs (the "B-count"). The "A-count" is considered the best estimator of the established adult nesting population, while the "B-count" estimates young, first-time nesting pairs.

Common Tern Common tern censuses, as in the case of the roseate tern, should be timed as closely as possible to the time of first hatch or about 23 days after the first eggs are laid. Since the first common tern eggs typically appear 6-8 days before Roseate eggs, the ideal census timing usually falls on or about June 10 (the "A-count"). "B-counts" at common tern colonies are not required or recommended given the great size of some of these colonies and the effort required.

Nests containing at least 1 egg should be counted. Also, nests should be counted if it is apparent that eggs have hatched and/or the chicks have moved away from the nest. Do not count empty scrapes or nests that are obviously abandoned.

All of the censusing methods discussed below require experience and should not be attempted unless accompanied by an experienced person. The following procedures are recommended, ranked in order of preference:

1. Total nest count using the Lincoln Index to account for nests missed (requires marking of nests; should be used only at research sites);

2. Total nest count obtained by line sweeps (5 people optimal) through the colony; In the line sweep method, counters walk abreast in a line with their distance of separation dictated by the density of the vegetation. In very dense dune grass, for example, counters may find it necessary to stay within two arms' lengths of each other in order not to miss nests. Each person in the crew should have a mechanical counter or should call out to a designated recorder each time they count 10 nests. Normally the crew

leader takes the middle position, sets the pace and does the recording. The crew members on each end must be responsible for dropping and retrieving flags at frequent intervals to mark the edge of each sweep. Depending on a colony's configuration, line sweeps may be accomplished most efficiently along either the colony's long or short axis, with the best approach varying from site to site.

3. Total nest estimate based on an extrapolated sample; While a complete nest count is always more desirable, this method may be used in instances where shortages of personnel and time leave no other alternatives. First, a careful estimate of the total colony area must be established. Second, a complete nest count within a sample plot or strip representing a known percentage of the total colony area must be done. Lastly, the resulting number obtained is expanded to obtain the estimate for the entire colony.

4. Factored adult estimate; This is the crudest and least desirable method of all and should only be used as a last resort and preferably only for small colonies (≤50 pairs). Before starting, try to estimate the number of loafing birds sitting on the beach or rocks around the colony; these should be subtracted from the estimated number of adults flushed from the colony. Next, the entire colony must be flushed and an estimate made of the number of individual birds. In very large colonies, it may be helpful to have several persons actually enter the colony to flush the birds, while one or more persons estimate the canopy of birds from a distance. The whole process should be accomplished in <10-15 minutes. The final estimate is given by:

Total Pairs = (Total Adults - Loafing Birds) (.8)

Arctic Tern While Arctic terns are few in number, they are difficult to census owing to their close resemblance to common terns. Nesting pairs of Arctic terns can sometimes be visually spotted on the edges of common tern colonies or within least tern colonies. Scan from a distance with binoculars or a telescope to pick-up incubating adults. It requires an expert using voice and sight cues and watching birds fly to nest sites to detect Arctic terns embedded within a large colony.

Arctic tern pairs are so few in number that they can usually be detected and censused incidental to efforts to census common and least tern colonies. The peak number of nests containing at least 1 egg in the standard census window, June 5-20 should be reported (the "A-count"). If additional pairs appear at a site after June 20, they should be reported in a "B-count" for the

site.

Least Tern Out of our 4 nesting species of terns, the least tern nests at the largest number of stations along the coast. As noted in Chapter 4, the least tern nests on relatively flat, unvegetated portions of beaches and low dunes and is thus relatively easy to locate and count. The biggest difficulty in estimating numbers of least terns is to figure out how to approach their nesting grounds for counting in ways that do not cause the birds to take flight, making an accurate count impossible.

Least tern colonies should not be entered for nest counting purposes (except as noted at 2 below). This is due to the excitable temperament of least terns, the wide spacing of their nests and the fact that entry into their colonies carries with it the significant risk of disturbing nesting piping plovers or unfledged plover chicks. Except as discussed below, counts of incubating least terns should be carefully taken from outside the fence only!

Do not attempt to mark individual least tern nests with stakes, tongue depressors, flags, paint or any other device! Given the barren substrate on which they nest, marked nests can be very obvious tip-offs to predators! The only exception to this is at colonies where authorized studies are underway.

Least tern colonies, sometimes the target of unrelenting predation, may vary unpredictably in size during the census window of June 5-20. As a result, plan to census least tern colonies as frequently as possible during the window. The actual "A-count" reported for least terns should be the peak number of incubating birds counted on a single day during the census window.

Least tern numbers at a site may change drastically after the census window has passed. In other instances, least tern nesting groups may appear at a site where there had been none during the census window. To report significant numbers of pairs of least terns that appear at a site after the census window has passed, "B-counts" may be taken.

Least tern colonies are also very vulnerable to washout by storm and spring tide events. Hence, it is advisable to watch conditions closely and time counts accordingly. Consult tide tables in advance and plan visits before high spring tides are due.

The following procedures should prove helpful in approaching and successfully counting least tern nesting groups:

1. Colonies spread out along beaches can usually be counted with great accuracy either from a vehicle (where permissible) or

on foot by working slowly along the beach, carefully counting all incubating birds.

(a) To prevent parallax error, count sitting birds along an imaginary perpendicular line extending from yourself to the far side of the colony. As you work slowly along the colony edge, it may be helpful to take careful notice of landmarks such as pieces of driftwood or plastic trash items in order to maintain the position of nests relative to each other and to minimize counting errors.

(b) Proceed slowly and methodically, keeping as far from the edge of the colony as possible but still close enough to make out the sitting birds. Use binoculars. Limit the crew size to 1 or 2 individuals to minimize alarm to the birds.

(c) If on foot, try to remain just below the wrack line on the beach slope as this is generally less alarming to the birds and they will tend to sit tight. In the event of the occasional "upflight," note where you left off counting in the colony (use driftwood or other similar beach detritus for landmarks), retreat below the wrack line and suspend the census until conditions in the colony settle--usually within a minute.

(d) If using a vehicle--which makes an excellent hide for this type of count--drive slowly along the edge of the colony (outside the fence). As in (c) above, suspend the count if there is an "upflight," sit still and wait for conditions in the colony to return to normal.

2. Colonies located atop bald dunes, in lightly grassed areas, dune hollows or any areas where incubating birds are not readily visible must be entered to properly census. In Massachusetts, this type of least tern nesting situation is relatively uncommon. Again it is stressed, that least tern colonies should not be entered unless it is impossible to ascertain a high confidence estimate from outside the colony boundary as outlined above.

(a) Use only the minimum size census crew necessary to establish an estimate of nesting pairs. In very small nesting groups a crew of 1-2 persons is all that is required. In other nesting situations where nesting birds are dispersed over a large grassy area, the line sweep method (see discussion under common tern) using a crew of 3 or 5 is ideal;

(b) When using the line sweep method, space yourselves appropriately to avoid missing nests. Make as many

"sweeps" back and forth through the habitat as required to cover all areas where activity is noted; the crew members on the line's flanks should drop and retrieve flags to keep track of the area covered. If the area being covered is sufficiently large and featureless, one of the crew may have to "steer" by maintaining a compass bearing.

(c) Count nests containing at least 1 egg. Also, count nests if it is apparent that eggs have hatched and/or chicks have moved away from the nest. Do not count empty scrapes or nests that are obviously abandoned (sanded-in clutches, no fresh tracks, etc.).

Black Skimmer Because nesting black skimmers are so infrequent in Massachusetts and their nesting phenology approximates that of other terns, they can usually be censused incidental to efforts to census common and least tern colonies. Report nests containing at least 1 egg during the standard "A-count" window, June 5-20. If pairs appear at a site after June 20, they should be reported in a "B-count" for the site.

Laughing Gull Laughing gulls appear at a handful of sites in Massachusetts, nesting within common tern colonies. Their phenology is similar to the common tern and should be censused incidental to common tern censuses. Report nests containing at least 1 egg during the standard "A-count" window. "B-counts" are not required.

Piping Plover

Census Techniques Piping plovers are widely distributed along many miles of Massachusetts beaches. Locating them usually comes down to lots of walking, listening, and careful observation.

Census for plovers on days with calm or light winds, as strong wind and blowing sand can make it difficult to hear and see birds. On very windy days, plovers may "sit tight" out of the wind, making them much more difficult to detect. Conditions for censusing are often most favorable in early morning when winds are calmer, light conditions optimal, and fewer people are present. If possible, census near the time of high tide when plovers will be easier to detect than at low tide, when they may be feeding hundreds of yards away from the beach on exposed intertidal flats. However, time constraints often require that censusing take place at all times of day and tidal cycles.

Walk at a moderate pace along the beach between the wrack line and foredune. Occasionally stop, listen, and use binoculars to scan the beach in front of you. On wide beaches or sand spits, walk in a zig-zag pattern in order to cover all available habitat and increase chances of detecting birds, especially ones that may sit tight on nests or may not vocalize unless you come within 50 yards. Make a pass through any areas of potential nesting habitat that may be behind foredunes.

Listen carefully for the plover's soft "peep-lo" call notes. Often this will be the first tip-off that plovers are present; they are typically heard before being seen. Plovers frequently utter these call notes when you approach and enter their territories.

Be sure to scan all intertidal areas with binoculars or spotting scope in order to detect feeding birds. These may include unpaired adults, non-incubating members of nesting pairs, adults with broods, or adults whose nests have been recently lost. Although the majority of attention during censusing should be directed at the upper beach, foredunes, and overwash and blow-out areas between and behind foredunes, you should regularly walk over to the crest of the berm and scan ahead of you along the lower beach and intertidal zone for feeding plovers.

Do your best to sort out how many breeding pairs of plovers are present. Usually, given sufficient observation time, pairs can be identified. Look for evidence of site tenacity (birds present in the same general area each time you visit) and breeding behavior, e.g. territorial and courtship displays, nest scraping, or copulation. Be alert for nests anytime after April 19, and chicks after May 20. When censusing relatively narrow beaches with contiguous pairs in residence, it is often possible to tell by watching the birds closely when you exit one territory and enter another. Birds from the first pair may run ahead of you along the beach for awhile, then turn back (running or flying) when they reach the limits of their territory or are confronted by another pair.

Accurate censusing becomes more difficult on wide beaches with broad expanses of suitable habitat and high densities of breeding plovers. You may at first feel overwhelmed when faced with the task of trying to census many pairs of plovers distributed over large areas of relatively homogeneous habitat. Pairs may be more difficult to sort out here than on narrow beaches that are spatially simpler. Take heart! One strategy is to partition the beach into several smaller sub-units and deal with each separately. Make a sketch map of each sub-unit, noting topographic features that may at first seem subtle but will soon become familiar landmarks. Periodically census all or a significant portion of the beach with several experienced observers; multiple observers can cover more habitat

systematically and can help sort out lots of birds on a large beach. Be patient and systematic, keep good notes, and refer back to your notes as the season progresses.

Whenever you encounter a least tern colony, it is likely that piping plovers are nearby too. Least tern colonies are usually noisy and confusing places to census, so take plenty of time to thoroughly scan the colony looking for plovers that may be incubating, standing, or running about.

Reporting Census Data Monitors report two different counts of piping plovers from their beaches each year, the "Total Count" and an "Index Count". The Total Count is the best estimate of total number of territorial pairs that are present on a given beach during a given breeding season. To be included in the Total Count, pairs must be observed in territorial or courtship behavior or with a nest or chicks, and must be present on a territory for at least 2 weeks between mid-April and mid-July. Note that pairs need not nest or hatch chicks to be tallied in the Total Count. They need only be observed courting or defending a territory at a given site for at least 2 weeks. This way, we include territorial pairs that are part of the population but may have failed to nest because of disturbance or competition or lost nests before they were detected.

The Index Count is the maximum number of pairs counted during a 9-day standardized count period in late May or early June. You will be notified by the Division or your supervisor as to the dates of the Index Count period each year. The Index Count seeks to provide a standardized index of population trends by taking a "snapshot" of the state's population during a short enough time period that double-counting of pairs that may move between sites will be minimized. Most plover nesting beaches in Massachusetts are monitored several times per week during late May and early June, so observers have multiple opportunities to determine the maximum number of pairs present during the Index Count period. However, some sites that are more remote or of lower priority may be censused only once during the Index Count period. Then, census takers must make as thorough and accurate a count as possible of pairs, as well as any single birds present. Contact your supervisor or the Division if you anticipate difficulties in adequately monitoring sites assigned to you during the Index Count, or if you are uncertain whether you are responsible for a given site.

For more information on censusing and reporting census results, see example of the Massachusetts Piping Plover Census Form and instructions in Appendix F.

Monitoring Nests and Chicks Whenever possible, plover monitors

should attempt to locate and monitor the survival of all nests and broods for all pairs on the beaches for which they are responsible. Gathering complete and accurate information on locations of nests and reproductive success of breeding pairs provides the foundation on which piping plover conservation efforts in Massachusetts are based.

Piping plover nests are relatively easy to find once you have gained a little experience. Nests can often be described as "easy" or "hard" to find, depending on stage of incubation, behavior of individual pairs, and location.

1. Easy nests After plovers have laid the last egg in a clutch, they begin full-time incubation. From then on, most nests are relatively easy to locate. Adult plovers that appear anxious or agitated as you approach are usually indicative of a nest or chicks. Adults that give a "broken-wing" distraction display almost always have a nest nearby that is well along in incubation.

The most efficient way to find most nests is to zig-zag slowly through suitable habitat, watching for territorial or incubating birds that react to you. Incubating plovers often “sit tight” on their eggs and seem almost invisible until an observer approaches within about 50 years. Eventually they will leave the eggs and run or walk away quickly, usually either toward you or perpendicular to your approach. They may be silent or call repeatedly. Be especially suspicious of plovers that suddenly "appear" in front of you, alternately running and stopping. Periodically use binoculars to scan the beach ahead of you for birds. Remember that plovers may leave nests without calling, run or walk away, and then stop and blend into the background and become almost invisible until they move again or vocalize.

When you detect a plover that you suspect has a nest nearby, back away and sit or crouch on the sand and watch the bird with binoculars. Often within a few minutes the bird will return to the nest, alternately running and stopping until it reaches the nest scrape and settles carefully back onto the eggs. If instead the bird continues to appear agitated, alternately walking and stopping, all the time remaining alert, you may need to move farther away. With experience, you will soon learn how far away you need to be before incubating birds will return to eggs. This distance will vary depending on the wariness of individual pairs and how far along in incubation they are.

If the bird you are watching stops to feed or preen, or begins scraping or "false brooding", this usually means it either has no nest or has an incomplete clutch (see "hard nests").

Let's assume the bird you have been watching moves steadily back in the direction from which it came, alternately walking or running and stopping, and soon settles down onto its eggs and

resumes incubation. Congratulations - you have found a new nest! Now, resist the urge to immediately rush over to pinpoint its location and count the eggs. Remember that as soon as you stand and begin walking, the plover will run off the nest again, leaving you to search for a perfectly camouflaged set of eggs. Before you stand up, take a minute to observe the incubating bird through your binoculars, pick out a landmark that is within 1-2 feet of the nest, and note its direction and approximate distance from the nest. Your landmark may be a distinctive shell, rock, clump of vegetation, or piece of driftwood, but it needs to be large enough that you can distinguish it with the unaided eye after you put your binoculars down. Once you can find your landmark without binoculars, stand and walk directly toward it. A few yards before you reach it, stop and look around carefully until you see the nest. If you lose sight of your landmark, or still can't see the nest when you get near, it's probably best to back off and sit down again, let the bird resume incubation, and then try again, unless you are experienced at following tracks and "reading" the sand. Don't blunder around looking for a nest that will be nearly invisible against the sand; back away, sit down, and let the incubating bird pinpoint the nest location for you again. If, on the second try you still can't find the nest, best to move on and try later or the next day. Don't keep birds off nests for longer than 10 minutes, especially on windy or rainy days, if temperatures are less than 60 or more than 80 degrees, or when potential predators such as crows or gulls are nearby.

2. Hard Nests Piping plovers typically lay an egg every other day until the clutch is complete (usually 4 eggs, occasionally 3 or less, especially for re-nests). Plovers usually do not begin full-time incubation until the last egg is laid, and may only infrequently visit the nest until the clutch is complete. As a result, finding nests before clutches have been completed (about a 7-day period) is usually harder than finding nests after full-time incubation is underway. Other "hard" nests are those of exceptionally wary pairs that leave their eggs before you get close and then are reluctant to return, and those that are placed in moderately dense vegetation.

Being able to find nests before clutches are complete is important for several reasons. First, each day that passes increases the chances that eggs may be depredated or washed away before you detect them. Second, where predation is a serious limiting factor, placing a wire predator exclosure around a nest a day or two before or after the clutch is completed may increase that nest's chances of survival. Finally, unless a nest is found before the last egg is laid, the hatching date cannot be predicted. This, in turn, has ramifications for the timing of restrictions on off-road vehicles (see state and federal guidelines, Appendices A and B).

Finding incomplete clutches takes time, patience, and skill

in "reading" the sand and interpreting plover behavior. It is also the mark of an experienced and skilled plover monitor. The first step in locating "hard" nests is becoming suspicious that a pair has begun to lay or will soon lay. From late April through June, the presence of 2 birds in suitable nesting habitat, even if they do not appear especially agitated, should arouse suspicion. If you have monitored a site frequently, you will have seen birds engaging in territorial or courtship behavior for several weeks. The presence of multiple nest scrapes, especially deep, well-formed ones, is often a clue that laying is imminent.

There are a couple of techniques for finding nests with incomplete clutches.

a. Follow plover tracks. Even if full-time incubation has not begun, there will usually be several trails leading to and from the nest where plovers have come and gone to lay eggs or check on and re-arrange the eggs. The density of tracks should increase as you get nearer the nest. By following tracks in the direction of increasing density, you may eventually find the nest. CAUTION: walk slowly and carefully! Finding nests by following tracks takes experience and a good search image.

If you suspect that full-time incubation has not yet begun, it is OK to search for longer periods, but as a rule you should avoid walking around looking for a nest in an area for longer than 10-15 minutes, and only if weather conditions are favorable. Remember, tracks are most visible in early morning or late afternoon, when the sun is low in the sky (longer shadows make tracks easier to see). They can be quickly erased by rain or strong winds.

b. Although plovers with incomplete clutches may not immediately reveal the location of their nest, your presence may stimulate them to return to the nest scrape to check on the condition of the eggs after you leave the immediate vicinity. (It is as if the birds need to re-assure themselves that the eggs are still safe). If you suspect a nest with an incomplete clutch may be nearby, move away 75-100 yards, lie or sit down, and watch carefully for 15-30 minutes. Once you are far enough away, one of the adults may go over to the nest and settle onto the eggs briefly or re-arrange them in the scrape. Now, even more than with a complete clutch, it is essential that you observe closely and pick out a reliable landmark that you can use to pinpoint the nest location. If you don't find it on the first try, you'll probably have another long wait!

The key to locating hard-to-find nests is patience and experience. It may take multiple visits over several days, with many minutes of observing the birds from a distance or carefully following their tracks.

3. Marking Nests Develop a system that will allow you to easily relocate nests that you are monitoring. Draw a sketch map that describes both the general location of the nest on the beach and specific landmarks that are within a few feet of the nest. Your sketch should be detailed enough that you can relocate the nest scrape even if the eggs have been depredated without a trace or washed away.

It is often helpful to use debris that you find on the beach to mark locations of nests, but be sure that markers are inconspicuous and placed far enough from the nest to avoid attracting passers-by or predators. One method is to place 2, 2-3 foot-long pieces of driftwood at different spots 20 to 30 ft. from the nest, with each pointing toward the nest. Two imaginary lines extended from the ends of these markers will then intersect at the nest.

4. Monitoring Nests Ideally, nests should be monitored every day. The more frequently nests are checked, the more likely you will be able to determine the fate of nests and identify causes of nest loss.

Once a clutch has been completed, it is not necessary to approach close enough to count the eggs on most subsequent visits. Instead, simply ascertain that an adult is still incubating. Usually this can be done without disturbing the bird off the nest. Once a week, however, it is prudent to approach close enough to count the eggs; occasionally some but not all of the eggs in a clutch disappear for various (often unknown) reasons. Whenever possible, count eggs from a distance with binoculars or spotting scope.

5. Monitoring Chicks An agitated adult that moves toward you and shows no sign of returning to a nest after you back away is often a sign that chicks are nearby. Quickly scan the beach in front of you with binoculars for chicks that may be running away farther down the beach or escaping into vegetation on a nearby dune. Then back up, sit down, and continue to scan with binoculars. Often within a minute or two you will see chicks moving about, perhaps 50 yards or more away. Chicks are small and perfectly camouflaged for the beach, and often are only visible when moving; as soon as they stop they seem to disappear. When in dunes or moderately dense vegetation they are especially difficult to see. Obtaining accurate counts of chicks often entails observing from a distance for a long enough period that the chicks feel safe enough to emerge from cover and move down onto the beach or intertidal area where they can be more easily counted.

If possible, monitors should try to obtain an accurate count of chicks in each brood every 2 to 3 days, until at least age 25 days. For purposes of monitoring chick survival, chicks are

assumed to have fledged at 25 days of age or when observed in continuous flight for at least a distance of 50 feet, whichever occurs first.

Exact causes of chick mortalities are seldom determined. However, be alert to potential causes of loss and time your field activities so as to determine as accurately as possible the date of chick deaths. For example, mornings after storms with heavy rain and strong winds or cold temperatures, or after especially busy weekends, are times to anticipate the disappearance of chicks and schedule monitoring visits. Effective chick monitoring requires disciplined scheduling. Make a chart that keeps a running tally of hatching and anticipated fledging dates for every brood and then record every brood observation on it. Use this chart to help you maintain a schedule of checking each brood at least every 2 to 3 days.

Chapter 9
Predation

General

Predation is a natural process--part of the complex web of natural food chains. Eggs and chicks of terns and plovers are vulnerable to many predators. To compensate for this, these birds have evolved numerous anti-predator characteristics and strategies that are quite effective in thwarting would-be predators. Human activity in or about nesting grounds may, in some cases, augment predation.

Under certain circumstances, control of predation may enhance productivity. However, it is not realistic, necessary or ecologically justifiable to try to completely eliminate predation. Sometimes control of one type of predator merely unleashes other forms of predation.

Nearly every person who monitors nesting terns and plovers will encounter predation in one form or another. DO NOT FEEL PERSONALLY DEVASTATED IF NESTS YOU ARE MONITORING ARE DESTROYED BY A PREDATOR! While it is difficult, for example, to accept the fact that a red fox may raid and destroy a least tern colony overnight, recognize that the terns may relocate and/or renest several times in a season in the wake of natural calamities such as storms and predator raids. In an extreme case, a piping plover female renested 5 times in one summer after recurrent depredations by red fox.

Missing Least Tern and Piping Plover Eggs

At some time, you will likely approach a nest and discover that the eggs are no longer present. One of several events has likely occurred: 1) the eggs have hatched, 2) the eggs have been depredated, 3) the eggs have been washed away by waves or heavy rains, or 4) the eggs have been abandoned and covered by blowing sand.

Keep track of nest chronology and be alert to the anticipated time when nests are due to hatch. Key on behavior of the adults. Adults with newly-hatched chicks will usually react much more vocally and with more agitation to your presence than adults that have lost or abandoned eggs. Be alert to the fact that adult plovers may move chicks hundreds of yards from nests within 1-2 days after hatching. If possible, try to monitor nests every day when they are within a day or two of the predicted hatching date, to improve your chances of determining how many chicks have

hatched.

If agitated adults with chicks are not nearby, carefully search the vicinity of the nest scrape for signs the eggs have been depredated, washed away, or buried in the sand (dig a few inches below the sand in the scrape to check).

Occasionally, some but not all eggs are missing and incubating birds may or may not be present. Loss of a portion of a clutch is often difficult to explain; suspected causes include predation by birds, small mammals, or ghost crabs, and flooding. Occasionally eggs may roll out of nests on very steep slopes. Although loss of part of a clutch is frustrating and perplexing, be aware that the remaining eggs will often continue to be incubated and will eventually hatch.

Abandonment of Piping Plover Nests

A small but significant number of piping plover nests is abandoned each year. Nests both with and without predator exclosures may be abandoned, although it tends to be more frequent with the former. Causes of nest abandonment are difficult to determine. We suspect the most frequent causes are instances where one of the adults is killed or when predators severely disturb incubating plovers by trying to gain access to an exclosure or stand or perch on it.

Be alert to the possibility of nest abandonment. Immediate clues that abandonment may have occurred are: 1) lack of an adult incubating the eggs, 2) lack of aggressive or agitated adults reacting to your presence near the nest, and 3) eggs that are beginning to be covered by blowing sand suggesting prolonged absence of incubating birds. Adults that have abandoned nests will often re-nest nearby but may seem inattentive and show little reaction to your presence (almost as if "sulking" at their loss) for several days.

If you suspect abandonment, spend a few minutes carefully and thoroughly looking for signs of the potential cause. Are there tracks of potential predators inside or near the exclosure? Any evidence that mammalian or avian predators continually circled the exclosure attempting to gain entry? Any signs that adult plovers were pursued? Any evidence that raptors or gulls perched on the exclosure (e.g., feathers or body parts from prey that a raptor may have been consuming, regurgitated pellets or excrement)?

After you have carefully assessed the situation in the immediate area of the nest scrape, begin to search outward for other evidence. Any signs that either of the adult plovers was killed? Be especially alert to determine if 1 or 2 adults are

still present nearby. The presence of only a single adult is suggestive that the other has been killed, although such evidence is not definitive.

Identification of Predation

Before any action to reduce predation can even be contemplated, it is important to try to identify the type of predator involved. This is not always easy, as many of the more important predators are extremely secretive and nocturnal. Major depredations are almost never witnessed! You are a detective trying to solve a puzzle.

The following general tips may prove helpful in dealing with predation:

1. Consult a field guide (see Suggested References) to identify mammalian predator signs on your beach and one of the numerous field guides to birds to acquaint yourself with the various avian predators.

2. Spend time with experienced field people who can help you identify tracks and other predator sign and visually identify avian predators.

3. As you see potential predators (e.g., gulls, crows, dogs), follow and study their tracks. Study behavior patterns (do foxes on your beach follow the wrack line or spend time in the dunes? Do new tracks suggest fox activity every night? Can you distinguish gull from crow from night-heron tracks?)

4. Maximize your time on the beach when conditions are most favorable for "reading" predator signs. These include:

    a. early morning; the higher the sun is in the sky the more difficult it is to distinguish tracks. Windy conditions that can obscure tracks are also more likely after mid-morning.

    b. before rain or storms; rain or wind-blown sand can quickly obscure tracks and other evidence of predators.

5. Stay in touch with weather predictions and budget field time wisely. If you have the option of checking nests Tuesday or Wednesday and a rainstorm is forecast for Tuesday night, check nests on Tuesday! That will allow you to read any signs of predation that might have occurred on Monday night but will be obscured by rain on Tuesday night.

6. Investigate depredated or abandoned nests slowly,

deliberately and intelligently. Stand in one spot and scan as much of the immediate vicinity as possible. Look for tracks or other clues (bits of hair, feathers, scat, dead birds, egg shells). Minimize walking over and obscuring signs.

7. Take good notes and be specific. For example, if fox tracks approached within 6 inches of a nest scrape and all eggs were missing, say so in your notes. Simply noting "fox predation" is much less specific and conveys no information to help the reader assess the information on which you based your conclusion.

Behaviors of the more common predators of terns and piping plovers in Massachusetts are discussed below:

Red Fox When red foxes depredate a tern colony, they typically do so very thoroughly, often striking 60-70 percent of the nests in a single night. They usually consume the entire egg, shell and all, leaving only footprints in the sand. Following these tracks reveals that red fox work systematically through the colony. Usually entire clutches are consumed. If a colony is not cleaned-out in one night, a fox will often return on successive nights. Plover nests within least tern colonies are often vulnerable to predation by foxes or other mammals. Plover nests away from tern colonies are also often depredated by foxes. The ability of individual foxes to find plover nests seems to vary considerably. Some are adept at finding clutches before they are complete and incubation has begun, while others may pass by within 20 feet of nests without detecting them. Be especially alert to signs that foxes are attempting to gain entry to exclosures placed around plover nests or are waiting outside exclosures to catch adults or newly-hatched chicks.

Skunk The tip-off of skunk predation of eggs is the condition of the egg shells. Shells appear well chewed-up or crushed into relatively small pieces; the membrane and shell fragments cling together in a shapeless mass, the contents all licked clean. Look for tracks. The distinct--though usually faint--odor of skunk is sometimes diagnostic. Skunks may kill newly-hatched tern chicks, but predation on more mobile piping plover chicks seems less likely.

Raccoon Eggs taken by raccoons are typically coarsely fractured and do not have a finely chewed or crushed appearance. Remaining fragments tend to be relatively large and often retain portions of their spherical shape. Raccoons may consume eggs at the nest site or carry them a short distance away--sometimes to a rock or piece of driftwood--where they are consumed, leaving a small pile of shells behind. Also, look for tracks in the sand.

Feral Cat Will eat eggs or chicks. Primarily nocturnal. Look for tracks.

Domestic Dog May kill chicks, break eggs, or chase adults. Look for tracks.

Norway Rat Will eat eggs. Look for tracks.

American Crow Crows are a regular predator of tern and plover eggs. Crows are a "smart predator", cueing-in on structures that indicate the presence of nests and eggs. For example, in some areas they have learned that predator exclosures surround nests and eggs. Eggs destroyed by crows usually retain their spherical shape and have a clean, rather large to moderate opening, most often on the side. The size of the opening may be dictated by the stage of the embryo within. Sometimes a smaller puncture, with outward projecting fragments, is present opposite the primary opening. The puncture is made on the ground at the nest site, after which the crow may carry the egg off some distance before consuming its contents. It is almost impossible for a crow to puncture an egg shell and pick it up without leaving some shell fragments, however small, in the nest.

Herring and Great Black-backed Gulls These large gulls may prey on both eggs and chicks of terns and plovers. The eggs and young of terns and plovers are vulnerable to gull predation, particularly when large gull colonies or roosting areas are near tern/plover nesting grounds. Gulls may also take adult terns and plovers, though this is rare. Look for tracks, droppings, pellets, or broken shellfish shells in the nesting area. Individual gull "specialists" sometimes loaf about the fringes of tern colonies specifically to prey upon unwary, newly-fledged terns.

Black-crowned Night-Heron This species is a documented predator on tern eggs and chicks and a suspected predator on plover chicks. Individual "specialists" often appear to target young tern chicks and systematically work through a colony, consuming large numbers of birds. When eggs are taken, night-herons consume the shell as well as the contents. When they are present, night-herons are one of the most serious predators in common and roseate tern colonies.

Great Horned Owl This owl is often a major predator in tern colonies. Virtually no colonies are remote enough from the

mainland to be safe from their nocturnal foraging. Great horned owl predation is unpredictable, can be extremely disruptive, and can trigger night desertion. This species kills wantonly and numbers of decapitated tern carcasses, most of them uneaten, will characteristically be strewn about the colony. Look for pellets. Preys on both adult and juvenile terns.

Short-eared Owl Short-eared owls have been documented to prey upon tern colonies. However, they are not usually a major predator in Massachusetts primarily because they are so rare and localized. In recent years, their nesting sites have been remote from any major tern colonies. Look for pellets.

Northern Harrier Known to take both young and, less commonly, eggs of least terns. In contrast to owls, harriers forage during the day, especially in the morning. Be alert if you observe harriers in or near a tern colony.

American Kestrel "Specialist" individual kestrels may occasionally menace least tern colonies, taking adults and young and disrupting the colony.

Merlin/Peregrine Falcon Individuals of these species may appear at tern and plover nesting areas at any time. Be especially watchful for merlins and peregrines during their migration from late April through May. They may occasionally depredate adult plovers. When a merlin or peregrine appears in a tern colony, it is often a "specialist" individual that will return over and over again, killing adults and disrupting the colony. These species usually perch nearby and leave behind feather remains of victims.

Anti-predator Devices and Techniques

Implementation of predator control measures or the use of predator exclusion devices is a matter for experts. Federal or state permits are usually required. Consult experts and secure proper permits before attempting to use any of the devices described in this section. The following anti-predator devices and techniques have proven effective under certain circumstances:

Chicken-wire Fencing A good general purpose anti-predator fence. This type of fencing is more substantial and replaces post and string "symbolic" fencing. Use of this type of fencing is usually associated with tern colonies, where each individual nest cannot

be fenced. However, be aware that encirclement of an entire tern colony with fencing is a major undertaking. Significant disadvantages are that it is much heavier, more expensive, and labor intensive to install, adjust, and take down than "symbolic" fencing.

Be aware that this type of fencing application is much more complicated than use of fencing for plover predator exclosures (see below). Due to the amount of time required to install this type of fencing around an entire tern colony and the amount of disturbance of nesting birds this is likely to entail, work should be accomplished at traditional nesting colonies before nesting birds have returned. If fence is to be installed around a colony site after birds have returned, a 500 foot buffer should be maintained between the fence and the nearest nest.

(1) Use 4 foot high plastic-coated welded wire fencing with a 2x2" or 2x4" mesh.

(2) Fencing should be buried 6-8" in a trench and attached as tightly as possible, using natural baling twine at the top, bottom, and middle, to 5-foot light-duty metal stakes driven 2 feet into the ground. Make sure the tops of the stakes are <u>below</u> the top wire so as to not provide avian predator perches.

(3) Affix warning signs to the stakes at appropriate intervals.

(4) Monitor the fence daily and <u>promptly</u> repair any breaks; predators will be quick to exploit any opening.

(5) Disassemble hardware as soon as all birds have fledged and are no longer utilizing the area; roll-up fencing and store all equipment ready for use the next season.

<u>Electric Fencing</u> Particularly for the discouragement of fox predation, electric fencing has reportedly proven quite successful. However, this method has not been used frequently, nor has it been thoroughly tested in New England. While reduced amount of heavy hardware is a distinct advantage, high cost, installation time, breakdowns and safety considerations are serious disadvantages.

Electric fencing may be used in conjunction with either "symbolic fencing" or chicken wire fencing. String "sheep wire" ($20/650' roll from Agway's) at 6, 18 and 36 inches above the surface. The number of charging units required will depend on the length of the fence. Battery-powered units ($85) or solar-powered units ($190) electrify 6 miles of wire. Consult Forster (1975), Patterson (1977) and Minsky (1980) for further details.

Predator Exclosures (for plover nests) Wire exclosures placed around individual plover nests have proven effective in reducing both mammalian and avian predation on eggs and are now widely used in Massachusetts and elsewhere (Fig. 9-1). While use of predator exclosures has significantly increased nest success, these devices are by no means fool proof and appear to slightly increase instances of nest abandonment. They may not be appropriate in all situations. There use should be undertaken thoughtfully and with great care and attention to detail, and their effectiveness should be monitored carefully.

Fig. 9-1. Predator exclosure around a piping plover nest.

Biologists or managers who have not installed exclosures should initially work with someone who has this experience in order to become proficient and safe. They should also practice erecting exclosures off-site before fencing actual nests. Construction of new exclosure designs should also be first practiced off-site as well.

A letter of authorization is required from the Division before predator exclosures can be installed around piping plover nests. Detailed information on exclosure design, construction, and monitoring is contained in "Guidelines for the Use of Predator Exclosures to Protect Piping Plover Nests", prepared by the Atlantic Coast Piping Plover Recovery Team and the U.S. Fish and

Wildlife Service (Appendix C). These guidelines should be followed closely unless otherwise authorized by the Division.

Tern Chick Shelters Occasionally individual harriers or kestrels develop a taste for tern chicks. Over a period of days or weeks, they can make inroads on the numbers of fledgling terns. Small conical-shaped shelters fashioned from snow fencing (Fig. 9-2) have been used successfully to afford some protection for least tern chicks. Chicks run into these "tepees" seeking shelter from the hot sun and in doing so become unavailable to predatory birds. Consult Jenks-Jay (1982) for details.

Fig. 9-2. "Teepees" fashioned from snow fencing provide shelter from the sun and provide tern chicks some protection from avian predators.

Shooting/Trapping While the various exclusionary devices discussed in above markedly reduce predation, especially mammalian predation, there are instances in which installation of fencing is not possible or practical. Avian predators--viz., gulls, black-crowned night-herons and great horned owls--are not excluded by fencing. And while twine can be strung over small exclosures to exclude avian predators, this method is impractical for areas exceeding 10,000 square feet. As a result, shooting or trapping and removal of predators are sometimes the only methods available.

The destruction and/or removal of predators should only be considered when predation has been documented as a consistent and significant limiting factor in preceding years, the species of predator(s) have been identified, and no other means of reducing predation to acceptable levels are available. Work, to the

greatest extent possible, should be carried-out in the 2 month period preceding the arrival of breeding terns. Occasionally an individual predator--such as a black-crowned night-heron or an owl--will turn up in the midst of the nesting season and systematically menace a tern colony. There may be little choice in these instances except to try to remove it.

Shooting or trapping of menacing predators is a matter for experts. Landowners and local governing bodies may have policies, bylaws or ordinances that place limitations on what can be done. Federal and/or state permits are required before wild animals may be taken for any reason. Contact the Division of Fisheries and Wildlife for assistance.

Suggested References

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Rimmer, D.W. and R.D. Deblinger. 1990. Use of predator exclosures to protect piping plover nests. J. Field Ornithol. 61:217-223.

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Chapter 10
Collection and Preservation of Biological Material

Salvage of carcasses of terns, plovers or their unhatched eggs requires a letter of authorization from the Division. In instances where it is necessary or desirable to salvage materials on short notice (including the collection of sick or injured birds) and an authorized individual cannot be located, verbal authorization may be given to cooperators by appropriate Division staff. It may be appropriate for some cooperators to obtain a letter of authorization before the season begins.

Eggs

In recent years, cooperators have been asked to collect unhatched eggs for analysis of levels of PCBs and other toxic chemicals. However, chemical analysis has been impeded by lack of funds. Before salvaging unhatched eggs, cooperators should first contact appropriate Division staff to 1) determine if collection of unhatched eggs is desired and 2) obtain authorization.

Eggs should only be collected after they have been left unincubated for at least 3 days, after observations on 3 different days fail to detect incubating birds. Conditions at the nest should also indicate that the eggs have been abandoned (i.e., sand drifting into the nest scrape and around the eggs, lack of fresh tracks, etc.).

Do not disturb:

1) eggs in incomplete clutches! Remember, piping plovers generally do not begin full time incubation until all the eggs have been laid, and eggs are usually laid every other day. Terns also delay incubation until their clutches are complete (except in the case of the roseate tern), laying eggs at intervals of 1-3 days. Roseate terns initiate incubation with the laying of the first egg.

2) eggs that are unhatched in the nest ≤2 days after hatching of the rest of the clutch for terns and piping plovers; except ≤4 days for the roseate tern. It is not unusual for eggs to hatch 1 or 2 days after the rest of the clutch and even 3-4 days for the roseate tern. In plovers, an adult sometimes returns to incubate unhatched eggs after the rest of the clutch has hatched and the chicks have left the nest. Occasionally, ambient temperatures in summer are sufficient

to hatch eggs several hours after adults have ceased incubation.

If you are asked or elect to salvage eggs, wrap them in aluminum foil and place them in an egg carton, paper cup padded with tissue, or a similar padded container. Do not place eggs in plastic bags, as eggs in plastic bags are more subject to breakage, and plastic may contaminate eggs and bias future tests for some toxics. Be sure to label each clutch with your name, date and location, species and circumstances. For plover eggs, also include the pair and nest number, as it will appear on your season-end reporting form.

Overdue Hatching

Occasionally terns and plovers will continue to incubate inviable eggs for days or even weeks past the normal incubation period. Because most plover nests are monitored so closely, the exact age of eggs is often known. This is not usually the case at most tern colonies since individual clutches are not marked and their fates are unknown. An exception is at research colonies where nest marking is authorized.

The average incubation period in piping plovers is 27-28 days; the longest incubation period with successful hatching that we are aware of is 39 days, although hatching after 32 days of incubation is very unusual. We normally assume that eggs incubated for more than 40 days are inviable and not going to hatch. In such cases, it is probably advisable to remove the eggs to allow the adults time to renest or, if too late in the season, to devote full time to feeding in preparation for fall migration. Such eggs should not be removed or salvaged, however, without first obtaining verbal or written authorization from appropriate Division staff.

Salvage of Carcasses

In some cases the salvage of a carcass may be important for law enforcement evidence (see Chapter 6). Otherwise, we are only requesting the routine salvage of federally-listed piping plovers and roseate terns. If you are not already authorized, contact the Division immediately for verbal authorization to retrieve a carcass. If the carcass is still fresh, try to get it out of the sun and heat as soon as possible. Whether fresh or not, the carcass should be stored in a freezer, preferably in a zip-loc freezer bag, with a tag written in pencil stating the date and location of collection and the name of the person who salvaged the specimen. The salvage of a piping plover, roseate tern or any federally-listed species should be reported to the Division as

soon as possible. At that time we can try to arrange for transfer of the specimen to the Division.

Occasionally, there may be a desire to salvage specimens of other species. The same procedure should be followed. If there is a desire to keep a specimen for educational or research use this must be authorized by the Division, and in some cases by the U.S. Fish and Wildlife Service as well. If the specimen is to be mounted by a taxidermist, a state and federal "mounting permit" will need to be acquired. Authorization to keep specimens for educational and research use can generally be granted for educational and research organizations but not for private individuals.

Sick or Injured Birds

If a sick or injured piping plover or roseate tern is found, it should be picked up and delivered to one of the wildlife rehabilitation facilities listed below and the Division should be notified as soon as possible. Once a sick or injured bird is captured it is important that it be delivered to someone that can stabilize it and be able to administer fluid therapy as soon as possible. A captured bird should not be subjected to any unnecessary stress of handling. A dark container such as a ventilated cardboard box will work well for holding and transporting the bird. All federally-listed birds will be transferred to the Wildlife Clinic at the Tufts School of Veterinary Medicine in North Grafton for primary treatment at the earliest opportunity.

Other species may be picked up or not at the cooperator's discretion. However, do not pick up any bird unless you are certain that it is sick or injured and you can get it to someone who can provide care within 2-4 hours. Species other than those that are federally-listed may be delivered to any wildlife rehabilitator who is licensed to handle migratory birds.

Following are names, addresses and telephone numbers of cooperating veterinarians that have handled terns and plovers:

New England Wildlife Center
(Dr. Gregory Mertz)
19 Fort Hill St.
Hingham, MA 02043
tele: (617) 749-5387

Dr. Mark Pokras
Tufts Wildlife Clinic
Tufts Univ. School of Veterinary Medicine
200 Westboro Road (Route 30)

North Grafton, MA 02536
tele: (508) 839-7918

Sandwich Wildlife Clinic
(Dr. Laurie Bergman)
HHUS Wildlife Rehabilitation Center
185 Meadow Lane
W. Barnstable, MA 02668
tele: (508) 362-0111