

Cover Sheet

Vermont Endangered and Threatened Species Recovery Plan

Species: Common Tern (*Sterna hirundo*) dated 17 September 1996

Approved by the **Scientific Advisory Group (SAG)** as a recommendation to the Conservation and Education Subcommittee to accept.

signature: Sam B Laugel date: 12 Nov 1996
SAG Chair

Approved by the **Conservation and Education Subcommittee** as a recommendation to the Endangered Species Committee to accept.

signature: Sam B Laugel date: 14 Aug 1997
Subcommittee Chair

Approved by the **Endangered Species Committee (ESC)** as a recommendation to the Agency of Natural Resources to accept.

signature: Tau A. Worley date: 11-10-98
ESC Chair

Signature below indicates acceptance of this Endangered and Threatened Species Recovery Plan by the **Agency of Natural Resources (ANR)**.

signature: J B Kunk date: 11/2/98
Secretary, ANR

VERMONT COMMON TERN RECOVERY PLAN

Mark S. LaBarr
Vermont Institute of Natural Science
Woodstock, Vermont 05091

In conjunction with: Nongame and Natural Heritage Program
Vermont Fish and Wildlife Department
Waterbury, VT 05671

January, 1996

17 September 1996 SJP

TABLE OF CONTENTS

Executive Summary iii

Part I. Background

 Species Description 1

 Distribution and Status 1

 Breeding Phenology 3

 Nesting and Pre-migratory Staging Habitat 4

 Food and Feeding Behavior 5

 Limiting Factors 6

 Predation 6

 Displacement by Ring-billed Gulls 6

 Human Disturbance 7

 Vegetative Overgrowth 8

 Research 8

 Management 9

Part II. Strategies and Recommendations for Recovery
 of Common Terns in Vermont 11

 Recovery Plan Goals 11

 Justification of Recovery Plan Goals 11

 Objectives and Priorities 12

 Recommendations and Strategies for Attaining Goals .. 13

Part III. Literature Cited 21

Part IV. Figures and Tables 25

VERMONT COMMON TERN RECOVERY PLAN

EXECUTIVE SUMMARY

The common tern is a colonial waterbird that annually nests on up to 6 rocky islands on Lake Champlain, Vermont. This species was listed as a Vermont endangered species in 1989 due to declining population levels. This plan reviews the status and life history of Lake Champlain common terns and discusses factors limiting the population. Current research and management efforts are also reviewed. A recovery goal of 300 nesting pairs, with sufficient productivity to maintain population stability at at least 2 colony sites over 5 consecutive years, is recommended.

The common tern has nested on Lake Champlain since at least the late 1800's. Although historical information is incomplete, surveys conducted in the late 1960's indicated that Lake Champlain supported approximately 300-400 pairs of breeding common terns. The population declined steadily throughout the 1970's and early 1980's due to chronic, extremely low, reproductive success. This low reproductive success was caused by several factors. These included the direct and indirect effects of nocturnal avian predation, competition for nesting space with ring-billed gulls, and human disturbance. The population reached a low of about 50 breeding pairs in 1988. Ongoing conservation efforts, including monitoring, research, management, and public education, have helped reverse this decline. In 1994, Lake Champlain supported approximately 130 pairs of nesting common terns. Current habitat requirements are believed sufficient to support the recovery goal of 300 pairs.

This plan outlines and prioritizes strategies designed to achieve the recovery goal. Many of these strategies have already been successfully implemented. We recommend that future recovery efforts be concentrated in 4 major areas:

- 1) Long-term protection of tern nesting islands on Lake Champlain.
- 2) Enhancement of breeding habitat, productivity, and colony stability at existing colony sites.
- 3) Increased public awareness of Common Terns on Lake Champlain through expanded educational and outreach efforts.
- 4) Development of sufficient public and private funding support to implement recovery plan goals, including adequate staffing to monitor, manage, and patrol the colony sites.

VERMONT COMMON TERN RECOVERY PLAN

PART I. BACKGROUND

Species Description

The common tern (*Sterna hirundo*) is a colonial nesting waterbird belonging to the avian order Charadriiformes, suborder Lari, family Laridae, and subfamily Sterninae. It measures between 33-41 cm (13-16 in.) in length with a wingspan of about 78-81 cm (31-32 in.) and an adult weight of approximately 120 g (4.5 oz.) (Harrison 1983, Terres 1980). The throat, belly and upper and undertail coverts are white contrasting with a grey back and grey secondaries and wing coverts. The forked tail is white with the outer rectrices having black edges. The primaries are greyish-white with the tips of the outer primaries black. Breeding plumage consist of a black cap and red-orange bill with a black tip. In winter the bill darkens and the crown and forehead are white. Sub-adults resemble adults in winter plumage, and plumages do not differ between the sexes.

This species is long lived, reaching ages of 20+ years. Breeding maturity is acquired at 3-4 years, although some individuals may breed at age 2 (Austin 1956, Nisbet 1984). Older terns (5-15 years) tend to have higher reproductive success than younger birds (Nisbet 1984). Immature common terns rarely return to the nesting grounds prior to their first year of breeding, remaining at wintering sites instead. Colony size for this species can range from several thousand individuals to a few pairs.

Distribution and Status

Common terns occupy a widespread breeding range, occurring on every major land mass except South America and Antarctica. Unlike most of the 44 species of terns in the world, the common tern breeds in both coastal and inland habitats. In North America, the breeding range extends along the Atlantic Coast, from Nova Scotia south to North Carolina and inland across the northern tier of the United States into the western provinces of Canada. There are also disjunct populations of breeding common terns on the Gulf coast and in the Caribbean. The winter range of North American breeding populations of this species includes the Caribbean and the coasts of Central and northern South America.

Lake Champlain currently supports the only known inland nesting population of common terns in New England. The closest established common tern colonies are located approximately 120 km to the north on the St. Lawrence River, near Montreal, Quebec. Nesting on Lake Champlain occurs on up to 6 small rocky islands in the northeastern part of the lake. Two of these islands, Popasquash Island and Rock Island are used annually by nesting

terns. The remaining 4 islands, Hen Island, Grammas Island, Gull Rock Island and Savage Island, have been used only sporadically in recent years. All but Savage Island have supported large numbers of nesting terns in the past (Table 1, Table 2). Popasquash Island is currently the largest and most productive colony site on Lake Champlain, supporting 120 of the estimated 130 total pairs in 1994. All 6 islands are located east of North Hero Island and Grand Isle, Vermont (Fig. 1).

The first documented record of common terns on Lake Champlain dates from 1892 (Chapman 1904), and nesting is thought to have first occurred on Popasquash Island (Laughlin 1986, Spear, pers. comm). Accounts suggest that this island supported the largest colony until the early 1960's when increasing ring-billed gull (*Larus delawarensis*) numbers resulted in the colonization of Rock, Hen, and Grammas islands by terns (Spear, pers. comm.). Whether these other islands supported nesting terns earlier this century is unknown.

Historical records of population size are scant but include estimates ranging from 100 adults on a single island (Popasquash Island) in 1947 (Ball 1947) to a high of approximately 400 nesting pairs on 4 islands in 1970 (Spear 1970, Table 1). Spear (1970) stated that Popasquash Island "throve" as a nesting colony in the early 1900's. However, no records of population size were reported prior to 1947 and no systematic surveys were conducted until 1980. Historical population levels are thus imprecisely known.

Regular surveys initiated in 1980 showed the number of breeding common terns on Lake Champlain had declined from population levels reported in the 1960's and early 1970's. This trend continued through the late 1980's (Fig. 2), and in 1987 the common tern was listed as a threatened species in Vermont. A similar reduction in the number of breeding pairs in the Great Lakes region was documented during this period (Courtney and Blokpoel 1983, Shugart and Sharf 1983.) A general population decline has occurred throughout the species' North American breeding range since 1930, although some coastal populations have stabilized in recent years (Nisbet 1973, Morris et. al. 1980, Matteson 1988).

In 1987, intensive monitoring and management of Lake Champlain's common tern population was initiated by the Vermont Institute of Natural Science (VINS) and the Vermont Fish and Wildlife Department (VTFW). Population numbers reached a low of about 50 pairs in 1988, and in 1989 the common tern's status was changed from threatened to endangered. The decline in numbers of adult breeders was due primarily to low reproductive success caused by nocturnal avian predation, overcrowding of nesting habitat by ring-billed gulls, and human disturbance (LaBarr and Rimmer 1994).

Population size, and the number of pairs fledging young have steadily increased since the implementation of management strategies in 1987 (Fig. 3). Annual productivity (fledglings/pair) has also increased during this period (Fig. 4). Current productivity levels, however, still fall below the 1.1 fledglings/pair suggested by Nisbet (1978) and DiConstanzo (1980) as necessary for a self-sustaining population. In 1994, approximately 130 pairs of common terns nested on Lake Champlain and 84 chicks survived to fledging. This represents a 160% increase from the 1988 low of 50 pairs and a modern high for the number of chicks fledged.

Banding returns show that 15 birds, banded as fledglings on Lake Champlain between 1987-1992, have returned there to breed. This represents 11% of the 135 fledglings banded during that period (LaBarr and Rimmer 1994). This figure, however, includes all banded terns 2 years and older. Since only a small percentage of common terns begin breeding at age 2 (Austin and Austin 1956), actual fledging return rates may be higher than calculated figures. Return rates of birds 3 and 4 years old average 15% and 14%, respectively (LaBarr and Rimmer 1994). These values fall within the range found by DiConstanzo (1980; 9-15%) for 4 year old birds at Great Gull Island, New York, but are higher than those found by Nisbet (1978; 5-10%) in Massachusetts.

Eleven breeding terns originally banded in colonies outside Lake Champlain have been documented nesting on Popasquash Island between 1990-1994. Five of these terns were banded on Oneida Lake, New York, 5 were banded on the St. Lawrence River and 1 was banded on Faulkner Island, Connecticut (LaBarr and Rimmer 1994). LaBarr and Rimmer (1994) suggest that immigration may augment population levels and offset low reproductive success of Lake Champlain common terns.

High site fidelity of adult breeders, documented recruitment of locally fledged chicks, and immigration of terns from inland and coastal colonies have contributed to a reversal in the downward population trend (LaBarr and Rimmer 1994). However, threats to the viability of this population continue to exist, necessitating ongoing management and monitoring efforts.

Breeding Phenology

Common terns arrive on Lake Champlain in late April and early May. Nesting occurs from the first week of May through July, sometimes extending into early August. The majority of clutches in most years are initiated in May and June. Clutches average 3 eggs, although 2 and 1 egg clutches are not uncommon. Laying occurs asynchronously in this species and total laying time ranges from 3-7 days per clutch (Austin 1932). Normal incubation lengths are from 21-23 days. However, if incubation is disrupted (e.g., by repeated disturbance or nocturnal

desertion) it can be extended as long as 34 days (LaBarr and Rimmer 1993). Common tern chicks are semi-precocial, becoming mobile after 2-4 days. Fledging occurs 3-4 weeks after hatching. On Lake Champlain fledging dates range from July to September.

Common terns often renest if initial clutches fail and can produce up to 3 clutches in a single nesting season. Movement of failed breeders from one Lake Champlain colony site to another, within a nesting season, is common.

Once nesting is completed, common terns move to pre-migratory staging areas. Staging on Lake Champlain begins in mid-July and ends by late September. Several staging areas have been located on the lake, primarily in the north (LaBarr and Rimmer 1992, Fig. 1). The Mississquoi River delta (Mississquoi National Wildlife Refuge [MNWR]), Lazy Lady Island, and the railroad trestle between Alburg and Rouses Point, NY have regularly supported terns in recent years. Other sites have been used less regularly (LaBarr 1992, Fig. 1). Banding data indicate that each year 60-80% of the terns breeding on Lake Champlain use these sites prior to migration (Fig. 5).

Banding data also indicate that Lake Champlain common terns disperse north to the St. Lawrence River before moving south to their wintering grounds. In 1991, 1993 and 1994, banded terns from Lake Champlain were observed among large numbers of staging terns at Beauharnois, Quebec (Fig. 5.) Haymes and Blokpoel (1987) showed that terns from Lake Ontario move to Lake Erie once nesting is completed. They postulated that most inland terns migrate eastward to the Atlantic Coast before moving on to their wintering grounds. Whether or not Lake Champlain common terns follow this route has yet to be determined.

Nesting and Pre-migratory Staging Habitat

Common terns are a ground-nesting species and prefer sparsely vegetated substrates at both natural (i.e., islands, beaches, salt marshes) and man-made (dredge spoils, breakwaters, navigational islands) sites. On Lake Champlain, 4 of the colony sites, Popasquash, Rock, Hen and Grammas islands, are small (<0.5 ha, 1.24 acre) rocky islands with a mosaic of gravel, bare rock, grasses, sedges and woody vegetation. The remaining 2 islands (Gull Rock and Savage islands) are available for use by nesting terns only after spring water levels have receded. Gull Rock Island is a small bare rock almost devoid of vegetation. The nesting site at Savage Island is a rocky spit with intermittent clumps of grasses and sedges, adjacent to the 80+ ha (198 acre) main island. A land bridge connects this site to the main island in low water years.

Common terns on Lake Champlain have utilized all 6 of the nesting islands in recent years (1980-1984). However, colony

size has fluctuated markedly at each site (Table 1). This may result more from predation pressure than from actual loss of suitable nesting habitat. Habitat availability is not currently considered a limiting factor for common terns nesting on Lake Champlain.

Common terns show strong site fidelity, often returning to the same colony site each year (Austin 1951). Band return data show high site fidelity to the Lake Champlain colonies. Approximately 102 (82%) of the 125 adult terns banded since 1987 have returned to nest in the colonies during at least 2 breeding seasons, 73 (75% of 97 possible) of which have nested during at least 3 breeding seasons (LaBarr and Rimmer 1994). Fidelity to individual nesting islands on Lake Champlain is slightly lower. Sixty-six (67%) of the 102 banded terns that have returned to nest during at least 2 breeding seasons have returned to nest on the same island.

Roosting substrates at Lake Champlain pre-migratory staging areas include rocky spits (Lazy Lady, Savage, and Popasquash islands), partially submerged logs (MNWR), sand bars (MNWR), and man-made structures (Alburg RR trestle, duck blinds at MNWR). All of these sites are associated with moderately to highly eutrophic waters.

Food and Feeding Behavior

Fish are the predominant food of the common tern, although they have been known to eat insects, mollusks, squid, and crustaceans (Palmer 1941, Burger and Gochfeld 1991). Common terns take small fish from the surface of the water by diving and seizing the fish with their bill. Most fish are taken from the upper 30 cm of water (Burger and Gochfeld 1991). Terns forage in both single and mixed species flocks. They also feed individually, sometimes defending feeding territories (Nisbet 1983).

Focused studies on the feeding ecology of common terns have not been conducted on Lake Champlain. However, incidental data suggest that smelt (*Osmerus mordax*) may make up a large portion of the terns' diet on the Lake (LaBarr, pers. obs.). These data are similar to prey species documented for common terns on western Lake Ontario and the Niagara River (Courtney and Blokpoel 1980).

Pinkowski (1980) and Lemmetyinen (1976) observed that common terns preferred eutrophic waters for foraging. The use of pre-migratory staging areas adjacent to eutrophic waters suggests that water quality may play a role in the distribution and availability of prey species. Fluctuations in water quality may therefore affect the seasonal distribution of common terns on Lake Champlain.

Limiting Factors

Several factors limit reproductive success and colony stability of the common tern population on Lake Champlain. These include: 1) predation; 2) occupation of traditional tern nesting areas by ring-billed gulls; 3) human disturbance, and 4) seasonal vegetative overgrowth of nesting substrate. These problems have been documented in other inland and coastal colonies and have contributed to population declines and colony desertions (e.g., Morris and Hunter 1976, Nisbet 1975, Courtney and Blokpoel 1983, Nisbet and Welton 1984, Kress 1992).

Predation. Predation, primarily by great horned owls (*Bubo virginianus*) and black-crowned night-herons (*Nycticorax nycticorax*), is the single most important limiting factor on common tern reproductive success on Lake Champlain (LaBarr and Rimmer 1994). Predation was responsible for the majority of nest failures between 1987-1994 (Fig. 6) and is suspected as the primary cause of the chronic low reproductive success experienced throughout the 1970-1980's. Predation by great horned owls has resulted in nightly desertion of nesting colonies by adult terns, and has caused seasonal variation in timing and synchrony of nesting, extended incubation periods, and direct and indirect loss of eggs and chicks (LaBarr and Rimmer 1994).

The regular nocturnal desertions associated with owl predation provide increased opportunities for predation by other avian species, including black-crowned night-herons and possibly ruddy turnstones (*Arenaria interpres*) (Morris and Wiggins 1986, LaBarr and Rimmer 1993). Nocturnal colony desertion also results in mortality of unbrooded chicks due to exposure and may increase rates of nest abandonment (Nisbet 1975).

Predation by tiny thief ants (*Solenopsis molesta*) of hatching eggs and chicks has been documented on Popasquash Island since 1989 and has resulted in annual nest failures. Tiny thief ants enter nests from below, attacking newly hatched chicks and pipping eggs. Popasquash Island is the only site with ant predation on Lake Champlain. Predation by tiny thief ants of tern chicks has also been documented on the St. Lawrence River (Harper, pers. com.)

Other known predators of tern eggs and chicks have been observed at the nesting islands and may have been responsible for some nest failures. These include great black-backed gulls (*Larus marinus*), herring gulls (*Larus argentatus*) and american crows (*Corvus brachyrhynchos*). Predation by these species has, however, not been confirmed.

Displacement by Ring-billed Gulls. Ring-billed gulls have been implicated in the decline of common terns throughout the lower

Great Lakes (Morris and Hunter 1976, Morris et al. 1980, Blokpoel and Tessier 1986). Early-arriving ring-billed gulls compete with terns for nesting space and may eventually usurp an entire colony site (Blokpoel and Tessier 1986). Ring-billed gulls were first documented nesting on Lake Champlain in the late 1940's (Laughlin 1986). The breeding population on the lake increased rapidly throughout the 1960's and 1970's but has stabilized in recent years at roughly 30,000 pairs (D. Capen pers. comm.). Ring-billed gulls currently nest with terns on only two islands, Popasquash and Rock.

Popasquash Island was first colonized in 1956 by 2 pairs of ring-billed gulls (Wetherbee and Wentworth 1967). Surveys conducted in the early 1960's indicated that the ring-billed gull population at this site had grown to where breeding gulls were competing with terns for nesting space (Adams 1964, Spear 1966). Researchers believed that the colonization of Rock, Hen, and Grammas islands by terns during this same period was a response to overcrowding and loss of nesting habitat at Popasquash Island. A similar situation existed in the early 1970's when McLaughlin (1973) indicated that approximately 600 pairs of gulls on Popasquash Island were "... seriously interfering with the nesting of common terns." He recommended that gull control measures be instituted the following year. Intensive control efforts, however, were not implemented until 1987.

Regular monitoring and management (nest and egg removal) of the ring-billed gull breeding population on the tern nesting islands began in 1987. Ring-billed gull numbers increased significantly during 1988-1992 on Popasquash Island but have declined slightly in recent years (Table 3). However, ring-billed gulls continue to nest in traditional tern nesting areas on Popasquash Island, requiring removal of gull eggs and nests at the beginning of the nesting season. Ring-billed gulls remain a threat to the growing number of nesting common terns at that site. Ring-billed gull numbers on Rock Island have fluctuated markedly during 1987-1994 (Table 3). Although some nests have been destroyed in most years their, impacts on tern nesting have been limited.

Great black-backed gulls and double-crested cormorants (*Phalacrocorax auritus*) have been documented roosting with increasing regularity on Popasquash and Rock islands. Nesting by either one of these species, especially on Popasquash Island, could result in increased displacement and predation rates, and might seriously affect colony size and productivity.

Human Disturbance. In Wisconsin, Matteson and Strand (1988) found that recreation on and around nesting areas negatively affected tern reproductive success. Heavy boating traffic, vandalism and human disturbance have been implicated in the low nesting success of common terns on Lake Champlain (Spear 1970).

Humans entering tern colonies can result in direct loss through egg destruction or indirect loss through nest and brood abandonment.

Vegetative Overgrowth. Loss of habitat due to successional growth of herbaceous and woody vegetation can result in abandonment of tern nesting colonies (Morris 1972). Although successional vegetative changes have not significantly affected the suitability of nesting islands on Lake Champlain, seasonal vegetative growth has resulted in the abandonment of late season nests on Popasquash Island and has limited renesting on Hen Island (LaBarr and Rimmer 1993). In 1991, growth of herbaceous vegetation accounted for approximately 50% of all abandoned nests. The majority of these nests were initiated late in the season and were probable renesting attempts by previously unsuccessful pairs (LaBarr and Rimmer 1991).

Heavily predated populations are especially vulnerable because much of the annual productivity can be lost to early season egg/chick predation. Reduced habitat suitability due to thick vegetative growth during the renesting period may limit renesting attempts. In years when early season predation is heavy and vegetation grows quickly, terns may be forced to abandon late season reneests, thus reducing the population's overall productivity.

Research

Common terns were surveyed sporadically on Lake Champlain between 1947 and 1978 (Table 1). Data from this period, although representing the bulk of the historical record, are incomplete. In most cases only rough estimates (i.e. "several hundred" adults and "many" nests [Miller et al. 1952]) from partial surveys were recorded. In very few instances were systematic census and nest counts conducted. Common tern chicks were banded on Popasquash Island between 1957-1974 (U.S. Banding Laboratory records). Two of these banded individuals were later recovered as adults on their wintering grounds, one on the coast of Ecuador the other in Trinidad. These constitute the only known foreign recoveries of Lake Champlain banded common terns.

Surveys conducted by VINS between 1980-94 (excluding 1982) provide the most recent estimates of tern population size and productivity (Fig. 2). Surveys of the nesting islands were conducted 3-4 times a year between 1980-1986 and almost daily between 1987-94. During the 1987-1994 seasons, colonies were entered every 2-4 days in order to locate nesting areas and investigate reproductive success. Dusk watches were also conducted to determine the effects of nocturnal avian predation and nightly desertion of colony sites. Other causes of reproductive failure were also documented. Detailed results of this research can be found in LaBarr and Rimmer (1988-1994).

An ongoing, long term banding project was begun in 1988 to study tern demographics. Adult terns received a U.S. Fish and Wildlife Service (USFWS) band and a unique combination of colored leg bands. Each bird was then marked with picric acid (a harmless temporary dye). Chicks received a USFWS band and a single colored leg band. Banding data have confirmed high annual site fidelity, recruitment of chicks fledged from this population, immigration of adult breeders from both inland and coastal colonies, and the location of pre-migratory staging areas (LaBarr and Rimmer 1993).

Management

Several management strategies have been implemented since 1987 to offset factors limiting the common tern population on Lake Champlain.

1) Warning sign buoys

Beginning in 1987, warning sign buoys have been employed during the breeding season to mark the nesting islands and the immediate lake area as "restricted". These buoys consist of 2 metal signs mounted on an inflated automobile tire anchored to the lake bottom with cable wire and cinder blocks. Three to 4 buoys surround each active nesting island at an average distance of 15 m (45 ft). Buoys notify boaters that the islands were restricted and that disturbances of nesting terns are punishable by a fine under state law. Buoys are removed following completion of tern breeding activities.

The consistent use of warning sign buoys has effectively limited human disturbance at Lake Champlain tern nesting islands (LaBarr and Rimmer 1994). Although many anglers and recreational boaters continue to visit the islands, they do so at a distance that causes little direct impact on nesting terns. The number of people known to land on the islands has also dropped significantly. In 1994 there were no reported landings on any of the nesting islands.

2) Chick shelters

Man-made and natural shelters have been used since 1987 to reduce predation on tern chicks. Shelters are constructed from natural materials on the nesting islands (i.e., rocks; driftwood) or from lumber, plywood and/or cinder blocks. Shelter design has varied from open sided boxes with flat roofs to the "teepee" design described by Burness and Morris (1991). Chick shelters are placed 10-25 cm (4-6 in) from nests just prior to hatching or next to nests with newly hatched chicks.

Burness and Morris (1991) showed that chick shelters limited predation of tern chicks by gulls. LaBarr (pers. ob.) states that

the majority of chicks that fledge in any given year on Lake Champlain have been observed using shelters. Although no quantitative data on the effectiveness of chick shelters has been collected, increases in the number of young fledging from this population since 1987 suggests chicks are benefitting directly from these shelters.

3) Management of ring-billed gull populations

Since 1987, between 20 and 50 ring-billed gull nests have been removed each year from Popasquash and Rock islands to provide adequate nesting space for terns. Gull eggs are removed from the islands and the nests destroyed. This is normally done over the course of 2-3 weeks at the beginning of the breeding season. Nesting gull control has been an effective way of preserving and increasing available tern nesting space and is believed to have contributed to the growth of tern numbers on Popasquash Island (LaBarr and Rimmer 1994).

4) Control of tiny thief ants

Tiny thief ants were first documented taking common tern chicks on Popasquash Island in 1988 (LaBarr and Rimmer 1988). Attempts to control the ant population began in 1989. A sugar-based ant-specific bait (Drax Ant Kill Gel) was deployed in approximately 50 traps in both 1989 and 1990. The bait system reduced the number of nests that failed due to ant predation but did not eliminate the problem. A barrier system was developed in 1991 to work with the bait system. In 1992-1994 a protein-based bait (Drax Ant Kill Gel PF) was substituted for the sugar based-bait. In each of these years, 1991-1994, about 50-60 traps were used. Ant predation continued to decline, reaching its lowest levels in 1994 (LaBarr and Rimmer 1994).

5) Control of encroaching vegetation

Vegetation control has been done sporadically since 1988. Portions of nesting islands, primarily Popasquash Island, have been hand weeded to increase nesting space and reduce vegetation related abandonment. Although this method has been effective for individual nests it is labor and time intensive. The disturbance created by vegetation control often outweighs the benefits the nesting population, as a whole, receives. In years of heavy vegetative growth, however, vegetation control can be an important means of reducing late-season abandonment (LaBarr and Rimmer 1991).

6) Education

Education of lake users and the general public about common tern biology and conservation has been conducted since 1987.

Conversations with anglers and pleasure boaters during tern watches, as well as, newspaper/newsletter articles, informational posters, slide lectures and boat cruises have all been used to convey information to the public. These efforts have helped increase awareness about Lake Champlain's common terns and reduce human disturbance.

Recent increases in the number of nesting terns and colony productivity suggest that management has had positive effects on the Lake Champlain Common Tern population. Management techniques have increased chick survival, maintained available nesting space and reduced human disturbance. Continued use of these techniques will be important to the viability of this population.

PART II. STRATEGIES AND RECOMMENDATIONS FOR RECOVERY OF COMMON TERNS IN VERMONT

Recovery Plan Goals: There are 3 recovery plan goals, these are:

Goal 1) A minimum Lake Champlain breeding population of 200 pairs of common terns with sufficient productivity over 5 years to maintain population stability (average > 0.6 fledglings/pair) would allow consideration of this species for downlisting from endangered to threatened status.

Goal 2) A minimum breeding population of 300 pairs nesting on at least 2 sites (2 sites are deemed necessary to support 300 nesting pairs) with sufficient productivity over 5 years to maintain population stability (average > 0.6 fledglings/pair) would allow this species to be considered for delisting from threatened status.

Goal 3) To secure and manage a minimum of 3 of the 6 known nesting locations, these include: Popasquash, Hen or Rock, and Grammas islands. Protection of the 3 remaining islands, including Savage and Gull should also be pursued.

Justification of Recovery Plan Goals: The recovery plan goals are based on 4 factors:

1) Common terns have nested on Lake Champlain since at least the late 1800's. Although historical information is incomplete, surveys conducted in 1964 (Spear 1964; ca. 350 breeding pairs), 1965 (Spear 1965; ca. 300 breeding pairs), 1968 (Miller and King 1982; ca. 300 breeding pairs) and 1970 (Spear 1970; ca. 400 breeding pairs) show that Lake Champlain once supported approximately 300-400 pairs of breeding terns.

2) During the 1970's and 1980's this population declined to a low of about 50 pairs, justifying placement of the species on

the Vermont Endangered and threatened Species List.

3) Sufficient habitat still exists to support a minimum of 400 pairs. The colony sites that were used by breeding terns during periods of peak population levels (i.e., 1960's and 1970's) remain relatively unchanged and are currently suitable for use by nesting terns. Nesting locations identified in Goal 3 as needing protection have been used by terns in recent years and are deemed important for the recovery of this population.

4) Although Nisbet (1978) and DiConstanzo (1980) suggest that 1.1 fledglings/pair are needed for a self sustaining population, productivity levels of about 0.6 fledglings/pair have accompanied a steadily growing tern population on Lake Champlain. Immigration is thought to offset low reproductive success, allowing population size to increase while productivity remains low (LaBarr and Rimmer 1994). Therefore we recommend a minimum average productivity level of greater than 0.6 fledglings/pair over 5 consecutive years for a breeding population that is a) increasing due to recruitment and/or immigration or b) has reached and stabilized at greater than 400 breeding pairs. If the above conditions are not met, then minimum productivity levels should be increased until the recovery goal of 400 pairs and population stability is attained.

A breeding population of 300 pairs of common terns, with sufficient productivity to maintain population stability at at least 2 of the 6 potentially protected nesting locations, is therefore considered the minimum necessary for delisting this species from its current state endangered status.

Objectives and Priorities

1. Secure long-term protection of existing and historical colony sites. Priorities include:
 - a) Protection/acquisition of Rock and/or Grammas islands.
 - b) Continue to enhance working relations with landowners of currently protected islands (Popasquash and Hen islands) and other nesting islands.
2. Enhance productivity, colony stability and breeding habitat at existing colony sites. Priorities include:
 - a) Purchase of U.S Coast Guard approved signed-buoys for nesting islands.
 - b) Increase cooperative efforts with Vermont game

wardens and state police to patrol nesting islands.

- c) Implement predator deterrent projects.
3. Annually monitor population size, breeding success, productivity, and factors limiting population stability and growth. Priorities include:
- a) Secure funding to adequately staff monitoring and management efforts.
 - b) Develop a volunteer program to support recovery efforts.
4. Continue research that enhances recovery efforts. Priorities include:
- a) Prioritize current and future management needs.
 - b) Identify funding sources for current and future (i.e. feeding study) research.
5. Increase public awareness of the common tern as a Vermont endangered species and expand educational outreach programs including slide show/lectures, and informational brochures.

Recommendations and Strategies for Attaining Goals

1. Secure and protect existing and historical colony sites.
- 1.1 Compile data on current and historic colony sites.
 - 1.11 Map current and historic colony sites, identifying primary nesting areas at each location. (Completed 1994)
 - 1.12 Describe habitat features and assess habitat quality/suitability of historic and active sites; including vegetation, nesting substrate, and location of site in relation to other topographical features (eg. other islands, mainland). (Completed 1994)
 - 1.13 Compile current and historic population data for each colony site; including population size, productivity, demographics and breeding phenology. (Completed 1994)
 - 1.14 Determine limiting factors at each colony site. (Completed 1994)

- 1.15 Determine ownership of current and historic colony sites. (Completed 1994)
- 1.2 Prioritize colony sites for protection.
 - 1.21 Determine relative significance of each colony site to overall population stability and growth. (Completed 1994)
 - 1.22 Identify actions needed to secure long-term protection of each colony site focusing on those sites which are deemed most significant.
- 1.3 Develop strategies to protect and secure colony sites.
 - 1.31 Identify management requirements needed to protect each colony site. (Completed 1994)
 - 1.32 Ensure protection of colony sites via fee title acquisition, acquisition of conservation easements and/or management leases. (Ongoing)
 - 1.33 Create partnerships and cooperative working relationships with landowners, conservation groups and local and state governments. (Ongoing)
 - 1.34 Protect colony sites using floating sign buoys. (Ongoing)
 - 1.35 Actively patrol colony sites to enforce protective restrictions by: 1) working in cooperation with law enforcement personnel (state police, game wardens) to patrol colony sites during the nesting season; and 2) developing a volunteer patrol network. (Ongoing)
- 1.4 Inventory Lake Champlain for sites not currently or historically used by terns which may be suitable for colonization.
 - 1.41 Locate and identify potential colony sites on Lake Champlain.
 - 1.42 Determine if the use of these sites by Common Terns will be beneficial to the recovery of this population.
 - 1.43 Determine management strategies which may: 1) enhance existing habitat for nesting and 2) attract common terns to these sites.

2. Enhance productivity, colony stability and breeding habitat at each colony site.
 - 2.1 Annually identify and monitor limiting factors at each colony site. (Ongoing)
 - 2.11 Determine timing and extent of egg and chick loss due avian predators and ants.
 - 2.12 Determine effects of ring-billed gull and other species populations on nesting terns.
 - 2.13 Determine extent and impacts of human disturbance.
 - 2.14 Determine extent and impacts of seasonal vegetative growth.
 - 2.2 Annually prioritize colony sites for management efforts. (Ongoing)
 - 2.21 Determine importance of each site to population growth and stability.
 - 2.22 Determine management requirements for each site.
 - 2.23 Concentrate intensive management efforts on most important sites.
 - 2.3 Continue, and expand as necessary, current management strategies to counteract limiting factors to enhance breeding habitat and reproductive success. (Ongoing)
 - 2.31 Continue the use of chick shelters to reduce chick loss to avian predators.
 - 2.32 Continue to use an ant-specific bait and barrier system on Popasquash Island to reduce tiny thief ant predation on chicks and pipping eggs.
 - 2.33 Continue site-specific measures to control Ring-billed Gull populations so that competition for nesting space with terns is reduced. Document control measures.
 - 2.34 Continue to control vegetation (mechanical removal) at existing colony sites to provide optimum nesting habitat.
 - 2.35 Continue to limit human access to colony sites by placing floating sign buoys around nesting islands and actively patrolling colony sites.

- 2.36 Annually evaluate management strategies for effectiveness and limitations.
- 2.4 Develop and implement new management strategies and techniques to enhance breeding habitat and reproductive success.
 - 2.41 Investigate new techniques to: 1) discourage or control predators at colony sites; 2) manage and control Ring-billed Gull populations; and 3) limit human disturbance.
 - 2.411 Review current literature as it becomes available for new management techniques.
 - 2.412 Determine if techniques are applicable and necessary at each site.
 - 2.413 Test and evaluate new techniques.
 - 2.414 If techniques are effective, implement them on a site by site basis.
 - 2.415 Assess effectiveness and limitations of new techniques and modify as necessary.
 - 2.42 Create or expand nesting habitat.
 - 2.421 Determine if increased availability of nesting habitat will benefit tern recovery efforts on Lake Champlain.
 - 2.422 Expand nesting habitat at existing colony sites by manipulating nesting substrate and vegetation.
 - 2.423 Create nesting habitat at potential colony sites by manipulating nesting substrate and vegetation.
 - 2.43 Continue to monitor and investigate other potential limiting factors.
 - 2.431 Monitor use of colony sites by Greater Black Backed Gulls, Double-crested Cormorants and Herring Gulls to determine if any of these species negatively effect tern nesting and productivity. (Ongoing)
 - 2.432 Implement management techniques if above species have a detrimental effect on tern nesting and productivity.

- 2.433 Investigate other known limiting factors currently not known to negatively affect this population (i.e., contaminants).
3. Annually monitor population size, breeding success, productivity and factors limiting population stability and growth. (Ongoing)
 - 3.1 Continue to survey nesting islands by boat every 2-7 days from late April to September.
 - 3.11 Identify active colony sites.
 - 3.12 Census the number of adults, breeding pairs and fledglings at each site.
 - 3.2 Continue to survey colony sites by foot every 4-5 days from late April to completion of fledging.
 - 3.21 Census tern nests at each colony site, individually marking each nest and plotting it on a colony map.
 - 3.22 Collect pertinent nest data including: 1) clutch size; 2) approximate or known nest initiation and egg hatching dates; 3) reproductive outcome; and 4) evidence of predation or other disturbance.
 - 3.23 Band all young with standard USFWS stainless steel bands and a single yellow color band. Track young to fledging or death to determine fledging success and productivity rates.
 - 3.25 Document factors that negatively affect tern nesting, reproductive success or colony stability (i.e., predation and human disturbance events).
 - 3.3 Continue to conduct detailed observations from a boat and/or blind.
 - 3.31 Collect information concerning intra- and inter-specific competition, colony behavioral characteristics and human disturbance.
 - 3.32 Continue to conduct dusk/dawn watches to determine the extent and effects of nocturnal predation and abandonment.

- 3.4 Use above data to determine annual statewide population trends, including: 1) total number of nesting pairs; 2) hatching and fledging success; 3) total number of fledglings; and 4) productivity (fledglings/pair).
- 3.5 Use above data to determine the extent to which limiting factors negatively affect population size, growth and reproductive success.
- 3.6 Annually evaluate survey techniques to determine effectiveness and possible negative impacts on breeding terns.
- 3.6 Create a volunteer network to aid data collection and management efforts.
- 3.7 Investigate and evaluate alternative censusing and sampling techniques to estimate reproductive success and productivity.
- 3.7 Develop a monitoring plan to accommodate changing demographic parameters (ie. increased population size).
- 3.8 Develop a long-term monitoring strategy to be implemented once recovery goals are attained.
4. Continue research that enhances recovery efforts. (Ongoing)
 - 4.1 Continue to selectively trap, band and mark breeding adults to investigate survivorship, site fidelity, inter-colony movement, immigration, emigration and recruitment rates.
 - 4.11 Prioritize adult terns to be trapped, focusing on banded individuals of unknown identity (i.e., immigrants, banded terns fledged from this population, banded terns which have lost color bands).
 - 4.12 Capture selected incubating adults in a Potter's trap or a drop trap triggered from a blind.
 - 4.13 Band each unbanded individual with a USFWS stainless steel band. Band all individuals with a unique combination of 3 Darvic colored leg bands. Mark each tern with picric acid in a pattern specific to its colony.
 - 4.14 Determine identity and original banding location of previously banded birds.

- 4.15 Locate and track movements of banded individuals within and between breeding seasons to determine nesting/re-nesting locations, inter-colony movement patterns, identity of mates, and reproductive success of each individual.
- 4.2 Continue to identify and monitor pre-migratory staging areas on and outside of Lake Champlain.
 - 4.21 Annually identify pre-migratory staging areas used by Common Terns.
 - 4.22 Regularly monitor Lake Champlain staging areas every 3-7 days to determine numbers of terns using each site and patterns of use. Monitor staging areas outside Lake Champlain as time and resources permit using local volunteers when possible.
 - 4.23 Identify banded and marked terns at each site and monitor site use and movement patterns of these individuals.
 - 4.24 Use above data to assess seasonal and long term importance of each site.
 - 4.25 Investigate and test ways to enhance each site (i.e., create roosting substrate).
 - 4.26 Protect important pre-migratory staging areas on Lake Champlain through fee title acquisition, conservation easements or long term management agreements.
- 4.3 Investigate and assess ways of improving survey methods.
- 4.4 Continue to experiment with and evaluate alternative management strategies to reduce predation, discourage or control competing species and limit human disturbance.
- 4.5 Determine the need and availability of resources for other research projects that may aid recovery efforts.
 - 4.51 Identify research that may enhance recovery goal (ie. feeding ecology studies, impacts of contaminants on Lake Champlain terns).
 - 4.42 Determine the need and availability of resources for each study.

4.43 Acquire resources to implement needed research.

5. Increase public awareness of the natural history and conservation status of Common Terns. (Ongoing)

- 5.1 Develop more informative sign buoys to increase boater awareness of tern conservation efforts and more clearly designate areas off-limits to boats and people.
- 5.2 Place informative signs at public boat ramps adjacent to tern nesting islands.
- 5.3 Distribute information concerning tern conservation efforts to marinas, bait shops and other local businesses.
- 5.4 Work with local state parks (Burton Island, Knight Point North Hero, Grand Isle and Sand Bar) to develop informational displays and posters for their nature centers and bulletin boards.
- 5.5 Develop and distribute press releases to local newspapers, magazines and newsletters.
- 5.6 Continue to present lecture/slide shows to students, state park visitors, civic and professional groups, and other interested parties.
- 5.7 Develop and coordinate volunteers to aid in island protection and collection of data. Use volunteer network as a means of distributing tern conservation information.
- 5.8 Develop partnerships with public and private organizations to enhance awareness and create sources of cooperative funding.
- 5.9 Develop programs that increase public awareness and raise funds for the recovery project (e.g., Adopt-A-Tern Program).
- 5.10 Publish articles in both popular and technical journals to increase visibility of the project and communicate findings for possible use by other managers/researchers.

PART III. LITERATURE CITED

- Adams, B. 1964. Popsquash-The crowded island. Eastern Bird-banding Assoc. News, Vol. 27, No. 1.
- Adams, B. 1969. Banding and population control studies of gulls at Popsquash Island, Vermont. Eastern Bird-banding Assoc. Vol. 32, No. 6.
- Austin, O.L., Jr. 1932. Further contributions to the knowledge of the Cape Cod Sterninae. Bird-Banding 3:123-139.
- Austin, O.L., Sr. 1951. Group adherence in the common tern. Bird-Banding 22:1-15.
- Austin, O.L., and O.L. Austin, Jr. 1956. Some demographic aspects of the Cape Cod population of common terns (*Sterna hirundo*). Bird-Banding 27:55-66.
- Ball, P. 1947. Records of New England Birds. 2:25-26. Lincoln, Mass.: Massachusetts Audubon Society.
- Blokpoel, H, and G.D. Tessier. 1986. The Ring-billed Gull in Ontario: a review of a new problem species. Canadian Wildlife Service Report Series 57.
- Burger, J., and M. Gochfeld. 1991. The Common Tern: Its Breeding Biology and Social Behavior. New York: Columbia University Press.
- Burness, G.P., and R.D. Morris. 1991. Shelters decrease avian predation on chicks at a Common Tern colony.
- Chapman, F.M. 1904. Handbook of the birds of eastern North America. 6th ed. New York: D. Appleton.
- Courtney, P., and H. Blokpoel. 1980. Food and indicators of food availability for common terns on the lower Great Lakes. Can. J. Zool. 58(7):1318-1323.
- Courtney, P., and H. Blokpoel. 1983. Distribution and numbers of common terns on the lower Great Lakes during 1900-80: a review. Colonial Waterbirds 6:107-120.
- DiConstanzo, J. 1980. Population dynamics of a Common Tern colony. Journal of Field Ornithology 51:229-243.

- Harrison, P. 1983. Seabirds, an identification guide. Boston: Houghton Mifflin Co. 448 pp.
- Haymes, G.T., and H. Blokpoel. 1978. Seasonal distribution and site tenacity of the Great Lakes common tern. Bird-Banding 49(2):142-151.
- Indridason, O. 1975. The most fragile islands in Lake Champlain. Vermont Life. Spring:28-31.
- Kress, S.W., and D.A. Shealer. 1991. Nocturnal abandonment response to black-crowned night-heron disturbance in a common tern colony. Colonial Waterbirds 14(1):51-56.
- LaBarr, M.S. 1992. Site fidelity and post-breeding dispersal of common terns on Lake Champlain. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- LaBarr, M.S., and C.C. Rimmer. 1988. The 1988 breeding status of Common Terns in Vermont. Unpubl. report, Vermont Institute of Natural Science, Woodstock, VT.
- LaBarr, M.S., and C.C. Rimmer. 1989. The 1989 breeding status of Common Terns on Lake Champlain. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- LaBarr, M.S., and C.C. Rimmer. 1990. The 1990 breeding status of Common Terns on Lake Champlain. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- LaBarr, M.S., and C.C. Rimmer. 1991. The 1991 breeding status of Common Terns on Lake Champlain. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- LaBarr, M.S., and C.C. Rimmer. 1992. The 1992 breeding status of Common Terns on Lake Champlain. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- LaBarr, M.S., and C.C. Rimmer. 1993. The 1993 breeding status of Common Terns on Lake Champlain. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- LaBarr, M.S., and C.C. Rimmer. 1994. The 1994 breeding status of Common Terns on Lake Champlain. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- Laughlin, S. 1980. 1980 Common Tern Survey. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- Laughlin, S. 1983. Vermont Institute of Natural Science Common Tern Survey. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.

- Laughlin, S. 1984. Common Tern survey - 1984. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- Laughlin, S. 1985. Common Tern. In The Atlas of Breeding Birds in Vermont, ed. S.B. Laughlin and D.P Kibbe. Hanover: University Press of New England. pp. 118-119.
- Lemmetyinen, R. 1976. Feeding segregation in the arctic and common terns in southern Finland. Auk 93:636-640.
- Martin, N., and C. Fichtel. 1985. Vermont Common Tern survey - 1985. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- Matteson, S.W. 1988. Wisconsin common tern recovery plan. Wisconsin Department of Natural Resources, Madison, Wisconsin.
- McLaughlin, F.L. 1973. Results of field trip to Four Brothers Islands, Lake Champlain. Unpubl. report, Vermont Fish and Wildlife Department, Waterbury, Vermont.
- Miller, B., and N. King. 1981. Partial history of the avifauna of some of Lake Champlain's islands, 1951-1981. Waterbury, Vt.: Vt. Fish and Wildlife Department.
- Miller, B., and N. King. 1982. Partial history of the avifauna of some of Lake Champlain's islands, 1963-1981. Waterbury, Vt.: Vt. Fish and Wildlife Department.
- Morris, R.D., and R.A. Hunter. 1976. Factors influencing desertion of colony sites by Common Terns. Can. Field Nat. 90:137-143.
- Morris, R.D., I.R. Kirkham, and J.W. Chardine. 1980. Management of a declining Common Tern colony. J. Wildlife Mgmt. 44:241-145.
- Morris, R.D and D.A. Wiggins. 1986. Ruddy Turnstones, Great Horned Owls and egg loss from Common Tern clutches. Wilson Bull. 98:101-109
- Nisbet, I.C.T. 1973. Terns in Massachusetts: Present status and historical changes. Bird-Banding 44:27-55.
- Nisbet, I.C.T. 1975. Selective effects of predation in a tern colony. Condor 77:221-226.
- Nisbet, I.C.T. 1978. Population models for Common Terns in Massachusetts: Present numbers and historic changes. Bird-Banding 44:241-245.

- Nisbet, I.C.T. 1983. Territorial feeding by common terns. Colonial Waterbirds 6:64-70.
- Nisbet, I.C.T., J.M. Winchell, and A.E. Heise 1984. Influence of age on the breeding biology of common terns. Colonial Waterbirds 7:117-126.
- Nisbet, I.C.T., and W.J. Welton. 1984. Seasonal variations in breeding success of Common Terns: consequences of predation. Condor 86:53-60.
- Palmer, R.S. 1941. A behavior study of the common tern. Proc. Boston Soc. Nat. Hist. 42:1-119.
- Pinkowski, B.C. 1980. Adaptations of common terns nesting on an island reservoir. Prairie Nat. 12:111-113.
- Rimmer, C.C., and J. Falk. 1986. Vermont Common Tern survey - 1986. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- Rimmer, C.C., and J. Falk. 1987. Vermont Common Tern survey - 1987. Unpubl. report, Vermont Institute of Natural Science, Woodstock, Vt.
- Shugart, G.W., and W.C. Scharf. Common terns in the northern Great Lakes: current status and population trends. J. Field Ornithol. 54:160-169.
- Spear, R.N. 1966. History of the common tern in Vermont to June 1966. Report to Vermont Fish and Wildlife Dept., Waterbury, Vt.
- Spear, R.N. 1970. The Common Tern on Lake Champlain. Lake Champlain Basin Studies: Wildlife-Part II. Bird Study no. 7-B, Burlington, Vt.: Lake Champlain Committee.
- Terres, J.K. 1980. The Audubon Society encyclopedia of North American birds. New York: Alfred A. Knopf. 1109 pp.
- Wetherbee, D.K., and B.C. Wentworth. 1967. Ecology and physiology of avian sterility, a progress report of 1967 and recommendations for 1968. Report to Vermont Fish and Wildlife Dept., Waterbury, Vt.

Table 1. Peak counts of Common Tern nests on Vermont tern nesting islands, 1980-1994.^a

	1980	1981	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Popasquash I.	30	150	31	26	38	96	34	24	36	52	58	72	86	96
Rock I.	16	10	12	12	14	5	20	23	13	13	7	5	3	7
Hen I.	0	68	51	46	9	15	13	18	5	0	11	7	0	
Grammas I.	4	4	0	0	0	0	0	2	0	0	0	0	20	5
Savage I.	1	12	0	0	0	0	0	0	0	0	15	1	2	0
Gull Rock	70	133	0	0	36	0	4	13	0	0	0	0	0	0
Total Nests ^b	-	-	-	-	-	-	163	129	108	115	143	139	226	216
Total No. of Active sites	5	5	3	3	4	3	4	5	3	3	3	4	5	3

^a Data for 1980-1984 is from Laughlin 1980, 1981, 1983, 1984. Data for 1985 is from Martin and Fichtel 1985. Data for 1986-1987 is from Rimmer and Falk 1986, 1987. Data for 1988-1994 is from LaBarr and Rimmer 1994. Surveys not conducted in 1982.

^b Total number of nests observed on all islands during the entire breeding season. Common Tern nests not individually marked in 1980-1986 thus the total number of nests could not be determined.

Table 2. Surveys of Vermont Common Tern nesting islands, 1947-1978.

<u>Location</u>	<u>Date</u>	<u>Observer</u>	<u>Source</u>	<u>Comments</u>
Popasquash I.	6-21-1947	-	RNEB (1947)	Ca. 100 terns.
Popasquash I.	5-9-1952	W. Miller and N. King	Miller and King(1982)	Ca. 40 terns, no nests.
Popasquash I.	5-24-1952	"	"	"several hundred" terns, "many" nests.
Popasquash I.	7-3-1952	-	RNEB (1947)	Ca. 100 terns.
Popasquash I.	5-13-1953	W. Miller and N. King	Miller and King (1982)	30-40 terns.
Popasquash I.	5-20-1954	"	"	"here in numbers".
Popasquash I.	5-21-1955	"	"	"nesting".
Popasquash I.	7-6-1955	"	"	Ca. 250 terns.
Popasquash I.	5-20-1956	"	"	56 terns.
Popasquash I.	June, 1957	J. Buckalew	NBS ^a	23 chicks banded.
Popasquash I.	June, 1957	N. St. Jacques	"	220 chicks banded.
Popasquash I.	July, 1959	B. Adams	"	1 chick banded.
Popasquash I.	June, 1960	"	"	71 chicks banded.
Popasquash I.	June/July, 1961	"	"	28 chicks banded.

Popasquash I.	June, 1962	B. Adams	NBS	34 chicks banded.
Popasquash I.	June, 1963	"	"	1 chick banded.
Popasquash I. Rock I.	5-21-1964 "	R.N. Spear "	Unpubl. data "	Ca. 350 terns. Ca. 300 terns.
Rock I.	7-17-1964	"	"	Ca. 100 terns.
Popasquash I. Rock I.	5-25-1965 "	" "	" "	Ca. 350 terns. Ca. 200 terns, 88 nests.
Rock I.	7-14-1965	"	"	12-15 nests.
Popasquash I. Rock I. nests.	6-4-1966 "	" "	" "	Ca. 200 terns. Ca. 80 terns, 26 nests.
Rock I.	7-4-1966	"	"	Ca. 80 terns.
Popasquash I.	5-1-1967	"	"	100-200 terns.
Grammas I.	5-24-1967	W. Miller and N. King	Miller and King (1982)	52 nests.
Grammas I.	6-25-1967	"	"	179 nests.
Popasquash I.	July, 1967	B. Adams	NBS	34 chicks banded.
Popasquash I.	5-24-1968	W. Miller and N. King	Miller and King (1982)	Ca. 500 terns, 260 nests.
Rock I. Grammas I.	" "	" "	" "	12 terns, 10 nests. No terns.

Popasquash I.	June, 1968	B. Adams	NBS	131 chicks banded.
Popasquash I. Rock I.	6-4-1970 "	R.N. Spear "	Spear (1970) "	Ca. 500 terns. 12 nests.
Grammas I.	6-7-1970	"	Spear (1970)	Ca. 150 terns, 75- 100 nests.
Hen I.	"	"	"	Ca. 100 terns, ca. 50 nests.
Rock I.	5-19-1971	W. Miller and N. King	Miller and King (1982)	36 nests.
Popasquash I.	July, 1972	B. Adams	NBS	63 chicks banded.
Popasquash I.	5-14-1973	W. Miller and N. King	Miller and King (1982)	75-100 terns, 26 nests
Grammas I.	"	"	"	30-40 terns, no nests.
Hen I.	"	"	"	20 terns, 9 nests.
Popasquash I.	June, 1973	"	"	Ca. 500 terns.
Popasquash I.	5-11-1974	O. Indridason	Indridason (1974)	20-30 terns.
Rock I.	"	"	"	12 nests.
Grammas I.	"	"	"	No terns.
Hen I.	"	"	"	14 terns.
Popasquash I.	5-28-1974	W. Miller and N. King	Miller and King (1982)	133 nests.
Popasquash I.	June, 1974	B. Adams	NBS	13 chicks banded.

Popasquash I.	5-20-1975	W. Miller and N. King	Miller and King (1982)	115 nests.
Popasquash I. Rock I.	5-24-1978 "	" "	" "	72 nests Ca. 100 terns, 40 nests.

^a National Biological Survey Bird Banding Laboratory

Table 3. Peak number of Ring-billed Gull nests on Vermont tern nesting islands, 1987-94.

	1987	1988	1989	1990	1991	1992	1993	1994
Popasquash I.	116	190	189	220	180	271	41	34
Rock I.	107	108	3	20	88	34	0	42
Grammas I.	0	0	0	0	0	0	0	0
Hen I.	0	0	0	0	0	0	0	0
Savage I.	0	0	0	0	0	0	0	0
Gull Rock	0	0	0	0	0	0	0	0
Totals	223	298	192	240	268	305	41	76

FIGURE 1. Location of Common Tern nesting islands and pre-migratory staging areas on Lake Champlain, Vermont.

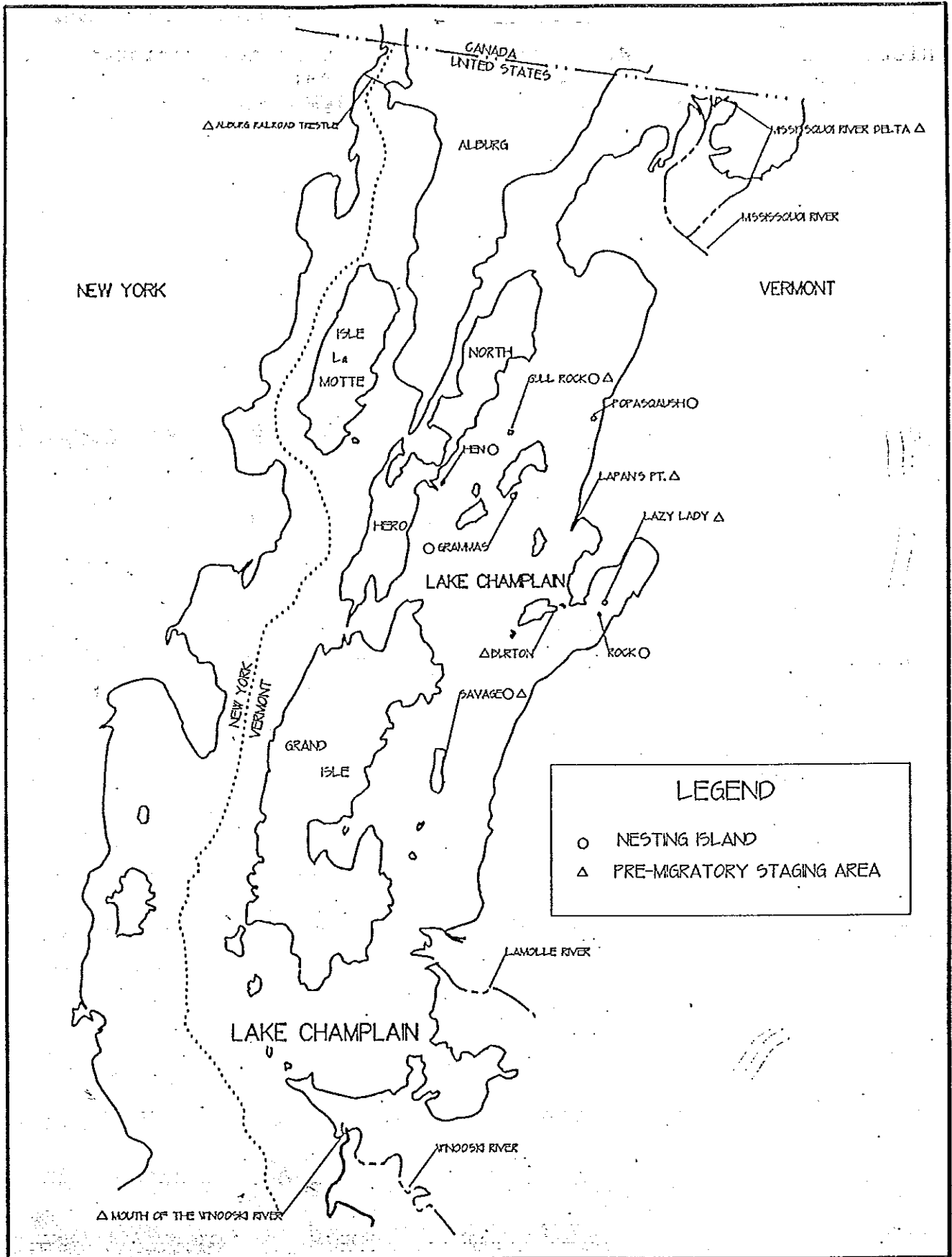


Figure 2. Population levels and reproductive success of Vermont Common Terns, 1980-1994.
Peak Counts

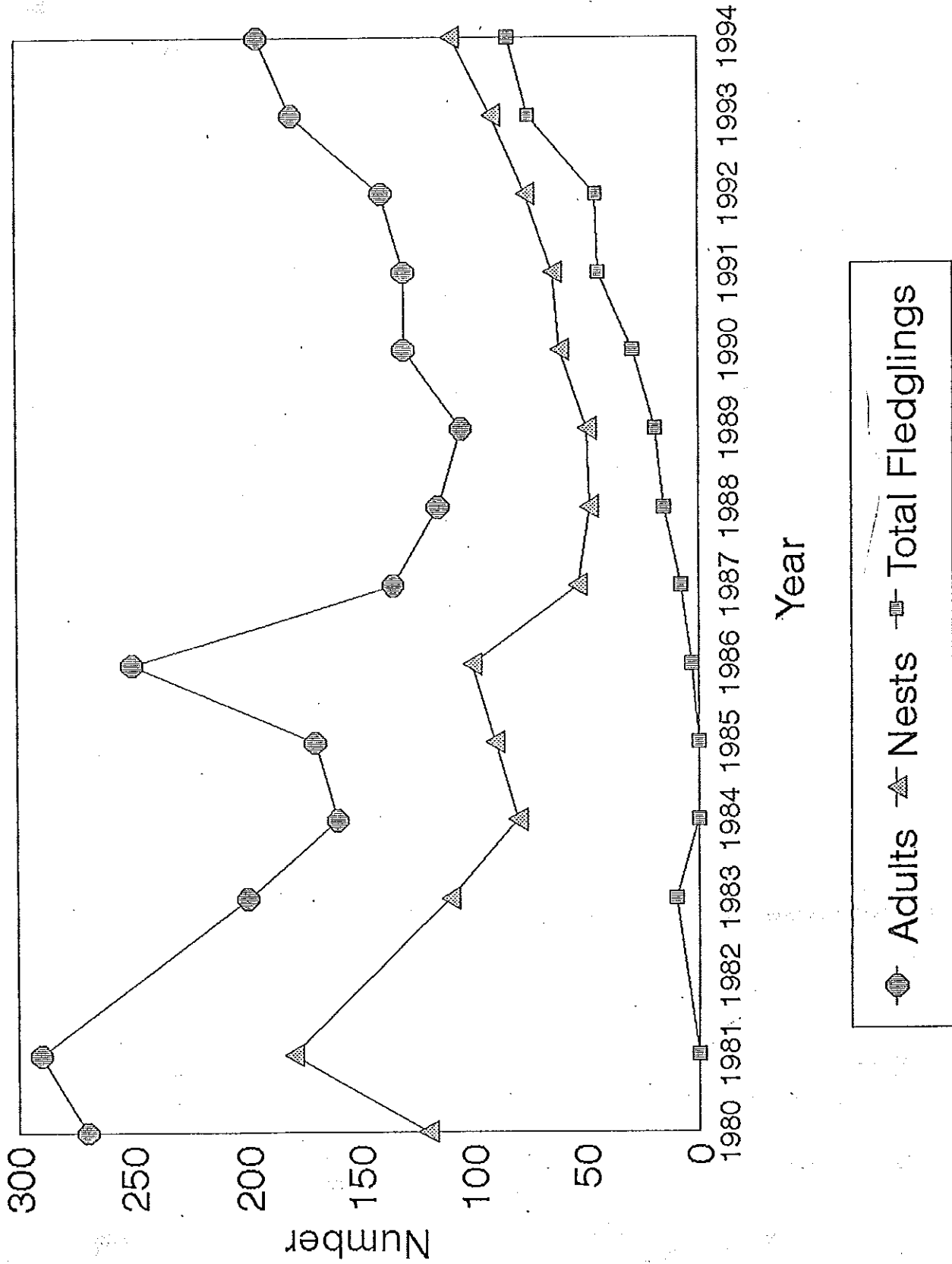


Figure 4. Vermont Common Tern productivity, 1986-1994.

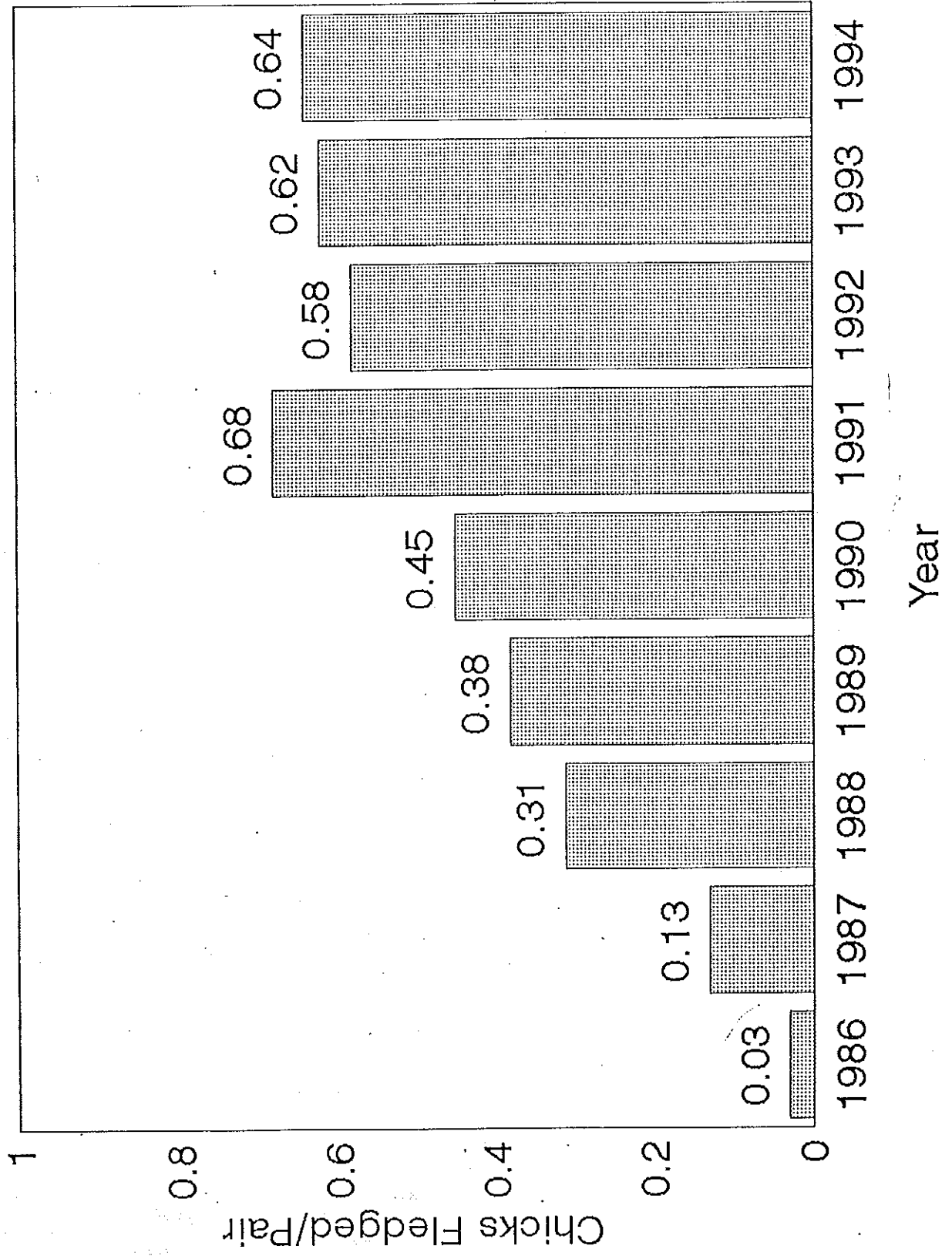


Figure 5. Percentage of banded Vermont Common Terns staging on Lake Champlain and at Beauharnois, Quebec, 1991-1994.

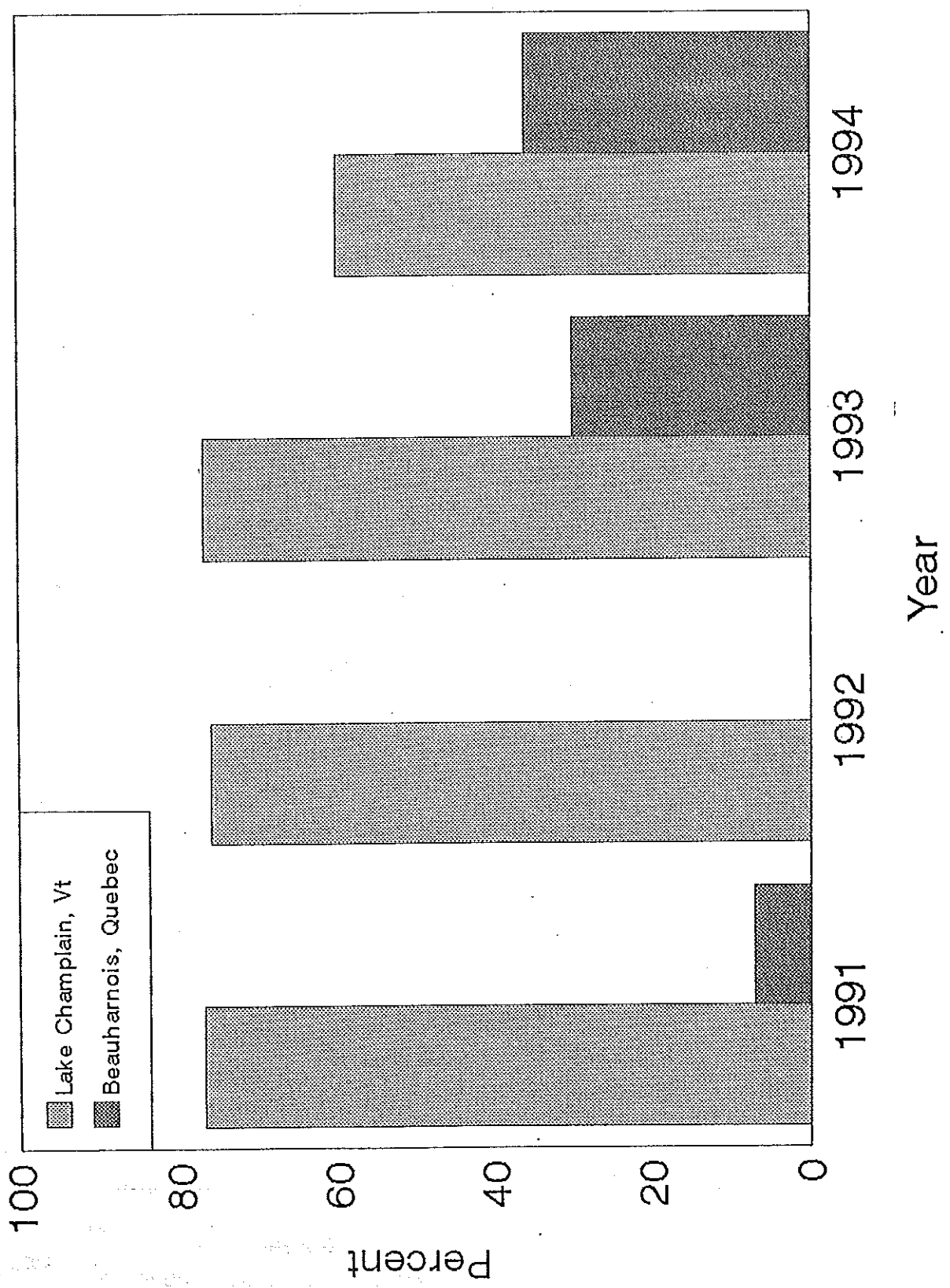


Figure 6. Reproductive outcome of Vermont Common Tern nests, 1988-1994.

