



The Status of Tern Populations in Northeastern United States and Adjacent Canada

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The Status of Tern Populations in Northeastern United States and Adjacent Canada

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Abstract.—This is a report of a workshop on tern populations in northeastern North America. Eighteen regional reports summarize data on numbers, trends, and productivity of 10 species of terns in the Great Lakes, the Gulf of St. Lawrence, and the Atlantic coast from Newfoundland south to Virginia. Although census techniques have varied in accuracy and comprehensiveness, the data permit the following estimates of tern populations in this area: Gull-billed Tern (*Sterna nilotica*), less than 1000 pairs; Caspian Tern (*S. caspia*), 4250 pairs; Royal Tern (*S. maxima*), 3000-4000 pairs; Sandwich Tern (*S. sandvicensis*), less than 20 pairs; Roseate Tern (*S. dougalli*), 3100 pairs; Common Tern (*S. hirundo*), 70-75,000 pairs; Arctic Tern (*S. paradisaea*), 5-6000 pairs (excluding Newfoundland); Forster's Tern (*S. forsteri*), 3100 pairs; Least Tern (*S. antillarum*), 7000-7500 pairs; Black Tern (*Chlidonias niger*), no estimate possible. Recently, Arctic and Gull-billed Terns have decreased, whereas Caspian, Forster's, Roseate, and (at least locally) Common, and Least Terns have increased. Data on breeding success are available for six species. Adverse factors include occupation of nesting habitat by gulls, human disturbance and development, predation, and flooding. Loss of nesting habitat due to these factors has left sub-optimal or man-made habitat such as salt marshes, dredged spoil islands, structures, and roofs of buildings. For several species, a large fraction of the population now nests on sites that are publicly owned, managed, or protected. Despite some recent population increases, most species still remain far below numbers of 40 years ago. Continued management and protection will be necessary to maintain suitable sites for current populations.

Key words: Terns, Eastern North America, Population trends, Reproductive success, Management, Conservation.

Many tern populations in the northeastern United States and adjacent Canada are presently experiencing intense pressure from human activities. Such pressures include loss of nesting habitat through human development and to early-nesting gulls, disturbance from recreational use, and increased mortality due to hunting in the winter ranges.

Previously, the high reproductive potential, relatively long life spans, and abilities of terns to relocate when disturbed have permitted most populations to persist through even the most intense persecutions of the past 120 years. However, these same characteristics—mobility and population fluctuations—also make it difficult to determine long-term population trends and the impact of current conservation measures. Without a coordinated census approach at the regional level, using standard techniques for determining population size and reproductive success, real population declines could be mistaken for local colony

shifting, and *vice versa*.

In November, 1982, we coordinated a workshop on tern populations in seventeen contiguous states and six Canadian provinces at the annual meeting of the Colonial Waterbird Group. This report is a summary of information presented at the workshop and subsequently prepared for publication by regional experts. Our goal in compiling this report was to assemble information on past and present population trends and the factors affecting reproductive success at a subcontinental level. From this review, it is apparent that many researchers face common problems of discontinuity in census techniques between years, or in many cases a complete absence of baseline data until the most recent years. It is our hope that a subcontinental approach to assessing the population status of terns will provide a format for identifying regional problems before they become twelfth-hour conservation crises.

The U.S. Great Lakes

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The islands and shoreline of the Great Lakes within U.S. boundaries (hereafter USGL) from Pigeon Point, Minnesota (plus Isle Royale), to Cape Vincent, New York, were censused completely in 1976 and 1977 (Scharf 1978, Scharf et al. 1979). Survey data for the entire USGL area before or after the 1976 and 1977 surveys do not exist. Two regions of the USGL that we have censused since 1977 (Table 1) and which we use as a geographical base for comparison of population trends are: 1) the Michigan Great Lakes (MGL), which is the contiguous area within Michigan's boundaries where Common Terns nested in 1976 and 1977; and 2) the Ludwig Survey Area (LSA), which is that part of MGL surveyed by Ludwig (1962) in 1962. Data from LSA provides the best long-term overview of nesting numbers. See Shugart and Scharf (in press) for maps of MGL and LSA.

TABLE 1. Common Tern nests counted in surveys of the U.S. Great Lakes. See text for definition of the survey areas. Counts are rounded to the nearest five nests. ND=not determined, data not available or data collected using different methods.
Source: Shugart & Scharf (1982), incorporating data from Ludwig (1962) and Scharf (1978).

Year	Number of Nests			Productivity (Chicks/ pr.)
	USGL	MGL	LSA	
1962	ND	ND	2855	ND
1976	2490	1390	1425	ND
1977	2500	2080	795	ND
1980	ND	2060	1495	< 0.2
1982	ND	2110*	1500	1.3

*Area not completely searched in 1982.

Note: The U.S. Fish and Wildlife Service (Anon., 1982a) listed 2000 pairs in Minnesota and 77 pairs in Ohio. These counts include more area than just the shorelines of the Great Lakes.

COMMON TERN¹

Past Trends and Present Status: In the LSA, the number of nesting pairs declined from the 1960's to the mid-1970's, but now appears stable (Table 1).

Adverse Factors: The major cause of the decline was loss of sites, primarily to rising Great Lakes water levels (Cohn & Robinson 1976, Shugart & Scharf in press), and a lack of suitable alternative sites in the study areas. The current stability primarily results from nesting on man-made structures that were constructed after the mid-1970's (Shugart & Scharf in press), and which are unaffected by fluctuating water levels. Although numbers have stabilized, considerable shifting between sites has occurred.

CASPIAN TERN

Past Trends and Present Status: All colonies in the USGL are within the MGL. The number of nests increased from 1145 in 1965 to 1435 in 1967, 1605 in 1976, and 1640 in 1978 (Ludwig 1968, Shugart et al. 1978). Since 1978 the number of nests has increased by about 10% (Shugart & Scharf, unpubl. data). Relative stability in USGL as compared to the 50% increase in the Canadian Great Lakes reflects differences in habitat availability (Shugart et al. 1978). In 1982 Caspian Terns began nesting in the U.S. portion of Lake Huron, as they had done in the 1960's (Ludwig 1968).

Factors Affecting Conservation: The Nature Conservancy has recently purchased two Caspian Tern sites, which should ensure that nesting habitat will be available to this species in the future.

FORSTER'S TERN

Past Trends and Present Status: In 1976,

¹For scientific names of terns, see Summary and Overview.

298 nests, and in 1977, 54 nests were located in Green Bay, Lake Michigan, but none was found in other portions of the USGL. In 1980 we found 100 nests in Saginaw Bay and Lake St. Clair. Using a comparable search effort, the number of nests had increased to 800+ at 12 sites in the same area

in 1982. The reason for the increase is unknown (Scharf & Shugart MS).

BLACK TERN

Past Trends and Present Status: Present in marshes throughout USGL; status unknown but presumed to be linked to availability of marsh habitat.

The Canadian Great Lakes

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The Canadian Great Lakes area encompasses the Canadian portion of Lake Superior, St. Mary's River, Lake Huron, St. Clair River, Lake St. Clair, Detroit River, Lake Erie, Niagara River, and Lake Ontario. No comprehensive inventory of the entire area has been conducted in any single year, but individual water bodies have been surveyed in different years. Inventories largely focused on island-nesting larids; hence data for marsh-nesting Forster's Terns and Black Terns are incomplete.

COMMON TERN

Past Trends: Unknown for Lake Huron. In the lower Great Lakes area the population has declined since the early 1970's (Courtney & Blokpoel 1983).

Present Status: Between 1976 and 1980, 88 colonies have been noted with a total of about 8000 nests (Table 2).

Reproductive Success: Much variability

among colonies and between years (Table 3).

Adverse Factors: Lowered reproductive success due to human disturbance, predation, and wash-outs. Loss of nesting habitat due to competition with gulls (mainly Ring-billed Gulls) and encroachment by vegetation (Courtney & Blokpoel 1983). Mortality on the wintering grounds may be high (Blokpoel et al. 1983).

CASPIAN TERN

Past Trends: Many of the colonies have had a long history. During the last decade the nesting population has probably increased by about 50% (J. P. Ludwig pers. comm., Blokpoel 1977, Weseloh et al. in press).

Present Status: In 1980, there were 10 colonies. Nest counts showed that colony sizes ranged from 72 to 523 nests, with a total of about 2450 nests. Eight colonies

TABLE 2. Estimates of numbers of Common Tern nests in the Canadian Great Lakes area.

Water body	Year	Basis of estimate*	Number of Colonies	Range in Colony Size	Total Number of Nests	References
Lake Superior	1978	as	0	—	0	1
St. Mary's River	1980	bs	0	—	0	2
Lake Huron	1980	nc	81	1-1082	5347	2
St. Clair River	1977	as	0	—	0	3
Lake St. Clair	1977	as	0	—	0	3
Detroit River	1977	nc	1	—	159	3
Lake Erie	1977	nc	4	6-938	1244	3
Niagara River	1977	nc	0	—	0	3
Lake Ontario	1976	nc	2	53-1246	1299	4

*as—air survey, bs—boat survey, nc—nest count

¹Blokpoel et al. (1980); ²Weseloh et al. (in press); ³Blokpoel and McKeating (1978) ⁴Blokpoel (1977).

TABLE 3. Hatching success and fledging success of Common Terns on the Canadian lower Great Lakes.

Colony		Number of eggs hatched per egg laid	Number of chicks fledged per egg laid	Number of chicks fledged per nest	Reference
Hamilton Harbour ¹	1972	0.35	0.05	0.13	Morris et al. 1976
Mugg's Island	1972	0.56	0.07	0.19	Morris et al. 1976
Port Colborne ²	1972	0.81	0.36	0.95	Morris et al. 1976
Fighting Island	1972	—	0.4-0.51	0.9-1.18	Simpson 1972
Mugg's Island	1973	0.27	0.15	0.34	Morris 1974
Eastern Headland	1973	0.78	0.53	1.56	Morris 1974
Port Colborne ³	1974	0.80	0.56	1.56	Hunter 1976
Gull Island	1975	0.67	0.18	0.49	Chardine 1975
Gull Island	1976	0.53	0.26	0.55	Morris et al. 1980
Port Colborne ²	1976	0.55	0.32	0.77	Courtney 1977
Eastern Headland	1977	0.88	0.60	1.71	Haymes and Blokpoel 1978

¹Neare and Farr Islands combined; ²Breakwater only; ³Breakwater and Canada Furnace combined

were located on Lake Huron (two in the North Channel, and six in Georgian Bay) and two on Lake Ontario (Blokpoel 1977; Weseloh et al. in press).

Reproductive Success: At the Eastern Headland (Lake Ontario) hatching success in 1977, 1980, and 1981 was 82%, 79%, and 75%, respectively, and the number of chicks fledged per egg laid in 1980 and 1981 was 0.69 and 0.73, respectively (Haymes & Blokpoel 1978, Fetterolf & Blokpoel 1983). At South Limestone Island (Lake Huron) the number of chicks fledged per egg laid in 1978 and 1979 was 0.43 and 0.32, respectively (Quinn 1980).

Adverse Factors: Human disturbance of nesting colonies (R. D. Morris, pers. comm.).

FORSTER'S TERN

Past Trends: No reliable data.

Present Status: This species nests in Lake St. Clair (15-25 nests in 1977: Blokpoel, unpublished air survey data) and at Long Point (20 nests counted in 1979: McCracken et al. 1981).

BLACK TERN

Past Trends and Present Status: Unknown. Has nested in the Long Point marshes (Lake Erie) at least since 1907.

Reproductive Success: At Long Point 39% of nests in 1975 and 72% of nests in 1976 failed completely (Dunn 1979).

Adverse Factors: Drainage of marshes reduces available nesting habitat.

Northern New York

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COMMON TERN

Past Trends: This report covers the international sector of the St. Lawrence River, Eastern Lake Ontario, and Oneida Lake. In 1915-1930 large numbers nested in the upper St. Lawrence River and the species

was established on the islands on Oneida Lake (Merwin 1918, Stoner 1932). From the late 1940's to the early 1960's large colonies occurred on Little Galloo Island and Sandy Pond in eastern Lake Ontario (Belknap 1968, Bull 1974, F. G. Scheider, pers. comm.). At this time, colonies were also

present in the western St. Lawrence River (Quilliam 1973) and in Oneida Lake. Based on information in Bull (1974) and regional reports from *Kingbird*, we suggest a minimum of 2500 pairs in this region in the early 1960's.

Present Status: In 1982 there were 991 nests in 21 colonies (Smith et al. 1983). Of these, 591 nests were on the St. Lawrence River and Eastern Lake Ontario where the mean productivity was 0.29 fledged young per active nest. The remaining 400 nests were on Oneida Lake (R. Chariff pers. comm.).

Adverse Factors: During the past 25 years several tern colonies have been elimi-

nated by encroaching Ring-billed Gulls. These include Little Galloo Island, formerly the largest colony in this region. The second largest colony in the region at Sandy Pond (Bull 1974) was eliminated by recreational pressures (F. G. Scheider, pers. comm.). Construction of cottages on Black Ant Island led to the recent abandonment of this long-occupied colony. Entanglement in fishing lines appears to be an increasingly serious problem. Human visitation to tern colonies on navigational marker platforms causes young to jump into the water and they are swept downstream by the current. Great Horned Owls (*Bubo virginianus*), are causing serious problems at tern colonies in the western St. Lawrence River (E. Waltz, pers. comm.).

Vermont

[Editors' Note: Common Terns nested on Popasquash Island in Lake Champlain at least as early as the late 1880's and may have nested in this vicinity without interruption to the present, but no surveys were made until 1980. Complete surveys in 1980 and 1981 found approximately 100 pairs nesting on six islands in Northern Vermont

waters of Lake Champlain. Since 1940, Ring-billed Gull populations have increased, displacing terns into marginal nesting habitat where they are vulnerable to flooding and human disturbance (Vermont Fish and Game Dept. and Vermont Institute of Natural Science)].

St. Lawrence River System

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COMMON TERN

Past Trends: Fig. 1 summarizes censuses conducted in six sanctuaries on the North Shore of the Gulf of St. Lawrence at 5-year intervals since 1925. These sanctuaries include only about 3% of the total number of terns in the Gulf. The censuses indicate four contrasting population trends. A decrease between 1925 and 1955 was followed by a marked increase up to 1965. Declines occurred between 1965 and 1972, but from 1972 to 1982 the population seems to have returned to former levels. More complete surveys will be carried out in the Mingan Archipelago in the near future. This area comprises the main concentration of terns in this region.

Present Status: The St. Lawrence river system is usually divided into 3 areas: 1) River system, 2) Estuary system and 3) Gulf system. Based on recent data, Common Tern populations for these three areas are: 150 pairs in the River system, 10 pairs in the Estuary, and 20,855 pairs in the Gulf (Chapdelaine & Bourget 1981). The figures for the Gulf include terns nesting on the North Shore, Gaspesia, Anticosti Island, Iles-de-la-Madeleine, New Brunswick, Prince Edward Island, and Nova Scotia.

Adverse Factors: Factors directly responsible for the declines observed in the periods 1925-55 and 1965-72 are difficult to determine because of the lack of precise data on terns in these remote areas. One of the most serious problems appears to be egg collect-

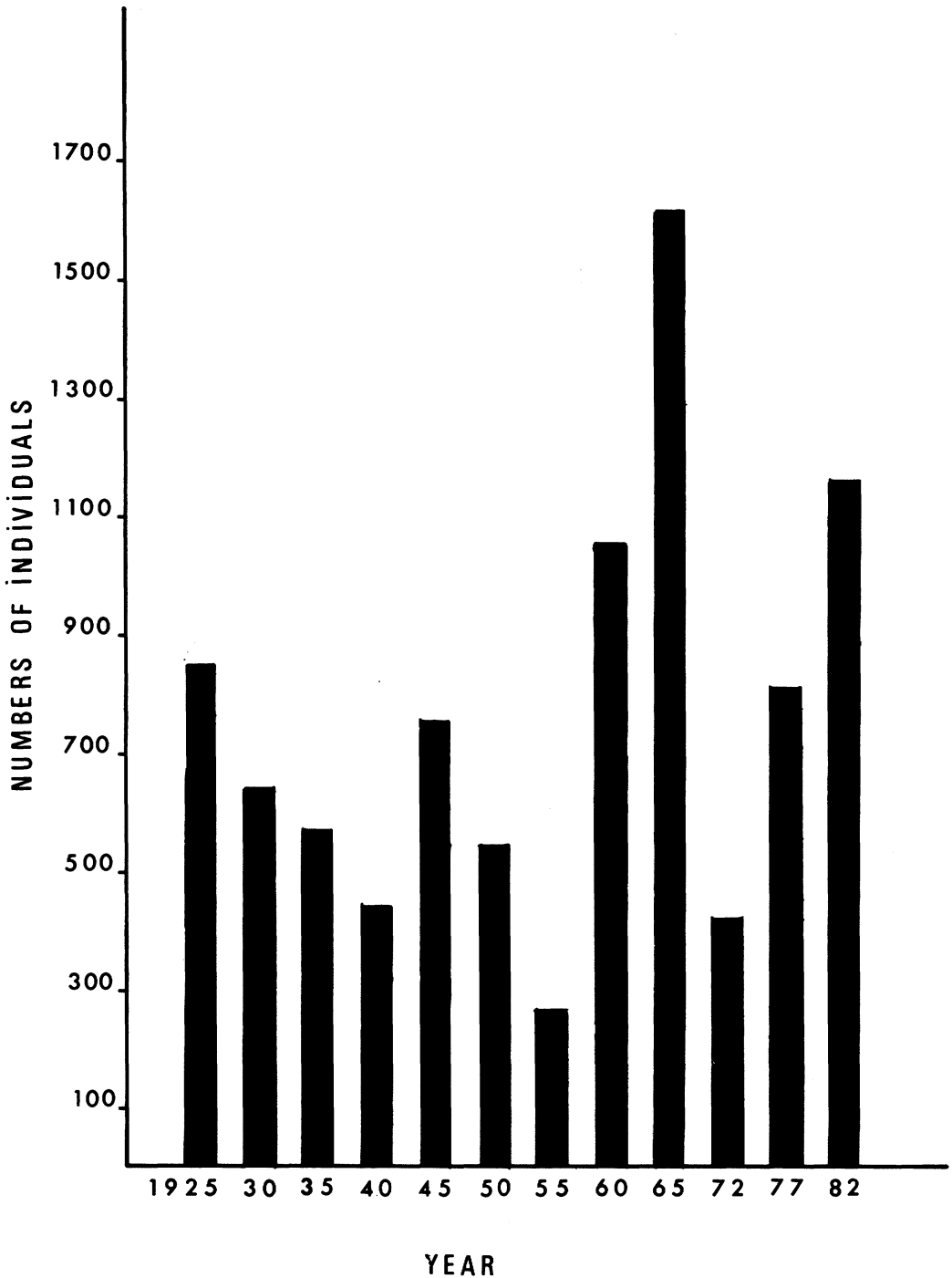


Fig. 1. Variation in numbers of Common Terns in six sanctuary islands on the North Shore of the Gulf of St. Lawrence at five-year intervals 1925-1982.

ing and human disturbance by residents in the area of the Mingan Archipelago.

ARCTIC TERN

Present Status: Earlier censuses from the

North Shore sanctuaries did not distinguish between Arctic and Common Terns. We estimate that about 3% of the present population (i.e., about 600 pairs) in the Gulf are Arctic Terns.

CASPIAN TERN

Past Trends and Present Status: Formerly bred in small numbers in the North Shore sanctuaries. In 1977 three adults and one nest were found on Fog Island Sanctuary, and in 1982 seven adults and three nests were present there.

ROSEATE TERN

Past Trends and Present Status: About six pairs nested on the Iles-de-la-Madeleine in 1972, and a few were still present in 1982 (McNeil 1973, Gosselin & David 1982).

Newfoundland

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COMMON, ARCTIC, AND
CASPIAN TERNS

Past Trends: Common and Arctic Terns nest on rocky islands all around the coast. Common Terns also breed in ponds in the interior and may nest singly or in sizeable colonies (Tuck 1967). Colonies of Arctic Terns have been estimated to contain up to 800 pairs (Peters & Burleigh 1951). Most of these colonies are concentrated on the northeast coast, especially on the Wadham Islands (Tuck 1967). Recent estimates indicate that hundreds of pairs of *Sterna* species (Common and Arctic Terns) nest on the Wadham and Penguin Islands and that about 100 pairs of Arctic Terns may nest on the nearby Cabot Islands (Nettleship 1980). In 1943-45, Peters & Burleigh (1951) documented 28 colonies of Common Terns containing 1030 pairs and 19 colonies of Arctic

Terns with 2700 pairs. Small numbers of Caspian Terns nest on a few coastal islands, inland ponds, lakes, and rivers (Tuck 1967); there is a recent estimate of about 20 pairs on the Wadham and Penguin Islands (Nettleship 1980).

Present Status: Unknown. No attempts at complete surveys of Newfoundland tern populations have been made since 1945.

Adverse Factors: "Egging" and disturbance by some local residents may have resulted in abandonment of a few tern colonies, such as the Arctic Tern colony at Funk Island where a large population existed in the late 1800s, and 17 pairs were last recorded in 1952 (Kirkham & Montevecchi 1982). Water level changes resulting from hydro-electric projects can displace Common Terns from certain fresh water nesting sites (Montevecchi et al. 1982).

New Brunswick, Nova Scotia, and Prince Edward Island

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Three species of oceanic terns breed in the Maritime Provinces: Arctic, Common, and Roseate. On the Atlantic coast of Nova Scotia, Arctic Terns likely predominate while on Prince Edward Island and the Gulf coasts of Nova Scotia and New Brunswick, most of the terns are Common Terns. Roseate Terns are very rare, almost certainly less than 1% of the total population, and not at present known to breed in sig-

nificant numbers in any colony. Caspian Terns do not breed in the Maritimes but they breed in small numbers in insular Newfoundland and Labrador.

With the exception of the Atlantic coast of mainland Nova Scotia, no systematic census of Maritime Provinces terneries has been made. But many estimates of individual colony sizes are on record, made by many different people, using a variety of

(often unstated) census methods. These are the basis of the population estimates presented here.

COMMON AND ARCTIC TERNS

Past Trends: The few colonies for which we have long-term records offer conflicting evidence. On Machias Seal Island, at the mouth of the Bay of Fundy, Brown (1911) and Pettingill (1939) reported 2000 pairs of Arctic Terns. In 1947 and 1948, Hawksley (1957) estimated that there were 2900 and 3450 pairs breeding there, although he used an indirect census method that was biased to give an overestimate. The Canadian Wildlife Service counted 2122 nests in 1974, and counts from 1979 to the present show a population fairly stable at around 1500 pairs. In contrast, the Kouchibouguac colony of Common Terns in northern New Brunswick, which has been censused since 1974, has shown a regular growth from around 1500 pairs in 1975 to 2676 pairs in 1980.

The only indisputable population crash occurred to the huge colony of Arctic and Common Terns on Sable Island. Here in 1901, Saunders (in St. John 1921) estimated that tern numbers "did not fall far short of a million on the island". Thomas Raddall (pers. comm.) remembered terns as nesting "everywhere" in 1921, and large gulls as uncommon non-breeding birds. E. Germaine (pers. comm.) thought that there were "thousands, perhaps a hundred thousand" terns and quite a lot of gulls in the late 1940's. I counted all the terns on Sable Island on 15 and 16 July 1971, and found only 2585 birds, though many more

than this were present early in the breeding season. In June 1982, Ian Kirkham (pers. comm.) estimated that only 340 pairs of Arctic, 220 pairs of Commons, and 4 pairs of Roseates bred there.

Present Status: The largest concentration of terns in this region is on 120 miles of the Gulf coast of New Brunswick between Caraquette and Shediac. Here twelve colonies are known, at least three of substantial size, which are thought to contain up to 9000 breeding pairs. Another concentration occurs at the mouth of the Bay of Fundy (Machias Seal Island, N.B., and Peter Island, N.S.), but over the remainder of Nova Scotia and Prince Edward Island colonies are generally small and widely dispersed. Recent estimates of the breeding tern populations in the Maritime Provinces are summarized in Table 4.

Adverse Factors: Gulls have displaced terns on Sable Island.

[Editors' Note: Terns breeding in northern New Brunswick and Prince Edward Island also have been reported in the section on the St. Lawrence River System.]

TABLE 4. Estimated numbers of Common and Arctic Terns nesting in the Maritimes.

	No. of Colonies	No. of pairs
Northern New Brunswick	12	9000
Prince Edward Island	16	1600
Atlantic Nova Scotia	18	2500
Sable Island	1	600
Bay of Fundy	2	2000
Total	49	15,700

Maine

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Table 5 summarizes historical data on the numbers of terns nesting in Maine, derived primarily from the review by Drury

(1973-74). Data for 1977 are from Korschgen (1979) and Arbuckle (1982). Data for 1982 are incomplete, but include the major colony sites for Arctic, Roseate, and Least Terns.

COMMON TERN

Past Trends: Rebounding after exploi-

¹ I thank Jane Arbuckle, Joe Cadbury, William Drury, Alan Hutchinson, Stephen Kress, Mrs. Charles Lee, Sandra Lovett, Ralph Palmer and Hank Tyler for unpublished information.

TABLE 5. Estimates of numbers of pairs of four species of terns in Maine, 1885-1982.

Year	No. of Colonies	Source	Arctic Tern	Common Tern	Roseate Tern	Least Tern
1885	75	B	present	present	present	0
1890	31	B	present	present	present	—
1900	20	A,D	*2500	1100-1700(15)	—	0
1902-1905	25	A,D	*5500	4800(16)	—	0
1911	25	A,B,C	*5500	4000(19)	—	0
1931	27	A,B,C	*8000	6500	275(3)	0
1936	27	B	*8000(10)	6000(25)	—	0
1940	—	A,B	4500	8000(25)	—	0
1945	—	A	5000	7900	—	0
1972	33	A,E,F	2900(11)	2600(18)	75-150(2)	40(2)
1977	31	G,H	1640(9)	2095(24)	80(3)	55(6)
1982	—	H,I	1300(5)	Incomplete	140(3)	42(4)

Sources: A. Drury 1973-74; B. Palmer 1949; C. Allen & Norton 1931; D. Dutcher 1901, 1902; E. Tyler 1975; F. Nisbet 1973; G. Korschgen 1979; H. Arbuckle 1982; I. unpublished data (see footnote, page 91)

*includes Machias Seal Island (now in New Brunswick)

Numbers in parentheses = number of colonies.

tation in the late 1880's, the population expanded for about 30 years and since 1940 has gradually declined (Drury 1973-74).

Present Status: The last state-wide census in 1977 found approximately 2095 pairs nesting on 24 islands (Korschgen 1979). Among the largest and most persistent colonies in the state have been those on Petit Manan (Milbridge), Thrumcap Island (Brooksville), North Sugarloaf Island (Phippsburg), Lower Clapboard Island (Falmouth), and Beach Island (Biddeford). However, Petit Manan and Thrumcap Island were abandoned in 1982. The re-establishment of terns at Eastern Egg Rock in Muscongus Bay from 80 pairs in 1980 to 1004 pairs in 1983 (Kress 1983) is the first nesting of terns on that island since gulls excluded terns in 1937.

Adverse Factors: Precise data on reproductive status and recruitment are lacking in Maine. Shifts between islands have been attributed to local weather (Palmer 1938), predators (Norton 1925), human disturbance (Drury 1973-74), and displacement by gulls (Nisbet 1971, 1973). Gulls have broken up several large, traditional tern nesting colonies (Palmer 1949, Norton 1921). Where gulls nest adjacent to a tern colony they can cause substantial chick mortality leading to lowered reproductive success (Hatch 1970).

ARCTIC TERN

Past Trends: Arctic Tern populations

remained more stable than those of Common Terns until the late 1970's owing to protection provided by lighthouse keepers at three of the major colonies (Drury 1973-74). Arctic Terns have nested without interruption at Machias Seal Island since at least 1873 (Palmer 1949) and at Matinicus Rock since at least 1870 (Norton 1924a). One important colony, Metinic Green Island (Matinicus), was lost when gulls displaced approximately 2000 terns by 1920 (Norton 1924b), and another (Petit Manan) was lost to gulls in the last four years.

Present Status: Excluding Machias Seal Island, the most recent statewide survey found this species nesting on nine islands in Maine, three of which had more than 300 pairs (Korschgen 1979). D. Enstrom found 963 nests at Matinicus Rock in 1982, suggesting relative stability since at least 1971 when 900-1100 pairs were estimated at the island (Nisbet 1971). However, an overall decline is apparent as the 700 pairs of Arctic Terns that formerly inhabited Petit Manan are unaccounted for and numbers at Matinicus Rock have dropped by about 50% since 1940 (Drury 1973-74).

ROSEATE TERN

Past Trends and Present Status: Roseate Terns in Maine have never comprised much more than about 1% of the total New England population (Nisbet 1973). Numbers

increased to a peak of about 275 pairs in 1931 and fell to less than 150 pairs by 1972 (Drury 1973-74). In 1982, about 35 pairs were nesting on North Sugarloaf Island (A. Hutchinson pers. comm.) and about 100 pairs on Little Stratton Island. The formation of this new island in the late 1970's provided isolation from human disturbance and growing gull numbers on Stratton Island.

Adverse Factors: Human disturbance and competition for nesting islands with gulls appear to be the principal factors limiting numbers and breeding distribution.

New Hampshire

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COMMON TERN

Past Trends: Common Terns have nested at four sites in New Hampshire: at Londoner's Island (Is. of Shoals) from 1922 to about 1950, with a peak of 1500-2000 pairs in 1928-38 (Jackson 1947, Drury 1973-74); at Seabrook from 1927-53, with a peak of 118 nests in 1929 (White 1929); on islands in Great Bay, with a peak of about 50 pairs in 1970 (A. C. Borrer, E. Whitaker, pers., comm.); and on salt marshes of Hampton Harbor, with 15-20 pairs in the early 1960's (E. Phinney, pers. comm.). Terns have nested at Back Channel in New Harbor at New Castle, Portsmouth since at least 1930.

Present Status: At Hampton Harbor estuary 50 pairs were present in 1982, apparently representing an all-time high for this area. At Back Channel, New Castle, 44 pairs nested in 1981 and 1982.

Adverse Factors: Heavy egg predation resulted in extremely poor nesting success

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LEAST TERN

Past Trends and Present Status: After extirpation in the late 19th century, Least Terns recolonized Maine in 1961 and increased to a peak of 94 pairs in 1978, but decreased abruptly to 42 pairs in 1982 (Nisbet 1973, Dorr 1976, Arbuckle 1982).

Adverse Factors: In 1977-82 productivity varied from 0.28 to 0.90 fledged chicks per pair. Adverse factors include human disturbance and tidal flooding, but most sites are under active protection (Arbuckle 1982).

at Hampton Harbor Estuary in 1982, with only five to seven fledged young from the 50 nesting pairs. A combination of factors at Back Channel, New Castle resulted in poor nesting success in 1981 and 1982, with 44 pairs fledging only 3-6 and 14 fledglings, respectively.

ROSEATE TERN

Past Trends and Present Status: About 10 pairs of Roseate Terns joined the colony on Londoner's Island in 1929 (Jackson & Allan 1931), and their numbers grew to 50-60 pairs by 1938 (Jackson 1947). This species, like the Common Tern, had abandoned the site by 1955 (Taber 1955), and no nesting records have been reported since then.

ARCTIC TERN

Past Trends and Present Status: Nesting Arctic Terns were discovered at the Londoner's Island colony in 1935 and 25-30 pairs nested there in 1936 (Jackson 1947). White (1927) noted a few pairs nesting at Seabrook in 1926. One pair nested at Back Channel in 1965 and 1966 and two pairs in 1967.

LEAST TERN

Past Trends and Present Status: Least

Terns may have nested at Portsmouth in 1932 (Shelley 1932). A colony of 2-10 pairs nested in Seabrook from 1953 to 1959 (Anon. 1953-1960), but no nesting activity has been reported since that time.

Massachusetts

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Table 6 summarizes past and present estimates for the four species of terns in Massachusetts. The reliability of the estimates has improved over the years (footnote 2), but the trends summarized below are judged to be real.

COMMON, ROSEATE, ARCTIC, AND LEAST TERNS

Past Trends and Present Status: All four species were severely reduced by plume-hunting in the 1870's and 1880's, but recovered under protection to reach peak numbers in the 1930's (Common and Roseate Terns) or 1950's (Arctic and Least Terns). Each species then decreased again until the early 1970's (Nisbet 1973). Arctic Terns have continued to decrease steadily,

but the other three species are now increasing slowly.

Adverse Factors: Table 6 also shows the average productivity of each species, from measurements or estimates made in most major colonies in most years since 1970. Predation is now the most important factor limiting breeding success of all four species. Since 1930, Herring Gulls (*Larus argentatus*) have occupied all the traditional offshore island sites, so that Common Terns are now nesting mainly in less favorable sites on inshore islands or on the mainland, where they are vulnerable to mainland predators (principally Great Horned Owls, rats, and Black-crowned Night-Herons). Roseate Terns have been affected similarly, but most are now concentrated on one predator-free island. Least Terns nest al-

TABLE 6. Estimated numbers of pairs of four tern species in Massachusetts, 1870-1982¹

Date	Basis of Estimate ²	Common Tern	Roseate Tern	Arctic Tern	Least Tern
Before 1871		hundreds of thousands			
1890's	re	(pnc)	thousands	scarce	abundant
1930's	pnc	ca. 5000	ca. 2000	ca. 20	ca. 100
1950's	bd	30-40,000	6-7000	250	950 (pnc)
1970	bd	15-20,000	3900	3-400	1500 (pnc)
1972	pnc/ae	9400	2300	110	—
1974	pnc/ae	7700	2400	105	1100
1976	ae	6100	1900	—	—
1978	ae	5900	1500	66	1450 (pnc)
1980	nc	5700	1600	53	1500
1982	nc	7250	1870	39.5	1830
1982	nc	7600	1980	23.5	1810
Average productivity (chicks/pair)		1.1	1.4	0.2	0.6

¹Updated from Nisbet (1973, 1978, 1980), with adjustments for known undercounts in the early 1970's. This summary is based on counts by personnel of the Massachusetts Audubon Society, Cape Cod National Seashore, Trustees of Reservations, U.S. Fish & Wildlife Service, and others, whose input is gratefully acknowledged. All estimates refer to peak period of nesting; late nesters are not included.

²re, rough estimate; pnc, partial nest count; ae, estimate based on counts of adults; bd, banding data (adults and chicks); nc, fairly complete nest count.

most exclusively on mainland sites (barrier spits), where they are vulnerable to mammalian predators as well as flooding, but they nest successfully in some years. Arctic terns nest with both Common and Least Terns, but are rarely successful.

During the 1970's, effective protection from human disturbance has been extended to most colonies in Massachusetts. Predator control has had local success, but several major colonies have been lost to gulls or

predators since 1970, and only one site (a new island) has been gained. Despite the favorable population trends in three species, most existing colonies are subject to predation, and few alternative sites are available if any others should be lost. The largest colony, at Monomoy National Wildlife Refuge, has been broken up by heavy predation since 1978, and the birds are now dispersing among other existing colonies.

Rhode Island

[Editors' Note: The history of terns in Rhode Island was summarized by Clement & Woodruff (1962). In 1977, 589 pairs of

Common Terns, 47 pairs of Least Terns, and possibly one pair of Roseate Terns were found in a state-wide survey (Erwin 1979).]

Connecticut

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COMMON AND ROSEATE TERNS

Past Trends: Few data exist on numbers of terns in Connecticut prior to the 1970's, but statewide censuses were conducted in 1972 (Drury 1973-74), 1975 (Duffy 1977),

1977 (Erwin 1979), and 1980 (Rozsa 1980). Differences in the timing and techniques used (i.e., nest counts and aerial surveys) make direct comparisons of numbers between years difficult. Available data are summarized in Table 7.

¹I thank Dan Cinotti, Frank Gallo, John Gaskell, Andrew and Michael Griswold, Scott Hopkins, Ray Schwartz, and Julie Sickefoose for unpublished information.

Present Status: Since the mid-1970s, populations of Roseate and Common Terns appear to be stable or increasing. Much of the increase may have been due to the immigra-

TABLE 7. Population estimates of three species of terns in Connecticut, 1900-1982. Estimates are given as the number of pairs, rounded off to the nearest five.

Year	Common Tern		Roseate Tern		Least Tern Total
	Total	Falkner Is. Only	Total	Falkner Is. Only	
1900	75 ^b	—	—	—	—
1931	—	—	30 ^b	—	—
1947	700 ^b	—	125 ^b	—	—
1952	900 ^b	—	100 ^b	—	—
1972	900-1150 ^c	400 ^{a,d}	40 ^{b,d} -65 ^b	30 ^{a,d}	25 ^b -55 ^d
1975	1035 + ^{b,d}	700 ^{a,d}	50 ^b	30 ^{a,d}	120 ^b -130 ^d
1976	975 ^b -985 ^d	690 ^d	40 ^b	25 ^d	105 ^b -115 ^d
1977	1390 ^d -1480 ^b	1100 ^d	65 ^{b,d}	50 ^d	120 ^b -130 ^d
1978	—	1300-1500 ^d	—	160-180 ^d	—
1980	1720 ^d	1125 ^d -1300 ^e	110 ^d -180 ^g	60 ^d -100 ^g	110-140 ^d
1981	—	1800-1850 ^g	250 ^g	185-190 ^f	—
1982	2800-2900 ^g	1900-1950 ^g	225 ^g	135 ^g	275 ^g

Sources: ^aDuffy 1977; ^bErwin 1979; ^cDrury 1973-74, ^eNisbet 1973; ^dRozsa 1980; ^eSibley 1981; ^fSpindelolow 1982; ^gSpindelolow, estimates

tion of birds from New York colonies, particularly Great Gull Island. Also, Roseate Terns were probably underestimated prior to 1980 due to difficulties in identification and their tendency to nest in concealed sites (Spendelov 1982).

Adverse Factors: Sibley (1981) reported "good" reproductive success of Common Terns only at protected colony sites. Banding studies in 1981-82 at Falkner Island suggested that Common Terns raised 1.2-1.6 chicks per pair and Roseate Terns 1.1-1.3 chicks per pair. At Falkner Island, Common Terns lose nests to storm waves and to erosion of earthen slopes. Gulls have been prevented from nesting, but some late chicks are taken by gulls and Black-crowned

Night-Herons. Ants are the main predators of Roseate Tern chicks (Spendelov 1982).

LEAST TERN

Past Trends and Present Status: See Table 7. Schwartz & Sibley (1982) estimated that 100-120 pairs recolonized Milford Point in 1981 and Schwartz (pers. comm.) found a minimum of 215 pairs nesting there in 1982. In 1982, 30 pairs of Least Terns fledged 14 young at Griswold Point (Griswold & Griswold, pers. comm.).

Adverse Factors: Unless protected, all Least Tern colony sites on the mainland coastal beaches are subject to heavy recreational use, but information on the importance of storms and predation is lacking.

Long Island, New York

[Editors' Note: Except for M. Gochfeld's report for western Long Island (see below), no written report was received for Long Island. Between 1974 and 1978, Buckley & Buckley (1980) conducted aerial censuses on Long Island. They found 11,128-14,005 pairs of Common Terns, 618-1854 pairs of Roseate Terns, 1719-2628 pairs of Least Terns, and 0-2 pairs of Gull-billed Terns. Roseate Terns decreased from 1854 pairs in 1974 to 618 pairs in 1978; other species

showed no marked trends. Earlier records were summarized by Nisbet (1973), Drury (1973-74), Bull (1974), Erwin (1979), and others. No comprehensive census has been carried out since 1978, but we understand that no striking changes have been observed. Paxton et al. (1982) reported a "marvelous year" for Roseate Terns at Great Gull Island in 1982, with about 700 pairs nesting.]

Western Long Island, New York

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COMMON AND ROSEATE TERNS

Present Status: This report covers the area from Fire Island inlet westward. Besides the estimated 1000 pairs of terns in Jamaica Bay, and an estimated 1000 pairs in salt marshes from Hewlitt Bay to Fire Island inlet, the bulk of the Common Terns in the region are at West End Beach and Cedar Beach, about 18 km apart, which in recent years together have held about 5000-6000 pairs of Common Terns, and about

125 pairs of Roseate Terns (the latter only at Cedar Beach). Substantial interchange of birds between these colonies occurs as demonstrated by nest-trapping of adults, and these colonies serve as important seed colonies for other areas of Long Island (Post & Gochfeld 1979).

The breeding population of Common Terns at West End Beach was about 1100 pairs in 1981 and 1000 pairs in 1982. The population at Cedar Beach was about 4500 in 1981 and about 4000 in 1982. These declines are close to the limit of sampling error ($\pm 10\%$).

Adverse Factors: Reproductive success at

¹I thank many field participants, particularly Joanna Burger and Carl Safina, for their help in studying and censusing the terns.

West End Beach was poor (less than 0.2 young/pair) in 1982 due to a single feral cat and, presumably, to Short-eared Owls, (*Asio flammeus*). Estimated productivity at Cedar Beach was at least 1.2 young/pair in 1982.

The main causes of mortality are flooding and predation. Many of the predators are domestic animals (dogs and cats) or human commensals (Norway Rat, *Rattus norvegicus*, see Austin 1948). Human disturbance has direct effects (trampling, vandalism, shooting, egging) and indirect effects (interference with incubation, brooding and feeding of young; Burger 1981). Often substantial mortality occurs from artifacts (particularly entanglement in kite string, fishing tackle, plastic six-pack

holders; Gochfeld 1973), and in some years this accounts for the majority of adult mortality. The Long Island State Park Commission deliberately tried to eliminate the West End Beach colony by planting beach grass (*Ammophila breviligulata*) in the more open areas to discourage nesting. Authorities apparently felt that repeated complaints by beach-goers who attempted to enter or sun themselves in the colony, as well as adverse publicity engendered by the road-killing of hundreds of young terns, made the colony location undesirable. I hope that the intervention of several concerned biologists has aborted further deliberate habitat degradation by a governmental agency.

New Jersey

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Presently, five species of terns nest along New Jersey's coasts. In general, most of these species (except Least Tern) nest on *Spartina* salt marshes or in the marsh upland with *Iva* and *Baccharis* bushes. Few reliable population estimates exist for New Jersey terns prior to 1976.

COMMON TERN

Present Status: Common Terns are the most abundant terns in New Jersey with

substantial increases in both numbers and colonies since 1976 (Table 8).

ROSEATE TERN

Present Status: Only one or two birds have been reported in the 1970s and 1980s, although Roseate Terns were reportedly "abundant" in the early 1800s (Stone 1894).

GULL-BILLED TERN

Present Status: Gull-billed Terns in New

TABLE 8. Population estimates of three species of terns in New Jersey, 1976-1979.

Species	1976	1977	1978	1979
Least Tern^a				
Number of Pairs	689	571	922	875
Number of Colonies	24	19	29	26
Common Tern				
Number of Pairs	1147	2946	4206	4814
Number of Colonies	22	44	?	106
Forster's Tern				
Number of Pairs	115	334	497	664
Number of Colonies	6	6	?	24
Source	Kane & Farrar (1976)	Kane & Farrar (1977)	Galli & Kane (1979)	Galli & Kane (1979)

^a1980 (1099 pairs, 22 colonies); 1981 (965 pairs, 22 colonies); 1982 (1103 pairs, 18 colonies).

Jersey are at the northern limit of their range. They were common in the 1800's, disappeared in the early 1900's, and a few have nested recently (8 birds in 1976, 15 birds in 1977; Kane & Farrar 1976, 1977).

LEAST TERN

Past Trends: The lack of statewide surveys prior to the mid 1970s makes population estimates difficult, but the species was clearly more abundant in the 1800s, probably extirpated in the 1880s, and recolonized in the 1920s (Stone 1894, 1937).

Present Status: Least Terns are on the New Jersey state endangered species list. In 1976, 53% of their colony sites were on barrier island beaches, 27% were on dredge spoil, 14% were on mainland beaches, and the remainder were on sandy sites in salt marshes (Buckley 1979). The general decrease in the number of breeding colonies in the 1970s and early 1980s suggests that Least Tern populations in New Jersey are unstable and vulnerable.

Adverse Factors: Human development of barrier islands has resulted in increasing

numbers of predators (cats, dogs, and rats). Least Terns nest on sand beaches and are vulnerable to development, human disturbance, and flooding. The protection afforded the large, more stable colonies is apparently succeeding, but new colonies are not becoming well established. Continued vigilance and protection is essential because at present over 60% of the Least Terns in the state are nesting at only two colonies (Corson's Inlet and Holgate).

FORSTER'S TERN

Present Status: Known colonies of Forster's Tern in New Jersey increased from 6 to 24 during the 1970s, with 664 pairs known in 1979 (Table 8).

[Editor's Note: Buckley (1979) reported 18 pairs of Gull-billed Terns in three colony sites and 4677 pairs of Common Terns in 52 colony sites in New Jersey in 1977. Some historical information on tern populations in New Jersey is summarized by Drury (1973-74), Nisbet (1973), and Buckley (1978).]

Delaware

[Editors' Note: Erwin (1979) reported 451 pairs of Common Terns and 166 pairs of Least Terns in Delaware in 1977. Historical data were fragmentary, but Common Terns had peaked at about 1700 pairs in

1967, and Least Terns at about 450 pairs in 1926 (Erwin 1929). Paxton et al. (1982) reported about 660 pairs of Least Terns at seven sites in 1982.]

Maryland

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Extensive surveys were conducted in 1976-77 by Dr. M. Byrd as reported earlier (Erwin 1979, Erwin & Korschgen 1979). Summaries are reported below. No studies of reproductive success and no surveys have been conducted since 1977 in the state.

GULL-BILLED TERN

Past Trends and Present Status: This species has been recommended for threatened status in the state (Robbins & Boone, in press). It has never been abundant (25-30

pairs in the 1950's) and was not found in 1976-77 surveys (Erwin 1979).

FORSTER'S TERN

Present Status: This species is relatively abundant on both the ocean coast (336 pairs in 1977) and in Chesapeake Bay (184 pairs in 1977) where it has increased recently (Erwin 1979).

COMMON TERN

Present Status: Both ocean coast and

Chesapeake Bay populations were sizeable (760 and 920 pairs, respectively) in 1977 (Erwin 1979), with an apparent increase in the Bay. On the ocean coast, virtually all nesting is on small marsh and dredge islands because of disturbances on the barrier beaches—development on Fenwick Island and recreational activity on Assateague Island.

LEAST TERN

Past Trends and Present Status: Declines along the ocean coast have been dramatic from the 1950's (Stewart & Robbins 1958) to 1977 when none was found (Erwin 1979). In the Bay, the number of colonies appeared to decrease from the 1940s to 1977 but numbers remained fairly stable (ca. 200 pairs). It has been recommended for state

threatened status (Robbins & Boone, in press).

Adverse Factors: Declines along the coast are probably due to resort development. Roof-nesting has recently been documented at Cambridge (E. Britton, pers. comm.).

ROYAL AND SANDWICH TERNS

Present Status: Both species are at their northern range limits in coastal Maryland. In the occasional year when a mixed colony of these species occurs, it usually occupies small marsh islands in Chincoteague Bay, with Common and Forster's Terns and Black Skimmers (*Rynchops niger*).

Adverse Factors: Great Horned Owl predation has caused recent colony abandonments (D. Smith, pers. comm.).

Virginia

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A complete coastal survey was conducted by Dr. M. Byrd in 1976-77 (Erwin 1979) and barrier island surveys have been ongoing from 1975 (Virginia Coast Reserve, The Nature Conservancy). Virginia's coast is in a relatively pristine condition compared to most Atlantic Coast areas. Most tern species are fairly stable in numbers but the Gull-billed Tern may be declining. Storms are probably the major cause of nesting failure for the group. Few studies of reproductive success have been conducted.

GULL-BILLED TERN

Past Trends and Present Status: This species has declined, both over the short and long term, and has been placed on the national list for species "with unstable or decreasing population trends" (Anon. 1982b). In Virginia, approximately 2000 pairs nested in 1975-76 but have declined to less than 1000 pairs in 1980 and 1982

(B. Williams, unpubl. data). They nest in mixed-species colonies on usually only 3-4 islands. Factors affecting breeding are unknown.

FORSTER'S TERN

Present Status: This species was abundant (ca. 1100 pairs) in 1977 and has probably been underestimated in earlier censuses (Erwin 1979). Forster's Terns sometimes nest with Common Terns.

Adverse Factors: High chick mortality (flooding?) has frequently been noted (M. Byrd, pers. comm.) but no one has examined the species closely.

COMMON TERN

Past Trends and Present Status: Common Terns are probably stable along the ocean coast, with usually 2-300 pairs nesting (Erwin 1979). No change has been evident from 1975 to 1982 on the barrier islands (B. Williams, unpubl. data). Small numbers nest on several Chesapeake Bay marsh islands.

Adverse Factors: Storms are probably the major cause of nesting failure.

¹I thank the Virginia Coast Reserve of The Nature Conservancy and B. Williams, J. Via, W. Akers, and T. Wieboldt for providing census data from 1975-1982.

LEAST TERN

Past Trends and Present Status: The species has been categorized as "rare" in the state (Russ 1973, in Christman & Lippincott 1978). Over the long term, it has probably declined (Erwin 1979) but not since 1975 (B. Williams, unpubl. data). In 1977, more Least Terns nested in the Chesapeake Bay (ca. 675 pairs) than nested along the ocean coast (165 pairs, M. Byrd) (Erwin 1979). Unlike most other areas, Virginia does not lack suitable nesting habitat.

Adverse Factors: Predation and storms are the major limiting factors.

ROYAL TERN

Past Trends and Present Status: Regionally, Royal Terns are probably stable in population but fluctuate markedly from year to year in several large colonies on the Virginia barrier islands, with numbers ranging usually between 3-4000 pairs (Erwin 1979). Some exchange apparently occurs between populations in Maryland, Virginia,

and North Carolina (M. Byrd & J. Weske, unpubl. data). No significant changes in coastal Virginia have occurred since 1975 (B. Williams, unpubl. data), but nesting in the Chesapeake Bay was noted for the first time in 1980 (J. Weske, pers. comm.) and occurred again in 1982.

Adverse Factors: Although some gull predation occurs, storm washouts are probably the major limiting factor.

CASPIAN TERN

Present Status: Armistead (1982) reported nesting on the eastern shore (three pairs) and in Chesapeake Bay (on three islands) in 1982. Prior to 1978 there had probably never been more than one or two pairs in the state (Erwin 1979).

SANDWICH TERN

Past Trends and Present Status: Only very small numbers nest in mixed colonies with Royal Terns. Seldom do more than 20 pairs nest in the state (Erwin 1979).

Summary and Overview

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This workshop has reviewed and summarized data on the past trends and current status of tern populations in a substantial part of eastern North America between 36° and 51°N (the Great Lakes, the Gulf of St. Lawrence, and the Atlantic coast from Newfoundland south to Virginia). A pervasive theme in the regional reports that precede this summary is that available census data have not been sufficiently precise and systematic to draw reliable conclusions about current population sizes and trends. It is true that censuses in different areas have not been synchronized and that techniques have varied widely in geographical coverage, precision and accuracy. However, almost the entire region was censused or surveyed at least once between 1976 and 1980, and for several areas sufficient information exists for 1980-82 to identify population trends. Apart from the reports published at this workshop, regional

surveys of tern populations have been published by Ludwig (1962), Lock (1971), Drury (1973-74), Nisbet (1973, 1978, 1980), Bull (1974), Blokpoel (1977), Blokpoel & McKeating (1978), Scharf (1978), Erwin (1979), Korschgen (1979), Erwin & Korschgen (1979), Courtney & Blokpoel (1979, 1983), Blokpoel et al. (1980), Buckley & Buckley (1980), and others. Several of these papers (e.g., Drury 1973-74, Nisbet 1973, 1980, Courtney et al. 1979, Erwin 1979) have included historical reviews. In reviewing this information, it is thus possible to piece together at least an outline of the present status and recent trends of tern populations in eastern North America.

GULL-BILLED TERN (*Sterna nilotica*). Apart from a few pairs in New Jersey and New York, this species is limited to three or four islands in Virginia, where numbers declined from about 2000 pairs in 1975 to less than 1000 pairs in 1980-82. Only 650

pairs were found on the Atlantic coast south of Virginia in 1976 (Portnoy et al. 1981).

CASPIAN TERN (*Sterna caspia*). The population in the Great Lakes (Lakes Michigan, Huron, and Ontario) has been increasing steadily since 1965 and now includes about 4250 pairs. A few pairs formerly bred in Labrador, but there have been no recent reports. Approximately 20 pairs bred in Newfoundland in 1980, at least three pairs in Quebec in 1982, and several pairs in Virginia in 1982. Only nine pairs were found on the Atlantic coast south of Virginia in 1976 (Portnoy et al. 1981).

ROYAL TERN (*Sterna maxima*). Some 3-4000 pairs usually nest on islands in Virginia, but there appears to be interchange between these colonies and those in the Carolinas and Georgia, where about 30,000 pairs were found in 1976 (Portnoy et al. 1981).

SANDWICH TERN (*Sterna sandvicensis*). Usually less than 20 pairs nest in Virginia. As with the Royal Tern, there appears to be interchange with colonies in the Carolinas and Georgia, where about 850 pairs were found in 1976 (Portnoy et al. 1981).

ROSEATE TERN (*Sterna dougallii*). This species declined from a peak of about 8500 pairs in the 1930's to about 4800 pairs in 1952 and to about 2600 pairs in 1978 (Nisbet 1980). Subsequent data indicate a slow increase to about 3100 pairs in 1982. The species has dwindled at the extremities of its range (Québec, Nova Scotia and New Jersey) and has become concentrated at a few colonies in Connecticut, New York, Massachusetts, and Maine. About 1800 pairs nested at Bird Island, Massachusetts, in 1982.

COMMON TERN (*Sterna hirundo*). Regional surveys in 1976-80 accounted for 70-75,000 pairs in our area, with the largest numbers in the Gulf of St. Lawrence (20,000 pairs, including 10,600 pairs in N. New Brunswick and Prince Edward Island), Long Island (14,000 pairs), Massachusetts (7600 pairs), Lake Huron (5300 pairs), and New Jersey (4-5000 pairs). An additional 4000 pairs nested in North Carolina in 1976 (Portnoy et al. 1981), and the species also breeds widely in prairie states and provinces to the west of our area. Between

1935 and the mid 1970s, major population declines were reported in the Lower Great Lakes, Nova Scotia, Maine, New Hampshire, and Massachusetts, although these may have been offset by smaller increases in Connecticut, New York, New Jersey, Delaware, and Maryland (Erwin 1979). Information since 1977 has been incomplete, but the available reports indicate local decreases (northern New York, New Hampshire), stable populations (Michigan, Virginia), or moderate increases (North Shore sanctuaries, northern New Brunswick, Massachusetts, Connecticut, and perhaps New Jersey).

ARCTIC TERN (*Sterna paradisaea*). Only limited recent data are available from Newfoundland, where 2700 pairs were found in the 1940's. Only 5-6000 pairs were found in Nova Scotia, New Brunswick, and Maine in 1982. This is scarcely half the number known in 1971-72, and far below the numbers reported in the 1940s. The small population in Massachusetts is disappearing. The main breeding range of this species is in subarctic and arctic Canada, but it nests there in small, scattered colonies. As in Europe (Lloyd et al. 1975, Bullock & Gomersall 1981), large, dense colonies of Arctic Terns have been reported only at the temperate southern fringe of its breeding range.

FORSTER'S TERN (*Sterna forsteri*). Recent reports summarized in this workshop include 840 pairs in the Great Lakes and 2300 pairs between New Jersey and Virginia. Known populations in all these areas have been increasing, but this may be due in part to improved coverage. The species is widespread in inland marshes to the west of the area, but only about 800 pairs were found on the Atlantic coast south of Virginia in 1976 (Portnoy et al. 1981).

LEAST TERN (*Sterna antillarum*). About 7000-7500 pairs are known to breed along the coast between southern Maine and Virginia (Erwin 1979, this workshop). Another 2200 pairs were found in North and South Carolina in 1976 (Portnoy et al. 1981), but few were found in coastal Georgia and Florida (Portnoy et al. 1981), where many now nest on inland roofs (Fisk 1975, 1978). The species is notoriously difficult to census, because it nests in small scattered

colonies that shift frequently. However, the reports in this workshop and in Erwin (1979) suggest that at least some populations have been increasing during the 1970's.

BLACK TERN (*Chlidonias niger*). This species nests in freshwater marshes and no useful information on population sizes is available.

To summarize, information presented in this workshop suggests continuing population declines for only two species: Arctic Terns in the northeast, and perhaps Gull-billed Terns in the south. The Caspian Tern is increasing steadily in its main stronghold, Forster's Terns are increasing at least locally, Roseate Terns appear to have started to recover from their population crash in the 1970s, and Common and Least Terns appear to be stable at their presently reduced numbers or increasing slowly along the Atlantic coast. Before indulging in complacency, however, several factors need to be considered:

1. Certain species, e.g., the Common Tern, have been insufficiently censused in much of their breeding range (Gulf of St. Lawrence, Newfoundland, Nova Scotia, and Maine), thus limiting conclusions that can be drawn about current subcontinental population trends.

2. While census techniques have generally improved in coverage and accuracy, changes in regional populations of less than 10-20% still cannot be measured reliably. Because it takes five or more years before a difference in reproductive success is manifested as a change in the breeding population, a population crash can be well under way before it is even detectable (Buckley & Buckley 1980). Furthermore, it is known that in the past some colonies in certain areas were underestimated or not visited. Hence, some of the reported increases may be artifacts of changes in techniques.

3. Two species (Gull-billed and Roseate Terns) have very limited populations and are becoming increasingly restricted to narrower ranges.

4. At least for Common, Arctic, Roseate, and Least Terns, present-day numbers are still well below the peak numbers estimated in the 1930s, which in turn were probably well below those reported prior to the population crash caused by plume-hunting in

the 1880s (Nisbet 1973).

5. Nesting habitat for all the island and beach nesting species has been restricted, to differing degrees, by the population expansion of gulls (Ring-billed Gulls, *Larus delawarensis*, in the Great Lakes, Herring Gulls, *L. argentatus*, and Great Black-backed Gulls, *L. marinus*, on the Atlantic coast) and by human development and disturbance of beaches and islands. This is particularly important for Common and Least Terns, which have been displaced or have moved from most of their traditional colony sites. These species are now commonly nesting in less suitable sites in salt marshes, on dredged spoil islands, on roofs or on man-made structures (in the northern Great Lakes man-made sites appear to be suitable nesting alternatives). Arctic and Roseate Terns have become highly dependent on a few gull-free islands.

6. Dredged spoil islands, which have been extremely important nesting sites for terns displaced from barrier beaches and islands, are now being managed in a way that makes them less suitable for nesting (Buckley 1978).

Adverse Factors: Although many studies of reproductive success in terns (especially Common and Least Terns) have been carried out in our region, many of the results are still unpublished. The information presented in the workshop suggests that reproductive success of Roseate and Caspian Terns has been generally high (1.0-1.4 chicks per pair), success of Common Terns has been variable and often lower than the 1.1 chicks per pair thought to be necessary for population stability (Nisbet 1978), success of Least Terns rarely exceeds one chick per pair, and success of Arctic Terns has been very low. Among factors limiting numbers and reproductive success, the most frequently mentioned were displacement by gulls, human disturbance, predation, and flooding. These factors are interdependent. Gulls and human disturbance have forced many terns to nest in marginal habitat on the mainland or in marshes where they are more vulnerable to mainland-based predators and to flooding (Nisbet 1978). Effects of toxic chemicals (primarily DDE) were certainly important to inland-breeding terns in the early 1970s (Fox 1976) and

were probably important to some coastal-breeding terns in the 1960s, but effects in these areas have probably been only minor since 1971 (Nisbet & Reynolds in press). Human predation and other adverse factors occurring in the winter quarters have only recently been investigated (Blokpoel et al. 1982).

Conservation: Several reports in this workshop refer to successful conservation programs. In Virginia, Least and Common Terns have maintained their numbers on protected barrier islands, whereas they have disappeared from the developed coast of nearby Maryland. In Massachusetts, most colonies have been protected from human disturbance during the 1970's, and this has resulted in improved productivity and, eventually, increased populations for three of the four species. Effective protection is also reported for major colonies in New Jersey, New York, Connecticut, and Maine. Habitat management and predator control are practised at several colonies. A large fraction of the terns in eastern North America now nests at publicly-owned, managed, or protected sites. However, as many of these sites are vulnerable, marginal or man-made habitats, continuous management and protection will be necessary to maintain even the reduced populations that now exist. The challenge to conservationists will be to identify and maintain a variety of alternative colony sites for these species, which are adapted to shifting sites wherever local conditions become unsuitable.

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Black-headed Heron (*Ardea melanocephala*)