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COLONIAL BIRDS NESTING ON MAN-MADE AND NATURAL SITES IN THE U. --ETC(U)

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REPORT NO. FWS/OBS-78/15

COLONIAL BIRDS NESTING ON MAN-MADE AND NATURAL SITES IN THE U. S. GREAT LAKES

by

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May 1978

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Habitats and nesting populations of colonial nesting birds of the U. S. Great Lakes were determined by aerial census, ground nest observations, and vegetation analysis during 1976 and 1977. Thirteen species at 267 colonies were found during this 2-year study. An atlas of nesting sites and populations for both years of the study locates and gives the sizes of the colonies. Intensive vegetation and habitat studies were performed on 24 sites: 8 natural

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20. ABSTRACT (Continued)

islands and 16 dredged material locations. A greater percentage of cover by herbaceous vegetation was favored by ring-billed gulls and herring gulls, but common and Caspian terns preferred less vegetative cover. Both ciconiiform and larid colonial nesters killed or badly stressed the vegetation supporting, surrounding, and/or below their nests. Soil analyses showed high levels of macronutrients in most colonies except those of Caspian and common terns. These nutrients were presumed to be toxic except to a few adapted plant species frequently found in heavily fertilized ring-billed gull colonies. The drop in Great Lakes water levels in 1977 produced new nesting sites and more nesting area. New colonies frequently had retarded nesting in relation to other colonies and lessened intracolony synchrony, nest density, and nesting success. This was regardless of whether the site was natural or dredged material in origin.

Colony size and previous experience of the breeders seemed more important than latitude in determining date of peak hatching and chronological sequence of nesting in ring-billed gulls. The water table at the site affected nesting success by changing vegetation from hydric to xeric seres. In the case of standing impounded water, it could be drained or dewatered to provide additional nesting space. Effective dewatering practices are important to the construction of dredged material sites where colonial nesting birds are desired. Other management considerations important for encouragement or discouragement of colonial bird use are the proximity and attractiveness to humans allowing intrusions, proximity to an aircraft hazard zone, prevention of access by predators, height of dikes, and initial cover seeding or plant establishment.

Appendix A presents maps of the colonies in the study. Appendix B lists common and scientific names of plants discussed in this report. Appendix C gives the relative density, coverage, and frequency of plants in the sample area. Appendixes D and E discuss the colonial nesting surveys in the St. Marys River area and the Beaver Islands archipelago, respectively.

THE CONTENTS OF THIS REPORT ARE NOT TO BE USED FOR ADVERTISING, PUBLICATION, OR PROMOTIONAL PURPOSES. CITATION OF TRADE NAMES DOES NOT CONSTITUTE AN OFFICIAL ENDORSEMENT OR APPROVAL OF THE USE OF SUCH COMMERCIAL PRODUCTS.

PREFACE

The study reported herein was conducted by Northwestern Michigan College, Traverse City, Mich., during 1976-1977. The study was jointly sponsored by the Office, Chief of Engineers, U. S. Army (OCE), and the U. S. Fish and Wildlife Service (USFWS), under Contract No. USFWS-CE7-255. The study was monitored by the Environmental Laboratory (EL), U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., and by the USFWS Office of Biological Services, National Coastal Ecosystems Team, NSTL Station, Miss.

USFWS participation in the study was under the Coastal Ecosystems Project of the Biological Services Program. WES participation was part of the Dredged Material Research Program (DMRP), sponsored by OCE and managed by EL, and constituted DMRP Work Unit No. 4F01A.

Dr. William C. Scharf and Messrs. Gary W. Shugart and Michael L. Chamberlin conducted the study. Dr. Scharf wrote the first and second drafts of the final report with the exception of Appendix A, which was prepared by USFWS and WES, and Appendixes D and E, which were written by Messrs. Chamberlin and Shugart, respectively. Ms. Mary C. Landin (WES) wrote the final draft. The text and some appendix figures were also prepared by WES.

Ms. Landin was Contract Manager and Mr. Larry Shanks (USFWS) was Project Officer. Dr. Robert F. Soots, Jr. (WES), served as a technical advisor. WES technical review was provided by Ms. Landin, Dr. Soots, Dr. R. T. Huffman, and Ms. L. J. Hunt. FWS technical review was provided by Mr. Shanks, Dr. David Smith, and Dr. Donald Woodard. Drs. H. K. Smith (WES) and Howard Tait (USFWS) provided general supervision.

During the conduct of the study and preparation of the report COL G. H. Hilt, CE, and COL J. L. Cannon, CE, were Directors of WES. Technical Director was Mr. F. R. Brown, and Dr. John Harrison was Chief of EL.

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COLONIAL BIRDS NESTING ON MAN-MADE AND NATURAL SITES OF THE U. S. GREAT LAKES

PART I: INTRODUCTION

1. Alteration of natural habitats due to recreation, urban expansion, dredging and filling, industrial activities, and changing water levels has caused displacement of colonial nesting birds in some areas and encouraged population growths in others. The purpose of this report is to document the habitat relationships at 24 selected natural and dredged material colonial bird nesting sites and to identify the species and population sizes of all colonial nesting birds of the U. S. Great Lakes up to 1.6 km inland. The following species of birds are included in this study: double-crested cormorant, *Phalcrocorax auritus*; great blue heron, *Ardea herodias*; cattle egret, *Bubulcus ibis*; great egret, *Casmerodius albus*; snowy egret, *Egretta thula*; black-crowned night heron, *Nycticorax nycticorax*; herring gull, *Larus argentatus*; ring-billed gull, *Larus delawarensis*; Forster's tern, *Sterna forsteri*; common tern, *Sterna hirundo*; Caspian tern, *Sterna caspia*; and black tern, *Chilodonias niger*. Little gull (*Larus minutus*) was observed as a first recorded nesting species in the Great Lakes during this study.

2. An interim report of this study (Scharf et al. in press) described the 1976 population status and the apparent relationship between vegetation and populations of colonial nesting species. This report concentrates on more detailed vegetation analysis of habitats and includes both 1976 and 1977 nesting populations. Such vegetation study has been done only at specific sites in the U. S. Great Lakes by Hoffman and Prince (1975) and Shugart (1976). Detailed studies of the vegetation habitat of colonial nesting birds elsewhere have been made by Bongiorno (1970), Weselow and Brown (1971), Soots and Parnell (1975) and others. Other accounts of colonial nesting bird populations of the Great Lakes are found in Ludwig (1962), Scharf (1971a), and for the Canadian portion of Lake Ontario in Blokpoel (1977).

PART II: MATERIALS AND METHODS

The Study Area

3. The study area included the shore and islands of the U. S. Great Lakes extending from Pigeon Point, Minnesota to Cape Vincent, New York. It extended nearly 1280 km from east to west and 840 km from north to south. The Great Lakes are located between 40^{o} and 48^{o} north latitude and 76^{o} and 94^{o} west latitude. They are composed of a series of five of the largest freshwater bodies in the world. Fluctuations in Great Lakes water levels have historically affected the land area available for colonial nesting birds and during this study the levels of Lakes Michigan and Superior varied from record high levels to average, a fluctuation of 60 cm (Monthly Bulletin and Lake Levels, U. S. Army Engineer District, Detroit, June, 1977).

Selection of Comparison Sites

4. After the initial 1976 population and site location survey, Ms. Mary C. Landin, U. S. Army Engineer Waterways Experiment Station (WES), Mr. Larry Shanks, U. S. Fish and Wildlife Service (USFWS), and the principal investigator met and chose 24 colony sites for intensive habitat analysis in 1977. These sites were chosen for their diversity of bird species, wide geographic location, and potential for comparison between natural and man-made origins. The sites included six ring-billed gull colonies, three common tern colonies, two herring gull colonies, one herring gull/ring-billed gull association, six common tern/ring-billed gull associations, one ring-billed gull/common tern/Caspian tern association, one herring gull/Caspian tern association, one black-crowned night heron/herring gull/ring-billed gull/double-crested comorant association, one black-crowned night heron/great blue heron/great egret association, and one black-crowned night heron/cattle egret association. Geographically, the sites were located as follows: two in Lake Superior; six in the St. Marys River; two in Green Bay, Lake

Michigan; five in northern Lake Michigan; two in Saginaw Bay, Lake Huron; two in the Detroit River; two in Lake Erie; and one in Lake Ontario. Sixteen of the intensive study sites were man-made by various dredging or construction processes, and seven were natural islands.

Study of Bird Colonies

5. In additional to the study of known colonies of long standing, an aerial survey search was conducted each season with a Cessna 180 floatplane, which also enabled landing for making nest counts, gathering chronological information, assessing nest success, and sampling vegetation. Some colonies such as small great blue heron, herring gull, or common tern sites could be counted from the air. Populations at other sites were determined by transects of a portion of the colony projected on the total area, total nest counts, or grid sampling of enlarged aerial photographs (detailed descriptions in Scharf et al. in press). Information on populations and nesting was recorded and filed with the Colonial Bird Registry, Cornell University, Ithaca, New York.

Study of Vegetation

6. A transect line was established through the representative vegetation types of a nesting site. In cases where one transect was not adequate to include all the different species present or the colony was too large for a single transect, several transects were used. Plants were identified and counted, and percent coverage was determined in quadrats along the transect lines. This information was used to calculate relative frequency, relative coverage, and relative density (microfiche Appendix C), from which importance values were calculated. Herbaceous vegetation was sampled in 1 m^2 quadrats at 1 m intervals. Shrubs were sampled in 16 m^2 (4 x 4 m) quadrats at 4 m intervals. Where shrubs occurred among herbs, the shrub samples were not contiguous, but spaced according to shrub distribution. The larger shrub quadrats were used only when it was subjectively determined that shrubs were present. Trees were sampled on 100 m^2 (10 x 10 m) quadrats, and diameter breast height (DBH) was used to determine dominance instead of

coverage. All vegetation sampling was done between 21 June and 28 July 1977.

7. Plant specimens were pressed and dried for identification. These specimens were deposited at the WES herbarium located at the Louisiana Technological University at Ruston, Louisiana. All plant names used in this report are listed in Appendix B by scientific and common names according to Gray's Manual of Botany (Fernald 1950).

Study of Soils

8. Soil samples were taken from the top 10 cm of substrate of the nesting area in order to establish the chemical and physical properties available for plant growth. This sampling was done to document the nutrient levels from the input of bird feces, which was felt to be stimulating to some plant species and toxic to others. No attempt was made at statistical reliability of sampling because only one or two samples were taken at each site. The soil samples were analyzed for the major nutrients; total nitrogen (N), phosphorus (P), and potassium (K), as well as for the pH and texture. Analyses were performed by the Soil Testing Laboratory at Michigan State University, East Lansing, Michigan.

Chronology of Nesting

9. The chronology of the nesting season was determined from field observations by all project personnel and the literature (for great blue herons, Edford 1976; for common terns, Palmer 1941; for black terns, Cuthbert 1954; for herring gulls, Paynter 1949 and Paludan 1951; and for ring-billed gulls, Vermeer 1970; and for herring gulls and Caspian terns, Shugart, unpublished data) to include each event from courtship through fledging. During 1977, an effort was made to determine latitudinal variation in the hatching date of ring-billed gulls by examining developing embryos and measuring tarsi of a sample of newly hatched chicks. Minimum sample sizes of 10 chicks were too small to be statistically significant, but backdating from the growth rates given by Vermeer (1970) established an approximate date of hatching at each site. The eggs of common terns were floated in water to

determine the chronology of the species according to the method of Hays and LeCroy (1971).

PART III: RESULTS

Colonial Nesting Sites of the U. S. Great Lakes

10. During the 2-year study period, 267 bird colonies were located and population estimates obtained. The location, species, and population size of these sites are arranged sequentially from north to south and west to east in Table 1 and in maps in Appendix A. Exceptions to the sequence occur for places where the southward progression of the shoreline is westerly, and where newly located 1977 colony numbers had to be added to the 1976 map sequence. The total number of colonies found (Table 1) increased from 207 in 1976 (Scharf et al. in press) to 267 in 1977 because some colonies were missed the first year, submerged land masses became emergent with the lowered water levels in 1977 and had colonies, and new man-made structures were built or altered and became colony sites. Also contributing to the larger number were the sub-colonies surrounding Isle Royale National Park which are included in Table 1, 1977 column only. Colonies found in 1976 which were abandoned in 1977 are shown on Table 1 in only the 1976 column.

11. Habitats of naturally occuring colony sites showed a range of vegetation succession and vary from bare rock, cobble, gravel, or sand to shrub and tree communities requiring over 50 years to develop. Generalizations are difficult, but common and Caspian terns usually were found in the earliest seral stages, ring-billed and herring gulls in herb-shrub mid-seral stages, black-crowned night herons and cattle egrets in shrub communities, and great blue herons and great egrets in mature trees. Exceptions in the Great Lakes, which were numerous among the gulls and terns, have been discussed in Scharf et al. (in press) and quantified in the specific site vegetation analysis in this report. Also important in characterizing habitat and vegetation succession of colonial nesting sites is the effect of the mechanical and chemical input of the birds on the vegetation as described in this report for specific sites and documented elsewhere by Bongiorno (1970), McColl and Burger (1976) and Wiese (1977).

Table I

Summary of Sites of Colonial Nesting Birds

Of U.S. Great Lakes, 1976–1977, by Numbers of Nests

Note: DCC = double-crested cormorant, *Phalcrocorax auritus*
GBH = great blue heron, *Ardea herodias*
NGH = northern green heron, *Butorides striatus*
CE = cattle egret, *Bubulcus ibis*
GE = great egret, *Casmerodius albus*
SE = snowy egret, *Egretta thula*
BCNH = black-crowned night heron, *Nycticorax nycticorax*
HG = herring gull, *Larus argentatus*
RBG = ring-billed gull, *Larus delawarensis*
LG = little gull, *Larus minutus*
FT = Forster's tern, *Sterna forsteri*
CT = common tern, *Sterna hirundo*
Cas.T = Caspian tern, *Sterna caspia*
BT = black tern, *Chlidonias niger*

*Man-made site

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Superior						(192001-192005 and 191001 have woody vegetation in their interiors.)
Pigeon River Islands 192001	47°57' to 47 59	089°33' to 089 36	226 HG	400 HG	Granite Rock	Mostly Bare
2nd. Island North of Pancake Island 192002	47 53	089 47	22 HG	38 HG	Granite Rock	Mostly Bare
1st. Island North of Pancake Island 192003	47 53	089 49	62 HG	76 HG	Granite Rock	Mostly Bare
Pancake Island 192004	47 53	089 50	44 HG	173 HG	Granite Rock	Mostly Bare
Blueberry Island 192005	47 53	089 50	47 HG	175 HG	Granite Rock	Mostly Bare
Rock West of Marr Island 191016	47 48	090 05	0	12 HG	Granite Rock	Mostly Bare

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Superior (continued)						
Marr Island 191001	47°48'	090°05'	97 HG	264 HG	Granite Rock	Mostly Bare
Guano Island 191002	47 46	090 14	45 HG	69 HG	Granite Rock	Mostly Bare
Rock Island 191003	47 44	090 25	5 HG	27 HG	Granite Rock	Mostly Bare
Gull Island-Taconite Harbor 191004	47 31	090 55	159 HG	189 HG	Granite Rock	Mostly Bare
North Silver Bay 191005	47 17	091 16	324 HG	356 HG	Granite Rock	Mostly Bare
South Breakwater Silver Bay 191006	47 16	091 16	65 HG	72 HG	Granite Rock	Mostly Bare
Beaver Bay Island 191007	47 15	091 17	18 HG	22 HG	Granite Rock	Mostly Bare
1st Island South of Beaver Bay Island 191008	47 13	091 20	45 HG	42 HG	Granite Rock	Mostly Bare
Split Rock Island 191009	47 13	091 22	25 HG	24 HG	Granite Rock	Mostly Bare
Encampment Island 191010	47 05	091 33	130 HG	210 HG	Granite Rock	Tree and Shrub
Knife Island 211001	46 57	091 46	250 HG	280 HG	Granite Rock	Tree and Shrub
Kimble Point 210001	46 43	092 09	47 GBH	55 GBH	Soil	Red Pine

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Superior (continued)						
*Piling Island 210002	46°44'	092°09'	27 HG	200 RBG	Rock and Piling	Tree, Shrub, Bare
*Minnesota Power and Light Company 210003	46 44	092 09	1 HG, 308 RBG, 4 CT	2 HG, 550 RBG	Heavy Soil & Cinder	Herbs & Some Willow
*Port Authority 210004	46 45	092 06	121 CT	5 HG, 234 RBG, 185 CT	Sand	Herbs, Grass & Bare
*Sky Harbor Airport 210005	46 42	092 03	7 CT	6 CT	Sand	Herbs
Roman Point Cliffs 211011	46 50 to 46 55	091 10 to 091 13	10 HG	4 HG	Rock Cliff	Bare
Eagle Island 211002	46 57	091 02	54 GBH, 300 HG	51 GBH, 450 HG	Rock & Soil	Deciduous Trees
Sand Island 211003	46 59	090 57	12 HG	0	Rock Cliff	Bare
Bear Island 191011	47 01	090 45	3 HG	4 HG	Rock Cliff	Bare
Devils Island 191012	47 04	090 44	4 HG	3 HG	Rock Cliff	Bare
Otter Island 191013	47 00	090 42	22 HG	20 HG	Rock Cliff	Bare
Outer Island 191014	47 02	090 26	7 HG	2 HG	Rock Cliff	Bare
Cat Island 191015	47 01	090 34	4 HG	0	Rock Cliff	Bare

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Superior (continued)						
Little Manitou Island 211004	46°58'	090°39'	7 HG	1 HG	Rock Cliff	Bare
Stockton Island 211005	46 56	090 35	6 HG	5 HG	Rock Cliff	Bare
Gull Island 211006	46 53	090 27	273 HG, 99 RBG	291 HG, 67 RBG	Cobble	Shrub & Bare Cobble
Hermit Island 211007	46 53	090 41	17 HG	10 HG	Rock Cliff	Bare
Basswood Island 211008	46 51	090 44	6 HG	8 HG	Rock Cliff	Bare
*Washburn Piling 211009	46 40	090 55	4 HG, 5 CT	0	Rock & Piling	Tree, Shrub, Bare
*Ashland Breakwater 211010	46 37	090 51	8 HG	9 HG, 9 CT	Breakwater	Bare
*Ashland Coal Dock 211012	46 37	090 51	0	8 CT	Dock	Shrub, Herb
Porcupine Mountains Rocks 212001	46 49	089 50	26 HG	12 HG	Rock	Bare
Gull Island 173001	48 16	088 16	88 HG	90 HG	Rock	Bare
Passage Island 173002	48 14	088 20	16 HG	21 HG	Rock	Bare
Isle Royale National Park 173003 Totals:	47 50 to 48 10	089 20 to 088 20	+500 HG	18 GBH, 595 HG	Rock	Mostly Bare, Some Tree & Shrub
Rock of Ages Light			not censused	4 HG	Rock	Mostly Bare, Some Tree & Shrub

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Superior (continued)						
Isle Royale National Park (continued)			not censused		Rock	Mostly Bare, Some Trees & Shrub
3rd. Rock South of Washington Island				43 HG		
2nd. Rock South of Washington Island				14 HG		
1st. Rock South of Washington Island				8 HG		
Gull Rocks				16 HG		
4th. Rock North of Wilson Point				10 HG		
North Todd Harbor Rock				36 HG		
2nd. Rock South of Hawk Island				12 HG		
1st. Rock South of Hawk Island				5 HG		
2nd.&3rd. Rock South of Amygdaloid Island				22 HG		
Rock North of Amygdaloid Island				12 HG		
Steamboat Island				34 HG		
South Government Island				5 GBH		
Flag Island				14 HG		
3rd. Rock North of Bat Island				8 HG		
2nd. Rock North of Bat Island				23 HG		

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
<u>Lake Superior</u> (continued)						
<u>Isle Royale National Park</u> (continued)			not censused		Rock	Mostly Bare, Some Trees & Shrub
1st. Rock North of Bat Island				3 HG		
2 Rocks South of Shaw Island				5 HG		
1st. Rock South of Mott Island				2 HG		
2nd. Rock South of Mott Island				2 HG		
Middle Passage Island				11 HG		
Tonkin Bay Rock				6 HG		
Rock South of Tonkin Bay Rock				18 HG		
Rock South of Malone Island				14 HG		
Menagerie Island				42 HG		
Long Island				51 HG		
Taylor Reef Rock				8 HG		
Castle Island				66 HG		
1st. Rock South of Long Island				6 HG		
2nd. Rock South of Long Island				2 HG		
Large Rocks North of Pauls' Island				6 HG		

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Superior (continued)						
Isle Royale National Park (continued)			not censused		Rock	Mostly Bare, Some Trees & Shrub
Large Pauls' Island				18 HG		
Small Pauls' Island				13 GBH, 16 HG		
Redfin Island				52 HG		
McCormick Rocks				6 HG		
Rocks south of Eagle Harbor 192006	$47^{\circ}27'$	$088^{\circ}12'$	27 HG	4 HG	Rock	Bare
Agate Harbor Rocks 192007	47 28	088 04	32 HG	39 HG	Rock	Bare
Copper Harbor Island 192008	47 29	087 53	10 HG	27 HG	Rock	Bare
Manitou Rock 192009	47 25	087 40	32 HG	32 HG	Rock	Bare
Manitou Island 192010	47 25	087 37	10 HG	4 HG	Rock	Bare
* Stamps Sands Island, Lake Linden 192011	47 11	088 25	HG present, but number not known 250 RBG	198 HG, 405 RBG	Stamp Sand	Shrub, Herb, & Bare
* Stamps Sands Island Hubbell 192012	47 10	088 25	5 HG	4 HG	Stamp Sand	Shrub, Herb & Bare
Traverse Island 192013	47 04	088 16	62 GBH, 177 HG	52 GBH, 96 HG	Rock, Soil	Shrub, Tree
Huron Island 213001	46 56	088 00	463 HG	485 HG	Rock	Few trees, mostly Bare Rock

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Superior (continued)						
Larus Island 213002	46°37'	087°26'	160 HG	160 HG	Rock	Bare
Granite Rocks 213003	46 37	087 23	95 HG	102 HG	Rock	Bare
White Rocks 213004	46 36	087 22	106 HG	110 HG	Rock	Bare
Ore Dock Rocks 213005	46 35	087 23	67 HG	72 HG	Rock	Bare, Herb, Shrub
Autrain Island 213006	46 29	086 54	89 HG	96 HG	Rock & Soil	Tree & Shrub
Wood Island 213007	46 30	086 44	50 HG	41 HG	Rock & Soil	Tree & Shrub
Williams Island 213008	46 29	088 43	78 GBH, 500 HG	78 GBH, 320 HG	Rock & Soil	Tree & Shrub
Pictured Rocks 213009	46 29 to 46 32	086 33 to 086 25	206 HG	120 HG	Rock Cliff	Bare
Taquamenon Island 214017	46 35	084 55	400 HG	420 HG	Cobble	Tree, Shrub, Herb
Island South of Taquamenon Island 214018	46 35	084 55	not censused	120 CT	Soil	Herb
Iroquois Island 214016	46 29	084 41	25 HG	28 HG	Cobble	Shrub, Herb
Round Island 214001	46 27	084 31	275 HG, 1454 RBG	300 HG, 1485 RBG	Cobble	Tree,Shrub, Herb

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
St. Marys River						
*Northwest Sugar Island 214002	46°27'	084°16'	81 CT	1 HG, 21 CT	Soil	Herb
*West Sugar Island II 214020	46 26	084 15	OCT, OHG nearly submerged	1 HG, 44 CT	Soil	Herb
*West Sugar Island I 214003	46 26	084 15	139 CT	116 CT	Soil	Herb
Gem Island 214004	46 26	084 11	43 GBH, 27 HG	33 GBH, 29 HG	Soil	Deciduous Tree
Rock Island 214005	46 23	084 09	23 GBH, 53 HG	27 GBH, 48 HG	Soil	Deciduous Tree
*Southeast Neebish Island 214006	46 14	084 07	1 HG, 49 RBG, 136 CT	55 RBG, 45 CT	Loose Rock	Herbs & Bare
*Moon Island 214007	46 13	084 10	18 HG, 982 RBG	7 HG, 1673 RBG	Sand & Muck Dredge	Herb, Shrub, Small Tree
*Southwest Neebish Island 214008	46 13	084 10	1263 RBG	2398 RBG	Muck Dredge	Herb, Some Shrub
Steamboat Island 214009	46 10	084 12	22 HG	16 HG	Soil, Boulder	Bare, Herb
Two Tree Island 214010	46 12	084 05	42 HG	46 HG	Soil, Boulder	Herb, Bare
Round Island 214011	46 06	084 01	39 GBH	39 GBH	Soil	Deciduous Tree
Bass Reef Island 215001	46 06	084 00	47 HG	43 HG	Cobble	Herb
Squaw Island 215002	46 02	083 54	108 HG	91 HG	Boulder, Soil	Herb
West Pipe Island Twin 215003	46 01	083 54	138 HG	145 HG	Cobble	Bare, Herb

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
St. Marys River (Continued)						
East Pipe Island Twin 215004	46°01'	083°54'	79 HG	100 HG	Cobble	Bare, Herb
Harbor Island Reef 215013	46 03	083 47	inundated	2 HG, 192 RBG	Cobble, Boulder	Herb
Propeller Island 215005	46 05	083 45	68 HG	52 HG	Cobble, Soil	Bare, Herb
Arrow Island 215006	46 01	083 49	21 HG	33 HG	Boulder, Soil	Bare, Herb
Bow Island 215007	46 02	083 50	7 HG	0	Cobble, Soil	Tree, Shrub, Herb, Bare
Bacon Island 215008	46 03	083 50	196 HG	192 HG	Boulder, Soil	Bare, Herb
*Macomb Island Dock 215009	46 04	083 52	5 RBG	0	Concrete	None
Andrews Island 215010	46 03	083 53	1815 RBG	0	Soil	Bare, Shrub, Tree, Herb
Little Cass Island 215011	46 04	083 54	7 HG	5 HG, 2063 RBG	Cobble, Boulder	Bare, Shrub
*Watson Reef Ruins 215012	46 00	083 54	53 CT	20 CT	Rock	Bare, Herb
Lake Huron						
*Cable Island 239002	45 59	083 53	23 HG	23 HG	Boulder, Soil	Coniferous Tree
Goetz Shoal 239018	46 04	083 34	inundated	17 HG	Cobble, Boulder	Bare

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Huron (Continued)						
Gravel Island 239002	45°56'	083°46'	4 GBH, 1 HG	3 GBH	Soil	Deciduous Tree, Shrub
Scammon Point 239003	45 56	083 38	34 GBH	40 GBH	Soil	Mixed Coniferous-Deciduous Tree
Point Detour Island Rocks 239004	45 57	083 55	2 HG	0 HG	Boulder	Herb
Carlton Bay Rock 239005	45 58	083 56	1 HG, 25 CT	0 HG, 13 CT	Boulder	None
North Island 239006	45 58	083 58	31 HG	26 HG	Boulder	Herb
South Island 239007	45 57	083 58	98 HG	104 HG	Cobble, Soil	Tree, Shrub
Saddlebag Island 238001	45 57	084 02	32 GBH, 334 HG	15 GBH, 309 HG	Cobble, Soil	Tree, Shrub, Herb
Little Saddlebag Island 238002	45 57	084 03	77 HG	96 HG	Boulder, Soil	Tree, Shrub, Herb
Bear Island 238003	45 58	084 14	87 HG	113 HG	Boulder	Shrub, Herb
Crow Island 238004	45 58	084 14	11 GBH, 241 HG	11 GBH, 196 HG	Boulder, Soil	Tree, Shrub, Herb
Bush Bay Rocks 238005	45 59	084 15	2 HG, 19 CT	1 HG, 8 CT	Boulder	Tree, Herb, Lichen
Goose Island 238006	45 55	084 26	75 GBH, 10 BCNH, 779 HG	67 GBH, 13 BCNH, 561 HG	Cobble, Soil	Coniferous Tree, Shrub Herb
St. Martin Shoals 238007	45 57	084 34	306 HG	439 HG, 66 RBG	Cobble, Boulder	Shrub, Herb

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Huron (continued)						
St. Martin Island 238008	45°58'	084°35'	3 HG, 6 CT	2 HG, 1 RBG, 54 CT	Gravel, Cobble	Bare, Herb
Lake Michigan						
Point LaBarbe Island 238009	45 50	084 46	116 HG	127 HG	Cobble	Tree, Shrub, Herb
Green Island 238010	45 50	084 45	6 BCNH, 589 HG, 1506 RBG	10 BCNH, 644 HG, 2168 RBG	Cobble, Gravel	Tree, Shrub, Herb
St. Helena Island 238011	45 52	084 52	27 GBH	24 GBH	Soil	Mixed Deciduous-Coniferous Tree
Point AuChenes Bay Island 238031	45 55	084 53	0	26 CT	Sand	Herbs, Bare
Brevort River Shoal 238012	45 57	084 56	1 HG, 28 CT	0	Sand	Herb
*Cut River Marina 214018	46 03	085 05	under construction	186 RBG, 95 CT	Riprap	Bare
Epoufette Point Island 214012	46 03	085 12	27 GBH	32 GBH	Soil	Mixed Deciduous-Coniferous Tree
Shoal West of Epoufette Island 214019	46 03	085 13	inundated	27 RBG, 14 CT	Gravel	Bare, Herb
Little Hog Island 214013	46 04	085 17	6 HG	8 HG	Cobble	Herb, Shrub, Bare
1st. Island West of Little Hog Island 214014	46 05	085 18	6 HG	5 HG	Gravel, Cobble	Herb, Shrub, Bare

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Michigan (continued)						
Naubinway Island 214015	46°05'	085°27'	78 HG	88 HG	Gravel, Cobble	Herb, Shrub, Bare
Rocky Island 237032	45 37	086 42	260 HG, 2656–3500RBG	123 HG, 5169 RBG	Soil, Gravel, Cobble	Bare, Shrub, Tree
Summer Island Shoal 237033	45 37	086 42	mostly submerged	9 HG	Gravel, Cobble	Bare
Round Island 237001	45 45	086 46	12 GBH, +21 BCNH, 80–100 HG, 2500–3000 RBG	31 GBH, 26 BCNH, 102 HG, 6905 RBG	Cobble, Gravel	Bare, Shrub, Tree
Snake Island 237002	45 44	086 39	350 HG, +3009 RBG	359 HG, 3550 RBG	Cobble, Gravel/Soil	Herbs
St. Vital Island 237003	45 48	086 45	6 GBH, 2 BCNH, 105 HG, 130 CT	67 HG, 191 CT	Rock, Soil, Sand, Gravel	Willow, Herb
Mouth of Big River 237004	45 50	086 48	4–7 Pair BT	2–4 BT	Marsh	Marsh
Unidentified Island 237005	45 40	086 58	+20 HG, 2 CT	4 HG, 4 CT	Gravel	Bare
Round Island 237006	45 38	087 10	+100 HG	163 HG	Soil, Gravel	Herb, Shrub
Rapid River Marsh 237007	45 55	086 58	+15 BT	10–15 BT	Marsh	Marsh
Kipling Marsh 237008	45 52	087 01	10–17 BT	0	Marsh	Marsh
Kipling South 237034	45 52	087 01	0	3 BT	Marsh	Marsh

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Michigan (continued)						
Cedar River 237009	45°24'	087°21'	1 NGH, +6 BT	1 NGH	Marsh	Shrub
Saunders Point 237010	45 51	087 00	8 BT	0	Land Fill	Bare
*Escanaba Tank Farm 237011	45 46	087 04	+3 BT	0	Marsh	Marsh
Portage Point 237012	45 42	087 05	3 NGH, 2 LG, 85 CT, +43 BT	2 NGH, 1 LG, 34 CT, 56 BT	Marsh, Soil	Herb
Ford River 237013	45 40	087 09	12–15 BT	0	Marsh	Marsh
Sea Gull Bar 237014	45 05	087 35	10–17 BT	3–5 BT	Marsh	Marsh
Peshtigo Point 261001	44 59	087 39	7–10 NGH, 16 HG, 35–40 FT, 10 CT, 60–70BT	3–5 NGH, 12 HG, 5 CT, 10–12 BT	Sand	Bare, Debris
Oconto Marsh 261002	44 54	087 51	100 NGH, 13 CE, 2 SE, 275–350 BCNH, 75 FT, 35–45 BT	20 NGH, 14 CE, 300 BCNH deserted, 10–15 BCNH, 2 FT, 13 BT	Marsh	Dead Shrub, Cattail
Oconto South Shore 261013	44 53	087 52	0	8–9 BT	Marsh	Marsh
Charles Pond Wildlife Area 261003	44 46	087 57	6 BT	0	Marsh	Marsh
Little Suamico Swamp 261004	44 42	088 00	7–9 GBH, 12–18 BT	15 GBH	Willow	Tree
Little Tail Point 261005	44 40	087 59	7–10 NGH, 103 FT	5 NGH	Marsh	Marsh

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Michigan (continued)						
Sensiba Wildlife Area 260001	44°38'	088°01'	28 BT	4 NGH, 6FT (Deserted) 15 BT	Marsh	Marsh
Long Tail Point 261006	44 36	087 59	35–40 BCNH, 7 HG, 3 RBG	1 NGH, 15 BCNH (Deserted)	Sand	Shrub
Peter's Marsh 260002	44 35	088 01	7–12 BT	2–3 BT	Marsh	Marsh
Cat Island Chain 260003	44 34	088 00	19 DCC	14 DCC(Destroyed)	Submerged	Tree
*Bay Port Industrial Tract 250004	44 33	088 01	80 FT, 75–80 BT	45–52 FT, 26–31 BT	Marsh	Marsh
Point Au Sauble 261007	44 35	087 54	3 NGH, 6–9 BT	3 NGH, 10 BT	Marsh	Marsh
*Willow Island 261008	44 34	088 00	46 BCNH, 9 HG	224 BCNH, 10–15 CE, 16 HG	Sand, Dredge	Willow, Shrub
Cat Island 261014	44 34	088 00	0	70 BCNH, 8 HG	Sand	Bare, Herb, Shrub
*Lone Tree Island 261009	44 34	088 00	3 HG, 213 RBG, 91 CT	2 HG, 374 RBG, 108 CT	Rubble, Soil	Bare, Herb, Shrub, Tree
Green Island 237015	45 03	087 30	394 HG	70–90 BCNH, 509 HG	Sand–gravel, Soil	Bare, Herb, Coniferous Tree
Hat Island 237016	45 06	087 19	32–40 BCNH, 800–1000 HG, 50–60 RBG	79 BCNH, 900–1100 HG, 219 RBG	Soil, Cobble	Herb, Shrub
Jack Island 237017	45 10	087 16	800 HG	12–20 BCNH, 850 HG	Soil, Cobble	Herb, Shrub

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Michigan (continued)						
Middle Strawberry Island 237018	45°10'	087°16'	20–30 HG	20–30 HG	Gravel	Bare, Shrub
Little Sister Island 237019	45 12	087 10	102 HG	121 HG	Gravel	Bare
Big Sister Island 237020	45 12	087 10	471 HG	531 HG	Cobble, Soil	Herb
Hog Island 237021	45 22	086 46	75–125 HG	118 HG	Rock, Soil	Herb, Shrub, Tree
Pilot Island 237022	45 17	086 55	35 HG	72 HG	Rock, Soil	Herb, Shrub, Tree
Fish Island 237023	45 24	086 46	18 DCC, 105 HG	52 DCC	Cobble	Bare
Gull Island 237024	45 30	086 43	505 HG	533 HG	Rock, Soil	Herb, Shrub, Tree
Little Gull Island 237025	45 30	086 43	+8 BCNH, 400 HG	5 BCNH, 536 HG, 22 Cas. T	Rock, Soil	Herb, Shrub, Tree
Gravelly Island 237026	45 31	086 43	11 DCC, 313 HG, 550–600 Cas. T	9 DCC, 408 HG, 537 Cas. T	Cobble	Bare, Herb
Poverty Island 237035	45 32	086 40	0	8 BCNH	Tree	Coniferous Tree
Spider Island 237027	45 13	086 59	6 BCNH, 450–550 HG	11 BCNH, 857 HG	Rock, Gravel, Soil	Bare, Herb
Gravel Island 237028	45 15	086 58	250 HG	391 HG	Rock, Sand	Grass, Bare

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Michigan (continued)						
Kangaroo Lake 237029	45°03'	087°10'	15–20 BT	5–7 BT	Marsh	Marsh
Kewanee Marsh 261010	44 28	087 31	50–60 BT	0	Marsh	Marsh
* Kewanee Engineer Corporation 261015	44 28	087 30	not censused	247 HG, 1292 RBG	Soil	Grass, Herb, Bare
* Kewanee Harbor 261011	44 28	087 30	9 HG	11 HG	Concrete	Bare
Two Rivers 261012	44 10	087 35	1 HG, 2 LG, 60 BT	3–5 BT	Marsh	Marsh
Mink River 237030	45 15	087 03	5–8 BT	2–3 BT	Marsh	Marsh
South Manitou Island 237031	45 03	086 05	428 HG, 4060 RBG	470 HG, 2686 RBG	Sand	Grass, Herb
Bellows Island 238013	45 06	085 34	728 HG	705 HG	Sand, Gravel, Cobble	Grass, Herb, Shrub, Tree
Gull Island 238014	45 42	085 50	1426 HG	1750 HG, 254 RBG	Sand, Gravel, Cobble	Grass, Herb, Shrub
High Island 238015	45 45	085 40	4 HG, 3313 RBG, 411 Cas. T, 63 CT	7 HG, 3442 RBG, 87 CT, 30 Cas. T (plus 86 Cas. T renests, not in total)	Sand, Gravel	Bare, Herb, Shrub
High Island Shoal 238031	45 45	085 40	inundated	42 Cas. T (renests not in total)	Sand, Gravel	Bare
Trout Island 238016	45 47	085 42	134 HG	105 HG	Gravel	Herb, Shrub, Tree

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Michigan (continued)						
Whiskey Island 238017	45°49'	085°37'	13 HG	13 HG	Gravel	Herb, Shrub
Squaw Island 238018	45 51	085 36	50 HG	72 HG	Sand	Herb, Shrub
Pismire Island 238019	45 46	085 27	270 HG	238 HG	Gravel	Cobble
Pismire Reef 238033	45 50	085 30	mostly submerged	2 HG, 80 CT	Cobble	Bare
East Grape Island 238020	45 47	085 24	1 HG, 1188 RBG	4 HG, 1278 RBG, 11 CT	Cobble, Soil	Bare, Tree, Shrub, Herb
West Grape Island 238021	45 47	085 25	5 GBH, 4 HG, 3979 RBG	3 GBH, 6 HG, 3660 RBG	Cobble, Soil	Bare, Tree, Shrub, Herb
Hat Island 238022	45 47	085 18	3 GBH, 690 HG, 730 Cas. T	603 HG, 686 Cas. T	Gravel, Cobble	Bare, Tree, Shrub, Herb
Shoe Island 238032	45 48	085 18	inundated	6 HG, 53 Cas. T (Repests not in total)	Gravel, Cobble	Bare
Ile aux Galets 238023	45 41	085 11	121 HG, 4000 RBG, 316 Cas. T	131 HG, 2870 RBG, 312 Cas. T	Gravel, Soil, Cobble Boulder	Herb, Shrub, Tree
Waugoshance Island 238024	45 46	085 04	18 GBH	33 GBH	Soil	Deciuous Tree
Waugoshance Point 238025	45 46	085 00	20 CT	0	Sand	Herb, Bare

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Michigan (continued)						
Waugoshance Point 238026	$45^{\circ}46'$	$085^{\circ}01'$	100 CT	11 RBG, 18 CT	Sand	Herb, Shrub, Bare
Big Stone Bay Island 238027	45 45	084 53	2 HG	25 HG	Cobble, Sand	Herb, Bare
*Cecil Bay Breakwater 238028	45 46	084 47	50 RBG, 100 CT	50 RBG, 80 CT	Concrete, Stone	Bare
Lake Huron						
Packard Point Island 238029	45 43	084 26	187 HG	5 HG	Cobble	Shrub, Bare
Duncan Bay Shoal 238030	45 40	084 26	35 CT	Connected to mainland.	Sand	Herb, Bare
* Calcite Plant 239008	45 25	083 46	838 HG, 5593 RBG	873 HG, 7916 RBG	Sand, Gravel, Soil	Herb, Bare
Middle Island 239019	45 11	083 20	0	9 HG	Cobble, Gravel	Bare, Shrub
Island south of 9 Mile Point 239020	45 08	083 21	0	2 HG	Cobble	Bare
Misery Bay Shoal 239009	45 05	083 18	35 HG, 125 CT	12 HG, 70 RBG	Sand	Bare, Herb
South Round Island 239010	45 05	083 18	6 HG	4 HG	Sand	Bare, Herb
Gull Island 239011	45 03	083 14	33 GBH, 27 BCNH, 1510 HG	33 GBH, 29 BCNH, 1220 HG	Sand, Cobble	Bare, Herb, Shrub, Tree

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Huron (continued)						
Sugar Island 239012	45°03'	083°13'	275 HG	288 HG	Sand, Rock	Bare, Tree, Shrub
Thunder Bay Island 239013	45 02	083 12	525 HG, 2697 RBG, 200 CT	475 HG, 2856 RBG, 138 CT	Rock	Bare, Grass, Herb
Whitefish Bay Shoal 239014	45 04	083 22	15 CT	0	Sand	Herb, Bare
*Huron Portland Cement Company 239015	45 04	083 25	2238 RBG	1504 RBG	Soil Fill	Herb, Bare
*Abitibi Waste Island 239018	45 04	083 27	Colony not present.	12 CT	Dredged Dike	Bare
Grassy Island 239016	45 02	083 26	16 BCNH, 150 HG	18 BCNH, 150 HG	Soil	Shrub, Tree
*Bare Point Harbor 239017	45 02	083 27	60 CT	50 CT	Rubble	Herb, Bare
Sulfur Island 263001	45 00	083 25	250 HG, 1655 RBG	250 HG, 1143 RBG	Sand, Soil	Herb, Shrub, Tree
Scarecrow Island 263002	44 55	083 20	24 GBH, 900 HG	18 GBH, 988 HG	Sand, Gravel	Herb, Shrub, Tree
Bird Island 263003	44 53	083 20	88 HG, 2275 RBG	120 HG, 2460 RBG	Sand, Gravel	Herb, Shrub, Bare
Black River Island 253004	44 50	083 18	1064 HG	1200 HG	Gravel, Cobble	Herb, Bare
Little Charity Island 263005	44 00	083 28	BCNH (present, but not censused) 455 HG	86 BCNH, 978 HG	Gravel, Cobble, Soil	Herb, Shrub, Tree

(Continued)

Table 1 (Continued)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Huron (continued)						
Nayaquining Point 291001	43°46'	083°57'	6 BCNH	0	Marsh	Marsh, Willow
*Channel Island 291002	43 40	083 49	4 BCNH, 2021 RBG	16 BCNH, 1666 RBG, 64 CT	Sand, Muck	Herb, Willow
*Shelter Island 291003	43 40	083 50	1 BCNH, 2087 RBG	5 HG, 1723 RBG	Sand, Muck	Herb, Willow
Windy Point—Weadock 291004	43 39	083 50	3 BCNH	4 BCNH	Sand	Willow
*Sebewaing Breakwater 291005	43 45	083 29	98 RBG, 287 CT	0	Muck	Herb
Lone Tree Island 291006	43 48	083 29	10 RBG, 25 CT	4 HG, 25 CT	Sand	Bare
Katchay Island Marsh 291007	43 50	083 26	50 RBG	0	Sand	Herb
Lake St. Clair						
Dickinson Island 318001	42 37	082 38	57 GBH, 2 GE	37 GBH, 1 GE	Soil	Deciduous Tree
Detroit River						
*Mud Island 318002	42 14	083 08	5040 RBG	2 HG, 5290 RBG	Muck, Riprap	Herb, Shrub, Tree
*Grassy Island 318004	42 15	083 07	0	1644 RBG, 20 CT	Pumped Dredge	Bare, Herb, Shrub
Stoney Island 318003	42 06	083 08	14 GBH, 29 GE	11 GBH, 23 GE	Soil	Deciduous Tree

(Continued)

Table 1 (Continued)

ITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake E						
*T or Dike .6001	41°42'	083°26'	6 HG, 77 CT	13 HG, 59 RBG, 263 CT	Pumped Dike, Dredge Material	Herb, Bare
West Sister Island 346002	41 44	083 07	1600 GBH, 200 GE, 3000 BCNH, 150 HG (Corrected)	1600 GBH, 200 GE, 3000 BCNH, 150 HG	Soil, Rock	Shrub, Tree, Bare
Rattlesnake Island 346003	41 41	082 51	72 HG	56 HG	Rock, Cliff	Bare
Green Island 346004	41 39	082 52	6 HG	33 HG	Rock	Bare
Starve Island 346005	41 37	082 49	130 HG	78 HG	Rock	Bare
Winous Point 346006	41 28	082 55	1634 GBH	938 GBH	Soil	Deciduous Tree
*Sandusky Turn Point 346007	41 27	082 43	983 HG	878 HG	Soil, Riprap	Herb, Shrub, Bare
Niagara River						
*Buffalo Breakwater 320001	42 53	078 54	46 CT. HG's and RBG's present but not censused.	50 HG, 524 RBG, 121 CT	Concrete, Cobble, Sand	Bare
*Southeast Buckhorn Island 292001	43 04	079 00	2638-3640 RBG, 46 CT	3704 RBG, 41 CT	Soil, Riprap	Herb
International Control Structure292003 (grassy island)	43 08	079 04	Not censused	4 HG, 1105 RBG, 356 CT	Rock	Bare
Niagara Gorge 292002	43 12	079 03	40 HG	56 HG	Cliff, Rock	Bare

(Continued)

Table 1 (Concluded)

SITE	LATITUDE	LONGITUDE	1976	1977	SUBSTRATE	VEGETATION
Lake Ontario						
Sandy Pond Island 293003	43°35'	076°11'	0	11 NGH, 5 CT	Sand	Bare, Herb, Shrub, Tree
Little Galloo Island 293001	43 53	076 24	+76 DCC, 121 BCNH, 200 HG, +30,000 RBG	96 DCC, 2 CE, 130 BCNH, 200 HG, 27,308 RBG	Soil	Herb, Shrub, Tree
Gull Island 293002	43 51	076 13	10 HG	6 HG	Cobble	Bare, Shrub, Tree
Bass Island 293004	43 55	076 10	0	7 HG, 37 RBG	Cobble, Sand	Bare, Herb, Shrub, Tree

Note: A small ring-billed gull colony is known from an island in Lake Calumet (American Birds, 1976, 30:963). A heronry in the same vicinity is also noted, but both sites are outside the limits of this study.

In all cases of variance, the numbers in this table take precedence over the 1976 interim report (Scharf et al. in press).

12. Thirty-two of the nesting sites in Table 1 are either man-made or man-influenced structures where the development of succession patterns of vegetation and ages of island were analyzed according to the method of Soots and Parnell (1975) for dredged material islands in North Carolina. Little correlation between age of the islands and succession of vegetation was evident because of variations in plant succession and parent dredged materials. Rock, sterile sands, and gravels were dredged in some Great Lakes areas, and heavy mucks and clays in others. These variations combined with ice conditions comprised a varied list of factors other than age that influenced habitat development. Present dredging policy in the Great Lakes prohibits open-water disposal. Thus all of the recent (10 years) dredged material deposits were at confined sites that prevent contamination of the surrounding water. This practice of diking formed a distinctive type of dredged material structure that should be considered separately from open water sites. Older open-water dredged material islands with bird colonies ranged in age from 11 to 77 years since completion of dredging, but some of the oldest of these showed significantly retarded succession rates due primarily to parent material, effects of bird usage, and erosion or inundation due to lake levels.

Study of Selected Bird Colonies

13. The following are descriptions of the breeding populations, vegetation analysis, and noteworthy information on vegetation-bird interactions at eight natural and 16 dredged material sites selected for comparison. Each site description is accompanied by an aerial photograph overlaid with a map showing sampling, transect, locations, and colony borders. (Figures 1-23b).

Site 1. Duluth Port Authority

14. Location: 46°45' N., 092°06' W., a mainland man-made site along the harbor of Duluth, Minnesota (Figure 1).

Species and Number of Nests:

common terns:	1976-121
	1977-185
ring-billed gulls:	1977-234
herring gulls:	1977-5

Colony Size:

1976 - 13.77 ha	
1977 - 1.5 ha	common terns
1.0 ha	ring-billed gulls

History: This area has had a long history of common tern nesting (Scharf 1971a). In May and June 1976, bare sand was exposed by bulldozing and excavation over the entire site (Figure 1). The area began to revegetate during late 1976 and 1977.

Nesting Success: Common terns were successful in fledging chicks in 1976 although the onset of laying was retarded by excavation, and the resultant late laying produced widely spaced nests (10 to 20 m) as described for bare areas by Palmer (1941). In 1977 the density of common tern nests was greater and the nesting chronology was more similar to that found in other Great Lakes colonies of this species. Fledging success appeared to be good, but heavy vehicle traffic on the border roads and human intrusions into the colony accounted for some excess mortality. The ring-billed gull colony had nests which were widely spaced and had several stages present at the same time which was found to be typical of first-year, small colonies. Less than optimal nesting success is hypothesized because of the apparent asynchrony and dispersion of nests in this species. No information was obtained on the success of herring gull nests at this site.

15. Habitat: The 1976 excavation work at this site offered an excellent opportunity to study succession of vegetation and its relationship to common terns and ring-billed gulls. Importance values of the plant species (Table 2) showed similarities between the common tern

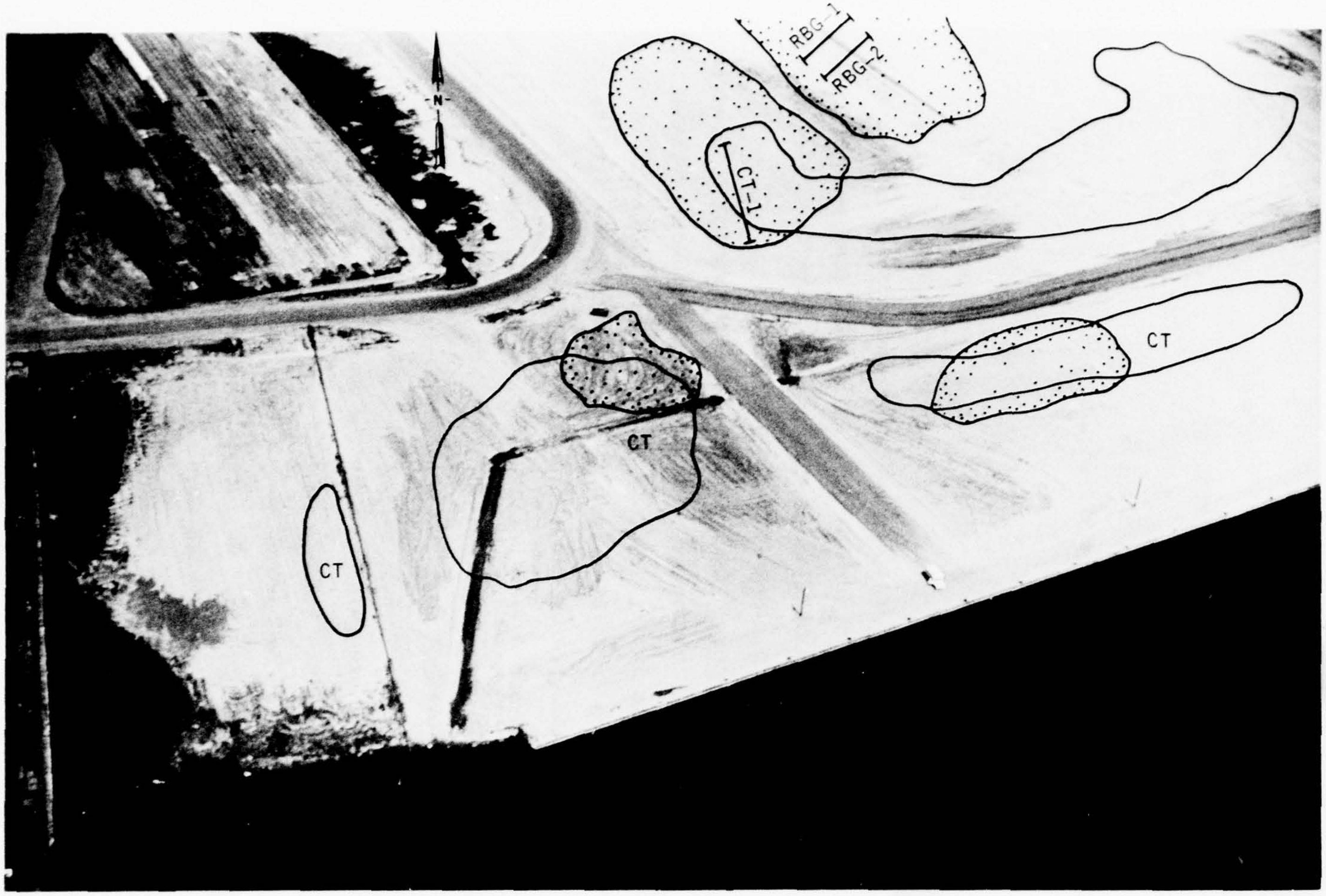

Figure 1. Duluth Port Authority showing a ring-billed gull colony and vegetation sampling transects

Table 2

Duluth Port Authority

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	CT[1]	RBG-1[2]	RBG-2
1 m^2 Quadrats*	(20)	(10)	(10)
Witch-grass (Agropyron repens)	-	9	5
Burdock (Arctium sp.)	13	55	82
Wormwood (Artemesia caudacta)	50	20	-
Common winter-cress (Barbarea vulgaris)	-	16	7
Pigweed (Chenopodium album)	10	9	21
Squirrel-tail grass (Hordeum jubatum)	5	-	-
Lettuce (Lactuca canadensis)	-	4	4
White melilot (Melilotus alba)	116	105	94
Evening primrose (Oenothera biennis)	8	-	10
Smartweed (Polygonum lapathifolium)	60	70	74
Sandbar-willow (Salix interior)	-	4	-
Tumble-mustard (Sisymbrium altissimum)	37	4	5
Yellow clover (Trifolium agrarium)	-	6	-

*Sample sizes are indicated in parenthesis.

1. CT= common tern.

2. RBG= ring-billed gull.

and ring-billed gull vegetation associations with tall (0.75 to 1 m) white meliot (Melilotus alba) being most important and a variety of lower herbs and grasses forming an understory vegetation. Two differences noted were the greater importance of burdock (Arctium sp.) in the ring-billed gull colony and greater importance of tumble-mustard (Sisymbrium altissimum) in the common tern colony. If the bird usage remains similar, these apparently minor differences may be precursors to an increase in importance of burdock in the ring-billed gull area. Percent coverage values (Tables 26 and 27) showed that the ring-billed gull colony had 34-47 percent more coverage than the common tern colony. This result was not expected because several bare openings were found within the ring-billed gull colony showing the puddling effect created by the action of feces and trampling by this species (Scharf et al. in press).

Site 2. Minnesota Power and Light Company

16. Location: $46^{o}44'$ N., $092^{o}09'$ W., a mainland man-made site along the harbor of Duluth, Minnesota (Figure 2).

Species and Number of Nests:

ring-billed gulls:	1976-308
	1977-550
herring gulls:	1976-1
	1977-2

Colony Size: 0.29 ha.

History: The first year of gull nesting at this site, 1973, coincided with the switch to oil as fuel by the adjacent generating plant, freeing this peninsula which had served as a coal dock.

Nesting Success: The strewn railroad ties from a former track afforded valuable visual and physical isolation between nesting territories and allowed relatively high nesting success at this site.

17. Habitat: The importance values for this site (Table 3) show a predominantly herbaceous cover for the first two transects near the base of the peninsula with progressively more sandbar willow (Salix interior) shrub cover toward the end at transects 3 and 4 (Figure 2).

Table 3

Minnesota Power and Light Company

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1[1]	RBG-2	RBG-3	RBG-4
1 m^2 Quadrats*	(8)	(8)	(6)	(5)
Common yarrow (Achillea millefolium)	13	-	-	-
Witch-grass	148	165	106	142
ragweed (Ambrosia sp.)	15	28	-	-
Wormwood	13	44	-	-
Common milkweed (Asclepias syriaca)	-	10	25	16
Canada thistle (Cirsium arvense)	-	10	-	-
Pineapple-weed (Matricaria matricarioides)	5	10	-	-
June grass (Poa pratensis)	29	18	-	-
Raspberry (Rubus idaeus var. strigosus)	15	-	-	27
Sandbar willow	-	-	91	59
Tumble-mustard	6	16	-	-
Goldenrod (Solidago sp.)	26	-	-	-
Common tansy (Tanacetum vulgare)	28	-	76	59

*Sample sizes are indicated in parenthesis.

+ = Trace.

1. RBG = ring-billed gull.

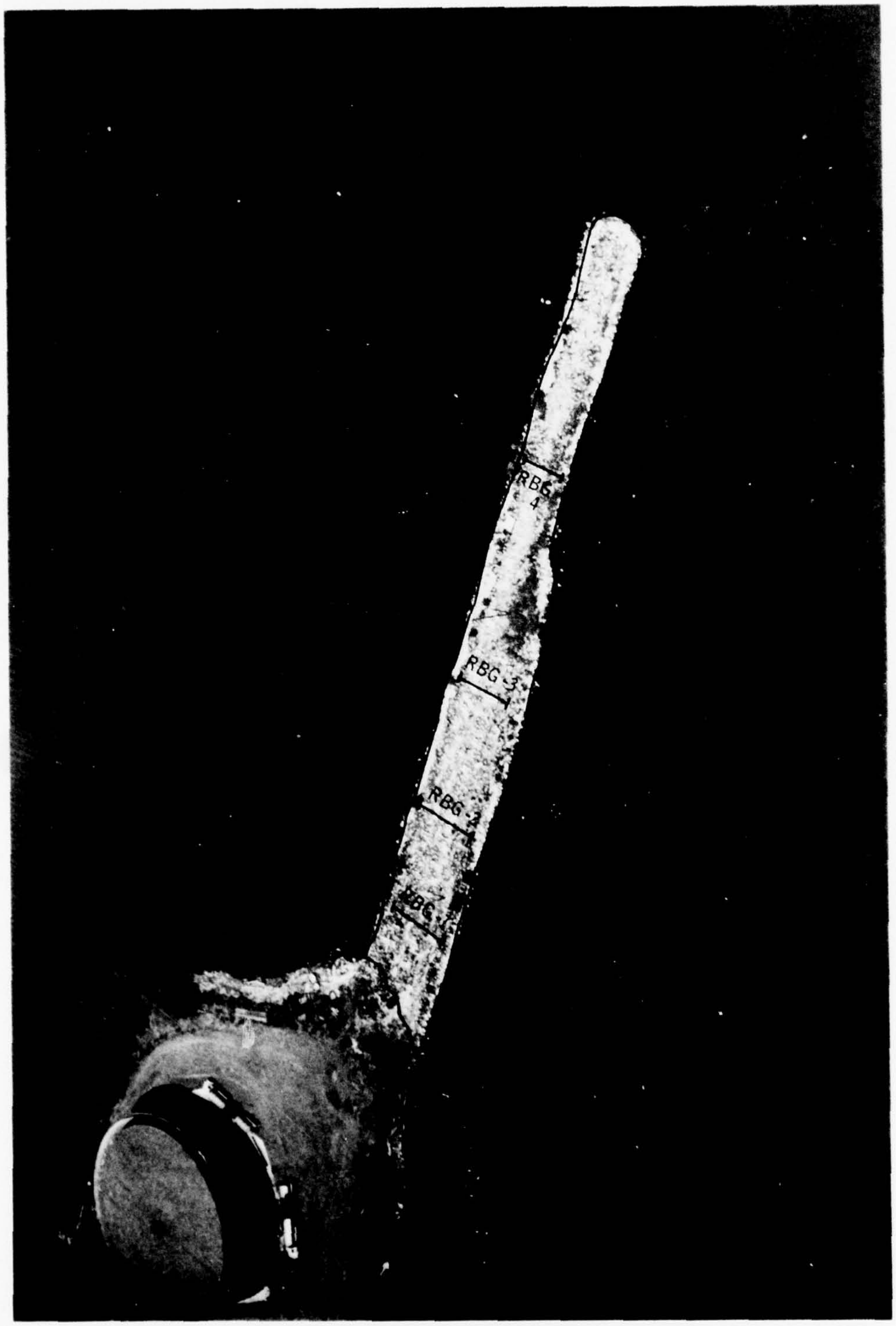

Figure 2. Minnesota Power and Light Company showing nesting of ring-billed gulls and vegetation sampling transects

No differences in the gull nesting density were noted because of this change. It was evident that witch-grass (Agropyron repens) gained an exaggerated importance value because of its high numbers in the dense sod. Average percent vegetation coverage for this site (33 percent) was more typical than the previous site for ring-billed gulls with continuous occupancy reflecting a large amount of puddled vegetation and bare area.

Sites 3, 4, and 5. Northwest Sugar Island, West Sugar Island II, and West Sugar Island I.

18. Locations: 46°27' to 46°26' N., 084°16' to 084°15' W., small dredged material islands in the St. Mary's River, 6 to 9 km southeast of Sault St. Marie, Michigan (Figures 3, 4, and 5).

Species and Number of Nests:

Northwest Sugar Island	common terns:	1976-81
		1977-21
	herring gulls:	1977-1
West Sugar Island II	common terns:	1977-44
	herring gulls:	1977-1
West Sugar Island I	common terns:	1976-139
		1977-116

Colony Size: 0.05 to 0.17 ha

History: These dredged material islands were formed atop natural islands between 1900 and 1960. In recent high water years they eroded extensively. Comparison of Figures 3 and 5 taken in 1976 with Figure 4 taken in 1977 showed that the lower lake levels of 1977 nearly tripled the emergent portions of these islands.

Nesting Success: Each of these sites was rated as highly successful. Although only 3790 of the eggs in the three colonies hatched, nearly 90 percent of the chicks fledged (Appendix D).

19. Habitat: The vegetation importance values (Tables 4, 5, and 6) show a wide mixture of herbaceous species with indications of invasion of shrubby plants such as sandbar willow and balsam poplar (Populus balsamifera). The increase in surface due to lowered water

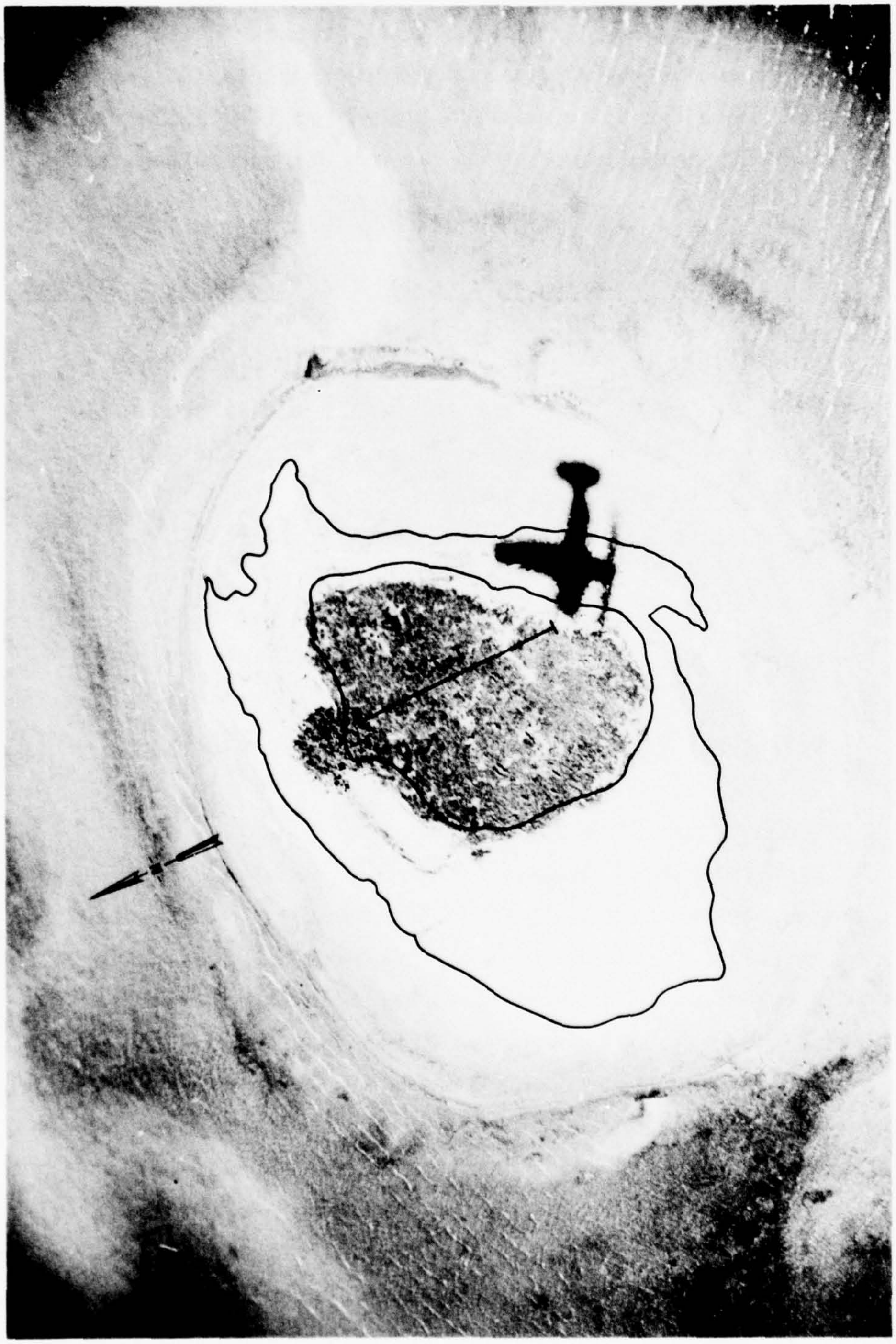

Figure 3. Northwest Sugar Island showing a common tern colony and a vegetation sampling transect

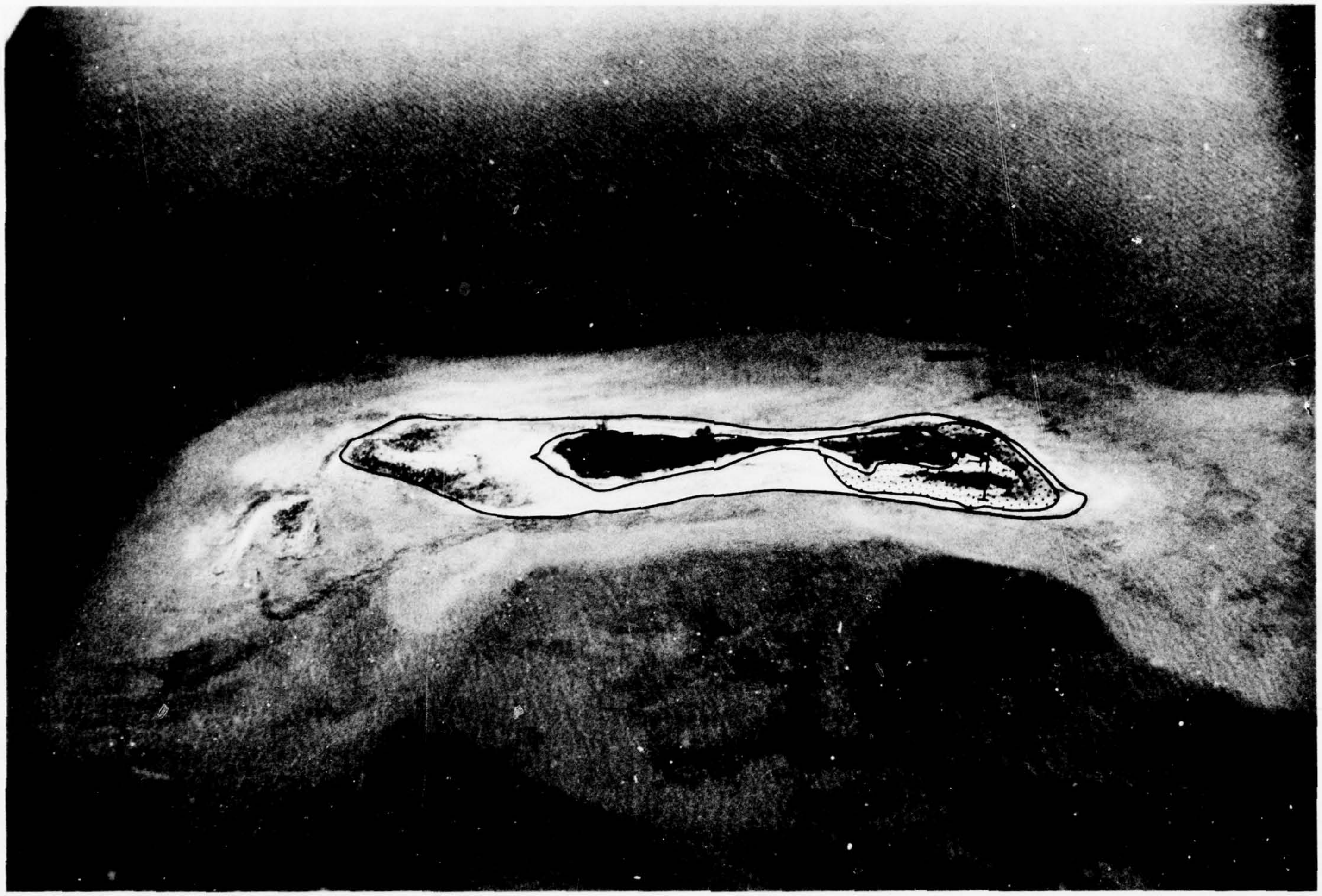

Figure 4. West Sugar Island II showing a common tern colony and a vegetation sampling transect

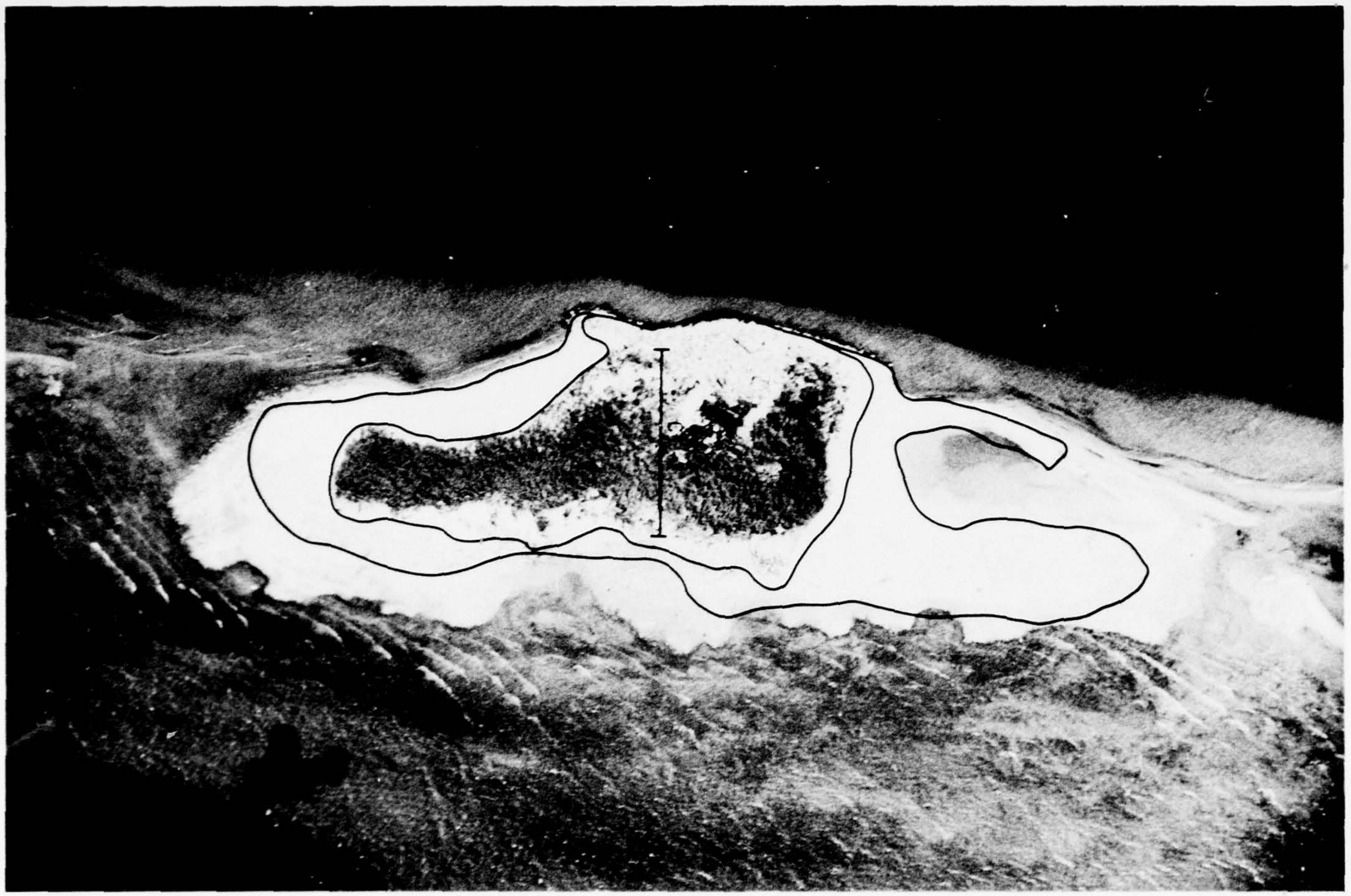

Figure 5. West Sugar Island I showing a common tern colony and a vegetation sampling transect

Table 4

Northwest Sugar Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	COMMON TERN
1 m^2 Quadrats*	(14)
Common yarrow	7.9
Common winter-cress	10.2
Sedge (*Carex* sp.)	1.2
Pigweed	4.7
Field daisy (*Chrysanthemum leucanthemum*)	6.7
Canada thistle	10.5
Great willow-herb (*Epilobium augustifolium*)	1.2
Horsetail	40.6
Orange hawkweed (*Hieracium aurantiacum*)	4.0
White melilot	8.7
Moss (Unidentified)	3.7
Common timothy (*Phleum pratense*)	4.0
Common plantain (*Plantago major*)	5.2
June grass	91.9
Smartweed	46.6
Tumble-mustard	9.3
Goldenrod	21.6
Field-sowthistle (*Sonchus arvensis*)	14.2
Common dandelion (*Taraxacum officinale*)	2.3
Yellow clover	1.4
Red clover (*Trifolium pratense*)	9.8

*Sample sizes are indicated in parenthesis.

Table 5

West Sugar Island II

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	COMMON TERN
1 m^2 Quadrats*	(15)
Common winter-cress	7.2
Sedge	14.7
Pigweed	20.0
Canada thistle	2.1
Rush (*Juncus* sp.)	18.4
White melilot	22.2
Common plantain	2.4
June grass	32.7
Smartweed	148.6
Tumble-mustard	13.9
Common dandelion	1.9
Yellow clover	1.9
Red clover	9.8

*Sample sizes are indicated in parenthesis.

Table 6

West Sugar Island I

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	COMMON TERN
1 m^2 Quadrats*	(12)
Sugar maple (Acer saccharum)	4.2
Common winter-cress	4.7
Sedge	5.8
Pigweed	19.2
Spotted touch-me-not (Impatiens capensis)	26.8
June grass	35.0
Smartweed	17.7
Balsam poplar (Populus balsamifera)	12.4
Sandbar willow	150.4
Bittersweet (Solanum dulcamara)	4.9
Field-sowthistle	14.3
Common dandelion	4.5

*Sample sizes are indicated in parenthesis.

levels led to a partial shift (56.3 percent of the nests) of the common terns from the vegetated areas where they nested in 1976 to the bare sands and clays exposed in 1977. West Sugar Island II was not used for nesting in 1976, but appeared to have been colonized in response to newly exposed bare areas that were available for nesting as the water receded.

Sites 6 and 7. Moon Island and Southwest Neebish Island

20. Locations: 46°13' N., 084°10' W., two dredged material islands in the St. Marys River, 14.5 km northeast of Pickford, Michigan (Figures 6 and 7).

Species and Number of Nests:

	Moon Island:	herring gulls:	1976-18
			1977-7
		ring-billed gulls:	1976-982
			1977-1673
	Southwest Neebish Island/	ring-billed gulls:	1976-1263
			1977-2398
Colony Size:	Moon Island:	herring gulls:	1976-1977 0.61 ha
		ring-billed gulls:	1976-0.32 ha
			1977-0.55 ha
	Southwest Neebish Island:		1976-0.34 ha
			1977-0.61 ha

History: The islands were the result of dredged material deposited over natural islands from 1900 to 1957. The herring gulls were noted present by Ludwig (1962) and ring-billed gulls were reported at this site by Scharf (1971a).

Nesting Success: No unusual mortality factors were apparent, and it was believed that chick survival was excellent. Hatching was retarded (10 percent and 21 percent) in newly exposed land areas compared to pre-existing areas of the same islands (83 percent and 84 percent).

Figure 6. Moon Island showing a ring-billed gull colony and vegetation sampling transects

Figure 7. Southwest Neebish Island (in part) showing a ring-billed gull colony and vegetation sampling transect

21. Habitats: These locations were very similar in that heavy clay substrates were mixed with stems of reed (*Phragmites communis*), the most important herb in all but one transect (Tables 7 and 8). In Scharf et al. (in press) it was hypothesized that the reed stands may be resistant to ring-billed gull puddling, but this was disproved in 1977 by the finding of high percentages of bare area and low percent cover (Table 27). It was also seen in the high importance value of pigweed (*Chenopodium album*) which replaces reed on one transect on Moon Island (RBG-1, Table 7) and in the high importance value for stinging nettle (*Urtica dioica*) on Southwest Neebish Island (RBG-1, Table 8). Both of these islands also had woody plants present in the 17 m^2 quadrats (Tables 7 and 8). The larger quaking aspen (*Populus tremuloides*) on Moon Island were cut by beavers (*Castor canadensis*), providing additional gull nesting habitat. Moon Island also had an increase in ring-billed gull nesting area of 72 percent and an increase of 691 nests (19 percent) due primarily to the lower water levels. The corresponding increases for Southwest Neebish Island were 79 percent more nesting area and 1135 nests (90 percent). Nest densities of ring-billed gulls on these two sites were 0.73 nests/per m^2 and 0.81 nests/per m^2 and 0.81 nests/per m^2 for Moon and Southwest Neebish Islands, respectively. These values showed very dense nesting.

Site 8. Southeast Neebish Island

22. Location: 46°14' N., 084°07' W., a large dredged material island 19.5 km northeast of Pickford, Michigan (Figure 8).

Species and Number of Nests:

common terns:	1976-136
	1977-45
ring-billed gulls:	1976-49
	1977-55
herring gulls:	1976-1

Colony Size: common terns: both years 0.3 ha

ring-billed gull: both years 0.04 ha

History: The date of construction of this island was unknown.

Table 7

Moon Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1[1]	RBG-2	RBG-3	RBG-4
1 m^2 Quadrats*	(24)	(2)	(9)	(4)
Witch-grass	98.3	-	-	-
Common milkweed	7.1	-	-	-
Sedge	-	-	5.6	-
Pigweed	105.4	-	16.5	-
Thoroughwort (Eupatorium perfoliatum)	-	-	12.9	-
Reed-meadow grass (Glyceria grandis)	-	-	56.5	-
Spotted touch-me-not	-	-	4.3	-
Rush	-	-	7.6	-
Pineapple-weed	-	-	4.3	-
White melilot	12.4	-	-	-
Reed (Phragmites communis)	69.2	-	105.1	-
Common plantain	-	-	10.7	-
June grass	-	-	20.4	-
Tall cinquefoil (Potentilla arguta)	-	-	4.3	-
Red clover	-	-	9.5	-
Stinging nettle (Urtica dioica)	7.8	-	32.8	-
Common mullein (Verbascum thapsus)	_	_	9.4	-
16 m^2 Quadrats*				
Red-osier dogwood (Cornus stolonifera)	-	-	-	59.3
Quaking aspen (Populus tremuloides)	-	96.4	-	-
Peach-leaved willow (Salix amygdaloides)	-	-	-	240.6
Red-berried elder (Sambucus pubens)	-	203.6	-	-

*Sample sizes are indicated in parenthesis. 1. RBG = ring-billed gull.

Table 8

Southwest Neebish Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1
1 m^2 Quadrats*	(15)
Reed	187.4
Stinging nettle	112.6
16 m^2 Quadrats*	(2)
Red-osier dogwood	31.7
Sandbar willow	220.6
Red-berried elder	47.7

*Sample sizes are indicated in parenthesis.

1. RBG = ring-billed gull.

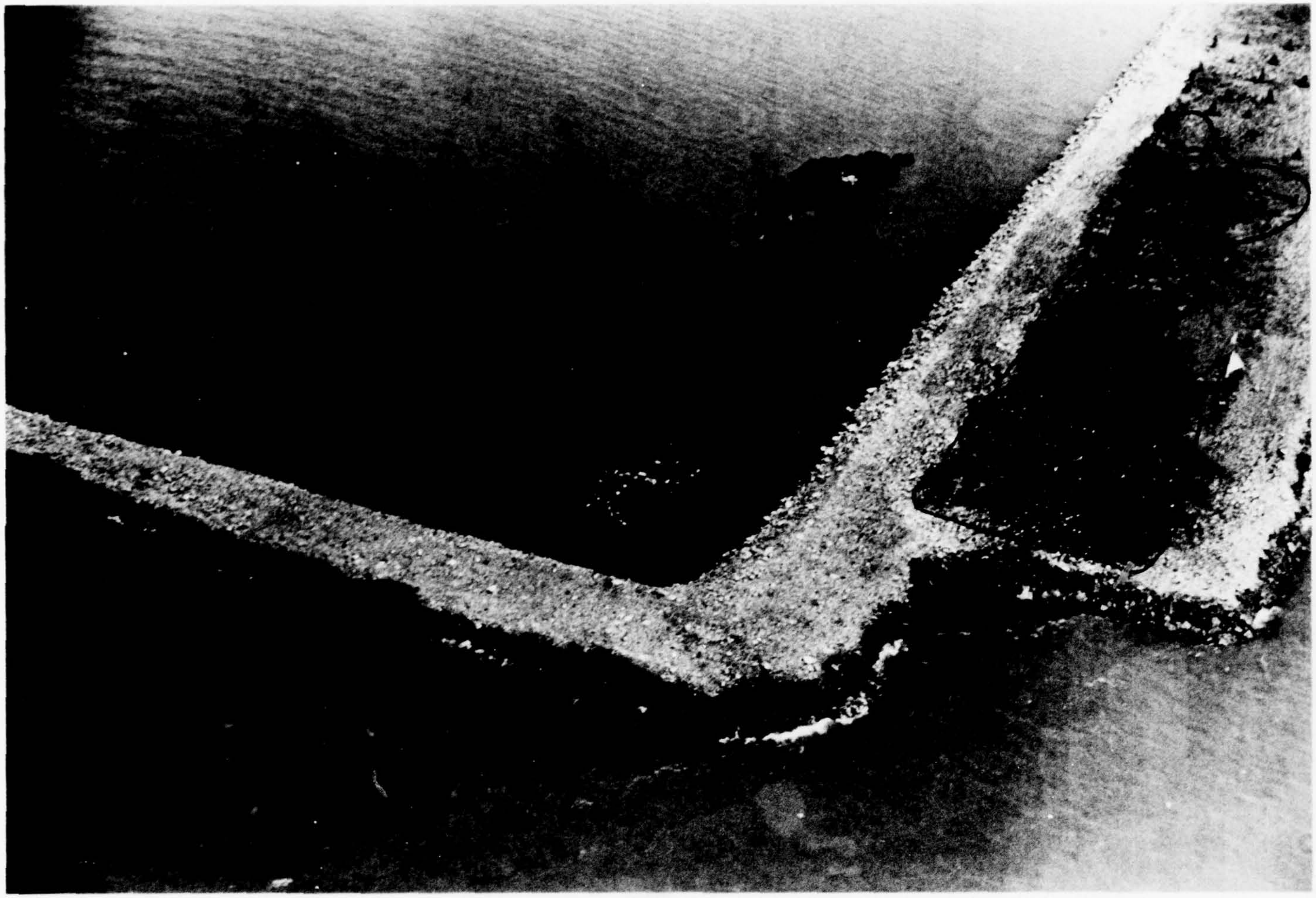

Figure 8. Southeast Neebish Island showing colonies of common terns and ring-billed gulls and vegetation sampling transects

Nesting Success: No unusual mortality was noted in either species. The common terns appeared to fledge most of their young, but the retardation by three to four weeks of the ring-billed gulls usually indicated poor survival of chicks.

23. Habitat: June grass (*Poa pratensis*) was the most important species among a sparse herb and grass community at this site (Table 9). The percent coverage (70 percent and 73 percent) for each species, shown in Tables 26 and 27, was biased by high density of the grasses, and did not reflect the lack of broadleaf shaded nesting cover visually evident. The island was composed of chipped igneous rock that was covered with a thin layer of soil. It was probable that the June grass was planted soon after construction and that the rocky surface resisted further plant succession. This feature seemed to make the area marginally attractive to ring-billed gulls and common terns, although they nested on bare rock and sand elsewhere in the Great Lakes. The marginality of the habitat was emphasized by the decrease in number of common terns in 1977 and by the low density of ring-billed gulls (0.13 nests per m^2) which led to widely asynchronous hatching and diminished nesting success.

Site 9. Willow Island

24. Location: $44^{o}34'$ N., $088^{o}00'$ W., a small dredged material island 2.3 km north of Green Bay, Wisconsin (Figure 9).

Species and Number of Nests:

black-crowned night herons:	1976-46
	1977-224
cattle egrets:	1977-15
herring gulls:	1976-9
	1977-16

Colony Size: Total island: 1976- 0.18 ha
1977- 0.25 ha

History: The date of construction of this island was unknown, but was believed to have been built in the early decades of this century.

Table 9

Southeast Neebish Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	CT[1]	RBG-1[2]
1 m^2 Quadrats*	(10)	(10)
Common winter-cress	-	9.6
Black mustard (Brassica nigra)	13.1	46.6
Pickpocket (Capsella bursa-pastoris)	-	6.9
Pigweed	-	2.4
Field daisy	22.1	9.1
Fleabane (Erigeron philadelphicus)	-	2.2
Common timothy	34.8	42.1
June grass	190.8	150.8
Smartweed	-	2.6
Sheep-sorrel (Rumex acetosella)	-	16.8
Common dandelion	-	8.2
Field penny-cress (Thlaspi arvense)	4.6	2.5
Yellow clover	6.0	-
Red clover	28.4	-

*Sample sizes are indicated in parenthesis.

1. CT = common tern.

2. RBG = ring-billed gull.

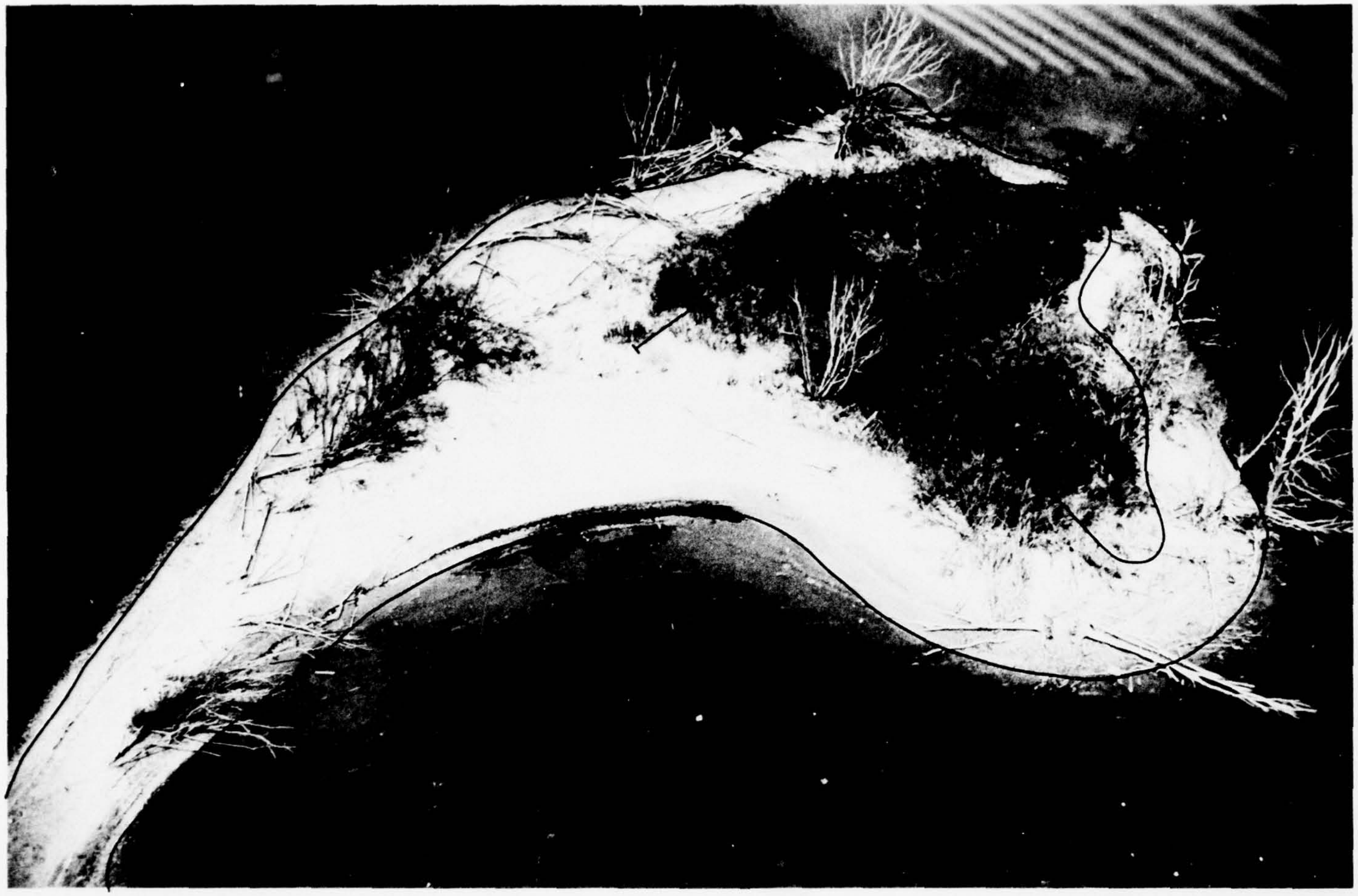

Figure 9. Willow Island showing colonies of black-crowned night herons, cattle egrets, and herring gulls and vegetation sampling transects

Nesting Success: The herring gulls produced only 0.33 fledglings per nest in 1976 (Scharf et al. in press) and similar low reproductive success was evident in 1977 because of excessive human disturbance. The black-crowned night herons produced 1.7 birds per nest in 1976 (Scharf et al. in press) and late nesting in 1977 was still in progress when this report was being written.

25. Habitat: The most important vegetation was the two species of willow which supported the nest trees (Table 10). This shrub and young tree community developed beyond that of any other dredged material colonial site in the U. S. Great Lakes. Hypothetically, if plant succession continues, this site would become suitable for tree nesting species such as great blue herons and great egrets some time in the future.

Site 10. Lone Tree Island

26. Location: $44^{o}34'$ N., $088^{o}00'$ W., a small rubble and dredged material island 2.1 km north of Green Bay, Wisconsin (Figure 10).

Species and Number of Nests:

common terns:	1976-100
	1977-108
herring gulls:	1976-3
	1977-2
ring-billed gulls:	1976-213
	1977-374

Colony Size: common terns, both years, 0.11 ha
ring-billed gulls, both years, 0.23 ha

History: The date of construction was unknown, but probably dated back to original dredged material deposits early in the century which were subsequently overlain with concrete and brick rubble. The common tern colony has been present for at least 15 years. There were 103 nests counted on the island in 1969. The highest number was an estimated 120 nests in 1972 and 1974. Ring-billed gulls first nested on the north end of the island in 1969, and four nests were again observed in 1972. By 1974 there were 30 nests, half on the north side

Table 10

Willow Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	BCNH-1[1]	BCNH-2	BCNH-3
1 m^2 Quadrats*	(10)		
Sandbar willow	300	-	-
16 m^2 Quadrats*		(5)	(5)
Box elder (Acer negundo)		7	8
Red-osier dogwood		-	7
Eastern cottonwood (Populus deltoides)		95	30
Peach-leaved willow		42	68
Sandbar willow		155	186

*Sample sizes are indicated in parenthesis.

1. BCNH = black-crowned night heron.

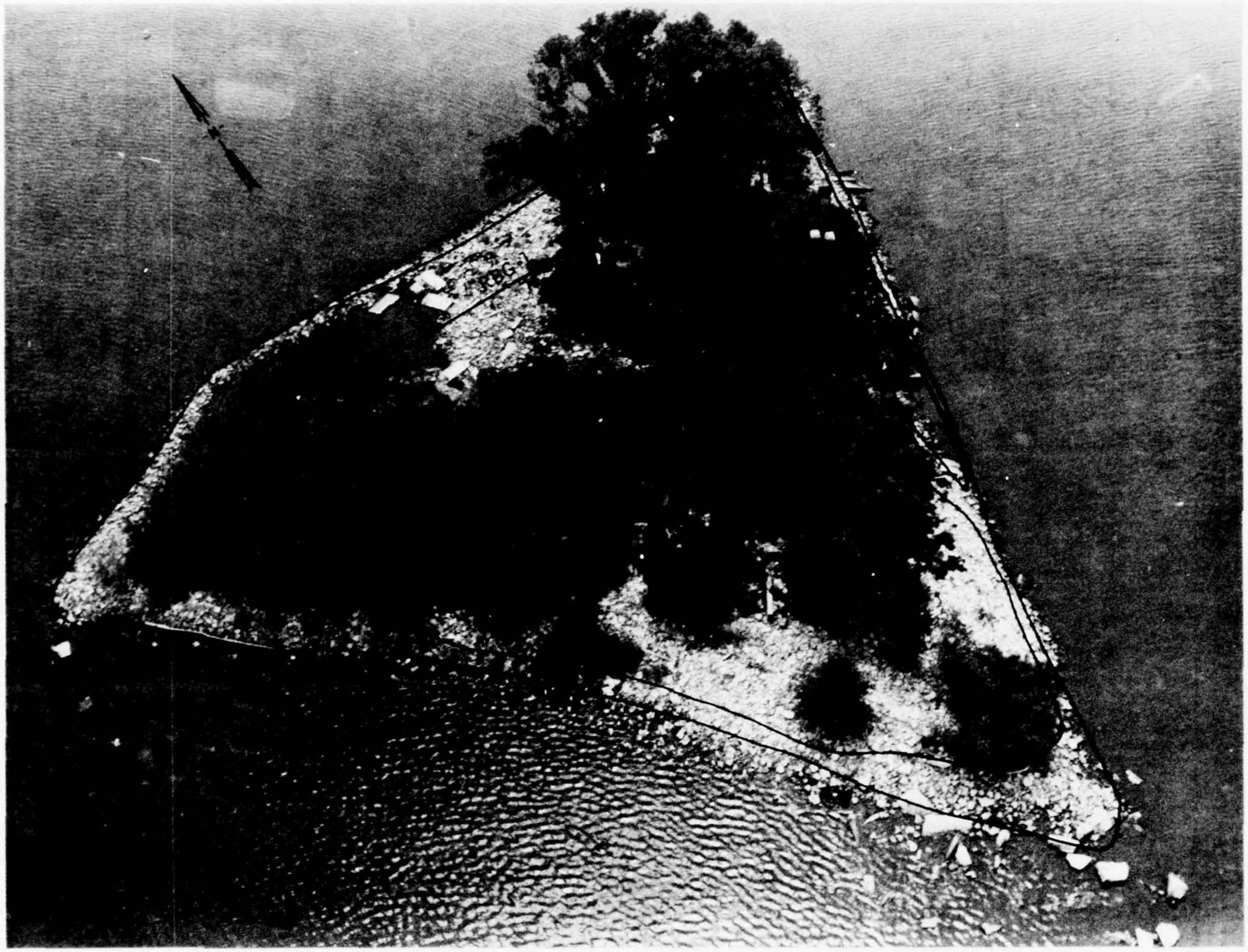

Figure 10. Lone Tree Island showing colonies of common terns and ring-billed gulls and vegetation sampling transects

and half on the southeast side. The number of nests increased to 87 in 1975. The ring-billed gull colony has continued to increase and the common terns have decreased or remained stable.

Nesting Success: (1976 only)

common terns, 0.66 per nest

herring gulls, 2.33 fledged per nest

ring-billed gulls, 0.84 per nest.

27. Habitat: The vegetation was a mix of herbaceous species with the greatest importance being on wild cucumber (*Echinocystis lobata*) and spotted touch-me-not (*Impatiens capensis*) (Table 11) which formed dense mats. Although the habitat, which had its continuity broken by rubble, appearedtoo heavily vegetated for optimum utilization by either ring-billed gulls or common terns, they both appeared to do well. Both of the important plant species mentioned above became most conspicuous later in the season, and probably the vegetation community first found by the birds during April and May was radically different than that shown in Table 11.

Site 11. South Manitou Island

28. Location: 45°03' N., 086°05' W., the northeast tip of a large natural island, 9.5 km west of Glen Arbor, Michigan (Figure 11).

Species and Number of Nests:

herring gulls:	1976-428
	1977-470
ring-billed gulls:	1976-4060
	1977-2686

Colony Size:

herring gulls:	3.3 ha
ring-billed gulls:	2.2 ha

History: This has been documented as one of the largest gull colonies in Lake Michigan (Scharf, 1971b). Scharf and Shugart (1975) documented the relative stability of the herring gull colony over a 6-year period. In recent years the ring-billed gull colony declined from 6000 in 1969 to 2686 in 1977 due to excessive human disturbance, red fox (*Vulpes vulpes*) predation, and changes in vegetation structure

Table 11

Lone Tree Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	CT[1]	RBG[2]
1 m^2 Quadrats*	(10)	(13)
Common burdock (Arctium minus)	-	15
Common milkweed	8	-
Pigweed	22	6
Canada thistle	4	6
Red-osier dogwood	7	--
Cruciferae unidentified	-	-
Wild cucumber (Echinocystis lobata)	129	91
Spotted touch-me-not	44	12
Morning-glory (Ipomoea sp.)	13	-
Spiked loosestrife (Lythrum salicaria)	-	7
Virginia creeper (Parthenocissus quinquefolia)	-	19
Smartweed	-	77
Common elder (Sambucus canadensis)	14	-
Bittersweet	6	51
Stinging nettle	58	11

*Sample sizes are indicated in parenthesis.

1. CT = common tern.

2. RBG = ring-billed gull.

Figure 11. South Manitou Island showing colonies of ring-billed gulls and herring gulls and vegetation sampling transects

(Shugart, 1976 and Scharf, et al. in press)

Nesting Success: Herring gulls had very low success and few fledged in 1976 due to fox predation; and had normal fledging rate in 1977. Ring-billed gulls did not fledge in 1976 due to foxes. Fledging rate was near normal in 1977 although the colony was 60 percent smaller than it was in 1971.

29. Habitat: The herring gulls were found in two distant grassy vegetations. The lakeward area was characterized by beach grass (*Ammophila breviligulata*) with the highest importance value (HG-2, Table 12) in this blowing dune-sand association. The other was an inward, more heavily fertilized and less wind-blown area where brome grass (*Bromus tectorum*) was the most important species (HG-1 Table 12). Both of these vegetations were stable, except where human traffic disturbed the beach grass. Some herring gulls also nested on bare beach sand in this colony.

30. The ring-billed gulls over a monitored period of 12 years have killed much of the woody vegetation through the action of feces and feet. In response to the destruction of the woody vegetation and human disturbance the colony moved to more vegetated portions which deteriorated rapidly to the extent that many gulls nest on bare ground. Coverage (Table 27) varied from 3 percent to 37 percent with the lower figure being typical of the main nesting area. The porous sands coupled with the mechanical and chemical inputs from the gulls made most of the plant species (Table 12) except sparse grasses show stress during the nesting season. Revegetation of the abandoned ring-billed gull nesting area appeared to be slowly re-occurring as is typical of dune areas. The abatement of fox predation in 1977 and control of human intrusions by the National Park Service should aid in the stabilization of this declining colony, but the continued destruction of the ring-billed gull habitat by the gulls' actions ultimately will determine the stable population level.

Site 12. Bellows Island

Table 12

South Manitou Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	HG-1[1]	HG-2	RBG-1[2]	RBG-2	RBG-3
1 m^2 Quadrats*	(11)	(10)	(12)	(10)	(10)
Agropyron (*Agropyron dasystachyum*)	-	45	54	61	-
Beach grass (*Ammophila breviligulata*)	-	175	177	204	-
Wormwood	36	5	-	-	-
Common milkweed	-	-	6	-	-
Brome grass (*Bromus tectorum*)	129	-	-	36	92
Sea rocket (*Cakile edentula*)	-	68	33	-	-
Pigweed	4	-	-	-	54
Creeping savin (*Juniperus horizontalis*)	-	-	-	-	46
Beach-pea (*Lathyrus japonicus*)	-	8	-	-	-
White champion (*Lychnis alba*)	4	-	-	-	-
White melilot	10	-	-	-	-
Canada bluegrass (*Poa compressa*)	77	-	-	-	-
Sand cherry (*Prunus pumila*)	-	-	8	-	-
Poison ivy (*Rhus radicans*)	-	-	21	-	-
Sheep-sorrel	16	-	-	-	-
Tumble-mustard	7	-	-	-	38
Field penny-cress	12	-	-	-	72
Goats'-beard (*Tragopogon major*)	4	-	-	-	-

*Sample sizes are indicated in parenthesis.

1. HG = herring gulls.

2. RBG = ring-billed gulls.

31. Location: $45^{o}06'$N., $085^{o}34'$ W., a natural island 5 km east of Northport, Michigan (Figure 12).

Species and Number of Nests: herring gulls: 1976-728
1977-705

Colony Size: 1976- 1.86 ha
1977- 2.2 ha

History: This large herring gull colony dates back at least to the early decades of this century. James P. Ludwig (1977, personal communication) had records of banding over 2500 chicks here in the early 1960's. A decline coupled with severe pesticide contamination (Ludwig and Tomoff, 1966) has brought about an apparent stabilization for the past 10 years at present population levels.

Nesting Success: The stable lowered population consistently produced an average of 0.70 fledglings per nest during the past eight years.

32. Habitat: The mix of trees, shrubs, and herbs (Table 13) in different zones of the island indicated the wide diversity of nesting habitat to which herring gulls adapt. Sandbar willow and red-berried elder (*Sambucus pubens*) were the most important shrub species. Witchgrass and brome-grass appeared to be the most important herbs, but the sampling bias favoring large numbers of small stemmed species greatly exaggerated their importance over visual evaluations. No clear trends appeared among the other species, although each transect showed a different mix of species usually associated with zonation of the soils and soil moisture. The vegetation on this island was responsive to changes in the water levels of the Great Lakes. In high-water years, the vegetation type of transect 4 (Table 13) expanded and large areas of stinging nettle were found in the area of transect 3 (Table 13).

Site 13. High Island

33. Location: $45^{o}45'$ N., $085^{o}40'$ W., the northern tip of a large natural island 4 km west of Beaver Island, Michigan (Figure 13).

Figure 12. Bellows Island showing a herring gull colony and vegetation sampling transects

Table 13

Bellows Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	HG-1[1]	HG-2	HG-3	HG-4
16 m^2 Quadrats*	(10)	(1)	-	-
Sandbar willow	-	300	-	-
Red-berried elder	257	-	-	-
Choke cherry (*Prunus virginiana*)	43	-	-	-
1 m^2 Quadrats*	(10)	(3)	(10)	(17)
Witchgrass	-	-	180	03
Alyssum (*Alyssum alyssoides*)	-	-	20	-
Ragweed	-	-	3	31
Common burdock	8	-	4	-
Common winter-cress	-	-	8	-
Brome-grass	72	-	-	3
Pickpocket	-	-	-	9
Spotted star-thistle (*Centaurea maculosa*)	-	-	16	28
Pigweed	15	15	-	21
Wildrye (*Elymus canadensis*)	-	-	-	4
Herb-Robert (*Geranium robertianum*)	6	19	3	-
Gill-over-the-ground (*Glecoma hederacea*)	6	10	14	15
Masterwort (*Heracleum maximum*)	-	25	-	-
Spotted touch-me-not	-	39	-	-
Lettuce	-	7	-	13
Common motherwort (*Leonurus cardiaca*)	11	-	-	-
White campion	41	-	27	3
Catnip (*Nepeta cataria*)	-	-	8	42

*Sample sizes are indicated in parenthesis.

1. HG = herring gulls.

Table 13 (Concluded)

Bellows Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	HG-1[1]	HG-2	HG-3	HG-4
1 m^2 Quadrats*	(10)	(3)	(10)	(17)
Poke (*Phytolacca americana*)	7	-	-	-
June grass	11	-	-	45
Smartweed	-	9	-	23
Silverweed	-	-	-	13
Sandbar willow	-	123	-	-
Red-berried elder	56	-	-	-
Bittersweet	16	20	-	5
Stinging nettle	50	36	14	40

*Sample sizes are indicated in parenthesis.

1. HG = herring gulls.

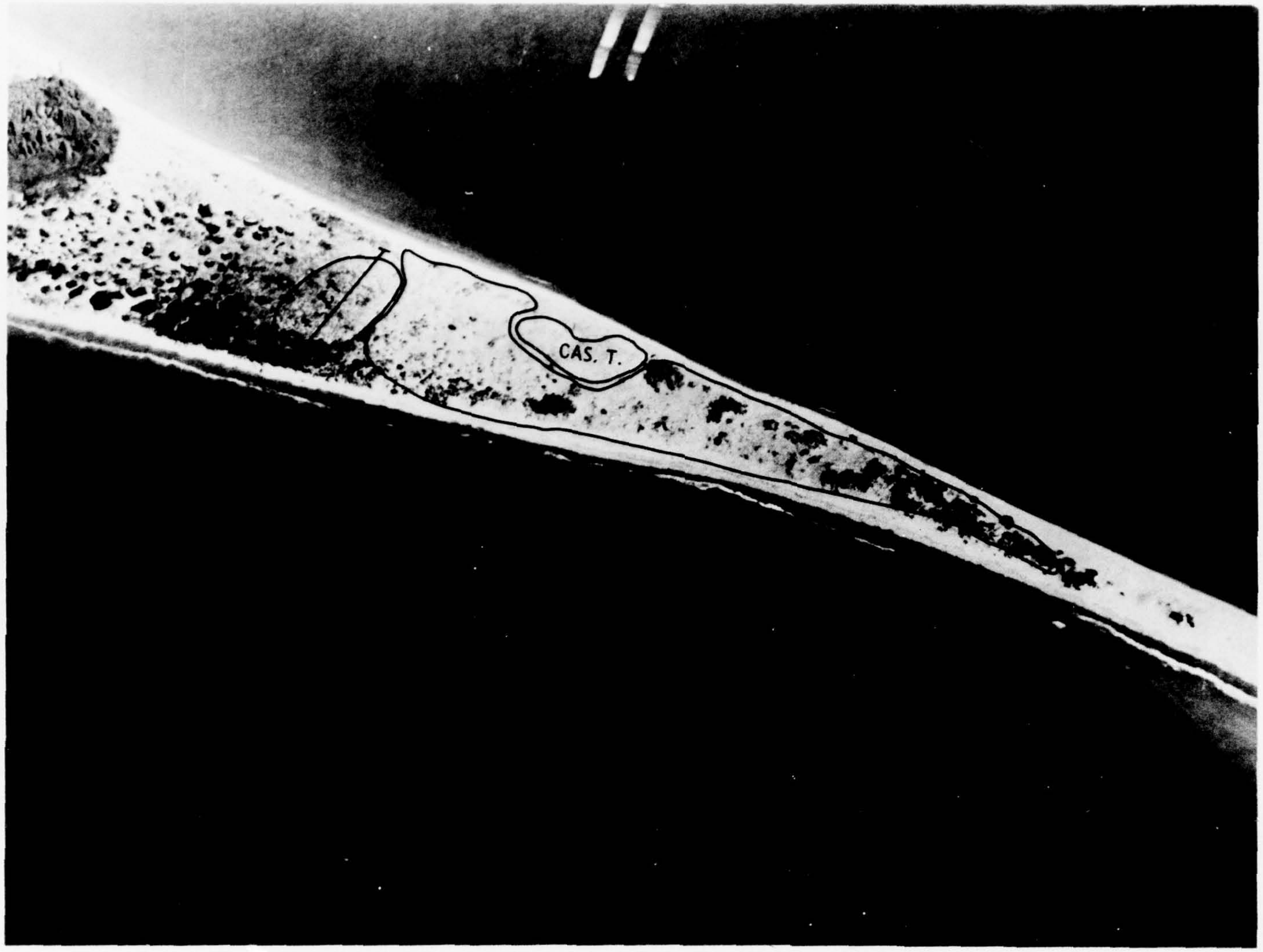

Figure 13. High Island showing colonies of ring-billed gulls, Caspian terns, and common terns and vegetation sampling transect

Species and Number of Nests:

common terns:	1976-411
	1977-87
ring-billed gulls:	1976-3313
	1977-3442
Caspian terns:	1976-63
	1977-116
herring gulls:	1976-4
	1977-7

Colony Size:

common terns:	1976- 0.117 ha
	1977- 0.152 ha
Caspian terns:	1976-0.047 ha
	1977-0.6 ha
herring gulls:	nests scattered
ring-billed gulls:	1976-1977 0.616 ha

History: Hatt et al. (1948) found Caspian and common terns nesting on a High Island gravel bar or shoal about 300 m north of the northeast point. There were 800 pairs of common terns nesting on the shoal in 1962 (Ludwig 1962). High Island Shoal was under water in 1960 (Ludwig 1962) and in 1974-74. Gulls and terns probably began nesting on the island in the 1960's in response to a cyclic increase in water levels inundating nesting areas such as High Island Shoal. Ludwig (1962) documented the onset of nesting of ring-billed gulls and common terns on the island. No ring-billed gulls nested on the island in 1960 or 1962, but 20 pairs nested there in 1961. In 1960, 1962, and 1963, there were 500, 0, and 75 nesting pairs of common terns, respectively. Investigators from Central Michigan University, Mount Pleasant, Michigan, worked with the Caspian terns that were nesting on the island in the late 1960's, but Scharf (1971a) was the first to document the nesting of Caspian terns. All species were preyed upon by coyotes (*Canis latrans*) during 1975, causing zero productivity and declines in 1976 returning nesting birds (Shugart in Scharf et al. in press).

Nesting Success: Reports (Shugart, Appendix E) of mortality caused by recreational boaters were the only inferences with nesting in 1977. The coyote predation abated in 1976 and was unimportant in 1977.

34. Habitat: Beach grass and agropyron (Table 14) had the highest importance values and typified both the common tern and ring-billed gull areas as dune-sand plant associations. The importance value of red-osier dogwood (*Cornus stolonifera*) in the ring-billed gull colony was an indication of the tolerance of shrubs by this bird species at this site. The average percent coverage (30 percent, Table 26) in the ring-billed gull transects illustrated well the large amount of bare ground commonly found in nesting areas of this species. The coverage in the common tern area (43 percent, Table 27) and the lack of quantifiable vegetation in the Caspian tern area were characteristic of the habitats of these species at other sites. The subsidence of lake water levels reduced erosion and exposed the adjacent High Island Shoals (Table 1), but otherwise has not affected this site.

Sites 14 and 15. East Grape Island and West Grape Island

35. Location: 45°47' N., 085°24' W., two natural islands, designated East and West Grape Islands, part of a peninsula extending 100 m west of the southwest corner of Hog Island, Michigan (Figure 14, East Grape Island).

Species and Number of Nests:

East Grape Island:	common terns:	1976-0 1977-11
	herring gulls:	1976-1 1977-4
	ring-billed gulls:	1976-1188 1977-1278
West Grape Island:		
	great blue heron:	1976-5 1977-3
	herring gulls:	1976-5 1977-6
	ring-billed gulls:	1976-3979 1977-3660

Table 14

High Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	CT[1]	RBG-1[2]	RBG-2
1 m^2 Quadrats*	(35)	(9)	(8)
Agropyron	91	-	-
Beach grass	90	216	240
Worm wood (*Artemisia absinthium*)	31	-	-
Harebell (*Campanula rotundifolia*)	11	-	-
Red-osier dogwood	4	84	60
Wild rye	14	-	-
Sand cherry	13	-	-
Poison ivy	3	-	-
Rose (*Rosa* sp.)	6	-	-

*Sample sizes are indicated in parenthesis.

1. CT = common tern.

2. RBG = ring-billed gull.

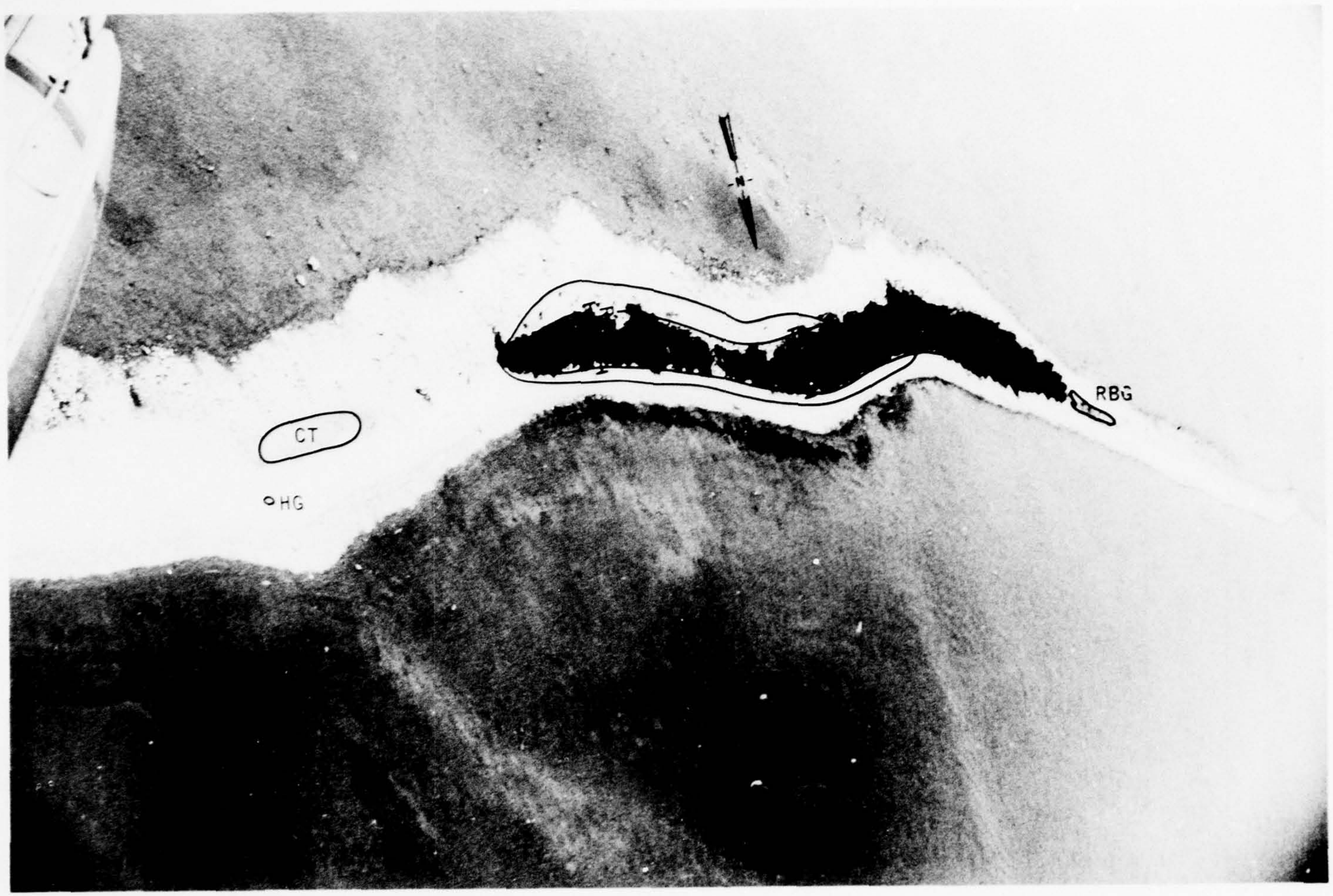

Figure 14. East Grape Island showing colonies of herring gulls, ring-billed gulls, and common terns and vegetation sampling transects

Colony Size: East Grape Island

common tern:	1976-none 1977-0.01 ha
herring gulls:	not aggregated
ring-billed gulls:	1976-0.15 ha 1977-0.2 ha

West Grape Island

herring gulls:	not aggregated
ring-billed gulls:	1976-0.6 ha 1977-0.86 ha

History: Ring-billed gulls were reported nesting here by Scharf (1971a). Other surveys (Hatt et al. 1948) may have observed the islands during low water years when they were connected to Hog Island and may not have had colonial nesting birds.

Nesting Success: Productivity appeared good during both seasons (Appendix E).

36. Habitat: Both shrub and herb communities were sampled (Tables 15 and 16) and exhibited a wide diversity of species with choke cherry (*Prunus virginiana*) and red-osier dogwood having the highest importance values of the shrubs or East and West Grape Islands respectively. The herb communities were found to be very diverse. Many quadrats were bare of herb cover due to the trampling and over-fertilization caused by the ring-billed gulls. The affect of the ring-billed gulls' activities was also indicated by vegetation coverage of one percent in the nesting area which sharply contrasts with the 54 percent vegetation coverage west of the nesting area.

Site 16. Hat Island

37. Location: $45^{o}47'$ N., $085^{o}18'$ W., a natural island 20 km northeast of Beaver Island, Michigan.

Species and Number of Nests:

great blue heron:	1976-3 1977-none
Caspian tern:	1976-730 1977-686
herring gulls: (Figure 15)	1976-690 1977-603

Table 15

East Grape Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1[1]	RBG-2
16 m^2 Quadrats*	(4)	(4)
Juneberry (Amelanchier laevis)	-	20
Red-osier dogwood	158	129
Ninebark (Physocarpus opulifolius)	27	-
Sandbar willow	-	44
Red-berried elder	20	-
Bittersweet	-	20
Arborvitae (Thuja occidentalis)	64	-
River-bard grape (Vitus riparia)	32	86
1 m^2 Quadrats*	(9)	(8)
Common milkweed	-	68
Meadow grass (Poa sp.)	-	39
Cinquefoil (Potentilla norvegica)	-	13
Poison ivy	-	41
Yellow-cress (Rorippa islandica)	-	10
Raspberry	-	41
Yellow-dock (Rumex crispus)	-	10
False Solomon's-seal (Smilacina stellata)	-	79

*Sample sizes are indicated in parenthesis.

1. RBG = ring-billed gulls.

Table 16

West Grape Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1[1]	RBG-2	RBG-3	AREA WITH NO NESTS
16 m^2 Quadrats*	(4)	(7)	(6)	(12)
Red-osier dogwood	-	10	23	11
White ash (Fraxinus americana)	25	12	-	36
Morning glory	-	-	50	-
Choke cherry	55	127	125	171
American mountain ash (Pyrus americana)	52	-	-	-
Staghorn sumac (Rhus typhina)	-	-	24	-
Gooseberry (Ribes hirtellum)	12	25	-	6
Raspberry	-	-	-	5
Red-berried elder	58	34	20	35
Arborvitae	66	62	32	28
Riverbank grape	36	30	27	8
1 m^2 Quadrats*	(8)	(14)	(12)	(22)
Common burdock	-	-	-	3
Wormwood	-	147	-	49
Sedge	-	30	-	-
Clovers (Galium aparine)	-	-	-	22
Herb-Robert	-	35	-	48
Rough avens (Geum virginianum)	-	60	-	-
Gramineae (unidentified)	-	-	-	24
Liverleaf (Hepatica acutiloba)	-	-	-	11
Masterwort	-	-	-	3
Balsam (Impatiens sp.)	-	-	-	20

(Continued)

*Sample sizes are indicated in parenthesis.

Table 16 (Concluded)

West Grape Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1[1]	RBG-2	RBG-3	AREA WITH NO NESTS
1 m^2 Quadrats*	(8)	(14)	(12)	(22)
Polypodiaceae (undentified)	-	-	-	4
Choke cherry	-	-	-	67
Poison ivy	-	-	-	5
Gooseberry	-	-	-	4
Raspberry	-	-	-	14
Yellow dock	-	30	-	-
Red-berried elder	-	-	-	15
False Solomon's-seal	-	-	-	11

*Sample sizes are indicated in parenthesis.

1. RBG = ring-billed gulls.

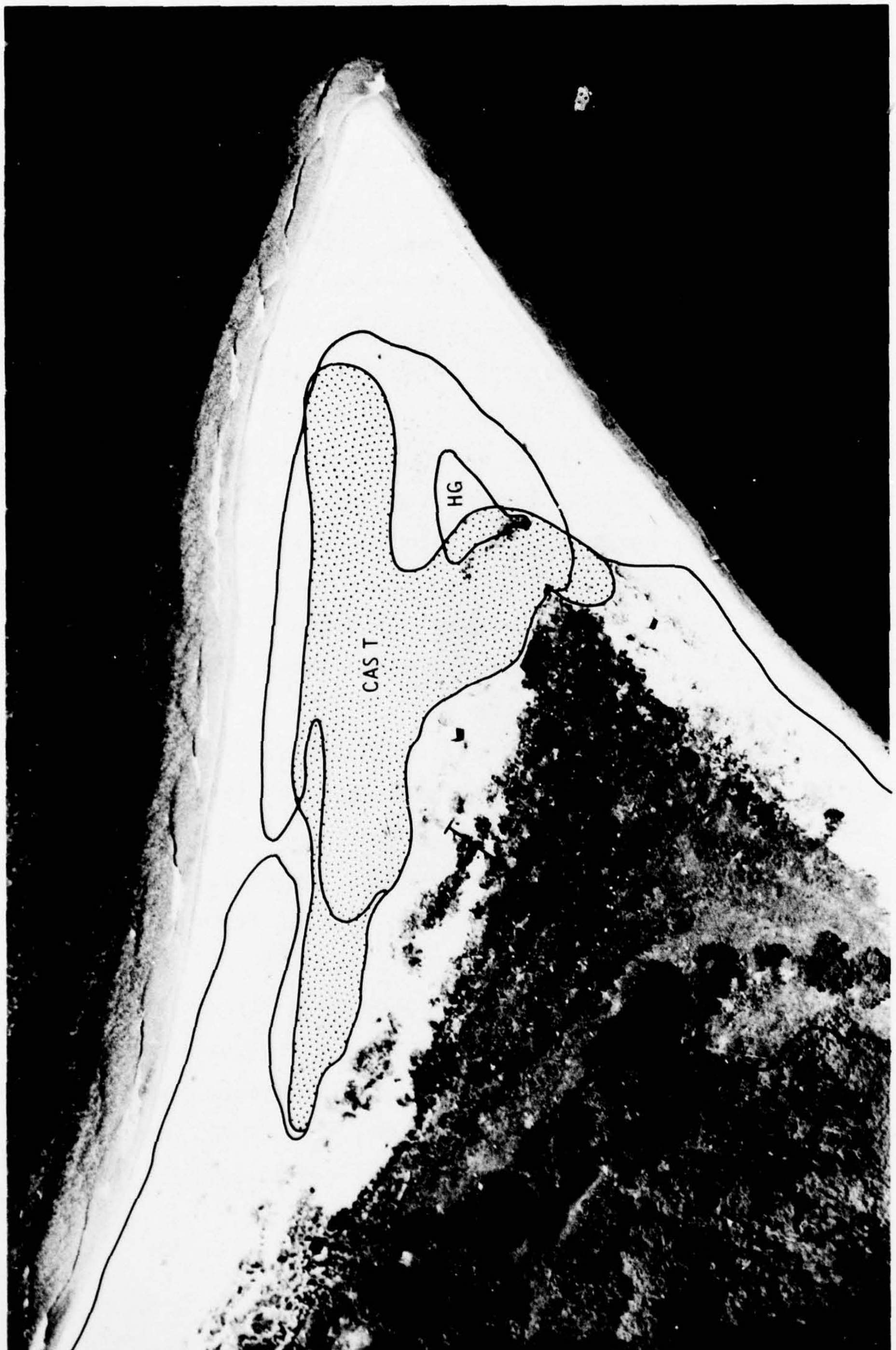

Figure 15. Hat Island showing colonies of herring gulls and Caspian terns and vegetation sampling transect

Colony Size: herring gulls: 2.3 ha each year

Caspian tern colony area shown on map (Shugart in Scharf et al. in press).

History: Hat Island and Shoe Island, which is 0.8 km south of Hat Island, have been used as a Caspian tern nesting site since 1896 (Ludwig, 1962). Lincoln(1926) banded herring gulls on Hat and Caspian terns on Shoe Island in 1927. Hatt et al. (1948) found great blue herons, herring and ring-billed gulls, and Caspian and common terns nesting on Hat Island. Ludwig (1962) and Scharf (1971a) also reported Caspian terns and herring gulls nesting here.

Nesting Success: Productivity of herring gulls seemed good both years, but Shugart (1977, personal communication) found many nearly fledged 1976 chicks dead on the island on his return during the 1977 season. An 11 percent reduction in herring gulls nesting in 1977 was attributed to disturbances associated with investigations during 1976 (Shugart, Appendix C). Caspian terns did well in 1976, but cannon netting in 1977 led to 65 percent abandonment of nests in late May and early June (Shugart, Appendix C).

38. Habitat: The herring gull area vegetation (Table 17) was very diverse and only brome-grass and common timothy (*Phleum pratense*) have an importance value above 50. Except for trails through grass and moderate fertilization, herring gulls seemed to have little effect on the surrounding vegetation. The habitat of Caspian terns had too few plants to warrant sampling, and was characterized by cobble beach stone which was arranged by winter lake storms and/or ice in drift rows. The terns seemed to prefer these ridges which were elevated, thus avoiding inundation during spring and summer, but still kept clear of interior island vegetation by the yearly cycle of weather . Great blue herons occupied one of the larger trees in 1976, but were absent in 1977.

Sites 17 and 18. Channel Island and Shelter Island

39. Location: 43°40' N., 083°49' to 50' W., two dredged material islands 2 km east of Bay City, Michigan (Figures 16 and 17).

Table 17

Hat Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	HG-1[1]	HG-2	HG-3	HG-4	HG-5	HG-6	HG-7
1 m^2 Quadrats*	(16)	(14)	(11)	(12)	(10)	(10)	(39)
Common yarrow	14	3	5	9	3	4	3
Witch-grass	5	-	-	-	-	85	-
Agropyron (Agropyron trachycaulum)	17	23	47	-	-	-	21
Wild columtrne (Aquilegia canadensis)	-	-	-	-	-	-	1
Common burdock	-	-	-	-	-	3	-
Wormwood	-	27	-	1	-	-	2
Chinese mustard (Brassica juncea)	11	9	-	16	7	-	-
Brome-grass	114	89	75	-	-	46	12
Harebell	-	-	-	-	-	-	2
Pickpocket	-	-	5	-	-	-	7
Field daisy	-	-	-	-	13	-	1
Red-osier dogwood	-	4	64	9	4	-	13
Clovers	-	-	-	1	-	14	7
Herb-Robert	-	-	7	7	13	-	2
Rough avens	5	-	-	1	4	-	-
Cow-cress (Lepidium campestre)	33	4	-	34	20	21	3
Poor-man's pepper (Lepidium virginicum)	2	3	-	-	7	-	-
White campion	5	24	5	9	-	-	7
Catnip	-	-	-	2	13	4	4
Parsnip (Pastinaca sativa)	-	-	46	46	27	18	12
Common timothy	28	-	-	36	94	9	86
Junegrass	47	79	25	37	18	46	60
Choke cherry	-	-	-	8	-	20	33

(Continued)

*Sample sizes are indicated in parenthesis.

Table 17 (Concluded)

Hat Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	HG-1	HG-2	HG-3	HG-4	HG-5	HG-6	HG-7
1 m^2 Quadrats*	(16)	(14)	(11)	(12)	(10)	(10)	(39)
Poison ivy	-	14	-	5	30	-	6
Staghorn sumac	-	-	-	-	-	-	4
Rose	-	10	-	-	13	4	5
Raspberry	-	-	5	6	-	-	8
Yellow-dock	1	-	13	21	9	-	2
Curly-leafed dock (*Rumex mexicanus*)	-	-	-	12	-	3	-
Red-berried elder	-	-	-	-	-	-	4
Night-flowering catchfly (*Silene noctiflora*)	-	4	-	18	-	-	1
Tumble-mustard	-	3	-	17	-	-	-
Fake Solomon's-seal	-	-	-	-	14	4	-
Common dandelion	+4	-	-	-	7	13	5
Common mullein	-	-	-	-	4	-	-

*Sample sizes are indicated in parenthesis.

1. HG = herring gull.

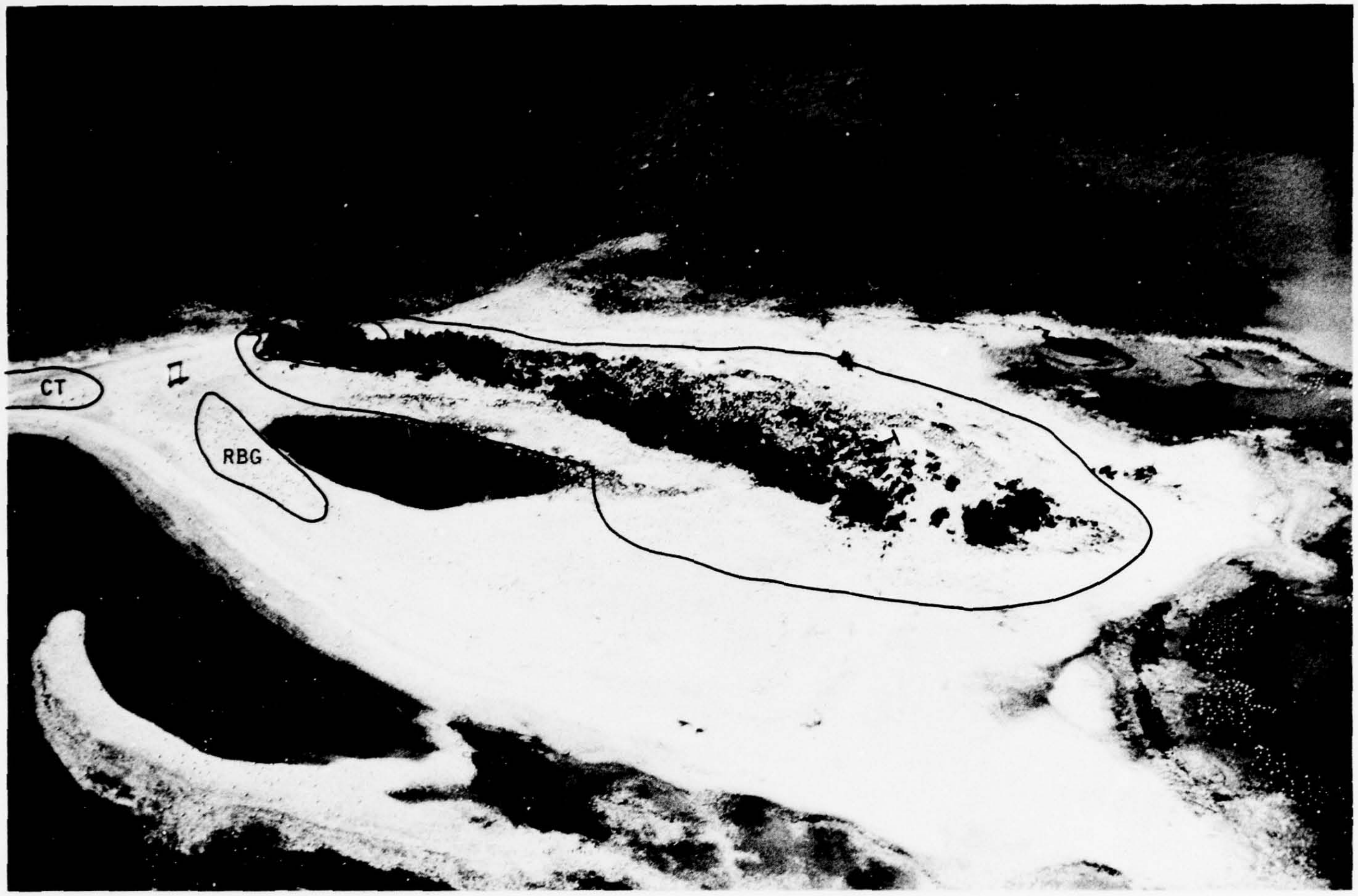

Figure 16. Channel Island showing colonies of black-crowned night herons, common terns, and ring-billed gulls and vegetation sampling transect

Figure 17. Shelter Island showing colonies of ring-billed gulls and herring gulls and vegetation sampling transect

Species and Number of Nests:

Channel Island: black-crowned night herons: 1976-4
1977-16

Shelter Island: black-crowned night herons: 1976-1
1977-none

Channel Island: common terns: 1976-none
1977-64

Channel Island: ring-billed gulls: 1976-2021
1977-1666

Shelter Island: ring-billed gulls: 1976-2087
1977-1723

Colony Size: Channel Island: 0.41 ha

Shelter Island: 0.5 ha

History: The date of construction of the islands was unknown. Nesting of ring-billed gulls was documented by Scharf (1971a).

Nesting Success: Large numbers of chicks fledged from both these islands in 1976 and 1977. However, the low-lying nests were apparently inundated and eliminated by storms in both seasons, as evidenced by the windrows of eggs found washed up along the high water mark each year. The common terns and black-crowned night herons seemed successful, but several early incubating black-crowned night herons deserted Shelter Island in 1976.

40. Habitat: The stage of shrub development on the original dredged material islands, coupled with an intergradation of herb and bare sand on eroded and washed areas, allowed the colonization of these islands by the three species of birds with seemingly divergent habitat preferences. The common terns on Channel Island nested on bare sand. The ring-billed gulls nested on some bare sand, but mainly in yellow melilot (*Melilotis officinalis*), sandbar willow, and herbaceous habitat (Table 18), and the black-crowned night herons were in small (3.0 to 3.5 m), shrubby, eastern cottonwood (*Populus deltoides*) trees. The relatively high coverage values for the ring-billed gull area (Table 27) did not convey the subjective visual impression of the severe effect the birds have had on the vegetation.

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COLONIAL BIRDS NESTING ON MAN-MADE AND NATURAL SITES IN THE U. --ETC(U)
MAY 78 W C SCHARF, G W SHUGART USFWS-CE7-255

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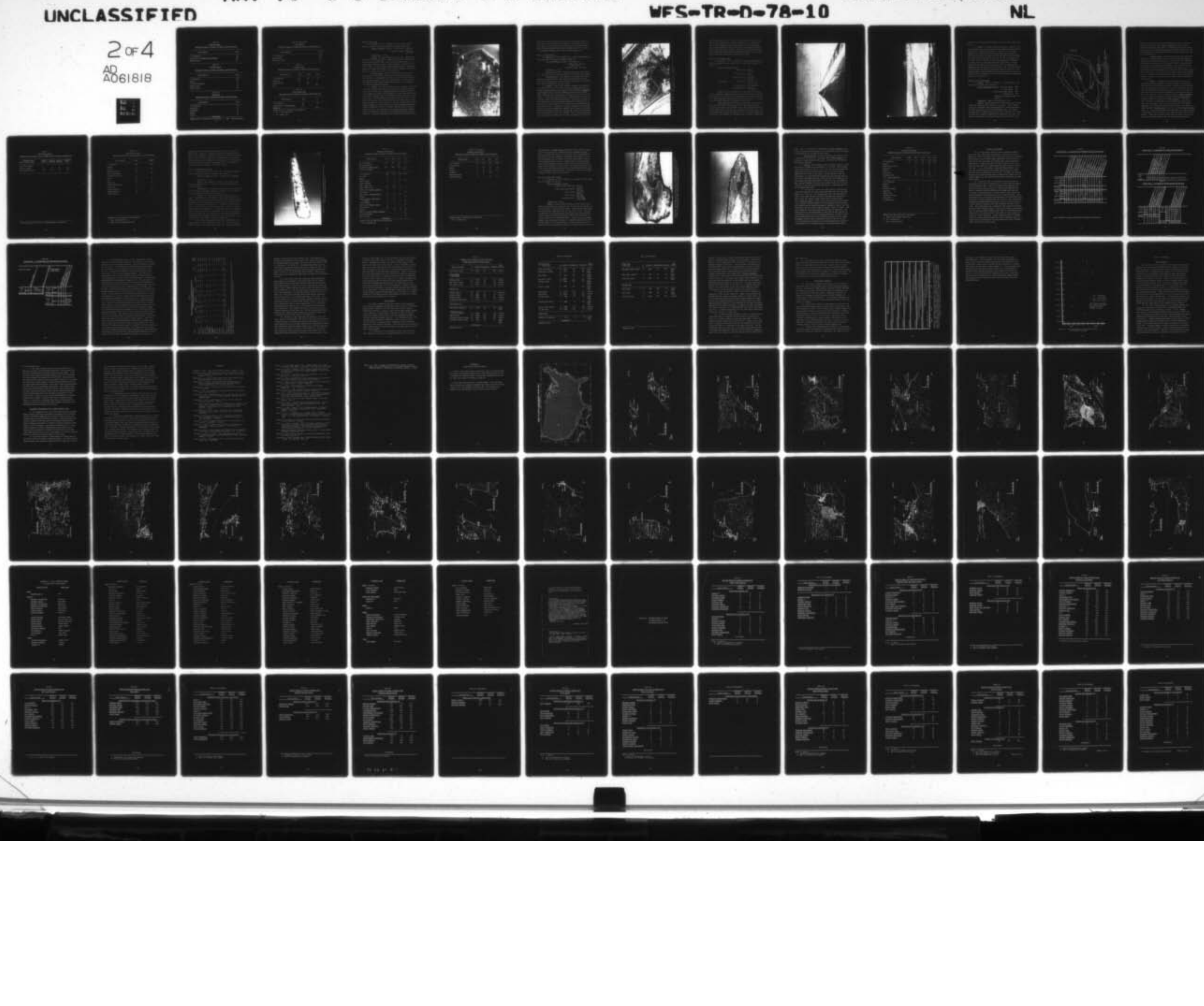

Table 18

Channel Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1
1 m^2 Quadrats*	(10)
Yellow melilot (*Melilotus officinalis*)	135
Sandbar willow	165

Table 19

Shelter Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1
1 m^2 Quadrats*	(10)
Pigweed	37
Gill-over-the-ground	47
Yellow melilot	70
Sandbar willow	148

Table 20

Mud Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1
1 m^2 Quadrats*	(15)
Brome-grass	13
Pickpocket	14
Pigweed	67
Lettuce	12

(Continued)

*Sample sizes are indicated in parenthesis. 1. RBG = ring-billed gull.

Table 20 (Concluded)

Mud Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1[1]
1 m^2 Quadrats*	(15)
White melilot	150
Field penny-cress	42

Table 21

Grassy Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG-1[1]	RBG-2	RBG-3
1 m^2 Quadrats*	(5)	(5)	(5)
Smartweed	300	-	-
Sandbar willow	-	300	-
Reed	-	-	300

Table 22

Toledo Harbor Dike

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	RBG[1]	CT[2]
1 m^2 Quadrats*	(5)	(5)
Common darnel (<u>Lolium perenne</u>)	300	-
Smartweed	-	300

*Sample sizes are indicated in parenthesis.

1. RBG = ring-billed gull.

2. CT = common tern.

Site 19. Mud Island

41. Location: 42°14' N., 083°08' W., a rip-rapped dredged material island 0.2 km east of Wyandotte, Michigan (Figure 18).

Species and Number of Nests:	herring gulls:	1976-none
		1977-2
	ring-billed gulls:	1976-5040
		1977-5290

Colony Size: 1.56 ha

History: The only published record of this colony was by Scharf (1971a) although James P. Ludwig (1977, personal communication) indicated the ring-billed gulls were long established there. U. S. Army Engineers District, Detroit, records indicate construction from 1959 to 1960. Ken Dalke (1976, personal communication) recalled large numbers of common terns nesting on Mud Island, although no ring-billed gulls, in the early years after its construction.

Nesting Success: High nest density of 0.52 nests per m^2 was indicative of the high reproductive potential per unit area for this species, even though moderate numbers of dead young were found in and along the periphery of the colony each season. The causes of the chick mortality were possibly human intrusions due to the proximity to an urban environment and marina.

42. Habitat: The lack of diversity (only six species, Table 20) of the herb community with white melilot having the highest importance value and field penny-cress (*Thlaspi arvense*) and pigweed with subordinate importance values were representative of the severe modification of the plant community caused by continuous long-term presence of ring-billed gulls. The high vegetation coverage of the tall (0.75 m) white melilot (77 percent, Table 28) indicated aerial coverage only and distorted the presence of large amounts of bare soil beneath these plants. High percentages of clay and muck in the original dredged material apparently allowed this site to re-vegetate with these guano-resistant plants each year. This vegetation cover during nesting and fledging seemed to contribute to the dense nesting and high productivity year after year. The gulls maintained their nesting area by preventing the

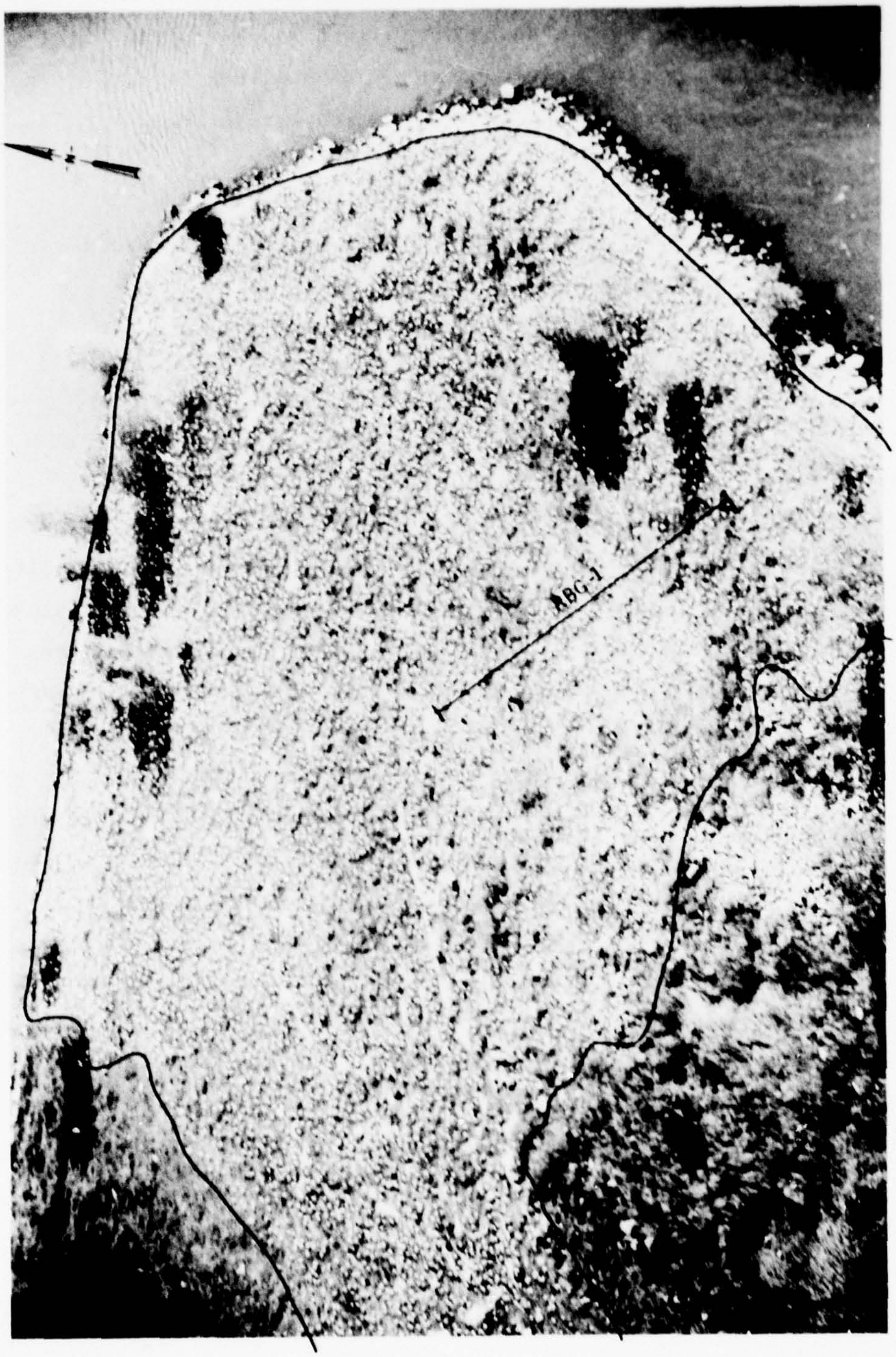

Figure 18. Mud Island showing a ring-billed gull colony and vegetation sampling transect

succession of woody species as has occurred on the western portion of this island. These young trees and shrubs on the western end of the island were at a stage where they could support black-crowned night herons and possibly great blue herons and common egrets if it were not for the human disturbance factor from the nearby urban area.

Site 20. Grassy Island

43. Location: 42°15' N., 083°07' W., a diked, dredged material island 2 km east of Wyandotte, Michigan (Figure 19).

Species and Number of Nests: No nesting 1976

common terns: 1977-20
all unsuccessful

ring-billed gulls: 1977-1644

Colony Size: 2.4 ha

History: Deposition of dredged material was still progressing at this site, and 1977 was the first year of colonial bird nesting.

Nesting Success: Large numbers of ring-billed gull chicks apparently fledged from this site, but many unsuccessful nests were found in the margins of the colony, and much late nesting or re-nesting was evident and presumed to be unsuccessful.

44. Habitat: Each of three separate transects was occupied by a single plant species. The 0.5 to 1.5 m tall sandbar willow and reed transects had the greatest nest density, and the smartweed (*Polygonum lapathifolium*) transect was just emerging during the nest building stage, giving that area an appearance of being nearly bare early in the season. A large bare alluvial crescent of sandy material can be seen in Figure 19 near the dredge dispersal pipe. No nesting was found outward from this 10 to 20 m fan of bare ground until vegetation was encountered. The reason for the lack of vegetation and nesting near the pipe was not clear. In addition to the near-completion of the dredged material fill in the nesting area, another factor leading to the colonization at this site in 1977 was a de-watering of the site by drainage either in late 1976 or before 1977 nesting. Many of the marginal nests were in such wet areas that they were built to heights of 8 to 10 cm in

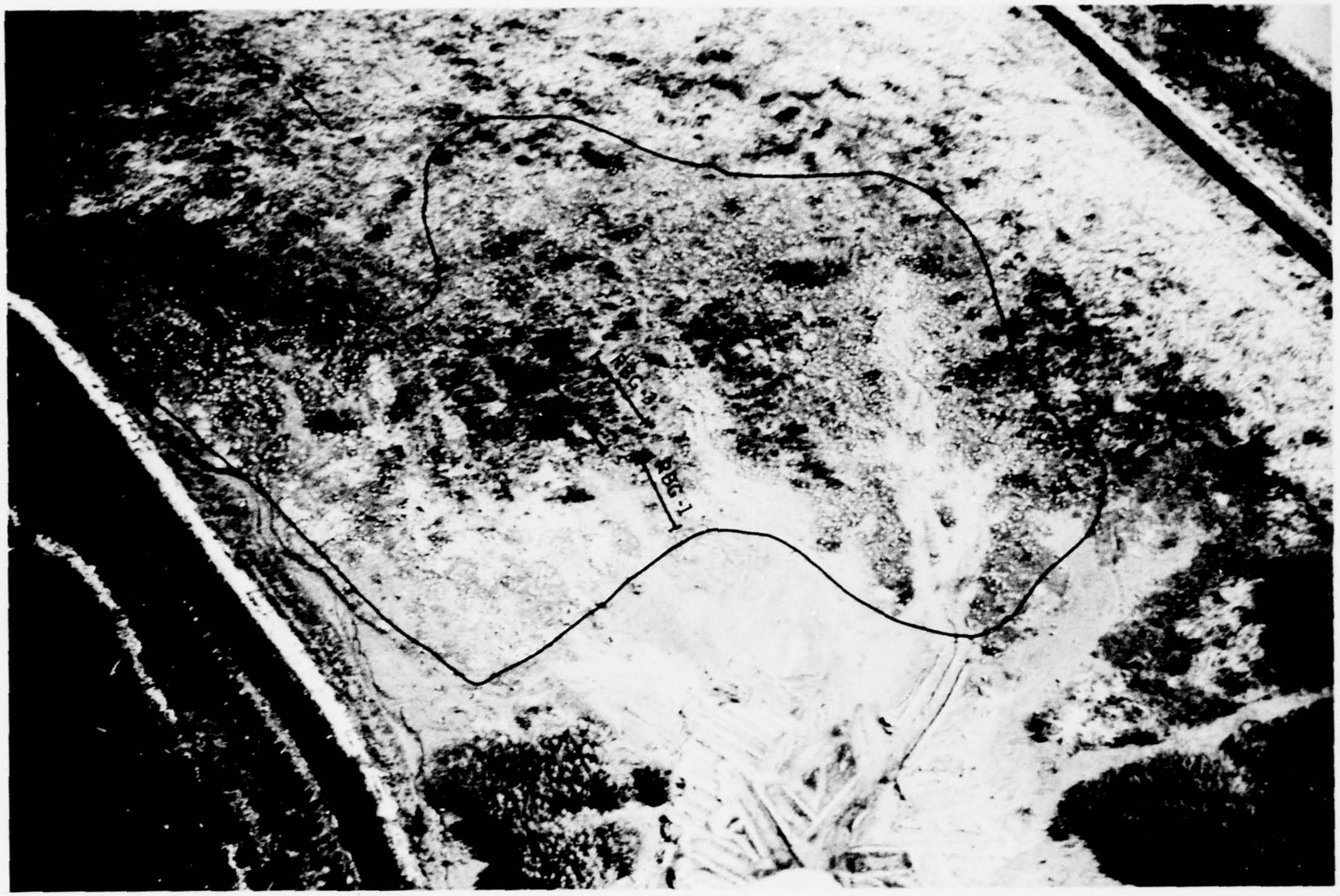

Figure 19. Grassy Island showing a ring-billed gull colony and vegetation sampling transects

order to keep the eggs dry. Typical of new, small, or marginal colonies, the nest density of this colony was low (0.15 to 0.22 nests per m^2), and certain groups of nests were retarded in their development. Common terns attempted to nest on the edge of the standing open water where filling had not yet occurred. These nests were unsuccessful probably because they were totally concealed by very dense cover of smartweed that grew up rapidly over the formerly bare muck.

Site 21. Toledo Harbor Dike

45. Location: 41°42' N., 083°26' W., a diked, dredged material disposal peninsula connected to the city of Toledo, Ohio (Figure 20a and 20b).

Species and Number of Nests:

	common terns:	1976-77 1977-263
	herring gulls:	1976-6 1977-13
	ring-billed gulls:	1976-none 1977-59
Colony Size:	common terns:	1976-0.14 ha 1977-0.34 ha
	herring gulls:	not aggregated
	ring-billed gulls:	1976-none 1977-0.12 ha

History: The rip-rapped dike was erected in 1975 and successful nesting of common terns and herring gulls occurred on the dike that season. In 1976, both species again nested successfully; but in 1977, ring-billed gulls began nesting and forced the terns to a portion of the dike where they were less productive than 1976.

Nesting Success: The common terns suffered about 95 percent mortality in the egg and chick stage in 1977, when they were found pierced but not eaten. The probable cause of this predation was black-crowned night herons which were seen frequently in the diked area. They were known to eat tern eggs and chicks. The only surviving common tern chicks were those sheltered by a dredging pipe. Nesting of ring-billed

Figure 20a. Toledo Harbor Dike showing colonies of common terns and ring-billed gulls and vegetation sampling transect

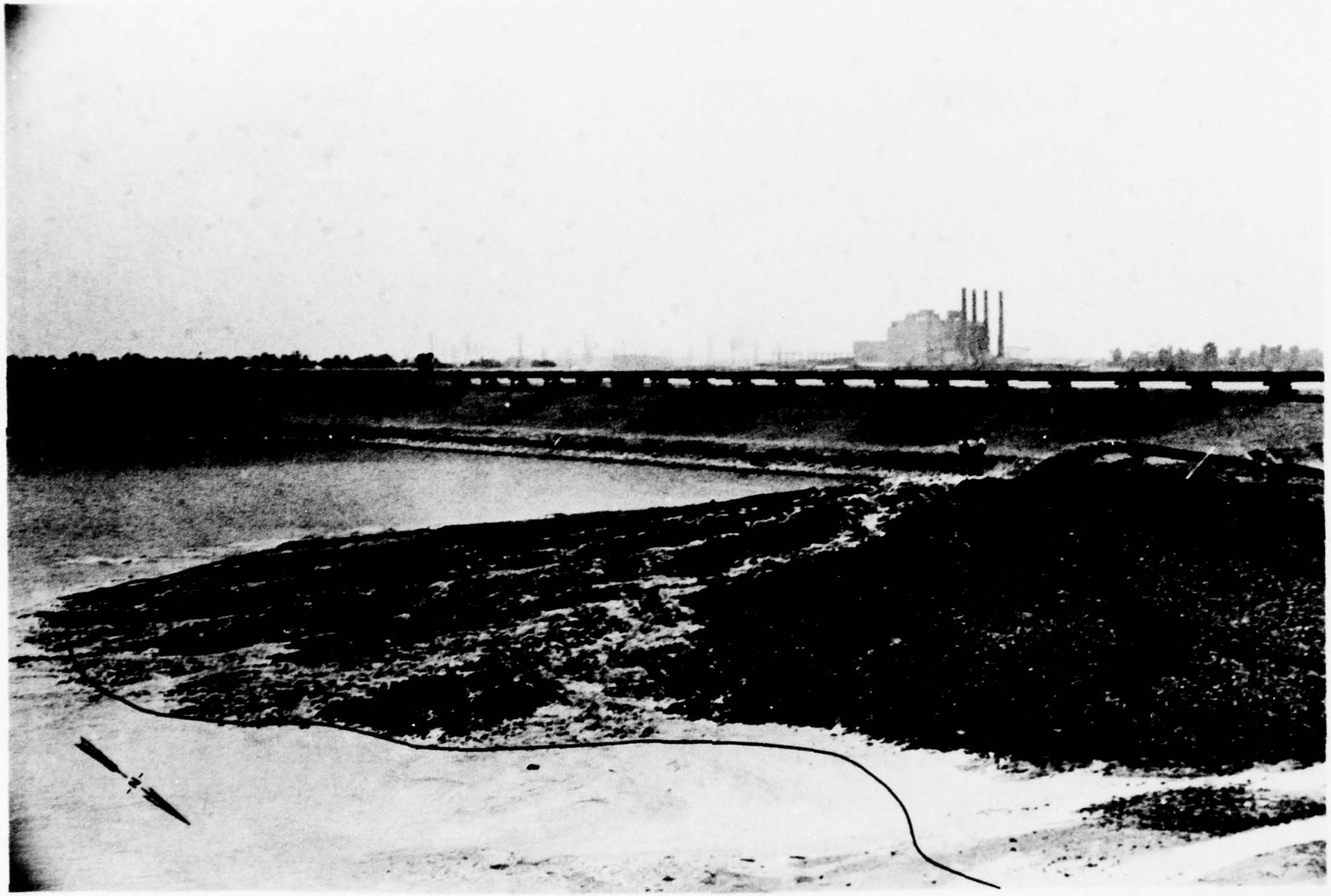

Figure 20b. Toledo Harbor Dike showing a common tern colony and vegetation sampling transect

gulls was very retarded and asynchronous in 1977 and their productivity was low.

46. Habitat: Different single plant species occurred in each of two transects in the ring-billed gull and common tern nesting areas, respectively. Common darnel, probably a survivor of the original seeding of the dike was found in the ring-billed gull nesting area. This area was used by the common terns in 1975 and 1976 with 20 common tern nests found on the edges of this site in 1977. Nest density of 0.22 nests per m^2 corroborated the recent development and marginally successful nature of this small ring-billed gull colony. The main nesting area of common terns nesting during 1977 was vegetated by smartweed which had less coverage (22 percent cover, Table 28) than the same vegetation that may have caused nest desertion at Site 19. The smartweed grew on freshly dredged material during the 1977 season, and it will probably provide more cover in later years unless fresh dredged material is placed over it.

Site 22. West Sister Island

47. Location: 41°44' N., 083°07' W., a natural island 15 km north of Port Clinton, Ohio (Figure 21).

Species and Number of Nests: great blue herons: 1600
great egrets: 200
black-crowned night herons: 300
herring gulls: 200
populations relatively stable 1976 and 1977.

Colony Size: (Equal to island size) 34.4 ha

History: Agriculture kept the island nearly free of woody vegetation during the early decades of the century. After farming ceased, the lighthouse keeper maintained domestic rabbits which kept the woody vegetation at an early successional stage. The rabbits declined when the lighthouse keeper left prior to World War II. Laurel Van Camp (1977, personal communication), during his first visit after the war, found great blue herons and great egrets nesting in trees.

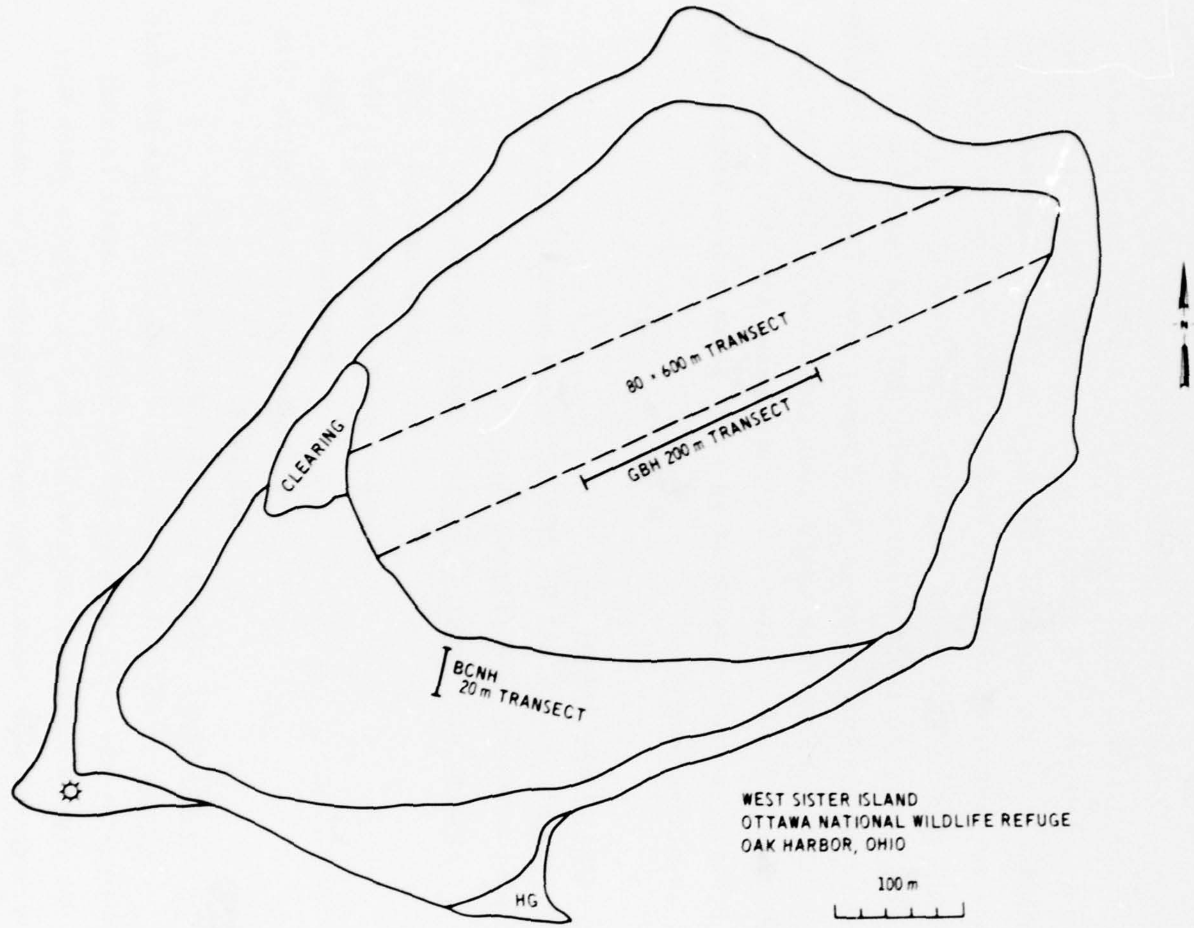

Figure 21. West Sister Island showing colonies of herring gulls, black-crowned night herons, great blue herons, and great egrets and population estimate transect and vegetation sampling transects

Since that time the vegetation has developed into a mature stage containing tall hackberry trees (Celtis occidentalis) with nesting of great blue herons and great egrets. The western portion of the island had young trees and brush with nesting black-crowned night herons. The island was a part of Ottawa National Wildlife Refuge and was classified as a Wilderness Area.

Nesting Success: Great blue herons and great egrets were successful in fledging many young each year, but some dead young were observed on the ground below the nests. Herring gulls often harrassed the fledglings learning to fly at the water's edge. It was unknown if any mortality resulted from this harassment, but this effect could be alleviated if more open fields were available for staging areas. The black-crowned night herons seemed to be successful with few dead present; and, as was typical of the species, many stages of nesting were evident in July. Herring gulls failed completely during 1976, and probably had very poor success in 1977 because of recreational boaters intruding on the nest site.

48. Habitat: Comparison of nest and non-nest trees of the single species stand of hackberry in which the great blue herons and great egrets nested surprisingly revealed a slightly greater importance value for the non-nest trees (Table 23). This is unusual for it would seem that the herons would nest in the largest trees. A few trees of other species were on the colony periphery, but no nesting occurred in them. The understory in this area showed wild rye (Elymus canadensis) to be most important followed by northern bedstraw (Galium boreale), spotted touch-me-not, and poison ivy (Rhus radicans). The smaller trees (less than 8 cm DBH) with the black-crowned night herons nests were entirely hackberry except for one small patch of plums (Prunus americana). The vegetation beneath the black crowned night herons has common chickweed (Stellaria media), wild rye, and catnip (Nepeta cataria) (Table 24). Trees in the black-crowned night heron area were increasing in size making it more suitable for the great blue heron and great egret nesting. Former open areas were being invaded by small trees suitable for the black-crowned night herons, but this eliminated important

Table 23

West Sister Island

Hackberry Trees Greater than 5 cm DBH in Great Blue Heron Nesting Area

HACKBERRY TREES (Celtis occidentalis)	RELATIVE DENSITY	RELATIVE DOMINANCE	RELATIVE FREQUENCY	IMPORTANCE VALUE
Ten 100 m^2 Quadrats				
Trees with Nests	40	45	50	135
Trees without Nests*	60	55	50	165

*Trees without nests less than 5 cm DBH averaged 1.03 trees/m^2.

Table 24

West Sister Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	GBH-1[1]	BCNH-1[2]
1 m^2 Quadrats*	(10)	(10)
Burdock	7	-
Wild rye	74	58
Northern bedstraw	68	-
Bottle-brush grass	-	69
Spotted touch-me-not	35	-
Catnip	17	67
Poke	13	-
Poison ivy	33	16
False Solomon's-seal	5	-
Bittersweet	7	-
Common chickweed	6	78
Common dandelion	8	-
Stinging nettle	29	12

*Sample sizes are indicated in parenthesis.

1. GBH = great blue heron.
2. BCNH = black-crowned night heron.

staging areas where young birds could begin to learn to fly without herring gull molestation. Ultimately, the black-crowned night herons will lose their habitat to normal plant succession. However, the recent death of some of the tall trees due to overfertilization may reverse this trend and provide new habitat for these herons. The herring gulls colonized a bare rock point on the southwest side of the island and also rocks around the periphery of the whole island.

Site 23. Sandusky Turning Point

49. Location: $41^{o}27'$ N., $083^{o}43'$ W., a rip-rapped, dredged material island, 0.5 km north of Sandusky, Ohio (Figure 22).

Species and Number of Nests: herring gulls: 1976-983
1977-878

Colony Size: 2.7 ha

History: The island was orginally constructed in 1900. Rip-rap was added in 1968. The history of the nesting herring gull colony was unknown.

Nesting Success: Although the island was easily accessible from city marinas and beaches, there was a high success rate and few dead chicks which indicated a high fledging rate.

50. Habitat: The vegetation was easily separated into two types: shrubs and herbs. Red mullberry (*Morus rubra*) and red-osier dogwood were the most important shrub species on the eastern portion of the island, and the red mulberry was mixed with small eastern cottonwoods on the western portion (Table 25). The shrub patches were very dense and precluded herring gull nesting in their centers, although their periphery was important as a nesting area and offered excellent visual isolation and territory separation. The growth of the shrubs would seem to make this site suitable to black-crowned night herons in the future, but the proximity to the urban area may prevent any colonization because they usually seek more secluded sites.

51. The herbaceous vegetation was diverse both within and between transects (HG-1 through HG-4, Table 25). On the eastern and middle portions of the island common winter-cress (*Barbarea vulgaris*)

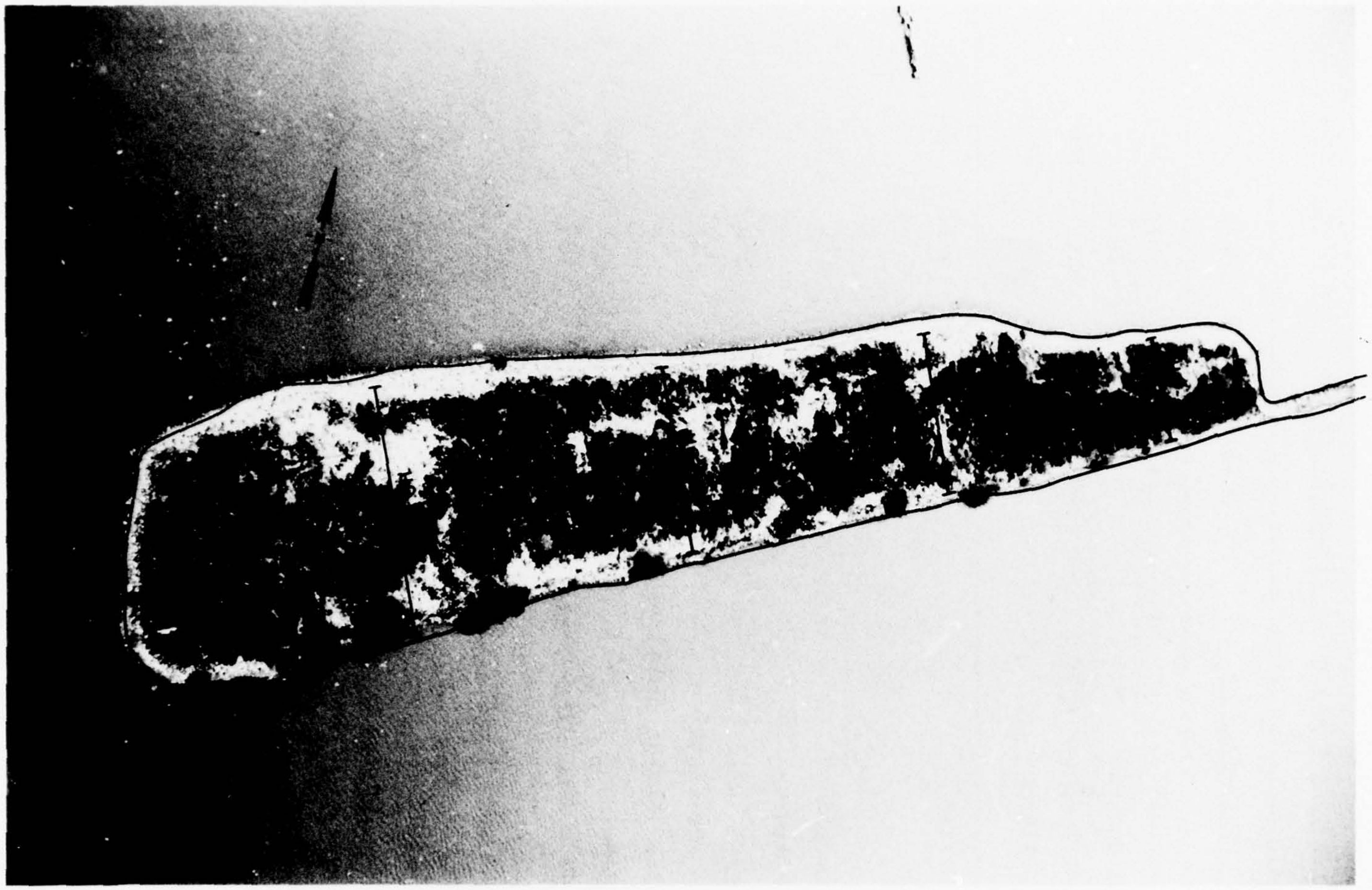

Figure 22. Sandusky Turning Point showing a herring gull colony and vegetation sampling transects

Table 25

Sandusky Turning Point

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	HG-1[1]	HG-2	HG-3	HG-4
16 m^2 Quadrats*	(1)	(2)	(4)	(1)
Red-osier dogwood	-	-	90	-
Red mulberry (*Morus rubra*)	300	300	210	170
Eastern cottonwood	-	-	-	130
1 m^2 Quadrats*	(16)	(13)	(10)	(20)
Box elder	6	-	-	-
Ragweed	-	-	9	-
Common burdock	14	4	14	39
Common milkweed	-	7	-	-
Aster (*Aster* sp.)	-	12	-	-
Common winter-cress	85	49	49	4
Brome-grass (*Bromus japonicus*)	5	-	-	-
Brome-grass	-	-	-	55
Musk thistle (*Carduus nutans*)	52	31	45	-
Pigweed	9	4	-	13
Common chickory (*Chichorium intybus*)	9	12	7	11
Canada thistle	-	-	-	14
Wild carrot (*Daucus carota*)	-	-	-	24
Morning glory	30	4	-	-
Lettuce	27	21	45	10
Butter and eggs (*Linaria vulgaris*)	-	-	-	11
Poor-man's pepper	-	-	-	10
White melilot	-	-	-	13

(Continued)

*Sample sizes are indicated in parenthesis.

1. HG = herring gull.

Table 25 (Concluded)

Sandusky Turning Point

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	HG-1[1]	HG-2	HG-3	HG-4
1 m^2 Quadrats*	(16)	(13)	(10)	(20)
Yellow melilot	-	-	-	4
Catnip	14	58	10	9
Parsnip	-	4	52	62
Goldenrod	37	90	20	-
Common dandelion	3	-	-	-
River-bank grape	5	-	55	22

*Sample sizes are indicated in parenthesis.

1. HG = herring gull.

and musk thistle, (Carduus nutans) comprised the most important vegetation, with varying mixes of goldenrod, parsnip (Pasitnaca sativa), lettuce, and other herb species. The percent cover of the herbaceous vegetation (49 percent, Table 29) revealed the large amount of rocky bare area present and was similar at two other herring gull sites already presented (Sites 11 and 15, 43 percent and 41 percent coverage respectively) which had a greater extent of bare area caused by the porous, sandy substrates in those areas. The relatively shallow slope of the rip-rap and lower elevation of this island allowed better survival of fledglings because they were less likely to fall off the island accidentally and could get back on easier.

Site 24. Little Galloo Island

52. Location: 43°53' N., 076°24' W., 5 km east of Stony Island, New York (Figures 23a and 23b).

Species and Number of Nests:

double-crested cormorants:	1976-76
	1977-96
black-crowned night herons:	1976-121
	1977-130
cattle egrets:	1976-none
	1977-2
herring gulls:	1976-200
	1977-200
ring-billed gulls:	1976-30,000
	1977-27,308

Colony Size: 10.5 ha

History: Double-crested cormorants, black-crowned night herons, and herring gulls nested here for at least the past decade, but no exact dates of colonization were known. Cattle egrets nested among the black-crowned night herons for the first time in 1977. The first documentation of ring-billed gulls nesting here was by Belnap (1961). Several employees at Stony Island recall common terns nesting on the island previous to the ring-billed gulls. Ludwig (1974) and personal communication) estimated 87,000 pairs of ring-billed gulls here in 1971 by what seemed to be reliable methods. If Ludwig (1974) was correct there has been a large population decrease of ring-billed gulls in recent

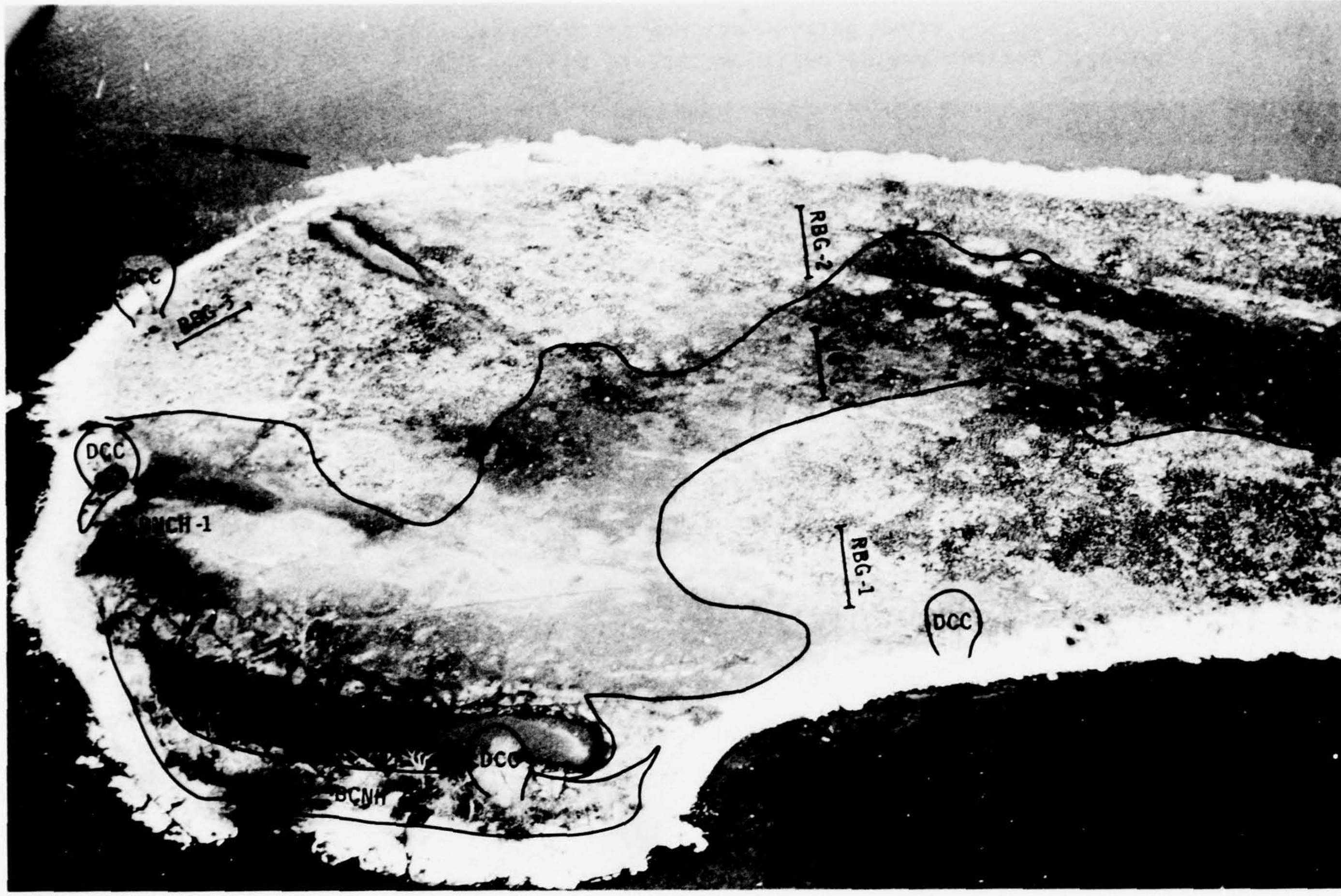

Figure 23a. The western end of Little Galloo Island showing colonies of double-crested cormorants, black-crowned night herons, cattle egrets, herring gulls, and ring-billed gulls and vegetation sampling transects

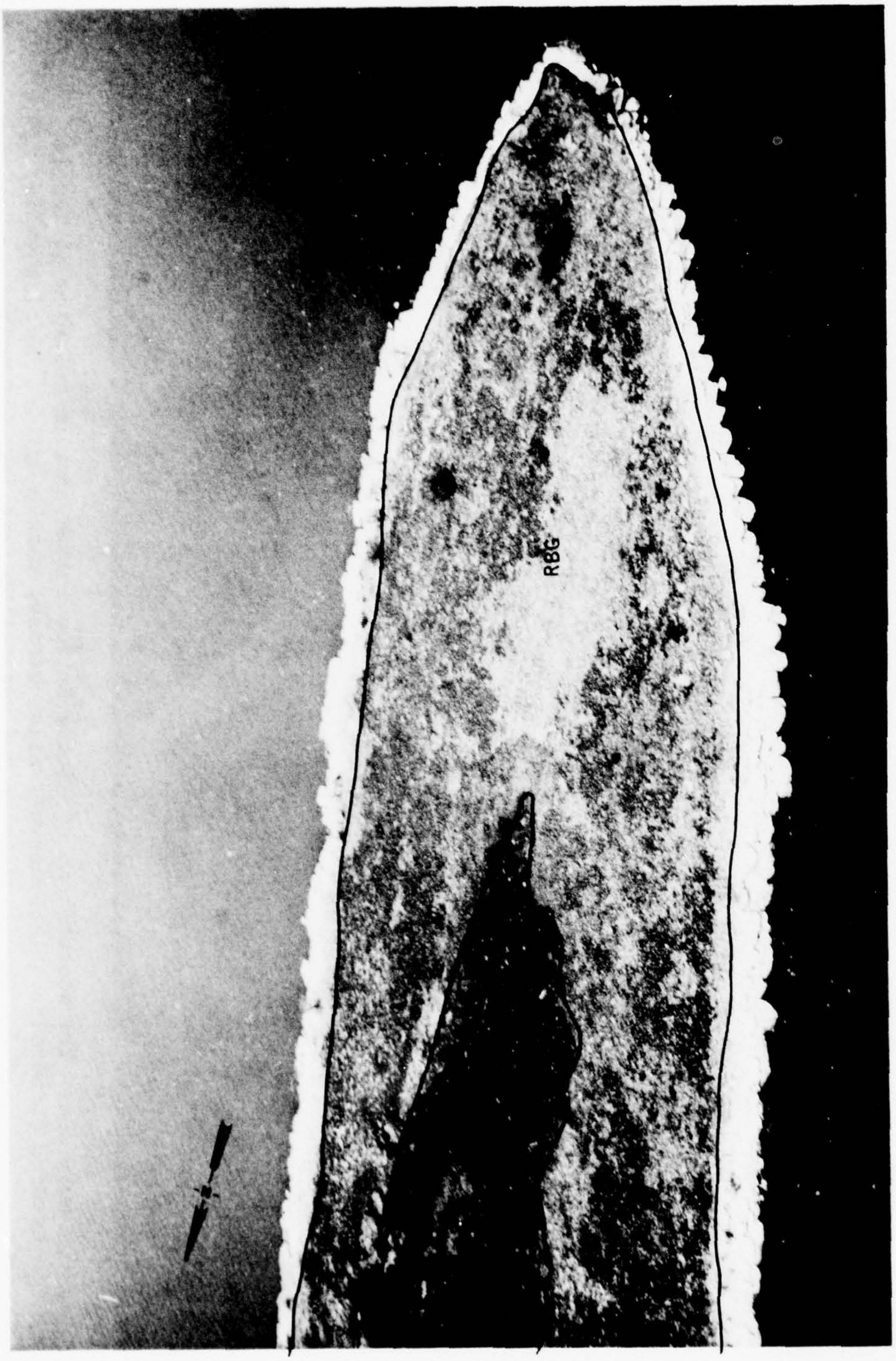

Figure 23b. The eastern end of Little Galloo Island showing colonies of herring gulls and ring-billed gulls

years. Also, in recent years, a Canada goose (Branta canadensis) herd of about 50 pairs has been nesting on the island, and has been encouraged by plantings made by the owners of the island.

Nesting Success: No unusual mortality was observed in any of the species and except for large water snakes (Natrix sipedon); no predators or human intrusions were noted. Therefore, nesting success was assumed to be high.

53. Habitat: The cormorants nested in several species of trees from 30 to 50 cm DBH along the periphery of the island. Black-crowned night herons nested in a mix of 1.5 to 2.0 m tall red-osier dogwood and red-berried elder with the dogwood being by far the most important (BCNH, Table 26) plants in the colony. The herring gull colony was surrounded by the ring-billed gull nesting area and coincided with the area plowed and seeded both about seven years ago for an emergency airplane runway and added goose habitat. The size of this area seemed to have increased somewhat in recent years, and may be due to the relative tolerance of the herring gulls and intolerance of ring-billed gulls to the increasing goose herd.

54. The ring-billed gulls were found nesting in predominantly herbaceous vegetation also with a high importance value for June grass (RBG-1 and 2, Table 26). The sampling bias toward the high number of stems of June grass obscures the visual impression that pigweed (in RBG-1, Table 26), ragweed, common winter-cress, stinging nettle, vetch (Vicia americana), (in RBG-2, Table 26) were also of major importance. Another contrast between the ring-billed gull and the herring gull habitats was the lesser percentage of vegetation cover in the ring-billed gull area (54 percent versus 87 percent, Tables 27 and 29). This again showed the effect the ring-billed gulls had on vegetation. The recent decline in ring-billed gulls at this site may have been due to four habitat factors; (a) loss of nesting habitat as a result of vegetation destruction by gulls, (b) flooding of nearly 1/8 of the island throughout 1976 with little subsequent nesting in this area in 1977, (c) the hypothesized antagonism of the increasing goose herd, and (d) overestimation of the nesting population by previous census takers.

Table 26

Little Galloo Island

Importance Values of Plants by Transect and Bird Species

PLANT SPECIES	BCNH[1]	HG-1[2]	RBG-1[3]	RBG-2	RGB-3
1 m^2 Quadrats*	(2)	(12)	(15)	(10)	(10)
Ragweed	-	-	15	50	-
Common winter-cress	-	32	-	73	-
Pickpocket	-	-	5	-	-
Pigweed	-	23	51	3	-
June grass	-	230	216	116	-
Stinging nettle	-	15	13	26	-
Vetch (*Vicia americana*)	-	-	-	32	-
16 m^2 Quadrats*					
Ragweed	-	-	-	-	15
Pigweed	-	-	-	-	26
Red-osier dogwood	255	-	-	-	-
Smartweed	-	-	-	-	16
Common elder	-	-	-	-	118
Red-berried elder	45	-	-	-	48
Bittersweet	-	-	-	-	18
Stinging nettle	-	-	-	-	59

*Sample sizes are indicated in parenthesis.

1. BCNH = black-crowned night heron.
2. HG = herring gull.
3. RBG = ring-billed gull.

Habitat Relationships

55. The seral stage present on the 24 intensively studied colony sites was indicated by determination of percent cover of the vegetation. Herb cover (Table 30) in a great blue heron colony and both herb and shrub cover in black-crowned night heron colonies always exceeded 50 percent, indicating the advanced seral stages preferred by those species. Common terns (Table 28) were at the other end of the seral spectrum with five of eight colonies having 22 percent to 43 percent cover. In one of the three colonies with higher percent cover (Site 3), the birds tended to move toward barer ground as it became available due to lowered water levels in 1977. The other two colonies (Sites 8 and 10) were unusually heavily vegetated for common terns, but probably showed much less vegetation early in the season when the terns begin nesting.

56. The percent cover of vegetation at sites colonized by ring-billed gulls (Table 27) showed nine of 16 sites with less than 50 percent herbaceous cover. Some of the higher values appeared to be biased by extensive aerial coverage of otherwise predominately bare ground or sampling bias which favored multi-stemmed grass species. In contrast, three herring gull colonies (Table 29) had less than 50 percent vegetation cover and two had cover of over 80 percent. These comparisons were in accord with the observations that ring-billed gulls were prone to damage vegetation with feet and feces, thus allowing only nitrophilous and guano-resistant species to grow in their colony sites on heavy soils and tending to kill most vegetation on sandy, porous soils. Both gull species were occasionally found nesting under shrubs and trees (16 m^2 Quadrats, Tables 27 and 29), but trends or preferences were not apparent, perhaps because these seemed to be marginal habitats. This is not to be interpreted that either gull was less successful in proximity to woody vegetation. Indeed, Chamberlin (1975) and Shugart (1976) have shown that woody vegetation could be important shade and hiding places for herring gull and ring-billed gull chicks, although it might not determine overall success.

Table 27

Percent Cover of Vegetation for Ring-billed Gulls by Location

		Duluth Port Authority	Minnesota Power and Light Co.	Moon Island	Southwest Neebish Island	Southeast Neebish Island	Lone Tree Island	South Manitou Island	High Island	West Grape Island	East Grape Island	Channel Island	Shelter Island	Mud Island	Grassy Island	Toledo Harbor Dike	Little Galloo Island
Shrubs	RBG-1			16	8					37	33						
$16m^2$	RBG-2			45						62	50						
Quadrats	RBG-3									81							66
	RBG-4									68*							
Average				30	8					60	42						66
Herbs	RBG-1	62	36	22	29	70	44	37	27	0	0	72	55	77	50	40	52
$1m^2$	RBG-2	75	43	19				3	34	4	14				85		56
Quadrats	RBG-3		27					36		0					43		
	RBG-4		26							56*							
Average		69	33	21	29	70	44	25	30	1	7	72	55	77	59	40	54

*Area adjacent to nesting colonies not included in tabulations.

Table 28

Percent Cover of Vegetation for Common Terns by Location

	Duluth Port Authority	Northwest Sugar Island	West Sugar Island II	West Sugar Island I	Southeast Neebish Island	Lone Tree Island	High Island	Toledo Harbor Dike	
Herbs $1m^2$ Quadrats	28	67	36	39	73	83	43	22	(Single transect at each site.)

Table 29

Percent Cover of Vegetation for Herring Gulls by Location

		South Manitou Island	Bellows Island	Hat Island	Sandusky Turn Point	Little Galloo Island	
Shrubs $16m^2$ Quadrats	HG-1		30		4		
	HG-2		100		12		
	HG-3		0		67		
	HG-4		0		25		
Average			32		27		

		South Manitou Island	Bellows Island	Hat Island	Sandusky Turn Point	Little Galloo Island
Herbs $1m^2$ Quadrats	HG-1	36	95	48	37	87
	HG-2	50	96	29	52	
	HG-3		71	34	66	
	HG-4		67	36	43	
	HG-5			38		
	HG-6			44		
	HG-7			56		
Average		43	82	41	49	87

Table 30

Percent Cover of Vegetation for Bird Species by Location

Great Blue Heron		West Sister Island	
Herbs $1m^2$ Quadrats	GBH	76	(Single Transect at each site.)

Black-Crowned Night Heron		Willow Island	West Sister Island	Little Galloo Island	
Shrubs $16m^2$ Quadrats	BCNH-2	78			
	BCNH-3	81			
Average		80			
Herbs $1m^2$ Quadrats	BCNH-1	51	54	63	(Single transect at each site.)

57. The lowered water levels in 1977 allowed shifts in some island populations by exposing new surface on existing sites, and whole new sites that were previously submerged. Observers recorded an increase in several species in the lakes that coincided with the lowered water levels, although it was not known if this event had any role in the increase. An increase is probable in future nesting seasons as more pairs return to nest on greatly expanded habitat. The effects of receding water levels with the resultant increase in nesting area and accompanying plant succession on the size and movements of larid breeding populations have been discussed by Ludwig (1974). The total number of breeding pairs of herring gulls in 1977 was 29,406, and represented a 8.19 percent increase from 1976 (Table 31). Major herring gull increases occurred in the colonies in the St. Marys River; in Green Bay, Lake Michigan; in northern Lake Michigan; and in Thunder Bay, Lake Huron, but numbers elsewhere were less affected because of the nature of the rocky islands of Lakes Superior, Erie and Ontario that showed little effect of the lowered water. The size of many low-lying island nesting sites in Lake Michigan was doubled by receding water levels. Almost two-thirds of the 8.19 percent increase occurred on these low-lying Lake Michigan sites. Some of the herring gull colonies, such as the one on Bellows Island (Site 12), have not expanded to fill the newly exposed land fully. The possibility of other species such as ring-billed gulls or common terns filling these areas in the future is great. The ring-billed gull population included 102,539 pairs in 1977, an increase of 10.69 percent from 1976 (Table 31). This increase coincided with the lowered water levels and resultant increase in available nesting habitat. Ring-billed gulls often increased at the expense of another species. Ring-billed gulls and common terns had some habitat requirements in common, and so during competition for suitable habitat that was exposed at the larger sites in 1977 common terns were usually preempted by the more aggressive and earlier-nesting ring-billed gulls. The lowered water levels also created land bridges between many previous nesting sites and the mainland, thus exposing the tern colonies to increased human disturbances and predation. The 1977 common tern population consisted of 2,497 pairs, a

Table 31

Numbers of Breeding Pairs of U. S. Great Lakes Colonial Nesting Birds

By Species And Lake During 1976 And 1977

SPECIES	SUPERIOR		HURON[1]		MICHIGAN		ERIE[2]		ONTARIO[3]		TOTALS		PERCENT CHANGE[4]
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	
HERRING GULL	5,634	6,619	9,141	9,276	10,347	11,978	1,347	1,210	250	323	26,719	29,406	+8.19%
RING-BILLED GULL	2,111	2,941	22,838	25,786	27,371	34,141	5,040	6,993	32,638	32,678	89,998	102,539	+10.69%
COMMON TERN	137	328	1,206	610	977	753	77	283	92	523	2,489	2,497	-18.80%
CASPIAN TERN	0	0	0	0	1,659	1,587	0	0	0	0	1,659	1,587	-4.34%
GREAT BLUE HERON	241	254	318	286	105	138	3,305	2,586	0	0	3,969	3,264	-17.76%
BLACK-CROWNED NIGHT HERON	0	0	67	166	519	558	3,000	3,000	121	130	3,707	3,854	+1.65%
DOUBLE-CRESTED CORMORANT	0	0	0	0	48	61	0	0	76	96	124	157	+26.61%
GREAT EGRET	0	0	0	0	0	0	231	224	0	0	231	224	-3.03%
SNOWY EGRET	0	0	0	0	2	0	0	0	0	0	2	0	-100.00%
CATTLE EGRET	0	0	0	0	13	29	0	0	0	2	13	31	+138.46%
LITTLE GULL	0	0	0	0	4	1	0	0	0	0	4	1	-75.00%
FORSTER'S TERN	0	0	0	0	298	54	0	0	0	0	298	54	-81.88%
TOTALS	8,123	10,142[5]	33,570	35,958	41,343	49,300	13,000	14,296	33,177	33,752	129,213	143,614	+10.03%

[1]Includes St. Marys River area.

[2]Includes Lake St. Clair and Detroit River Areas.

[3]Includes Niagara River area.

[4]Calculations excluded ten colonies of four species known to exist both seasons but for which an exact census was unavailable during one year.

[5]Reflects location of numerous herring gull colonies in 1977 at Isle Royale that are not shown in 1976.

decrease of 18.80 percent from 1976 (Table 31). Seven Caspian tern colonies existed during the 1977 season, all in northern Lake Michigan. The breeding population decreased 4.34 percent from 1,659 pairs in 1976 to 1,587 pairs in 1977 (Table 30). Both High Island Shoals and Shoe Island had been underwater during 1976 but were exposed in 1977. They were used for renesting attempts by terns that had been disturbed by human activities in the Hat and High Island colonies. These disturbances, plus coyote predation on High Island, accounted for the observed decrease.

58. Great egrets, great blue herons and black-crowned night herons showed little response to the lowered water levels, except at Oconto Marsh near Green Bay, Lake Michigan, where 300+ black-crowned night herons deserted a colony due to lack of standing water under the shrubs. Many of these birds were believed to have relocated at nearby Willow Island (Site 9). The 1977 great blue heron population was 3,264 pairs, and represented a 17.76 percent decrease from 1976 (Table 31). Almost all of the loss was from the Winous Point heronry in western Lake Erie and was due to an extensive blow-down of nest trees. The overall severity of this loss was tempered somewhat by indications that the herons renested at inland colonies outside the survey area proper. Great egrets were located at three nesting sites, all in the Lake St. Clair-Detroit River-Lake Erie area, and in association with nesting great blue herons. Their numbers (231 pairs, 1977; 224 pairs, 1977) remained essentially stable (Table 31). The black-crowned night heron population also remained stable, showing only a slight increase from 3,707 pairs in 1976 to 3,854 pairs in 1977 (Table 31).

59. The status of the double-crested cormorant in the Great Lakes appeared to be improving. The effect of the lower water levels in reducing the threat of washing away nests and killing nest trees as occurred during 1976 at the Gravelly Island and Cat Island Chain colonies, were reflected in the 26.61 percent increase in the breeding population from 124 pairs in 1976 to 157 pairs in 1977 (Table 31). Two pairs of snowy egrets were found nesting on flooded willows within the Oconto Marsh black-crowned night heron colony in the Green Bay region of Lake

Michigan in 1976 (Table 31). In 1977 the water under the willows dried up and the snowy egrets deserted the site, as did 300+ of the night herons. Although cattle egrets also nested in Oconto Marsh in 1976, they did not desert their nests in 1977. In fact, the number of cattle egrets in the Green Bay area increased 138.46 percent from 13 pairs in 1976 to 31 pairs in 1977 (Table 31). The little gull and Forster's tern also nested in Green Bay marshes during 1976. However, the drying up of their marsh habitats in 1977 resulted in the absence of any nesting little gulls, and in a reduction in Forster's terns from 298 pairs in 1976 to only 54 pairs in 1977 (Table 31). A census of northern green herons and black terns was made only in the Green Bay region of the survey area, although nesting black terns were observed in all five Great Lakes and the herons in all but Lake Superior. However, the situation that was documented in Green Bay appeared representative throughout the Great Lakes: dried up marshes due to lower water levels, reduced nesting habitat, reduced breeding populations of both species. Further evaluation of both historical and recent population trends for the above species was given in Scharf et al. in press.

Soil Analyses

60. Table 32 summarizes pH, soil texture, and the nutrients, total nitrogen, phosphorus, and potassium for most of the 24 intensively studied sites in addition to Ile aux Galets and Gravelly Island in northern Lake Michigan. Generally, these results showed massive amounts of soil nutrients. In the heavily fertilized colonies, pH typically ranged from slightly below neutral to alkaline (exceptions seemed to correlate with highly organic textures). It is hypothesized that levels of soluble salts increased to phytotoxic levels, as noted by Wiese (1977), and McColl and Burger (1976), although the levels of specific nutrients are not directly comparable. The former study was in marsh and aquatic habitats and the latter was conducted on sandy soils and did not report total nitrogen.

61. Precise levels of phytotoxicity varied with texture, pH, and a variety of other factors and published values were few or non-

Table 32

Summary of pH, Texture, and Soil Nutrients in ppm, by Location and Bird Species

GREAT BLUE HERON	pH	NITROGEN	PHOSPHOROUS	POTASSIUM	SOIL TEXTURE
West Sister Island	7.0	17400	458	388	Organic
BLACK-CROWNED NIGHT HERON					
*Willow Island	7.6	7700	294	415	Organic
West Sister Island	6.2	11230	352	748	Organic
West Sister Island	6.4	8970	144	288	Organic
HERRING GULL					
*Willow Island	8.1	100	16	14	Sand soils
Bellows Island	6.8	18000	1138	297	Organic
Bellows Island	4.7	10400	144	212	Organic
*Sandusky Turning Point	6.8	5420	94	114	Organic
RING-BILLED GULL					
*Duluth Port Authority	6.6	1300	384	467	Sandy Loam
*Minnesota Power and Light Company	7.3	10200	554	458	Organic
*Moon Island	7.0	24800	1510	660	Organic
*Southwest Neebish Island	6.6	32000	1700	440	Organic
Southeast Neebish Island	7.6	1400	141	177	Sandy Clay Loam

(Continued)

*Man-made sites.

Table 32 (Continued)

RING-BILLED GULL (continued)	pH	NITROGEN	PHOSPHOROUS	POTASSIUM	SOIL TEXTURE
*Lone Tree Island	7.2	8300	652	588	Organic
South Manitou Island	7.1	3370	352	206	Sand Soils
High Island	6.8	600	1289	93	Loamy Sands
West Grape Island	4.2	30800	554	343	Organic
*Channel Island	7.5	23000	1996	917	Sandy Clay Loam
*Shelter Island	7.6	7400	1112	396	Sandy Clay Loam
*Mud Island	7.3	32700	1343	572	Organic
*Mud Island	6.9	10570	560	360	Organic
*Grassy Island	7.3	3000	407	440	Sandy Clay Loam
*Toledo Harbor Dike	7.5	4000	39	480	Sandy Clay Loam
Little Galloo Island	5.0	25900	1407	308	Organic
Ile aux Galet	6.3	25900	1621	510	Organic
COMMON TERN					
*Duluth Port Authority	7.7	400	21	40	Sandy Loam

(Continued)

*Man-made sites.

Table 32 (Concluded)

COMMON TERN (continued)	pH	NITROGEN	PHOSPHOROUS	POTASSIUM	SOIL TESTURE
*Northwest Sugar Island	7.3	3030	127	928	Sandy Clay Loam
*West Sugar Island I	7.3	200	144	67	Sand Soil
*Lone Tree Island	7.5	1600	117	139	Loamy Sand
CASPIAN TERN					
High Island	7.7	500	503	209	Loamy Sand
Hat Island	7.3	3680	640	330	Sand Soils
Gravelly Island	7.4	76300	7071	1861	Organic

*Man-made sites.

existent. However, where certain plant species seemed to thrive in the presence of extremely high nutrients to the exclusion of other plant species, it was concluded that they were tolerant or resistant to the chemical onslaught of bird feces. Such plants were most apparent at ring-billed gull colony sites with heavier soils of organic to sandy-clay-loam textures (Table 32). A brief list of species resistant to excess nutrients found in ring-billed gull colonies would include: pigweed, yellow melilot, reed, choke cherry (*Prunus virginiana*), stinging nettle, and various Cruciferae species listed in the importance values of each site. Low grasses such as witch-grass, brome-grass, and June grass also seem resistant to overfertilization, but are usually eliminated before the herbs of the first list. On coarse sands such as South Manitou Island (Site 11), the most resistant species persisted longest, but finally almost all the plants were eliminated by over-fertilization, forcing the birds to move to more vegetated areas.

62. There was clearly a difference in the soil textures and nutrients of larid colonies (Table 32). Common tern and Caspian tern colonies had lower levels of nutrients present on coarser soils. The one exception was Caspian terns (Gravelly Island) in which an organic layer of fish castings overlying a sterile cobble surface was present. Ring-billed gulls seemed to be most successful on the heavier textured, nutrient rich soil types, but none of the organic textured soils showed the levels of nutrients above 20,000 ppm that were found at ring-billed gull sites. It should be noted that all four larid species also nested on bare rock in the U. S. Great Lakes.

63. A contrast between the nutrient input of common terns and ring-billed gulls at Duluth Port Authority (Site 1) was evident in Table 32. The whole colonized area was bare sandy loam in 1976, and common terns were present both in 1976 and 1977. However, in the first year of occupancy, the nutrient values in the ring-billed gull colony varied from three to 15 times that of the common tern area. This new ring-billed gull colony was lower in nutrients in comparison to other established ring-billed gull colonies, and the values were comparable to other first year colonies at Grassy Island (Site 20) and Toledo Harbor

Dike (Site 21).

64. The great blue heron and black-crowned night heron sites sampled show more moderate enrichment than the gull sites, but the values (Table 32) were probably still phytotoxic to many species of plants. Some of the woody species in which the herons nested showed signs of stress from the over-fertilization at all sites. These trees and shrubs, once weakened, were often killed, abandoned, or blown down by winds. The soil textures at the heron sites sampled were all organic, indicating the more advanced seral stages occupied by these birds.

Chronology of Nesting

65. The breeding season could be thought of as a sequence of stages that build on the preceding events and each gradually changes to the next. The successive stages (Figure 24) could be briefly described as courtship, egg laying, incubation, hatching, chick brooding at the nest and chick care away from the nest. Initially, control of the sequence was endogenous control which was externally triggered by factors such as light and temperature. As the sequence progressed, external stimulation from eggs and chicks maintained hormonal systems and behavioral responses.

66. Breaks in the sequence of events usually recycled the pattern starting approximately one to two weeks prior to egg laying. The chronology shown in Figure 24 only reflects initial nesting attempts and has been made sufficiently broad for predictive purposes to encompass the differences in light and temperature experienced within the 700 km latitudinal distance of the U. S. Great Lakes. Additional factors affecting the chronology of colonial nesters in this region are ice conditions, and the migration routes and dates of arrival at the site. Some sites in Canadian Lake Ontario have birds in nearly continuous residence (Peter M. Fetterolf, 1977, personal communication).

67. Another factor determining the chronology of the breeding season was the age and experience of returning pairs. Experienced pairs need not go through the process of establishing a pair bond, but need

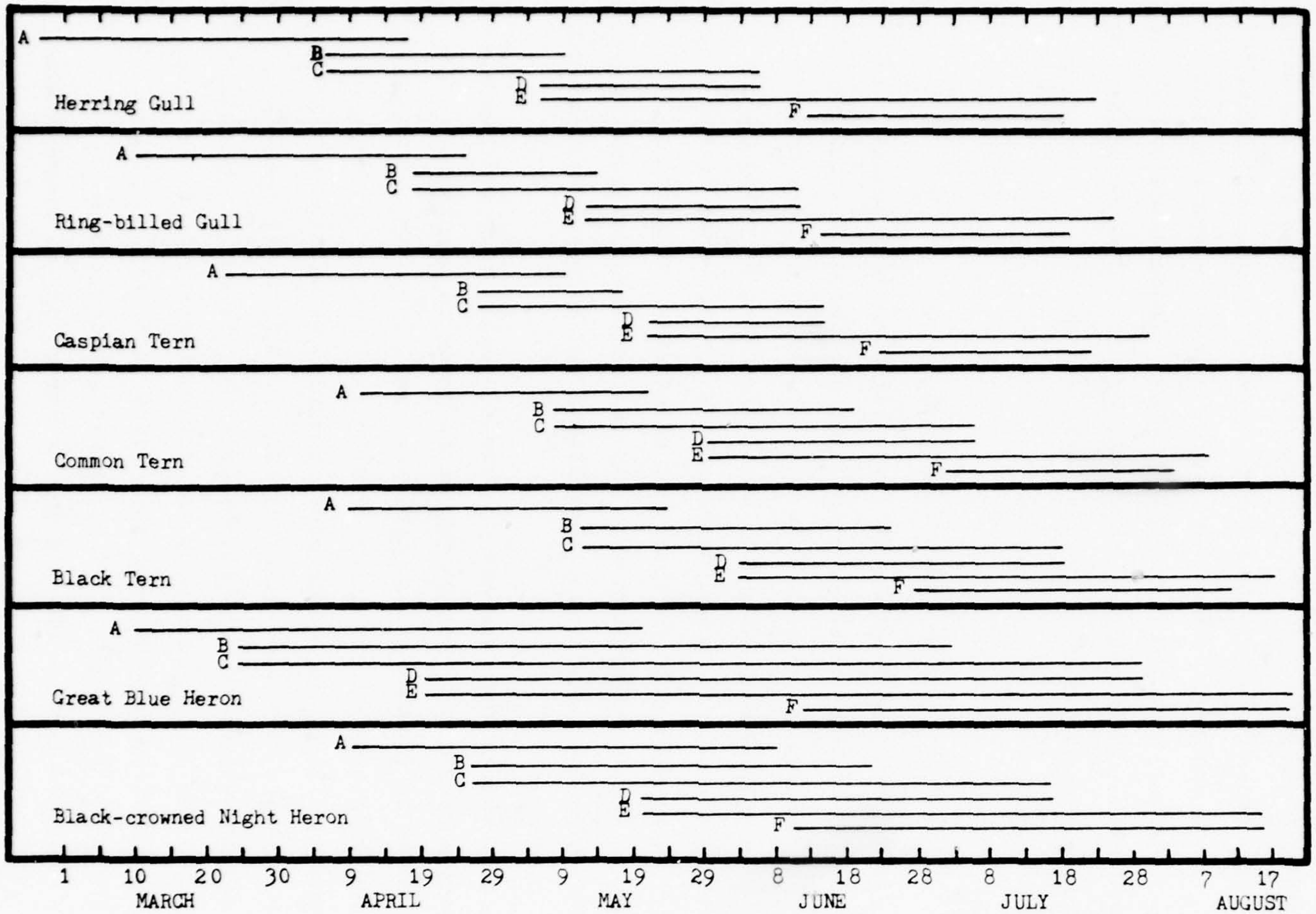

Figure 24. Chronology of initial nesting for major colonial nesting bird species of the U. S. Great Lakes. Within each period (i.e. A,B,C,D,E,F), birds nesting at southern most latitudes will begin nesting earlier than birds of the same species in the north. Period A = courtship; period B = laying; period C = incubation; period D = hatching; period E = chick care at the colony; period F = fledging

only renew it, and probably lay eggs one to two weeks before newly established pairs. This was shown in 1977 when large established colonies of ring-billed gulls, which probably have a high proportion of returning pairs, showed earlier peak hatching dates regardless of latitude than did new colonies, large or small (Figure 25). The new colonies also showed wider nest spacing, excessive mortality, and less synchrony of hatching. This could have been because new colonies were selected at the time of first breeding and few experienced birds move to new sites. Parson (1976a and 1976b) and Davies (1976) showed that younger herring gulls nested at lower densities and had less success than older, more experienced birds.

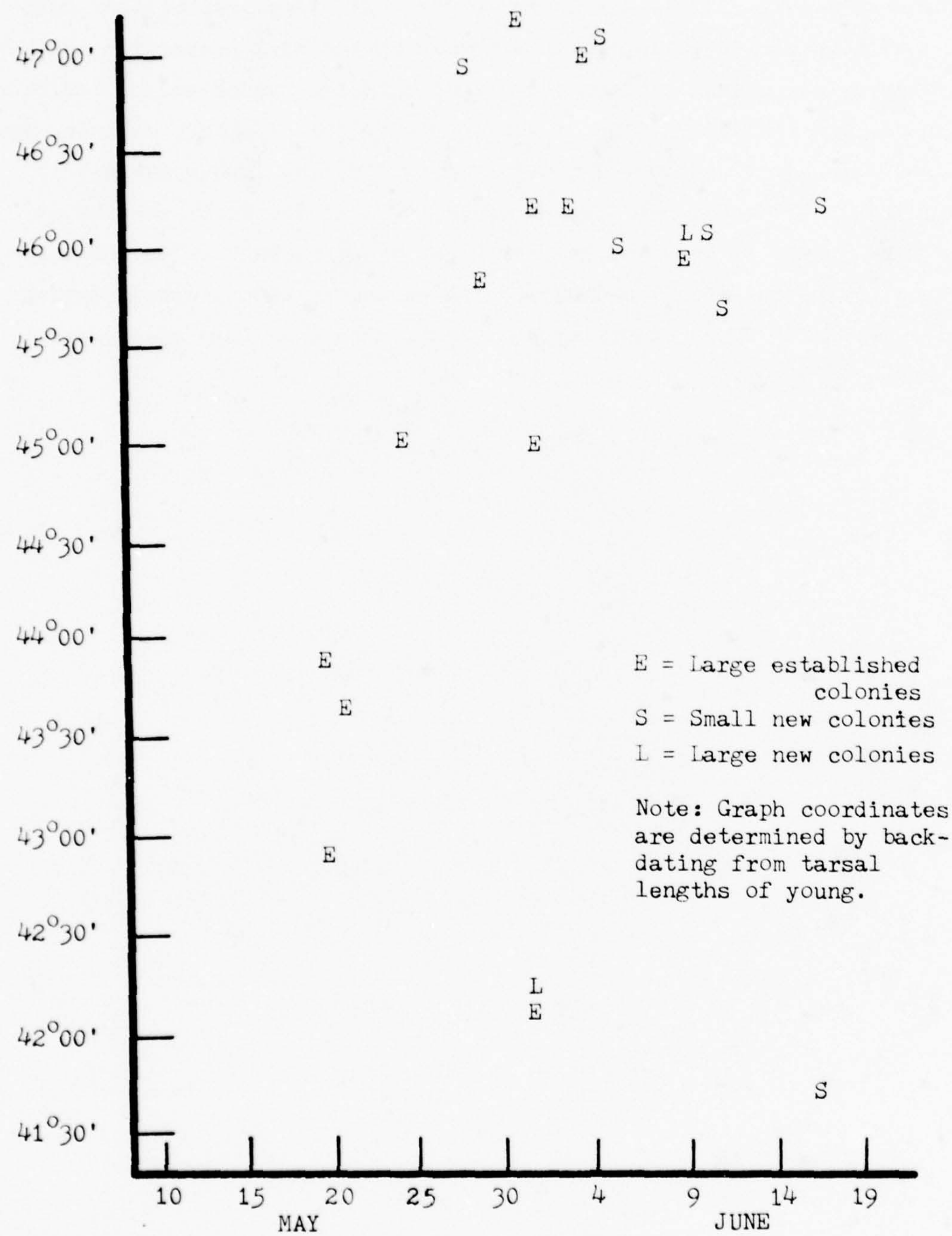

Figure 25. Peak hatching dates of ring-billed gulls in relation to latitude

PART IV: DISCUSSION

Plant Succession

68. The rate of plant succession on Great Lakes colonial bird nesting sites, both natural and dredged material, appeared to be slower than that reported for dredged material sites in North Carolina (Soots and Parnell, 1975). Dredged material islands 20 to 40 years after construction were just beginning to show growth of shrubs and saplings. Occupancy by ring-billed gulls would retard succession indefinitely, depending on the nature of the soil. Heavier soils (with higher clay and organic matter content) seemed to be able to support plants resistant to over-fertilization, and the sites will re-vegetate each season to remain suitable for ring-billed gulls. Lighter, sandier soils experienced more severe plant mortality due to trampling and over-fertilization from ring-billed gulls resulting in movement of nesting sites in subsequent seasons. Ludwig (1962) stated that red-osier dogwood and willow grew in newly exposed sites in five to six years and crowded ring-billed gulls seeking nesting sites. In this study no evidence for this trend was observed. In fact, ring-billed gulls frequently severely damaged or killed most woody vegetation, and at several sites willows formed important visual barriers that promoted high nest density.

69. The rate of plant succession on both dredged material and natural sites was greatly influenced by the groundwater table which determined whether the sere was hydric or xeric. In 1977, lowered water levels in the Great Lakes caused formerly wet areas to become dry, and plant composition was greatly altered. Some dredged material islands remained with standing water for many years which prevented colonial bird nesting. A modified dewatering procedure at Grassy Island, a diked dredged material island in the Detroit River, lowered standing water enough to allow ring-billed gull and common tern nesting for the first time in 1977. Draining, damming or timing of deposition are management techniques that could be planned to attract colonial nesting birds, depending on the species desired. Addition of new dredged material could also be managed to control plant succession, and thereby control the

colonial nesting birds.

70. Only three dredged material sites had progressed to the shrub sere suitable for black-crowned night herons, and none had trees which might be inhabited by great blue herons or great egrets. Two of the black-crowned night heron dredged material sites will be destroyed by a newly planned diked disposal site in 1978-1979. Several natural sites historically occupied by great blue herons (Scharf et al. in press) lost their trees through cutting or bird-accelerated mortality and did not regain their woody vegetation. These sites in 1977 had nesting gulls and show little sign of developing woody plants. Other natural sites such as West Sister Island in Lake Erie had some trees being killed by the great blue herons and great egrets, while the shrubs bearing nests of black-crowned night herons were becoming trees suitable for the larger herons. Clearly at a site such as this, management by cutting or burning would be needed to maintain high levels of nesting by both species. At this site, the openings that served as staging areas for young after they leave the nest had become overgrown with shrubs, and succession needed to be reversed in this sere.

Management Recommendations for Dredged Material Sites

71. All dredged material sites with suitable habitat and appropriate isolation from human and predatory disturbance had bird nesting colonies in 1976-1977 suggesting that if more suitable sites are constructed, they also would probably be colonized. Human disturbance and access by predators could and should be discouraged through posting against trespass and placement of islands at isolated locations if bird nesting is to be encouraged. The regulation requiring the U. S. Army Corps of Engineers to give up dredged material sites after use as a disposal site has resulted in a decision by Detroit District to deed large diked disposal areas to units of government for recreation purposes. This will cause conflicts between public and bird usage.

72. The recent practice of diked disposal of dredged material had several effects on nesting or potential nesting. One effect was that high rip-rapped dikes sometimes caused mortality to young that fell down

the steep slopes and could not regain access to the colony. Another effect was that the diked areas were frequently large and filled by sections. This allowed different stages of substrate and vegetation development which might be more or less suitable to colonial nesting birds. More specifically, at one site de-watering of recent dredged material allowed colonial nesting there, but in another part of the same site treated differently the vegetation had succeeded beyond desired stage for nesting. The area was essentially a marsh growing on the dredged material. Another effect of diked disposal practices was that nesting on the dike prior to filling frequently was attractive to the birds and the filling and construction efforts were possibly disruptive to nesting success.

73. Dredged material varied greatly in its particle size and potential for soil and vegetation establishment. This factor could determine the rate of vegetation succession and hence the avian species using a site. Common terns and Caspian terns respond to bare sterile sites, and great blue herons, great egrets, and black-crowned night herons occupy tree and shrub stages. Recommendations set forth by this study are to maintain both bare habitats and encourage wooded habitats. Plantings can augment this procedure by which grasses are planted on bare sites, rather than trees as was done by private citizens on one site studied.

74. Finally, the construction of dredged material sites of heavy soil materials are most likely to lead to more ring-billed gull nesting. Ring-billed gulls increased recently in the Great Lakes (Scharf et al., in press and Ludwig, 1974), and concern was expressed about possible aircraft hazards and their displacement of common terns (Morris and Hunter, 1976). Coverings of porous-sandy materials or rock might encourage common tern or herring gull nesting. This would aid their population stability and prevent further expansion of ring-billed gulls. Management has been attempted recently in Canada (Blokpoel, 1977, personal communication) where ring-billed gull nests were destroyed in a mixed colony with common terns in order to aid the terns.

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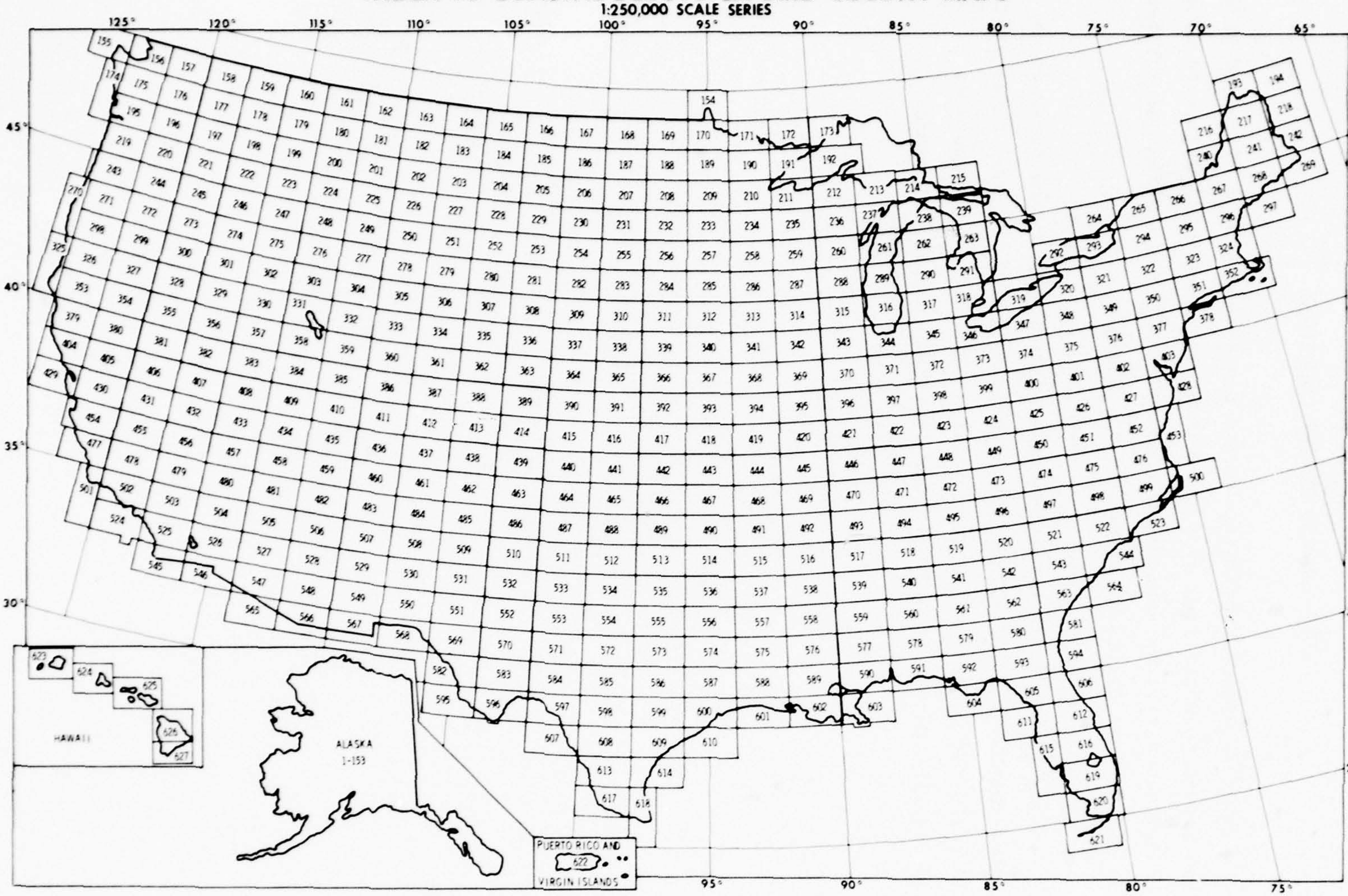
APPENDIX A:
MAPS SHOWING COLONY LOCATIONS

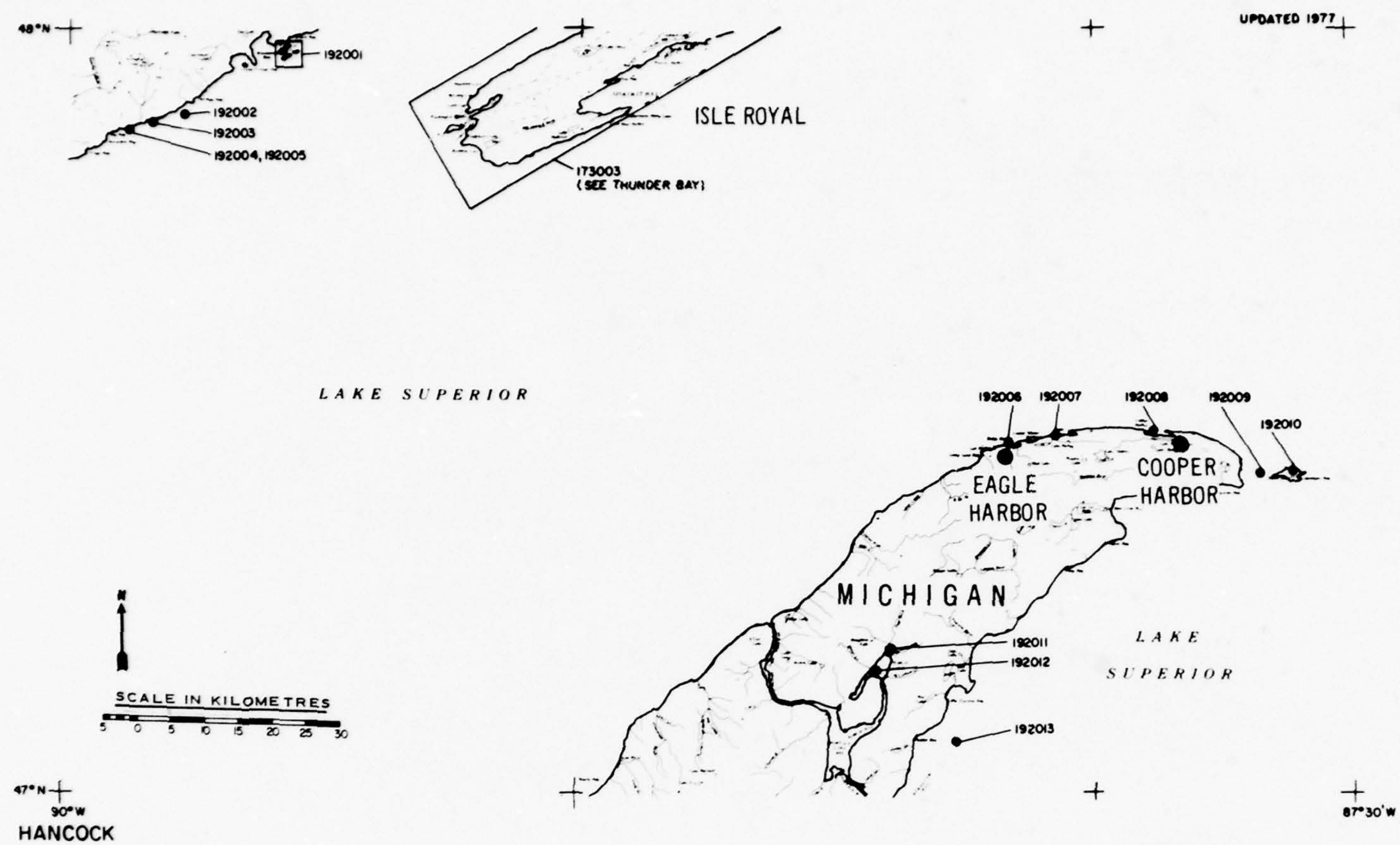
1. Colony location identification was based on the U. S. Fish and Wildlife Service computerized mapping system, which assigned digits to USGS 1:250,000-scale topographic maps. An index map designating the key for the first three digits is presented on page A2.

2. Colony identification was by a six-digit number. The first three digits indicated the assigned topographic map, and the last three digits indicated the colony number on a specific map. The colonies were numbered in the chronological order in which they were located.

INDEX TO COASTAL ECOSYSTEM BIRD COLONY MAPS

1:250,000 SCALE SERIES




UPDATED 1977
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192003
192004, 192005
ISLE ROYAL
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(SEE THUNDER BAY)
LAKE SUPERIOR
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192009
192010
EAGLE
HARBOR
COOPER
HARBOR
MICHIGAN
192011
192012
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HANCOCK
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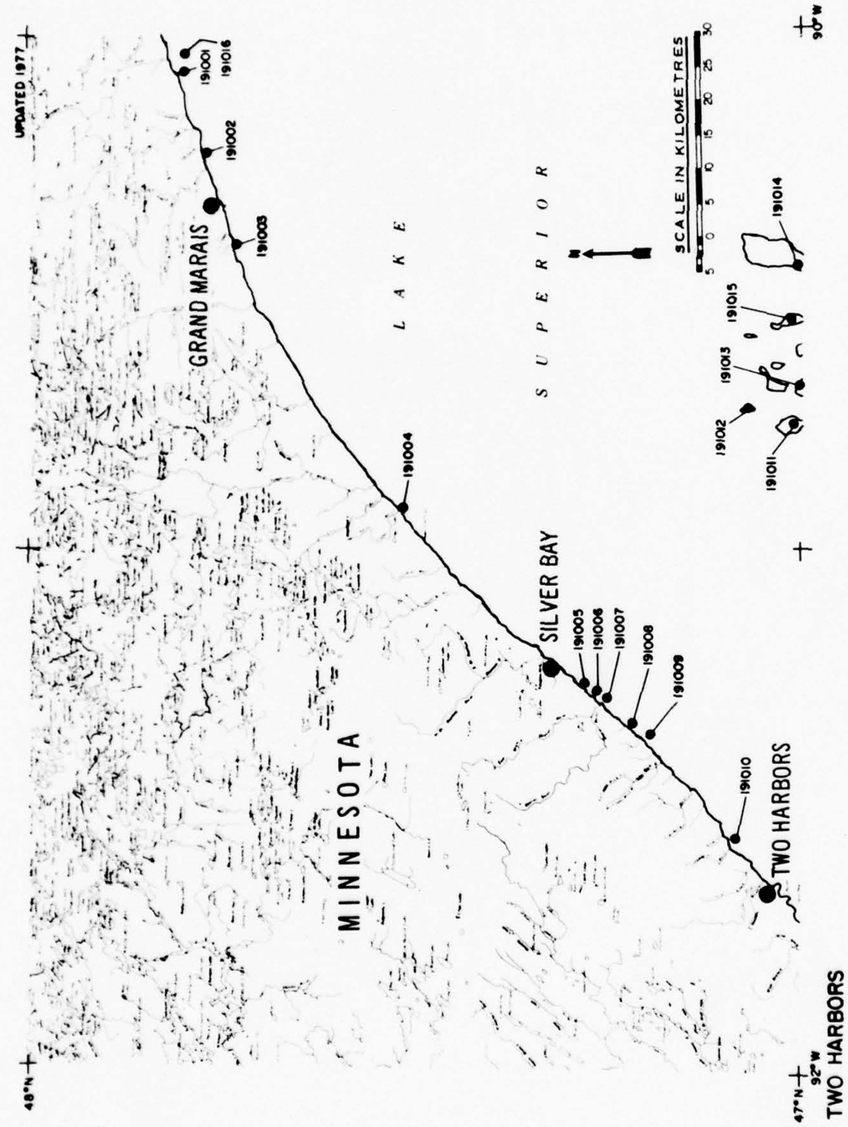
UPDATED 1977
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SUPERIOR
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SCALE IN KILOMETRES
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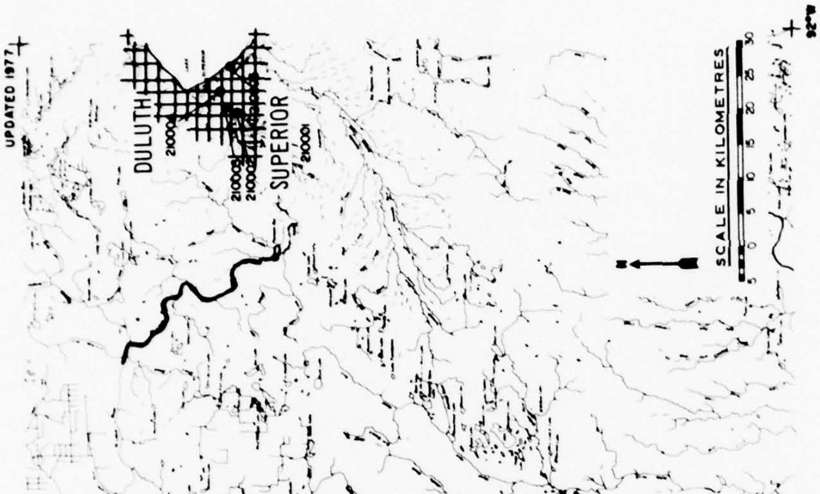
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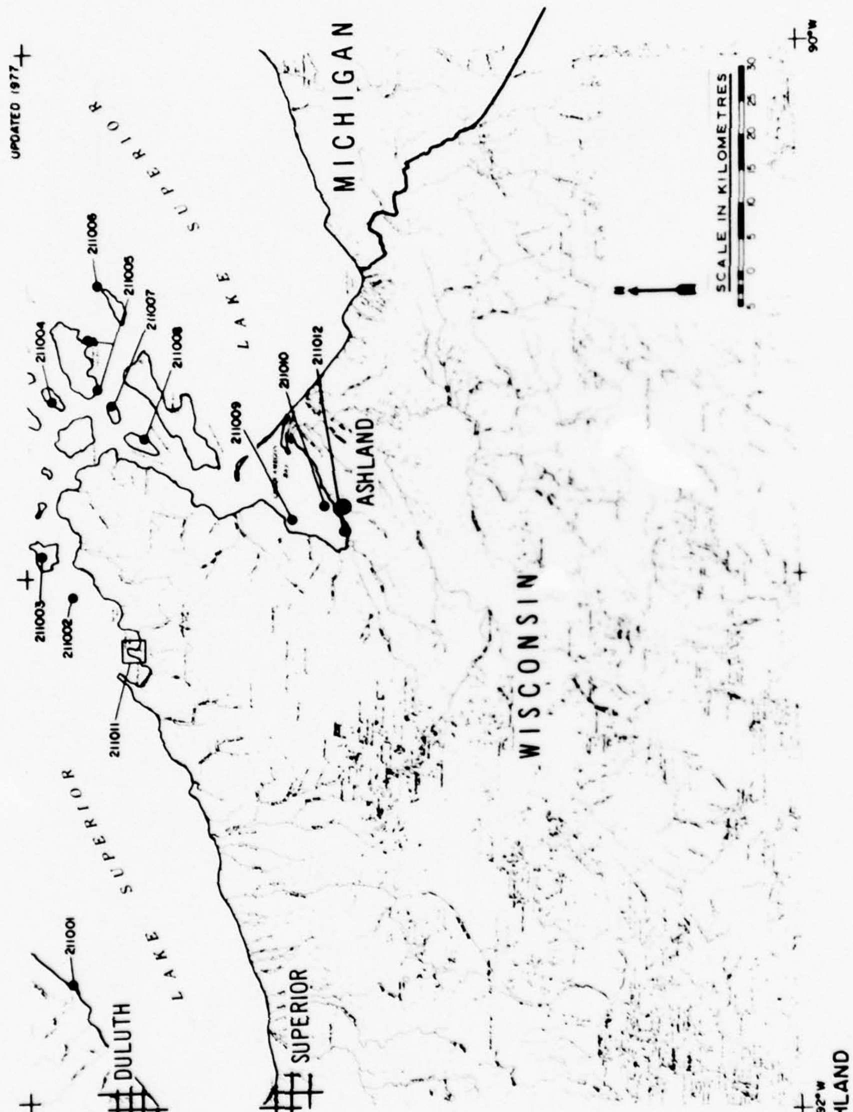
DULUTH



ASHLAND
47°N
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90°W
UPDATED 1977
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SUPERIOR
LAKE SUPERIOR
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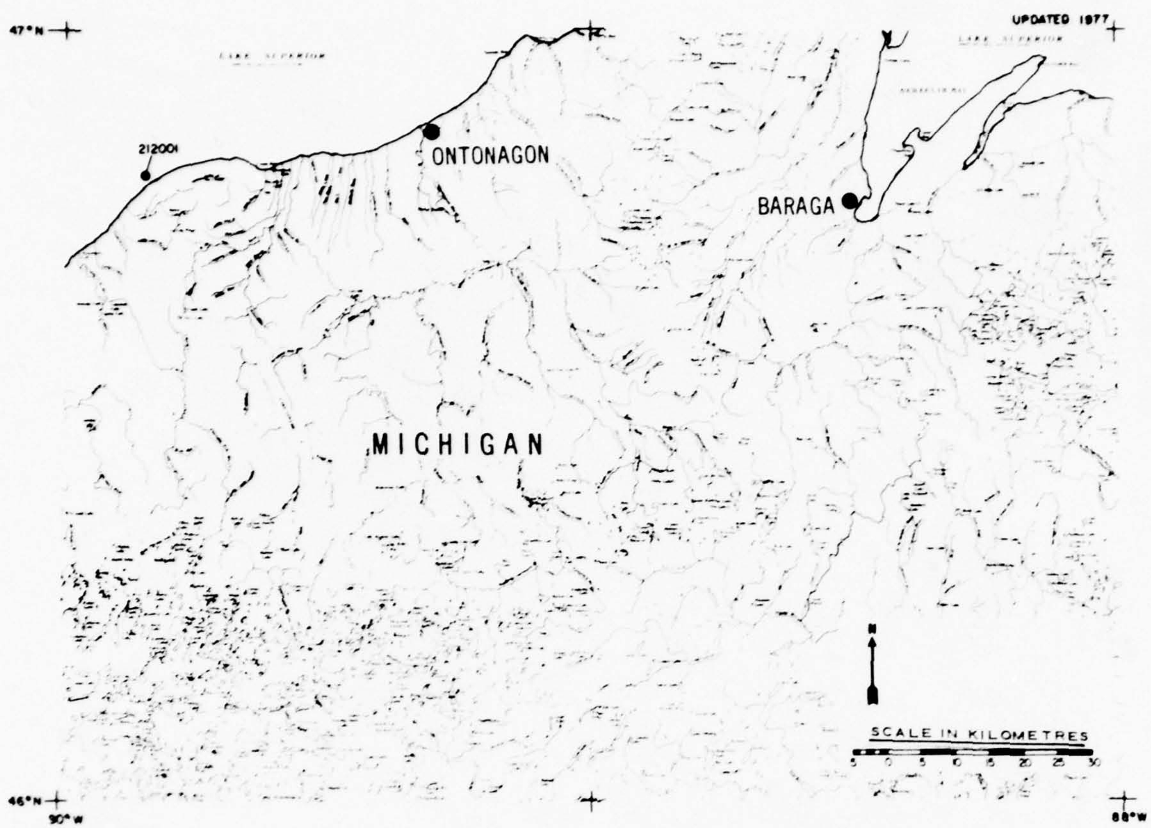
211010
211011
211012
ASHLAND
WISCONSIN
MICHIGAN
SCALE IN KILOMETRES


UPDATED 1977
47°N
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88°W
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ONTONAGON
BARAGA
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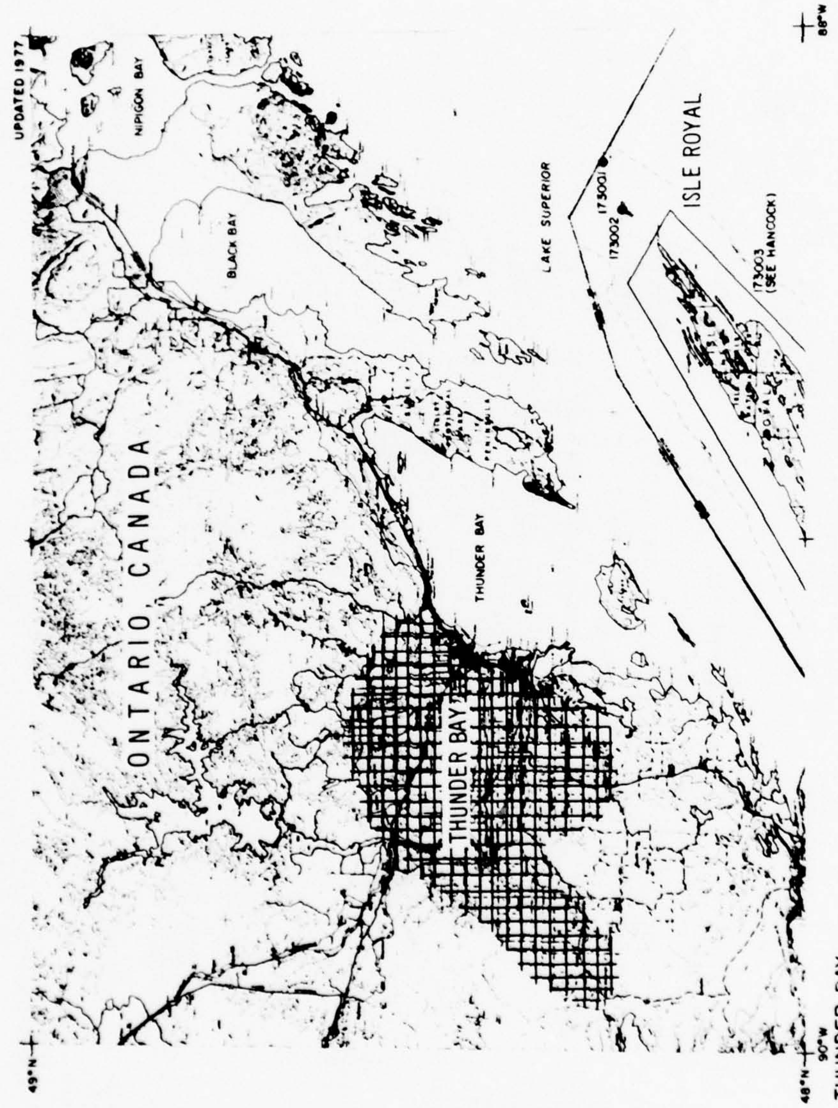
5 0 5 10 15 20 25 30

IRON RIVER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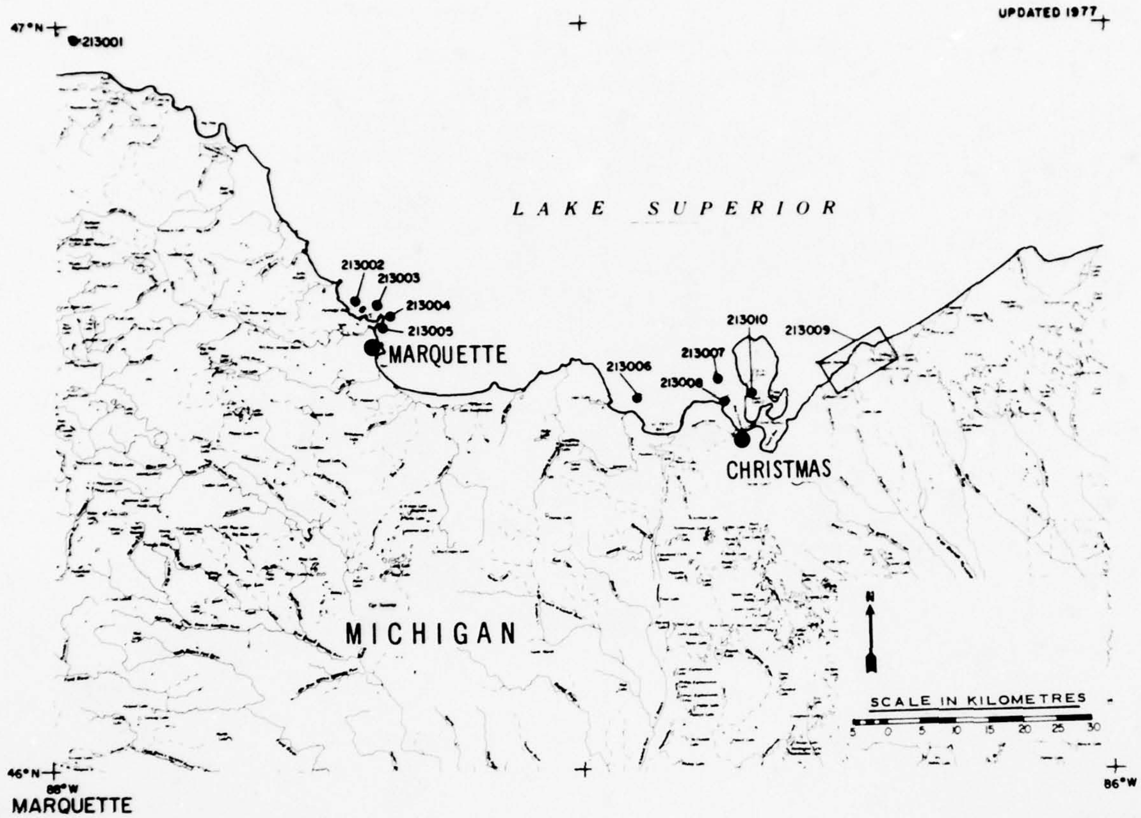
(SEE HANCOCK)
ONTARIO CANADA
THUNDER BAY
THUNDER BAY
49°N
48°N
90°W
88°W
THUNDER BAY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MICHIGAN
N
SCALE IN KILOMETRES
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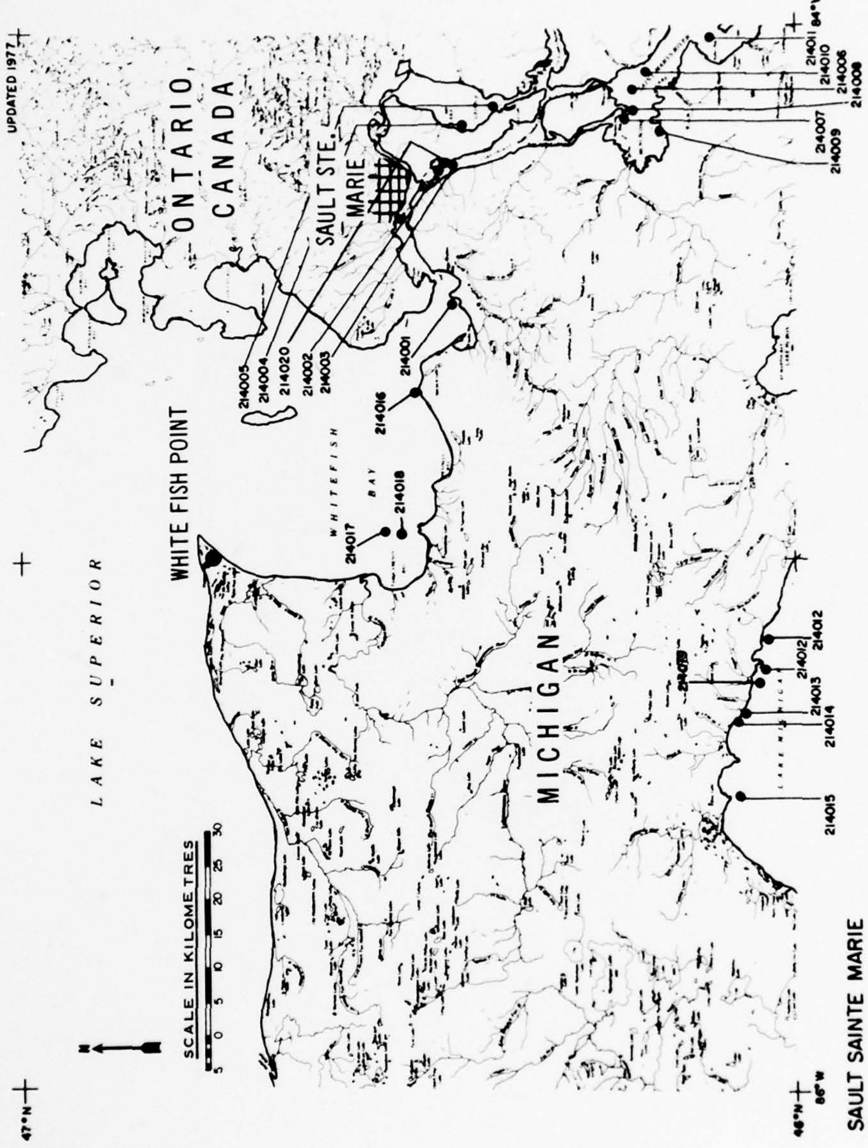
46°N
88°W
86°W
MARQUETTE



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LAKE SUPERIOR
WHITE FISH POINT
WHITEFISH BAY
ONTARIO, CANADA
SAULT STE. MARIE
MICHIGAN
214001
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214003
214004
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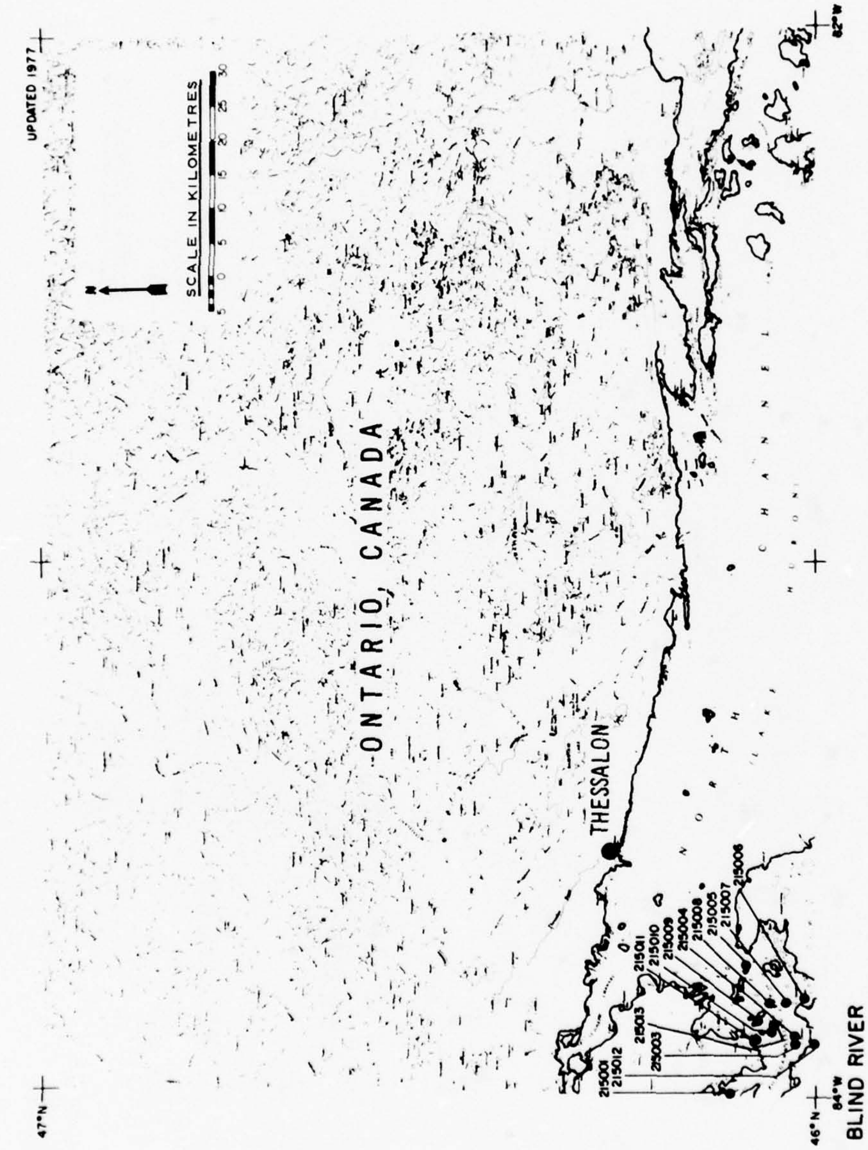
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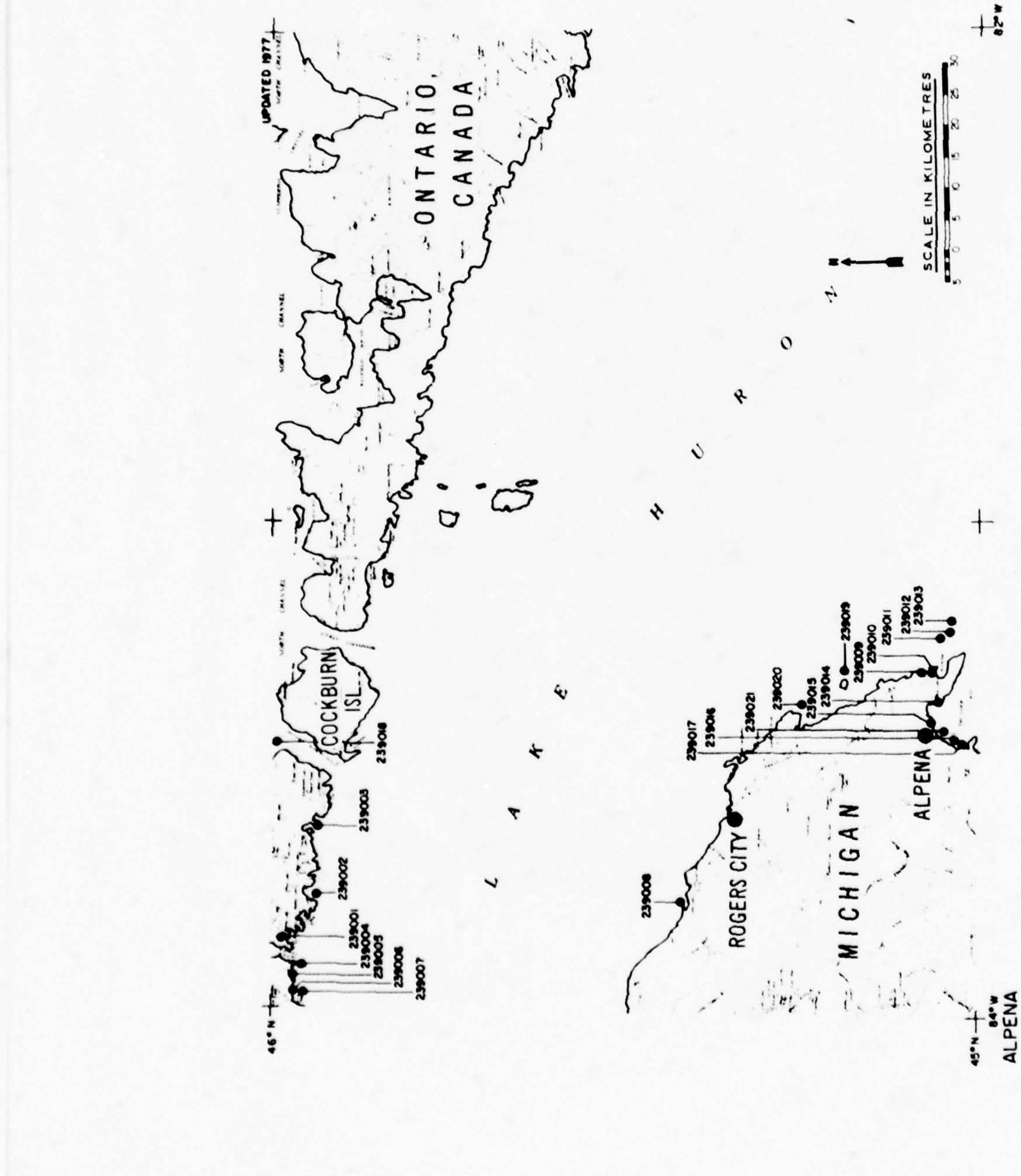
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ROGERS CITY
ALPENA
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N
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45°N
84°W
82°W
ALPENA
239001
239002
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239004
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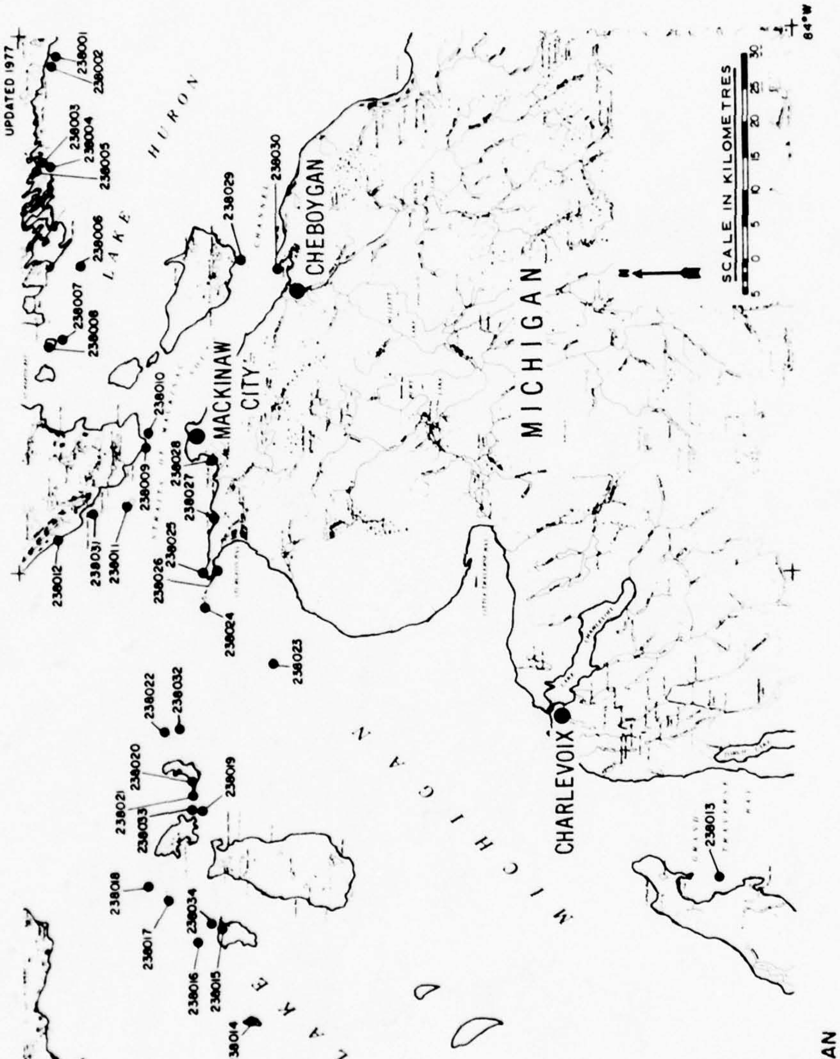
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LAKE MICHIGAN
MICHIGAN
MACKINAW CITY
CHEBOYGAN
CHARLEVOIX
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46°N
45°N 86°W
84°W
238001
238002
238003
238004
238005
238006
238007
238008
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238012
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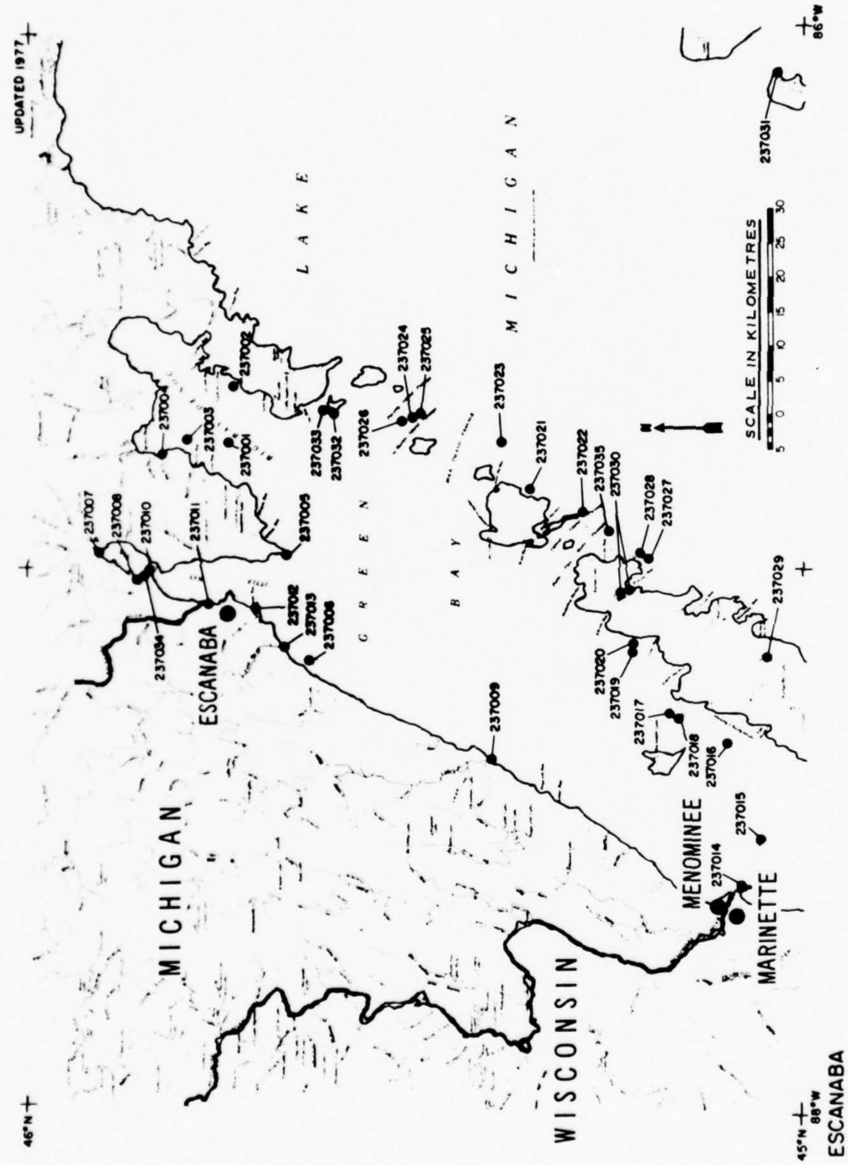

MICHIGAN
WISCONSIN
ESCANABA
MENOMINEE
MARINETTE
GREEN BAY
LAKE MICHIGAN
SCALE IN KILOMETRES
UPDATED 1977
46°N
45°N 88°W
86°W
237001
237002
237003
237004
237005
237006
237007
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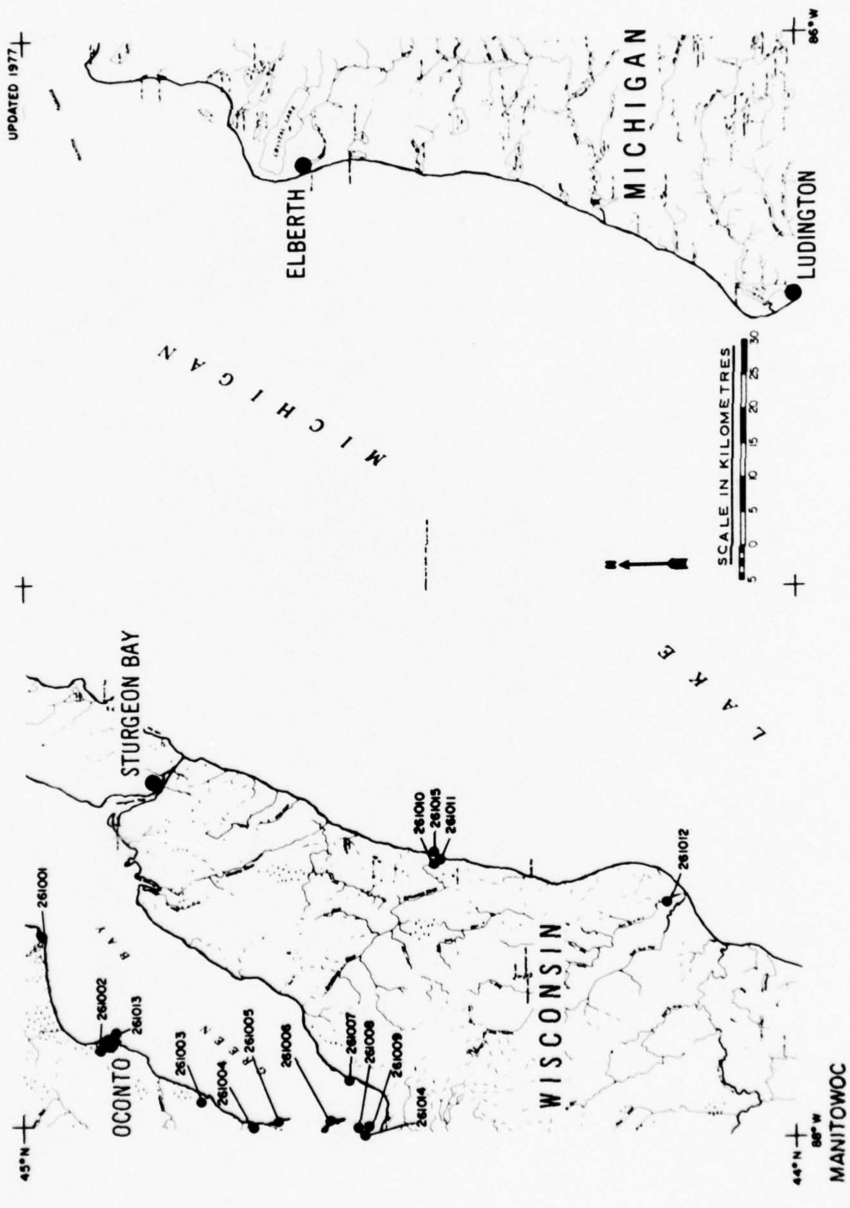
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MANITOWOC
WISCONSIN
GREEN BAY
LAKE MICHIGAN
ELBERTH
MICHIGAN
LUDINGTON
SCALE IN KILOMETRES
5 0 5 10 15 20 25 30
261001
261002
261013
261003
261004
261005
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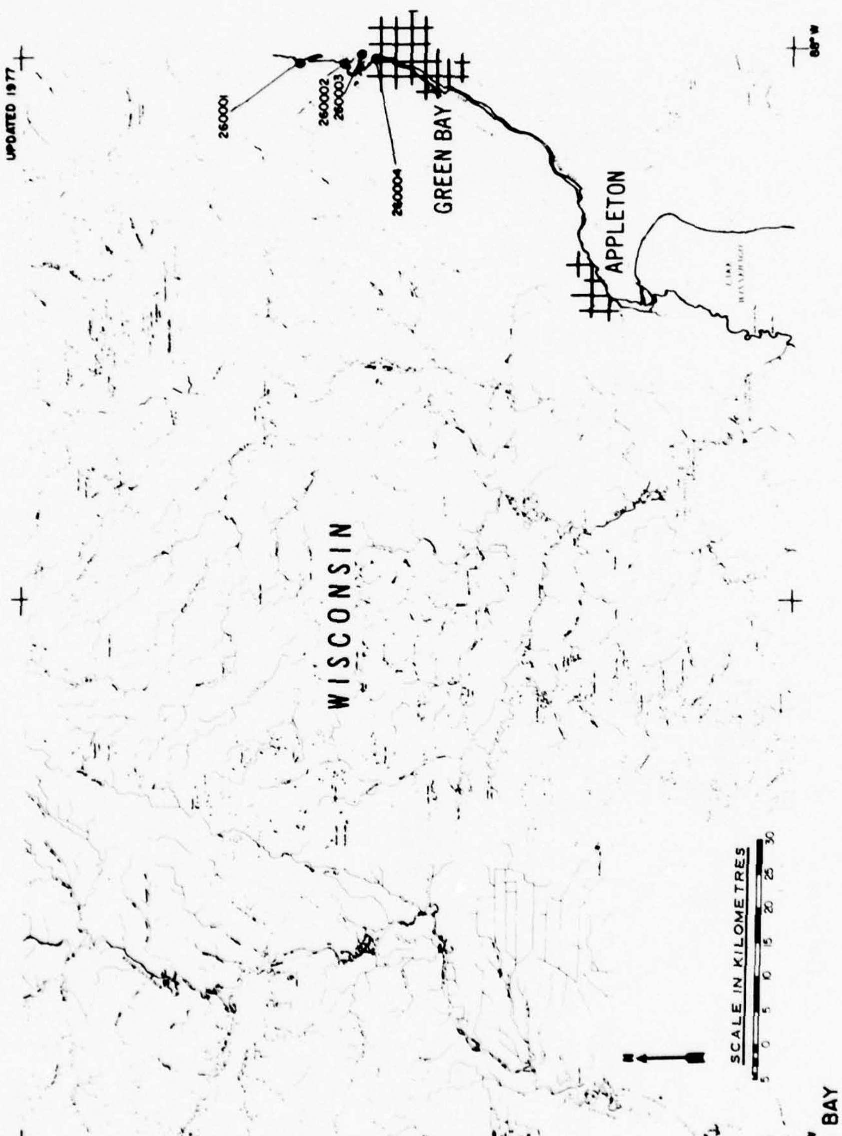
261012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260002
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260004
GREEN BAY
APPLETON
WISCONSIN
SCALE IN KILOMETRES
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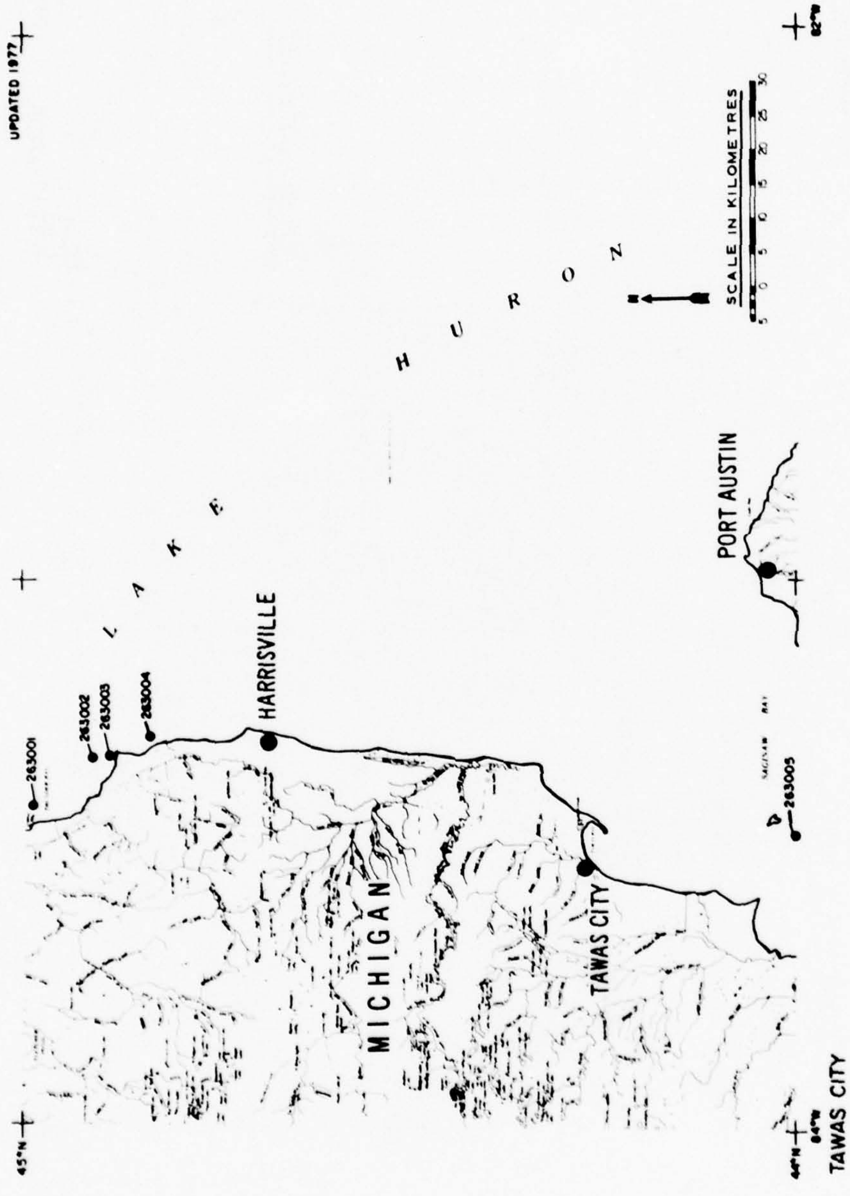
45°N
44°N
90°W
88°W
GREEN BAY



UPDATED 1977
45°N
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82°W
LAKE HURON
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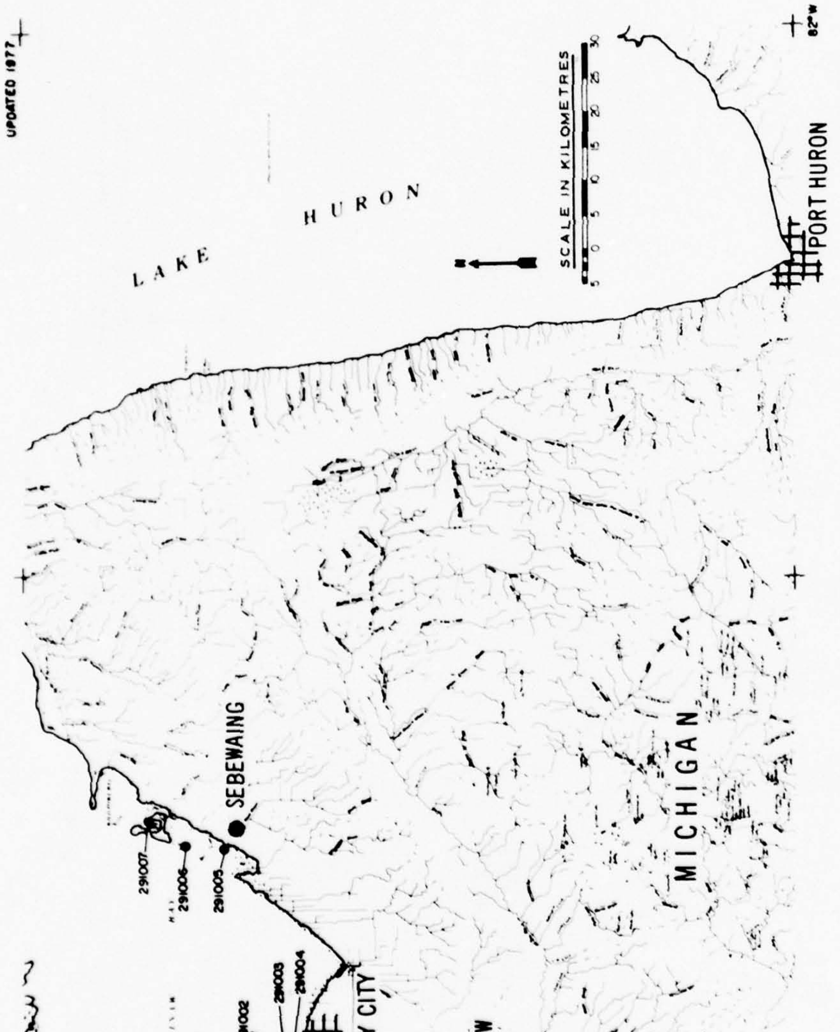
HARRISVILLE
TAWAS CITY
PORT AUSTIN
263001
263002
263003
263004
263005
SCALE IN KILOMETRES
TAWAS CITY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LAKE HURON
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PORT HURON
82°W
44°N
43°N
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BAY CITY
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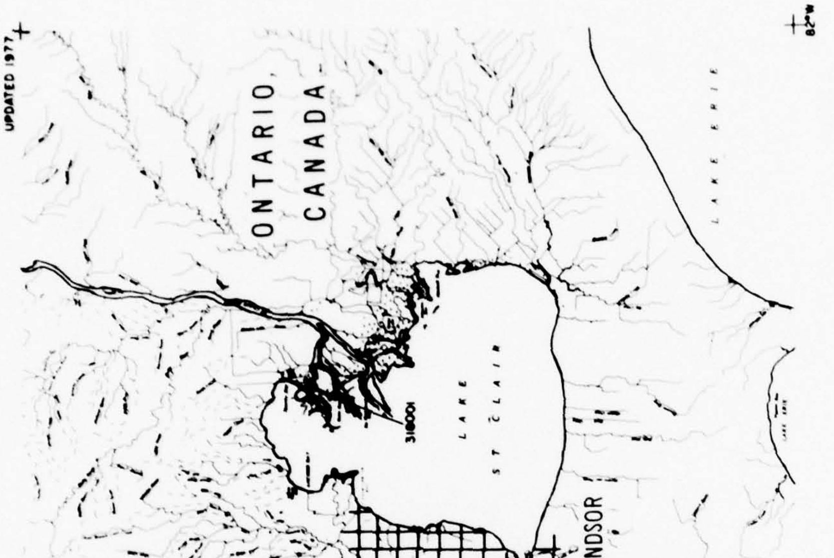
291003
291004
291005
291006
291007
SEBEWAING
MICHIGAN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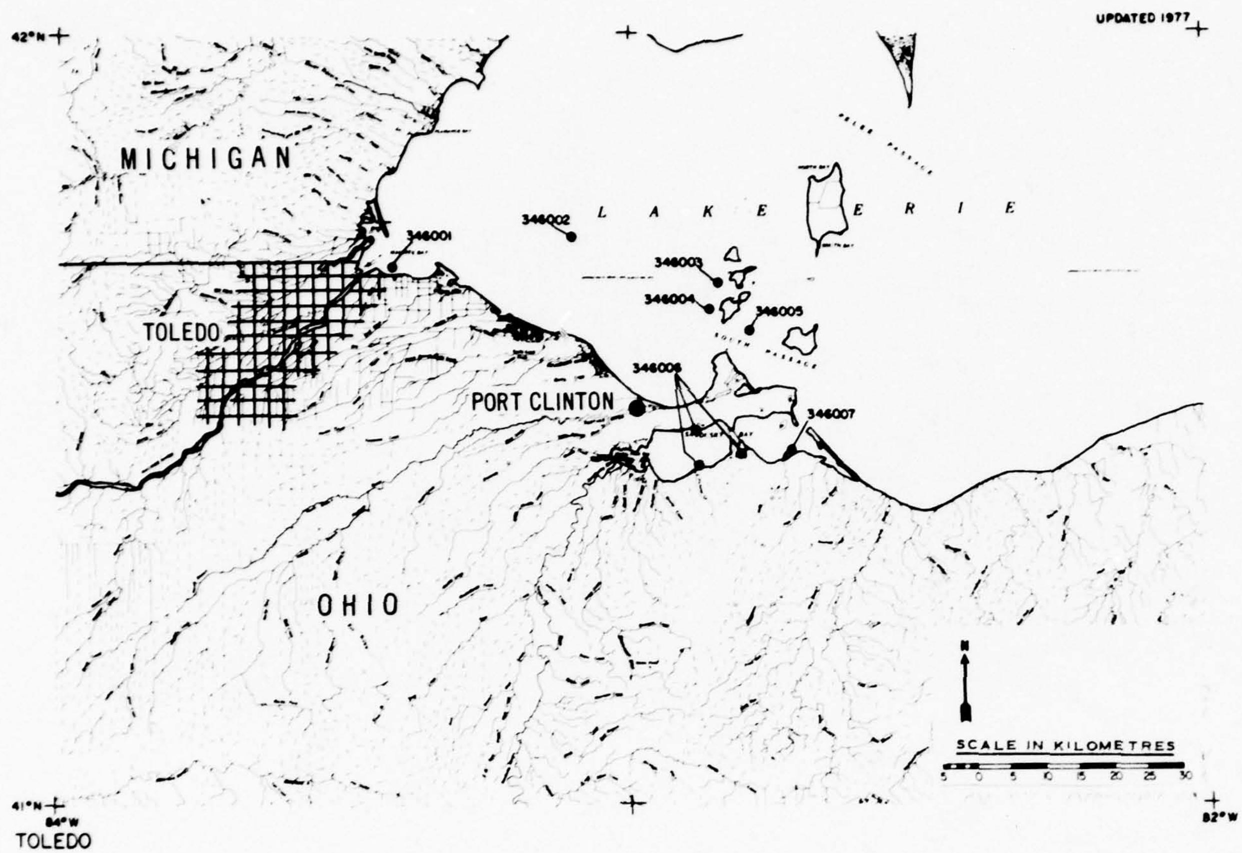
ONTARIO, CANADA
LAKE ST CLAIR
318001
318002
318003
318004
WINDSOR
DETROIT
DETROIT RIVER
LAKE ERIE
SCALE IN KILOMETRES
43°N
42°N
84°W
82°W
DETROIT



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42°N
MICHIGAN
TOLEDO
PORT CLINTON
OHIO
LAKE ERIE
346001
346002
346003
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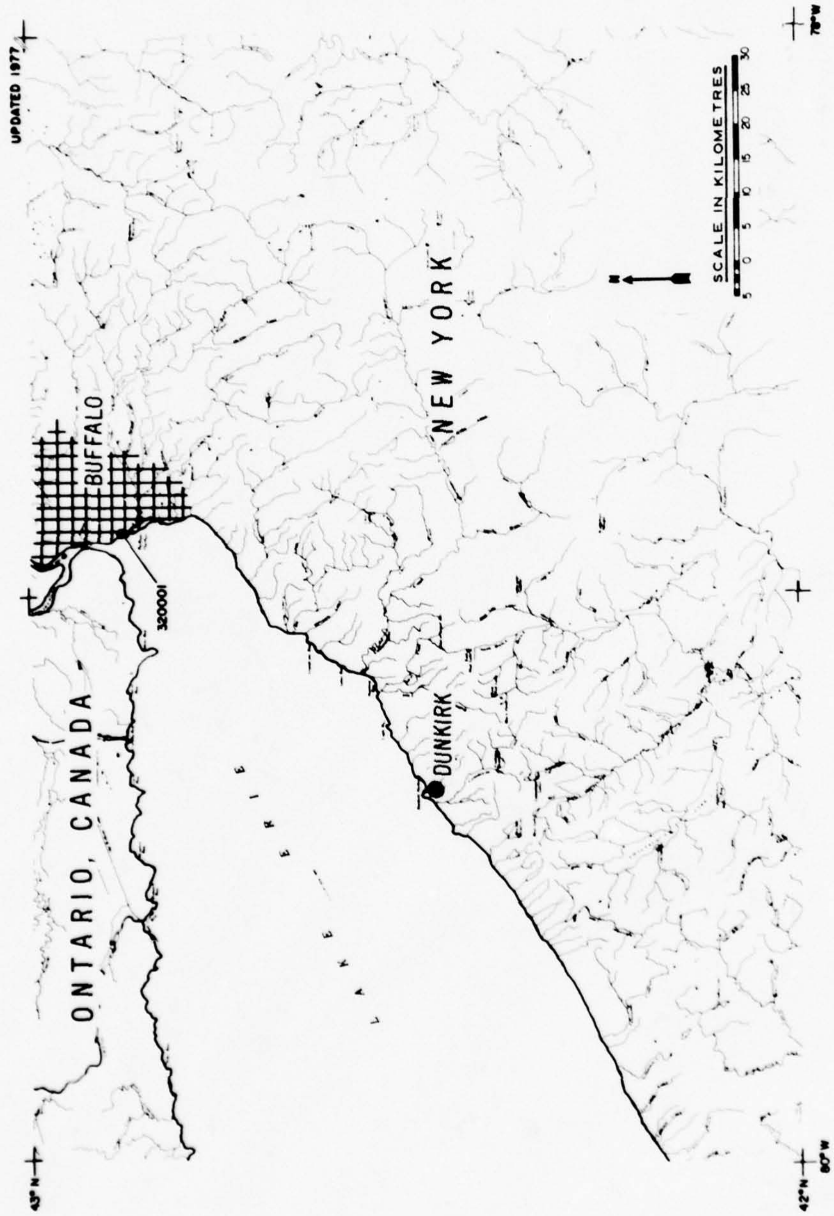
346006
346007
N
SCALE IN KILOMETRES
5 0 5 10 15 20 25 30
41°N
84°W
82°W
TOLEDO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ONTARIO, CANADA
BUFFALO
320001
LAKE ERIE
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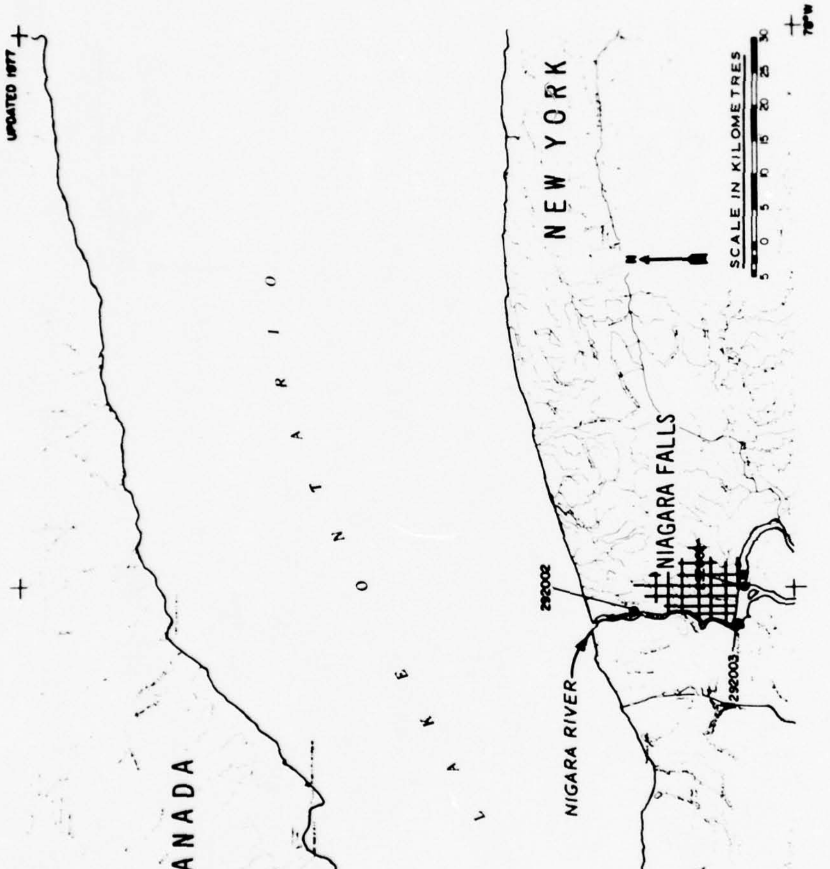
NEW YORK
SCALE IN KILOMETRES
5 0 5 10 15 20 25 30
43°N
42°N
80°W
78°W
BUFFALO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ONTARIO, CANADA
L A K E O N T A R I O
NEW YORK
NIAGARA FALLS
292002
292003
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ONTARIO, CANADA
43°N
80°W
TORONTO
78°W
N
SCALE IN KILOMETRES
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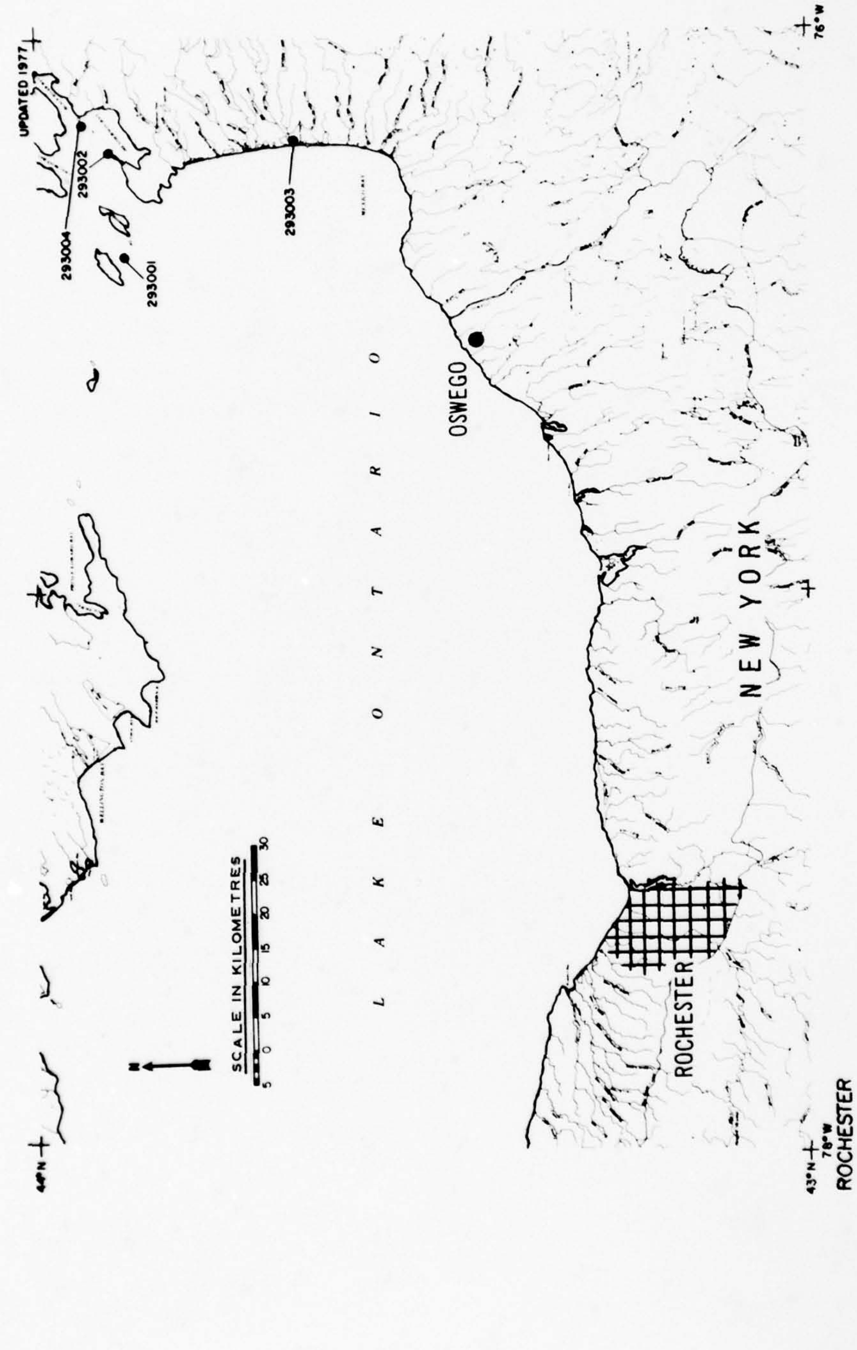
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293004
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76°W
LAKE ONTARIO
OSWEGO
NEW YORK
ROCHESTER
SCALE IN KILOMETRES
5 0 5 10 15 20 25 30
43°N
78°W
ROCHESTER

APPENDIX B: LIST OF SCIENTIFIC NAMES OF PLANTS USED IN THIS REPORT

SCIENTIFIC NAME	COMMON NAME
FERNS	
Polypodiaceae sp.	Fern
GRASSES	
Agropyron dasystachyum	agropyron
Agropyron repens	witch-grass
Agropyron trachycaulum	agropyron
Ammophila breviligulata	beach grass
Bromus japonicus	brome-grass
Bromus tectorum	brome-grass
Elymus canadensis	wild rye
Glyceria grandis	reed-meadow grass
Hordeum jubatum	squirrel-tail grass
Hystrix patula	bottle-brush grass
Lolium perenne	common darnel
Phleum pratense	common timothy
Phragmites communis	reed
Poa compressa	Canada bluegrass
Poa pratensis	june grass
Poa sp.	meadow grass
HERBS	
Achillea millefolium	common yarrow
Alyssum alyssoides	alyssum
Ambrosia sp.	ragweed

SCIENTIFIC NAME	COMMON NAME
HERBS (continued)	
Aquilegia canadensis	wild columbine
Arctium sp.	burdock
Artium minus	common burdock
Artemisia absinthium	worm wood
Artemisia caudata	worm wood
Asclepias syriaca	common milkweed
Aster sp.	aster
Barbarea vulgaris	common winter-cress
Brassica juncea	Chinese mustard
Brassica nigra	black mustard
Cakile edentula	sea rocket
Campanula rotundifolia	harebell
Capsella bursa-pastoris	pickpocket
Carduus nutans	musk thistle
Centaurea maculosa	spotted star-thistle
Chenopodium album	pigweed
Chrysanthemum leucanthemum	field daisy
Cichorium intybus	common chicory
Cirsium arvense	Canada Thistle
Unidentified crucifer	mustard
Daucus carota	wild carrot
Echinocystis lobata	wild cucumber
Epilobium augustifolium	great willow-herb
Erigeron philadelphicus	fleabane
Eupatorium perfoliatum	thoroughwort
Galium aparine	cleavers

SCIENTIFIC NAME	COMMON NAME
HERBS (continued)	
Galium boreale	northern bedstraw
Geranium robertianum	herb-Robert
Geum virginianum	rough avens
Glecoma hederacea	gill-over-the-ground
Hepatica acutiloba	liverleaf
Heracleum maximum	masterwort
Hieracium aurantiacum	orange hawkweed
Impatiens capensis	spotted touch-me-not
Impatiens sp.	balsam
Ipomoea sp.	morning-glory
Lactuca canadensis	lettuce
Lathyrus japonicus	beach-pea
Leonurus cardiaca	common motherwort
Lepidium campestre	cow-cress
Lepidium virginicum	poor-man's pepper
Linaria vulgaris	butter and eggs
Lychnis alba	white campion
Lythrum salicaria	Spiked loosestrife
Matricaria matricarioides	pineapple-weed
Melilotus alba	white melilot
Melilotus officinalis	yellow melilot
Nepeta cataria	catnip
Oenothera biennis	evening primrose
Parthenocissus quinquefolia	Virginia creeper
Pastinaca sativa	parsnip
Phytolacca americana	poke

SCIENTIFIC NAME	COMMON NAME
HERBS (continued)	
Plantago major	common plantain
Polygonum lapathifolium	smartweed
Potentilla anserina	silverweed
Potentilla arguta	tall cinquefoil
Potentilla norvegica	cinquefoil
Rorippa islandica	yellow-cress
Rubus idaeus var. *strigosus*	raspberry
Rumex acetosella	sheep-sorrel
Rumex crispus	yellow dock
Rumex mexicanus	curly-leafed dock
Silene noctiflora	night-flowering catchfly
Sisymbrium altissimum	tumble-mustard
Smilacina stellata	false Solomon's-seal
Solanum dulcamara	bittersweet
Solidago racemosa	goldenrod
Solidago sp.	goldenrod
Sonchus arvensis	field-sow thistle
Stellaria media	common chickweed
Tanacetum vulgare	common tansy
Taraxacum officinale	common dandelion
Thlaspi arvense	field penny-cress
Tragopogon major	goat's-beard
Trifolium agrarium	yellow clover
Trifolium pratense	red clover
Urtica dioica	stinging nettle

SCIENTIFIC NAME	COMMON NAME
HERBS (continued)	
Verbascum thapsus	common mullein
Vicia americana	vetch
Vitis riparia	river-bank grape
RUSHES AND FALSE RUSHES	
Equisetum sp.	horsetail
Juncus sp.	rush
SEDGES	
Carex sp.	sedge
SHRUBS	
Cornus stolonifera	red-osier dogwood
Juniperus horizontalis	creeping savin
Physocarpus opulifolius	ninebark
Ribes hirtellum	gooseberry
Rhus radicans	poison ivy
Rhus typhina	staghorn sumac
Rosa sp.	rose
Salix interior	sandbar willow
Sambucus canadensis	common elder
Sambucus pubens	red-berried elder
TREES	
Acer negundo	box elder

SCIENTIFIC NAME	COMMON NAME
TREES (continued)	
Acer saccharum	sugar maple
Amelanchier laevis	juneberry
Fraxinus americana	white ash
Morus rubra	red mulberry
Populus balsamifera	balsam popular
Populus deltoides	eastern cottonwood
Populus tremuloides	quaking Aspen
Prunus pumila	sand cherry
Prunus virginiana	choke cherry
Pyrus americana	American mountain ash
Salix amygadaloides	peach-leaved willow
Thuja occidentalis	arborvitae
Prunus americana	plum

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Scharf, William C

Colonial birds nesting on man-made and natural sites in the U. S. Great Lakes / by William C. Scharf, Northwestern Michigan College, Traverse City, Mich. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.

136, [189] p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; D-78-10)

Prepared for U. S. Fish and Wildlife Service, Washington, D. C., and Office, Chief of Engineers, U. S. Army, Washington, D. C., under Contract No. USFWS-CE7-255, Coastal Ecosystems Project, Biological Services Program (DMRP Work Unit No. 4F01A)

Monitored by National Coastal Ecosystems Team, Office of Biological Services, U. S. Fish and Wildlife Service, National Space Technology Laboratories, NSTL Station, Miss., and Dredged Material Research Program, Environmental Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Appendixes C-E on microfiche in pocket.

FWS/OBS-78/15.

References: p. 134-136.

(Continued on next card)

Scharf, William C

Colonial birds nesting on man-made and natural sites in the U. S. Great Lakes ... 1978. (Card 2)

1. Birds. 2. Great Lakes. 3. Habitats. 4. Nesting. 5. Vegetation. I. Northwestern Michigan College. II. United States. Army. Corps of Engineers. III. United States. Fish and Wildlife Service. IV. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; D-78-10.

TA7.W34 no.D-78-10

APPENDIX C: RELATIVE VALUES OF PLANTS IN SAMPLE AREAS AT 23 INTENSIVELY STUDIED SITES

Table C1

Relative Values of Plants in Sample Area

Duluth Port Authority

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Common Tern (Transect 1)*			
Arctium sp.	2	3	8
Artemesia caudata	24	8	18
Chenopodium album	1	3	6
Hordeum jubatum	2	1	2
Melilotus alba	31	61	24
Oenothera biennis	1	5	2
Polygonum lapthifolium	32	10	18
Sisymbrium altissimum	6	9	22
Ring-billed Gull (Transect 1)**			
Agropyron repens	1	1	3
Arctium sp.	14	18	23
Artemesia caudata	9	3	8
Barbarea vulgaris	2	6	8
Chenopodium album	2	2	5
Lactuca canadensis	+	1	3
Melilotus alba	26	56	23
Polygonum lapathifolium	43	9	18
Salix interior	+	1	3

(Continued)

Note: + = trace.
* Twenty 1 m^2 quadrats were sampled.
** Ten 1 m^2 quadrats were sampled.

Table C1 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1 (continued))			
Sisymbrium altissimum	+	1	3
Trifolium agrarium	1	2	3
Ring-billed Gull (Transect 2)*			
Agropyron repens	1	1	3
Arctium sp.	31	26	25
Barbarea vulgaris	1	1	5
Chenopodium album	2	4	15
Lactuca canadensis	+	1	3
Melilotus alba	23	46	25
Oenothera biennis	2	3	5
Polygonum lapathifolium	39	17	18
Salix interior	+	1	3
Sisymbrium altissimum	1	1	3

* Ten 1 m^2 quadrats were sampled.

Table C2

Relative Values of Plants in Sample Area

Minnesota Power and Light Company

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Achillea millefolium	1	3	9
Agropyron repens	75	47	26
Ambrosia sp.	1	5	9
Artemesia caudata	1	3	9
Matricaria matricarioides	+	1	4
Poa pratensis	11	5	13
Rubus idaeus var. strigosus	1	10	4
Sisymbrium altissimum	+	2	4
Tanacetum vulgare	3	16	9
Ring-billed Gull (Transect 2)*			
Agropyron repens	84	50	31
Ambrosia sp.	3	10	15
Artemesia caudata	4	25	15
Asclepias syriaca	+	2	8
Cirsium arvense	+	2	8
Matricaria matricarioides	+	2	8
Poa pratensis	8	2	8
Sisymbrium altissimum	0	8	8

(continued)

Note: + = Trace.
* Eight 1 m^2 quadrats were sampled.

Table C2 (concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Ring-billed Gull (Transect 3)*		
Agropyron repens	61	12	33
Asclepias syriaca	2	12	11
Salix interior	13	45	33
Tanacetum vulgare	24	30	22
	Ring-billed Gull (Transect 4)**		
Agropyron repens	76	28	38
Asclepias syriaca	+	3	13
Rubus idaeus var. strigosus	4	10	13
Salix interior	9	25	25
Tanacetum vulgare	11	35	13

* Six 1 m^2 quadrats were sampled.
** Five 1 m^2 quadrats were sampled.

Table C3

Relative Values of Plants in Sample Area

Northwest Sugar Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Common Tern (Transect 1)*		
Achillea millefolium	1.1	1.4	5.4
Barbarea vulgaris	0.8	2.9	6.5
Carex sp.	0.04	0.1	1.1
Chenopodium album	0.6	0.8	3.3
Chrysanthemum leucanthemum	0.3	2.1	4.3
Cirsium arvense	1.1	2.9	6.5
Epilobium augustifolium	0.04	0.1	1.1
Equisetum sp.	12.4	20.6	7.6
Hieracium aurantiacum	0.4	0.3	3.3
Melilotus alba	0.6	1.6	6.5
Moss	0.04	2.6	1.1
Phleum pratense	0.8	1.0	2.2
Plantago major	0.6	1.3	3.3
Poa pratensis	55.8	24.1	12.0
Polygonum lapathifolium	16.7	22.3	7.6
Sisymbrium altissimum	0.2	0.4	3.3
Solidago sp.	4.5	9.5	7.6
Sonchus arvensis	2.2	4.4	7.6
Taraxacum officinale	0.7	0.5	1.1
Trifolium agrarium	0.1	0.2	1.1
Trifolium pratense	1.2	1.0	7.6

* Fourteen 1 m^2 quadrats were sampled.

Table C4

Relative Values of Plants in Sample Area

West Sugar Island II

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Common Tern (Transect 1)*			
Barbarea vulgaris	0.4	0.9	5.9
Carex sp.	4.0	1.9	8.8
Chenopodium album	3.3	6.4	10.3
Cirsium arvense	0.1	0.5	1.5
Juncus sp.	9.4	1.6	7.4
Melilotus alba	4.0	6.4	11.8
Plantago major	0.4	0.5	1.5
Poa pratensis	12.2	7.3	13.2
Polygonum lapathifolium	61.6	67.9	19.1
Sisymbrium altissimum	1.8	3.3	8.8
Taraxacum officinale	0.2	0.2	1.5
Trifolium agrarium	0.1	0.3	1.5
Trifolium pratense	2.6	2.8	8.8

* Fifteen 1 m^2 quadrats were sampled.

Table C5

Relative Values of Plants in Sample Area

West Sugar Island I

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Common Tern (Transect 1)*			
Acer Saccharum	0.3	0.2	3.7
Barbarea vulgaris	0.6	0.4	3.7
Carex sp.	0.6	1.5	3.7
Chenopodium album	10.9	0.9	7.4
Impatiens capensis	13.8	5.6	7.4
Poa pratensis	20.9	3.0	11.1
Polygonum lapathifolium	2.9	3.7	11.1
Populus balsamifera	7.4	1.3	3.7
Salix interior	34.1	79.3	37.0
Solanum dulcamara	0.6	0.6	3.7
Sonchus arvensis	7.4	3.2	3.7
Taraxacum officinale	0.6	0.2	3.7

* Twelve 1 m^2 quadrats were sampled.

Table C6

Relative Values of Plants in Sample Area

Moon Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1, Pre-existing Area)*			
Agropyron repens	57.2	18.2	22.9
Asclepias syriaca	0.2	1.2	5.7
Chenopodium album	20.8	50.3	34.3
Melilotus alba	1.5	8.0	2.9
Phragmites communis	19.4	21.2	28.6
Urtica dioica	0.9	1.2	5.7
Ring-billed Gull (Transect 2, Pre-existing Area)**			
Populus tremuloides	13.6	15.8	67.0
Sambucus pubens	86.4	84.2	33.0

(Continued)

* Twenty-four 1 m^2 quadrats were sampled.
** Two 16 m^2 quadrats were sampled.

Table C6 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 3, New Area)*			
Carex sp.	1.7	0.6	3.3
Chenopodium album	2.5	4.0	10.0
Eupatorium perfoliatum	1.2	1.7	10.0
Glyceria grandis	44.6	5.2	6.7
Impatiens capensis	0.4	0.6	3.3
Juncus sp.	3.7	0.6	3.3
Matricaria matricarioides	0.4	0.6	3.3
Phragmites communis	17.4	64.4	23.3
Plantago major	1.7	5.7	3.3
Poa pratensis	12.0	1.7	6.7
Potentilla arguta	0.4	0.6	3.3
Trifolium pratense	1.7	1.1	6.7
Urtica dioica	12.0	7.5	13.3
Verbascum thapsus	0.4	5.7	3.3
Ring-billed Gull (Transect 4, New Area)**			
Cornus stolonifera	17.6	16.7	25.0
Salix amygdaloides	82.3	83.3	75.0

* Nine 1 m^2 quadrats were sampled.
** Four 16 m^2 quadrats were sampled.

Table C7

Relative Values of Plants in Sample Area

Southwest Neebish Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Phragmites communis	73.2	53.3	60.9
Urtica dioica	26.8	46.7	39.1
Ring-billed Gull (Transect 1)**			
Cornus stolonifera	0.9	5.8	25.0
Salix interior	83.0	82.6	50.0
Sambucus pubens	11.1	11.6	25.0

* Fifteeen 1 m^2 quadrats were sampled.
** Two 16 m^2 quadrats were sampled.

Table C8

Relative Values of Plants in Sample Area

Southeast Neebish Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Barbarea vulgaris	0.4	2.8	6.4
Brassica nigra	7.9	23.8	14.9
Capsella bursa-pastoris	0.1	0.4	6.4
Chenopodium album	0.02	0.3	2.1
Chrysanthemum leucanthemum	0.7	2.0	6.4
Erigeron philadephicus	0.02	0.1	2.1
Phleum pratense	6.8	16.2	19.1
Poa pratensis	80.6	48.9	21.9
Polygonum lapathifolium	0.05	0.4	2.1
Rumex acetosella	3.0	3.2	10.6
Taraxacum officinale	0.3	1.5	6.4
Thlaspi arvense	0.05	0.3	2.1
Common Tern (Transect 1)*			
Brassira nigra	0.6	3.4	9.1
Chrysanthemum leucanthemum	0.9	7.6	13.6
Phleum pratense	9.5	11.7	13.6
Poa pratensis	88.2	66.2	36.4

(Continued)

* Ten 1 m^2 quadrats were sampled

Table C8 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Common Tern (Transect 1 (Continued))			
Thlaspi arvense	0.02	0.1	4.5
Trifolium agrarium	0.1	1.4	4.5
Trifolium pratense	0.6	9.6	18.2

Table C9

Relative Values of Plants in Sample Area

Willow Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Black-crowned Night Heron (Transect 1)*		
Salix interior	100	100	100
	Black-crowned Night Heron (Transect 2)**		
Acer negundo	+	+	7
Populus deltoides	30	32	33
Salix amygdaloides	5	10	27
Salix interior	64	58	33
	Black-crowned Night Heron (Transect 3)**		
Acer negundo	1	+	7
Cornus stolonifera	+	+	7
Populus deltoides	6	4	20
Salix amygdaloides	3	32	33
Salix interior	89	64	33

Note: + = Trace.

* Ten 1 m^2 quadrats were sampled.

** Five 16 m^2 quadrats were sampled.

Table C10

Relative Values of Plants in Sample Area

Lone Tree Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Common Tern (Transect 1)*			
Asclepias syriaca	2	2	4
Chenopodium album	3	5	14
Cirsium arvense	+	+	4
Cornus stolonifera	1	2	4
Echinocystis lobata	48	52	29
Impatiens capensis	20	13	11
Ipomoea sp.	8	1	4
Sambucus canadensis	2	8	4
Solanum dulcamara	1	1	4
Urtica dioica	17	16	25
Ring-billed Gull (Transect 1)**			
Arctium minus	1	10	4
Chenopodium album	1	1	4
Cirsium arvense	1	1	4
Unidentified crucifer	2	3	4
Echinocystis lobata	30	37	24
Impatiens capensis	5	3	4
Lythrum salicaria	1	2	4
Parthenocissus quinquefolia	5	2	12

(Continued)

Note: + = Trace
* Ten 1 m^2 quadrats were sampled.
** Thirteen 1 m^2 quadrats were sampled.

Table C10 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1 (Continued))			
Polygonum lapathifolium	1	1	4
Solanum dulcamara	24	19	8
Urtica dioica	2	1	8

Table C11

Relative Values of Plants in Sample Area

South Manitou Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Herring Gull (Transect 1)*			
Artemisia caudata	2	16	18
Bromus tectorum	64	38	27
Chenopodium album	+	3	4
Lychnis alba	+	1	3
Melilotus alba	+	4	6
Poa compressa	27	32	18
Rumex acetosella	6	4	6
Sisymbrium altissimum	+	1	6
Thlaspi arvense	+	1	3
Tragopogon major	+	1	3
Herring Gull (Transect 2)**			
Agropyron dasystachyum	19	8	18
Ammophila breviligulata	73	66	36
Artemisia caudata	+	1	4
Cakile edentula	8	24	36
Lathyrus japonicus	+	1	7

(Continued)

Note: + = Trace.
* Eleven 1 m^2 quadrats were sampled.
** Ten 1 m^2 quadrats were sampled.

Table C11 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Agropyron dasystachyum	19	13	22
Ammophila breviligulata	73	56	48
Asclepias syriaca	+	2	4
Cakile edentula	4	16	13
Prunus pumila	1	3	4
Rhus radicans	2	10	9
Ring-billed Gull (Transect 2)**			
Agropyron dasystachyum	29	19	13
Ammophila breviligulata	68	73	68
Bromus tectorum	3	8	25
Ring-billed Gull (Transect 3)**			
Bromus tectorum	50	22	20
Chenopodium album	14	16	24
Juniperus horizontalis	7	24	15
Sisymbrium altissimum	3	15	20
Thlaspi arvense	27	23	22

Note: + = Trace.
* Twelve 1 m^2 quadrats were sampled.
** Ten 1 m^2 quadrats were sampled.

Table C12

Relative Values of Plants in Sample Area

Bellows Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Herring Gull (Transect 1)*			
Prunus virginiana	16	7	20
Sambucus pubens	84	93	80
Herring Gull (Transect 1)**			
Arctium minus	+	4	4
Bromus tectorum	42	16	14
Chenopodium album	5	2	8
Geranium robertianum	1	1	4
Glecoma hederacea	1	1	4
Leonurus cardiaca	2	3	6
Lychnis alba	17	12	12
Phytolacca americana	1	2	4
Poa pratensis	2	3	6
Sambucus pubens	4	36	16
Solanum dulcamara	4	6	6
Urtica dioica	15	17	18
Herring Gull (Transect 2)+			
Salix interior	100	100	100

(Continued)

Note: + = Trace.
* Ten 16 m^2 quadrats were sampled.
** Ten 1 m^2 quadrats were sampled
\+ One 16 m^2 quadrat was sampled.

(Sheet 1 of 4)

Table C12 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 2)*		
Chenopodium album	7	2	6
Geranium robertianum	6	2	11
Glecoma hederacea	2	2	6
Heracleum maximum	6	8	11
Impatiens capensis	14	8	17
Lactuca canadensis	1	+	6
Polygonum lapthifolium	1	2	6
Salix interior	48	58	17
Solanum dulcamara	5	4	11
Urtica dioica	11	14	11
	Herring Gull (Transect 3)**		
Agropyron repens	92	64	24
Alyssum alyssoides	3	7	10
Ambrosia sp.	+	+	3
Arctium minus	+	1	3
Barbarea vulgaris	+	1	7
Centaurea maculosa	1	5	10
Geranium robertianum	+	+	3
Glecoma hederacea	+	4	10

(Continued)

* Three 1 m^2 quadrats were sampled.
** Ten 1 m^2 quadrats were sampled.

(Sheet 2 of 4)

Table C12 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 3 (Continued))		
Lychnis alba	2	11	14
Nepeta cataria	+	1	7
Urtica dioica	1	6	7
	Herring Gull (Transect 4)*		
Agropyron repens	+	1	2
Ambrosia sp.	14	5	12
Bromus tectorum	1	+	2
Capsella bursa-pastoris	4	1	4
Centaurea maculosa	7	15	6
Chenopodium album	7	4	10
Elymus canadensis	1	1	2
Glecoma hederacea	1	4	10
Lactuca canadensis	1	2	10
Lychnis alba	+	1	2
Nepeta cataria	13	13	16
Poa pratensis	25	14	6
Polygonum lapthifolium	11	10	20
Potentilla anserina	2	7	4
Solanum dulcamara	+	1	4

(Continued)

* Seventeen 1 m^2 quadrats were sampled.

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Table C12 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Herring Gull (Transect 4 (Continued))			
Urtica dioica	12	20	8

(Sheet 4 of 4)

Table C13

Relative Values of Plants in Sample Area

High Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Common Tern (Transect 1)*			
Agropyron dasystachyum	37	24	30
Ammophila breviligulata	36	39	15
Artemisia absinthium	4	8	19
Campanula rotundifolia	1	2	8
Cornus stolonifera	1	3	1
Elymus canadensis	20	18	14
Prunus pumila	1	5	7
Rhus radicans	+	+	1
Rosa sp.	1	1	4
Ring-billed Gull (Transect 1)**			
Ammophila breviligulata	88	71	57
Cornus stolonifera	94	63	83
Ring-billed Gull (Transect 2)+			
Ammophila breviligulata	12	29	43
Cornus stolonifera	6	37	17

Note: + = Trace.
* Thirty-five 1 m^2 quadrats were sampled.
** Nine 1 m^2 quadrats were sampled.
+ Eight 1 m^2 quadrats were sampled.

Table C14

Relative Values of Plants in Sample Area

East Grape Island

Plant Species	Relative Desity	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Cornus stolonifera	63	57	38
Physocarpus opulifolius	7	7	13
Sambucus pubens	3	4	13
Thuja occidentalis	17	22	25
Vitis riparia	10	9	13
Ring-billed Gull (Transect 1)**			
No herbaceous vegetation.			
Ring-billed Gull (Transect 2)*			
Amelanchier laevis	4	5	11
Cornus stolonifera	32	64	33
Salix interior	14	8	22
Solanum dulcamara	4	5	11
Vitis riparia	46	18	22
Ring-billed Gull (Transect 2)+			
Asclepias syriaca	22	22	25

(Continued)

* Four 16 m^2 quadrats were sampled.
** Nine 1 m^2 quadrats were sampled.
\+ Eight 1 m^2 quadrats were sampled.

Table C14 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Ring-billed Gull (Transect 2 (Continued))		
Poa sp.	13	13	13
Potentilla norvegica	3	4	6
Rhus radicans	15	13	13
Rorippa islandica	3	1	6
Rubus idaeus var. *strigosus*	10	18	13
Rumex crispus	3	1	6
Smilacina stellata	33	27	19

Table C15

Relative Values of Plants in Sample Area

West Grape Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Fraxinus americana	3	14	8
Prunus virginiana	33	14	8
Pyrus americana	18	19	15
Ribes hirtellum	3	1	8
Sambucus pubens	18	17	23
Thuja occidentalis	18	25	23
Vitis riparia	10	11	15
Ring-billed Gull (Transect 1)**			
No herbaceous vegetation.			
Ring-billed Gull (Transect 2)+			
Cornus stolonifera	3	2	5
Fraxinus americana	5	2	5
Prunus virginiana	52	42	32
Rhus typhina	4	5	16
Sambucus pubens	10	11	11
Thuja occidentalis	16	30	16
Vitis riparia	8	6	16

(Continued)

* Four 16 m^2 quadrats were sampled.
** Eight 1 m^2 quadrats were sampled.
\+ Seven 16 m^2 quadrats were sampled.

(Sheet 1 of 4)

Table C15 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Ring-billed Gull (Transect 2)*		
Artemisia caudata	56	71	20
Carex sp.	6	4	20
Geranium robertianum	11	4	20
Geum virginianum	22	18	20
Rumex crispus	6	4	20
	Ring-billed Gull (Transect 3)**		
Cornus stolonifera	7	10	6
Ipomoea sp.	22	11	17
Prunus virginiana	35	62	28
Rhus typhina	8	5	11
Sambucus pubens	6	3	11
Thuja occidentalis	11	4	17
Vitis riparia	11	5	11

Ring-billed Gull (Transect 3)+

No herbaceous vegetation.

(Continued)

Note: + = Trace.
* Fourteen 1 m^2 quadrats were sampled.
** Six 16 m^2 quadrats were sampled.
\+ Twelve 1 m^2 quadrats were sampled. (Sheet 2 of 4)

Table C15 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Area with No Nests (Transect 4)*		
Cornus stolonifera	4	3	4
Fraxinus americana	6	18	12
Prunus virginiana	71	56	44
Ribes hirtellum	1	1	4
Rubus idaeus var. strigosus	1	+	4
Sambucus pubens	8	11	16
Thuja occidentalis	6	10	12
Vitis riparia	3	1	4
	Area with No Nests (Transect 4)**		
Arctium minus	1	1	1
Artemisia caudata	17	21	11
Galium aparine	8	4	10
Geranium robertianum	18	13	17
Gramineae (unidentified)	11	3	10
Hepatica acutiloba	4	3	4
Heracleum maximum	+	1	1
Impatiens sp.	8	5	7
Polypodiaceae (unidentified)	1	1	2
Prunus virginiana	21	29	17

(Continued)

* Twelve 16 m^2 quadrats were sampled.
** Twenty-two 1 m^2 quadrats were sampled. (Sheet 3 of 4)

Table C15 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Area with No Nests (Transect 4 (continued))			
Rhus radicans	2	2	1
Ribes hirtellum	1	1	2
Rubus idaeus var. strigosus	3	5	6
Sambucus pubens	3	8	4
Smilacina stellata	3	1	7

(Sheet 4 of 4)

Table C16

Relative Values of Plants in Sample Area

Hat Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 1)*		
Achillea millefolium	1	4	9
Agropyron repens	1	1	3
Agropyron trachycaulum	2	6	9
Brassica juncea	+	4	7
Bromus tectorum	56	43	15
Geum virginianum	+	1	4
Lepidium compestre	1	16	16
Lepidium virginicum	+	1	1
Lychnis alba	+	1	4
Phleum pratense	10	11	7
Poa pratensis	28	7	12
Rumex crispus	+	+	1
Taraxacum officinale	1	4	9
	Herring Gull (Transect 2)**		
Achillea millefolium	+	1	2
Agropyron trachycaulum	3	6	14
Artemsia caudata	2	11	14
Brassica juncea	+	4	5
Bromus tectorum	48	30	11

(Continued)

Note: + = Trace.
* Sixteen 1 m^2 quadrats were sampled.
** Fourteen 1 m^2 quadrats were sampled. (Sheet 1 of 7)

Table C16 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 2 (Continued))		
Cornus stolonifera	+	2	2
Lepidium campestre	+	2	2
Lepidium virginicum	+	1	2
Lychnis alba	1	7	16
Poa pratensis	43	20	16
Rhus radicans	1	6	7
Rosa sp.	+	5	5
Silene noctiflora	+	2	2
Sisymbrium altissimum	+	1	2
	Herring Gull (Transect 3)*		
Agropyron trachycaulum	21	16	10
Bromus tectorum	45	13	17
Capsella bursa-pastoris	1	1	3
Cornus stolonifera	9	42	13
Geranium robertianum	3	1	3
Lychnis alba	1	1	3
Pastinaca sativa	9	14	23
Poa pratensis	5	7	13
Rubus idaeus var. strigosus	1	1	3

(Continued)

* Eleven 1 m^2 quadrats were sampled.

(Sheet 2 of 7)

Table C16 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 3 (Continued))		
Rumex crispus	4	2	7
Verbascum thapsus	1	1	3
	Herring Gull (Transect 4)*		
Achillea millefolium	3	2	4
Artemesia caudata	+	1	1
Brassica juncea	3	6	7
Cornus stolonifera	3	2	4
Galium aparina	+	+	1
Geranium robertianum	2	2	3
Geum virginianum	+	+	1
Lepidium campestre	12	15	7
Lychnis alba	2	3	4
Nepeta cataria	+	1	1
Pastinaca sativa	10	21	15
Phleum pratense	20	6	10
Poa pratensis	23	6	8
Prunus virginiana	1	6	1
Rhus radicans	1	1	3
Rubus ideaus var. strigosa	1	2	3

(Continued)

* Twelve 1 m^2 quadrats were sampled. (Sheet 3 of 7)

Table C16 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Fequency
	Herring Gull (Transect 4 (Continued))		
Rumex crispus	4	14	3
Rumex mexicanus	2	3	7
Silene noctiflora	2	2	14
Sisymbrium altissimum	7	7	3
	Herring Gull (Transect 5)*		
Achillea millefolium	+	1	2
Brassica juncea	1	2	4
Chrysanthemum leucanthemum	2	2	9
Cornus stolonifera	1	1	2
Geranium robertianum	3	3	7
Geum virginianum	1	1	2
Lepidium campestre	4	7	9
Lepidium virginicum	2	3	2
Nepeta cataria	3	3	7
Pastinaca sativa	5	13	9
Phleum pratense	58	20	16
Poa pratensis	8	3	7
Rhus radicans	6	20	4
Rosa sp.	1	8	4

(Continued)

* Ten 1 m^2 quadrats were sampled. (Sheet 4 of 7)

Table C16 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 5 (Continued))		
Rumex crispus	2	3	4
Smilacina stellata	2	8	4
Taraxacum officinale	1	2	4
Verbascum thapsus	1	1	2
	Herring Gull (Transect 6)*		
Achillea millefolium	+	1	3
Agropyron repens	50	29	6
Arctium minus	+	+	3
Bromus tectorum	23	10	13
Cornus stolonifera	+	11	3
Galium aparine	+	1	3
Lepidium campestre	1	4	16
Nepeta cataria	+	1	3
Pastinaca sativa	1	8	9
Phleum pratense	1	2	6
Poa pratensis	22	11	13
Prunus virginiana	+	17	3
Rosa sp.	+	1	3
Rumex mexicanus	+	+	3

(Continued)

* Ten 1 m^2 quadrats were sampled. (Sheet 5 of 7)

Table C16 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 6 (Continued))		
Smilacina stellata	+	1	3
Taraxacum officinale	+	4	9
	Herring Gull (Transect 7)*		
Achillea millefolium	+	1	2
Agropyron tachycaulum	2	14	5
Aquilegia canadensis	+	+	1
Artemesia caudata	+	+	1
Bromus tectorum	7	2	3
Campanula rotundifolia	+	1	1
Capsella bursa-pastoris	+	3	4
Chrysanthemum leucoanthemum	+	+	1
Cornus stolonifera	1	1	6
Galium aparine	1	1	5
Geranium robertianum	+	+	2
Lepidium campestre	+	1	2
Lychnis alba	+	2	5
Nepeta cataria	+	1	3
Pastinaca sativa	1	3	8
Phleum pratense	57	17	12

(Continued)

* Thirty-nine 1 m^2 quadrats were sampled. (Sheet 6 of 7)

Table C16 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Herring Gull (Transect 7 (Continued))			
Poa pratensis	29	20	11
Prunus virginiana	1	24	8
Rhus radicans	+	2	4
Rhus typhina	+	1	3
Rosa sp.	+	2	3
Rubus idaeus var. strigosus	+	3	5
Rumex crispus	+	1	1
Sambucus pubens	+	2	2
Silene noctiflora	+	+	1
Taraxacum officinale	+	1	4

(Sheet 7 of 7)

Table C17

Relative Values of Plants in Sample Area

Channel Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Melilotus officinalis	64	28	43
Salix interior	36	72	57

* Ten 1 m^2 quadrats were sampled.

Table C18

Relative Values of Plants in Sample Area

Shelter Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Chenopodium album	5	13	19
Glecoma hederacea	13	15	19
Melilotus officinalis	26	19	25
Salix interior	56	54	38

* Ten 1 m^2 quadrats were sampled.

Table C19

Relative Values of Plants in Sample Area

Mud Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Ring-billed Gull (Transect 1)*		
Bromus tectorum	1	2	10
Capsella bursa-pastoris	2	6	6
Chenopodium album	23	20	24
Lactuca canadensis	2	2	8
Melilotus alba	66	53	31
Thlaspi arvense	6	16	20

* Fifteen 1 m^2 quadrats were sampled.

Table C20

Relative Values of Plants in Sample Area

Grassy Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Polygonum lapathifolium	100 [182/m^2]	100 [50%]	100 [1.0]
Ring-billed Gull (Transect 2)*			
Salix interior	100 [14/m^2]	100 [85%]	100 [1.0]
Ring-billed Gull (Transect 3)*			
Phragmites communis	100 [24/m^2]	100 [43%]	100 [1.0]

Note: Density, coverage and frequency values are indicated in brackets.

* Five 1 m^2 quadrats were sampled.

Table C21

Relative Values of Plants in Sample Area

Toledo Harbor Dike

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 1)*			
Lolium perenne	100 [$261/m^2$]	100 [40%]	100 [1.0]
Common Tern (Transect 1)*			
Polygonum lapathifolium	100 [$20/m^2$]	100 [22%]	100 [1.0]

Note: Density, coverage and frequency values are indicated in brackets.

* Five 1 m^2 quadrats were sampled.

Table C22

Relative Values of Plants in Sample Area

West Sister Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Great Blue Heron (Transect 1)*			
Arctium sp.	1	3	3
Elymus canadensis	45	15	14
Galium boreale	31	20	17
Impatiens capensis	6	15	14
Nepeta cataria	5	6	6
Phytolacca americana	2	5	6
Rhus radicans	2	14	17
Smilacina stellata	1	1	3
Solanum dulcamara	1	3	3
Stellaria media	2	1	3
Taraxacum officinale	+	2	6
Urtica dioica	5	15	9
Black-Crowned Night Heron (Transect 1)*			
Elymus canadensis	47	2	9
Hystrix patula	14	28	27
Nepeta cataria	12	37	18
Rhus radicans	1	6	9
Stellaria media	25	26	27
Urtica dioica	1	2	9

Note: + = Trace.
* Ten 1 m^2 quadrats were sampled.

Table C23

Relative Values of Plants in Sample Area

Sandusky Turn Point

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Herring Gull (Transect 1)*			
Morus rubra	100	100	100
Herring Gull (Transect 1)**			
Acer negundo	2	2	2
Arctium minus	2	2	6
Barbarea vulgaris	24	34	27
Bromus japonicum	2	1	2
Carduus nutans	16	20	16
Chenopodium album	3	2	4
Cichorium intybus	2	3	4
Ipomoea sp.	14	6	10
Lactuca canadensis	7	8	12
Nepeta cataria	5	3	6
Solidago sp.	20	11	6
Taraxacum officinale	+	1	2
Vitis riparia	+	3	5
Herring Gull (Transect 2)+			
Morus rubra	100	100	100

(Continued)

Note: + = Trace.
* One 16 m^2 quadrat was sampled.
** Sixteen 1 m^2 quadrats were sampled.
\+ Two 16 m^2 quadrats were sampled.

(Sheet 1 of 4)

Table C23 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 2)*		
Arctium minus	+	1	3
Asclepias syriaca	1	3	3
Aster sp.	9	6	3
Barbarea vulgaris	10	20	19
Carduus nutans	5	13	13
Chenopodium album	+	1	3
Cichorium intybus	2	4	6
Ipomoea sp.	+	1	3
Lactuca canadensis	2	6	13
Nepeta cataria	15	24	19
Pastinaca sativa	+	1	3
Solidago sp.	55	22	13
	Herring Gull (Transect 3)**		
Cornus stolonifera	33	7	50
Morus rubra	67	93	50

(Continued)

* Thirteen 1 m^2 quadrats were sampled.
** Four 16 m^2 quadrats were sampled.

(Sheet 2 of 4)

Table C23 (Continued)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
	Herring Gull (Transect 3)*		
Ambrosia sp.	3	2	4
Arctium minus	1	9	4
Barbarea vulgaris	11	23	15
Carduus nutans	25	5	15
Cichorium intybus	1	2	4
Lactuca canadensis	14	16	15
Nepeta cataria	3	3	4
Pastinaca sativa	13	20	19
Solidago sp.	11	5	4
Vitis riparia	20	16	19
	Herring Gull (Transect 4)**		
Morus rubra	50	70	50
Populus deltoides	50	30	50
	Herring Gull (Transect 4)+		
Arctium minus	3	20	16
Barbarea vulgaris	1	1	2
Bromus tectorum	40	9	6
Chenopodium album	4	3	6

(Continued)

* Ten 1 m^2 quadrats were sampled.
** One 16 m^2 quadrat was sampled.
\+ Twenty 1 m^2 quadrats were sampled.

(Sheet 3 of 4)

Table C23 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Herring Gull (Transect 4 (Continued))			
Cichorium intybus	2	3	6
Cirsium arvense	2	6	6
Daucus carota	6	8	10
Lactuca canadensis	3	3	4
Lepidium virginicum	7	1	2
Linaria vulgaris	5	2	4
Melilotus alba	2	6	4
Melilotus officinalis	1	1	2
Nepeta cataria	3	2	4
Pastinaca sativa	16	28	18
Vitis riparia	4	8	10

(Sheet 4 of 4)

Table C24

Relative Values of Plants in Sample Area

Little Galloo Island

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Black-Crowned Night Heron (Transect 1)*			
Cornus stollinfera	96	96	67
Sambucus pubens	4	4	33
Herring Gull (Transect 1)**			
Barbarea vulgaris	2	11	19
Chenopodium alba	1	3	19
Poa pratensis	97	81	52
Urtica dioica	15	4	10
Ring-Billed Gull (Transect 1)+			
Ambrosia sp.	2	6	7
Capella bursa-pastoris	+	1	4
Chenopodium album	3	11	37
Poa pratensis	94	74	48
Urtica dioica	1	8	4

(Continued)

* Two 16 m^2 quadrats were sampled.
** Twelve 1 m^2 quadrats were sampled.
\+ Fifteen 1 m^2 quadrats were sampled.

Table C24 (Concluded)

Plant Species	Relative Density	Relative Coverage	Relative Frequency
Ring-billed Gull (Transect 2)*			
Ambrosia sp.	16	14	20
Barbarea vulgaris	18	31	24
Chenopodium album	+	1	2
Poa pratensis	59	37	20
Vicia americana	2	8	22
Ring-billed Gull (Transect 3)**			
Ambrosia sp.	1	8	6
Chenopodium album	6	4	16
Polygonum lapathifolium	7	3	6
Sambucus canadensis	21	65	32
Sambucus pubens	38	4	6
Solanum dulcamara	4	4	10
Urtica dioica	21	13	23

* Ten 1 m^2 quadrats were sampled.
** Ten 16 m^2 quadrats were sampled.

APPENDIX D: SURVEY OF COLONIAL BIRD NESTING AREAS STRAITS OF MACKINAC, POTAGANNISSING BAY AND ST. MARYS RIVER AREAS, MICHIGAN

1. Thirty-eight nesting sites, involving 56 colonies of five species, were surveyed in July 1977 (Table D1). Twenty-eight Herring Gull colonies (1-644 nests), eight Ring-billed Gull colonies (1-2, 398 nests), eight Common Tern colonies (8-116 nests), eight Great Blue Heron colonies (3-67 nests), and two Black-crowned Night Heron colonies (10-13 nests) were studied.

2. Four 1976 nesting sites and seven colonies were abandoned in 1977; however, there were three new nesting sites and nine new colonies in use in 1977. With one exception, the abandoned colonies were small, peripheral colonies consisting of only a few nests. There was one major relocation involving the largest Ring-billed Gull colony in the Potagannissing Bay area in 1976. This colony apparently relocated on two newly created land masses resulting from the lower water levels. Some of the Common Terns from two dredged material island colonies also relocated on another newly exposed dredged material island.

3. Five colonies were exposed to the effects of human intrusion in varying degrees of frequency. The low water levels, while creating new nesting sites, also created land bridges to some near-shore island colonies. One nesting site was for sale as part of a land development project. One colony failed because of predation by a small rodent or insectivore. Five heronries lost nests and nest trees to strong spring winds. A total of 25 nests (1-10/colony) were blown down in five of eight Great Blue Heron colonies. Two dead adults were found in fallen nests.

4. Twenty-nine (76 percent) of the nesting sites were on natural islands, seven (19 percent) were on man-made structures (i.e., dredged material islands, ruins), and two (5 percent) were on large off-shore boulders. The nest site substrate of Herring Gulls throughout the survey area was rock (75 percent), dirt (21 percent), and upland grass (4 percent). The nest site substrate of Ring-billed Gulls was rock (51 percent), clay dredged material (48 percent), and upland grass (1 percent). The nest site substrate of Common Terns was sand dredged material (50 percent), rock (30 percent), upland grass (14 percent), and clay dredged material (7 percent). The nest trees of the Great Blue

TABLE 1

1977 NESTING SITES AND TOTAL NEST COUNTS

Nesting Site	Species				
	HG	RBG	CT	GBH	BCNH
STRAITS OF MACKINAC					
Point LaBarre Island	127				
Green Island	644	2168			10
LES CHENEAUX					
St. Martin Island	2	1+	54		
St. Martin Shoals	439	66+			
Goose Island	561			67	13
Bush Bay Rocks	1		8		
Crow Island	196			11	
Bear Island	113				
Little Saddlebag Island	96				
Saddlebag Island	309			15	
South Island	104				
North Island	26				
Carlton Bay Rock	0-		13		
Pt. DeTour Island Rocks[o]	0-				
DRUMMOND ISLAND					
Gravel Island	0-			3	
Scammon Point				40	
Goetz Shoals	17+				
DETOUR PASSAGE					
Cable Island	23				
Watson Reef Ruins			20		
POTAGANNISSING BAY					
Little Cass Island	5	2063+			
Andrews Island[o]		0-			
Macomb Island Dock[o]		0-			
Bacon Island	192				
Bow Island[o]	0-				
Arrow Island	33				
Propeller Island	52				
Harbor Island Reef*	2+	192+			
ST. MARYS RIVER					
East Pipe Island Twin	100				
West Pipe Island Twin	145				

Table 1 (concluded)

Nesting Site	HG	RBG	CT	GBH	BCNH
Squaw Island	91				
Bass Reef Island	43				
Round Island					
Two Tree Island	46				
Steamboat Island	16				
Southwest Neebish Island		2398			
Moon Island	7	1673			
Southeast Neebish Island	0-	55	45		
Rock Island	48			27	
Gem Island	29			33	
West Sugar Island I			116		
West Sugar Island II*	1+		44+		
Northwest Sugar Island	1+		21		
TOTAL ACTIVE NESTS	3469	8616	321	235	23
TOTAL ACTIVE COLONIES	30	8	8	8	2

KEY:
HG= Herring Gull
RBG= Ring-billed Gull
CT= Common Tern
GBH= Great Blue Heron
BCNH= Black-crowned Night Heron

* = new nesting site
o = former site-abandoned in 1977
\+ = new species present
\- = species not present in 1977

Herons were 85 percent deciduous and 15 percent coniferous. The Black-crowned Night Heron nests were 96 percent in coniferous and 4 percent in deciduous trees.

5. The four predominant (by percent frequency) plant species encroaching onto newly exposed rock beaches were 23.1 percent smartweed (*Polygonum lapathifolium*), 19.2 percent nettles (*Urtica dioica*), 15.4 percent yellow rocket (*Barbarea vulgaris*) and 11.5 percent spotted touch-me-not (*Impatiens capensis*). Some of the other species present included lamb's-quarters (*Chenopodium album*), reed grass (*Phragmites* communis), red clover (*Trifolium pratense*), nightshade (*Solanum dulcamara*) and Kentucky bluegrass (*Poa pratensis*).

6. For the entire survey area the total number of nesting Herring Gulls decreased from 1976 by 2 percent (110 birds), Ring-billed Gulls increased by 53 percent (5,992 birds), Common Terns decreased by 30 percent (276 birds), Great Blue Herons increased by 4 percent (16 birds), and Black-crowned Night Herons increased by 44 percent (14 birds).

7. In 20 (95 percent) of 21 sites with birds nesting of both new and preexisting areas the percent hatched was 13-91 percent lower (mean = 55; standard deviation= 20) for nests in the new areas. Only once was the percent hatched higher in the new area, and then it was only a 2 percent difference and involved only a couple of nests.

8. The mean nesting densities for Herring Gulls, Ring-billed Gulls and Common Terns were 0.06 nests/m^2, 0.80 nests/m^2 and 0.23 nests/m^2, respectively (Table 4). These densities do not represent the highest densities known to occur in selected areas of some of the colonies, but were derived from random samples and therefore include some of the more open areas with lower nest densities. The above mean values are just that - averages for entire colonies of that species. Table 4 shows that the size of Herring Gull colonies ranged from 0.01 - 20.30 ha (mean = 1.43 ha), Ring-billed Gull colonies ranged from 0.01 - 0.55 ha (mean = 0.23 ha), and Common Tern colonies ranged from 0.003 - 0.31 ha (mean = 0.09 ha).

9. The beaches and points of every low-lying island nesting site increased in size due to the lower water levels. Available nesting area

was also created through the drying up of ponds and inlets. Colonization of these newly exposed areas was what one might anthropomorphically term as "cautious." Almost without exception, the breeding cycle of birds utilizing these new areas was retarded, and the nesting density was lower relative to those nesting in the preexisting areas of the colony. A typical case in point is the St. Martin Shoals Herring Gull colony. When available nesting area tripled, one-third of all nests were on the newly exposed beaches. On 13 June nests in the new area had a lower percent hatched (61 percent vs 91 percent), younger mean age of chicks (100 percent class 1-2a vs 100 percent class 2b-3b; $\bar{X}_t$ = 38.6 mm vs $\bar{X}_t$ = 57.6mm; $\bar{X}_w$ = 112.4gm vs $\bar{X}_w$ = 564.8gm), and a lower nest density (0.03 nests/m^2 vs 0.16 nests/m^2).

10. The degree of utilization of newly exposed land at 32 nesting sites ranged from 0-100 percent, with a mean of 25 percent (s.d.=19). The mean degree of utilization of new areas by Ring-billed Gulls was 47 percent, three times the useage by Herring Gulls or Common Terns (Table 4). This suggests a greater adaptability by the Ring-billed Gulls to exploit and colonize newly available nesting habitats before other species. The large number of Ring-billed Gulls nesting on new areas accounted for much of this year's large population increase for this species in the survey area.

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11. For each of the nesting sites located the following major tasks were performed: (a) population estimates of each species present were made, (b) density samples were taken, (c) comparative samples were taken of nest contents in preexisting and new areas, (d) ten randomly selected young were aged in each colony, (e) measurements were taken of the newly exposed beaches were recorded, and (g) Cornell University Colonial Bird Register Forms were completed.

12. Detailed vegetation analyses were conducted and three-way (density, coverage, and frequency) importance values were calculated at each of the six man-made dredged material islands in the St. Mary's

River (Moon Island, Southwest Neebish Island, Southeast Neebish Island, Northwest Sugar Island, West Sugar Island I, and West Sugar Island II. Three of the dredged material islands consisted of clay, two sand and one silt. There were three Ring-billed Gull and four Common Tern colonies involved.

13. Methodology consisted of line transects being established in each colony. Transects were established with three criteria in mind: (a) include the highest and lowest points within the colony, (b) cross the entire width of the colony, thereby including the densest area of nesting (i.e. the center) and the less dense periphery, and (c) include all visibly significant plant species. For herbaceous species, $0.5m^2$ or $1.0m^2$ plots were sampled at one meter intervals along the transect line. For woody species, $16m^2$ plots were sampled at 4m intervals. The density and percent cover of plant species within each plot were recorded, in addition to maximum heights of the predominant species were recorded.

14. Density was calculated from a total count of each individual of each species within each plot. Each clump of grass was considered as an individual plant. Relative density for each species was calculated using the formula:

$$\frac{\text{density of species X in all sample plots}}{\text{total density of all species in all sample plots}} \times 100$$

15. Cover values were expressed as a percentage. They were assigned to each species by a visual estimation of the area covered by each. Relative coverage was calculated using the formula:

$$\frac{\text{coverage of species X in all sample plots}}{\text{total coverage of all species in all sample plots}} \times 100$$

Two strata of vegetative cover were recognized: an upper canopy of shrubs and a lower understory of herbaceous species. The two levels were not mutually exclusive, and occasionally both covered the same ground area. For this reason, separate importance values were calculated for herbaceous and woody species. However, many colonies also had heavily-puddled areas devoid of any vegetative cover. Therefore the percent cover of the total area sampled (herbaceous and/or woody) and bare areas were calculated separately and are given in the individual colony reports.

16. Frequency is the number of times a given species occurred in the sample plots and is calculated as follows:

$$\text{Frequency*} = \frac{\text{number of plots in which species X occurred}}{\text{total number of plots sampled}} \times 100$$

Relative frequency was calculated using the formula:

$$\frac{\text{frequency* of species X in all sample plots}}{\text{sum of all frequencies of all species in all sample plots}} \times 100$$

17. The maximum value for each index is 100. Therefore the maximum value for a three-way importance index is 300 (100 + 100 + 100). Listings of the plant species and their importance values are given in the individual colony reports under the text section entitled Vegetation Analysis. Table D2 lists the scientific names of all the plant species for which importance values were calculated.

18. The 1977 individual colony reports are principally an update and a comparison of the 1976 findings. Island descriptions and listings of vegetation were given in the 1976 report. These will not be repeated here, except where descriptions of newly exposed land areas and new plant species necessitate. Throughout the report frequent comparisons are made between preexisting areas and new areas. Preexisting areas are the parts of a site that existed in 1976 and on which birds nested both in 1976 and in 1977. New areas are defined as land that was newly exposed in 1977 by the lower water levels and that became available for nesting for the first time in 1977. Three new sketches of significant new colony sites have been included (Harbor Island Reef, Little Cass Island, and West Sugar Island II). Former (1976) sites abandoned this year are also briefly discussed. Normal periods of colony use and colony history were given in the 1976 report and will not be repeated. It was felt that only those colonies whose breeding cycles were not synchronized with those of the majority of colonies warranted explanations.

TABLE D2

SCIENTIFIC NAMES (ACCORDING TO THE EIGHTH EDITION OF GRAY'S MANUAL OF BOTANY) OF PLANT SPECIES FOR WHICH IMPORTANCE VALUES WERE CALCULATED

Scientific Name	Common Name
Equisetaceae	
Equisetum sp.	Horsetail rush
Gramineae	
Glyceria grandis	American manna grass
Poa pratensis	Kentucky bluegrass
Phragmites communis	Giant reed grass
Agrophyron repens	Quackgrass
Phleum pratense	Timothy
Cyperaceae	
Carex sp.	Sedge
Juncaceae	
Juncus sp.	Rush
Salicaceae	
Salix amygdaloides	Peachleaf willow
Salix interior	Sandbar willow
Populus tremuloides	Quaking aspen
Populus balsamifera	Balsam poplar
Polygonaceae	
Rumex acetosella	Sheep sorrel
Polygonum lapathifolium	Smartweed
Chenopodiaceae	
Chenopodium album	Lamb's-quarters
Cruciferae	
Capsella bursa-pastoris	Shepherd's-purse
Sisymbrium altissimum	Tumble-mustard
Barbarea vulgaris	Yellow rocket
Brassica nigra	Black mustard
Thlaspi arvense	Penny mustard
Rosaceae	
Potentilla arguta	Tall cinquefoil
Leguminosae	
Trifolium agrarium	Yellow clover
Trifolium pratense	Red clover
Melilotus alba	White sweet clover

Table D2 (concluded)

Aceraceae	
Acer saccharum	Sugar maple
Balsaminaceae	
Impatiens capensis	Spotted touch-me-not
Onagraceae	
Epilobium angustifolium	Fireweed
Cornaceae	
Cornus stolonifera	Red-osier dogwood
Asclepiadaceae	
Asclepias syriaca	Common milkweed
Labiatae	
Urtica dioica	Nettle
Solanaceae	
Solanum dulcamara	Nightshade
Scrophulariaceae	
Verbascum thapsus	Common mullein
Caprifoliaceae	
Sambucus pubens	Red-berried elder
Compositae	
Eupatorium perfoliatum	Boneset
Solidago racemosa	Goldenrod
Erigeron philadelphicus	Fleabane
Achillea millefolium	Common yarrow
Chrysanthemum leucanthemum	Field daisy
Matricaria matricarioides	Pineapple-weed
Cirsium arvense	Canada thistle
Taraxacum officinale	Dandelion
Sonchus arvensis	Field sowthistle
Hieracium aurantiacum	Orange hawkweed

NESTING DATA TABLES

19. Much of the 1977 data for each individual colony report has been placed in tabular form for easier referral and comparisons. When more than one visit is indicated, all data refers to the earlier date unless otherwise explained. The table headings are explained in the following paragraphs.

20. Active Nests/Censusing Methods: Censusing techniques used for determining the total number of nests included (a) total nest counts, (b) 2-m wide belt transects, (c) point-quarter method (after Cottom & Curtis 1956), and rarely (d) total count of flying adults/ 1.5.

21. Change From 1976: This subheading to the percentage of increase or decrease in the number of active nests between 1976 and 1977. Possible explanations, probable relocations, relationships to nearby colonies, and other factors are given in the text of each island summary where appropriate.

22. Percent Hatched: The percent hatched was determined from (a) total number of young (alive & dead) divided by the total number of eggs and young, (b) total number of nests with young divided by the total number of active nests, and rarely, (c) visual estimates. Both methods (a)and(b)were conducted either using samples ($10m^2$, $100m^2$ or belt transects) or from total counts taken throughout the entire colony.

23. Nesting Stage: Stage of nesting cycles are the same as those used on the Cornell University Colonial Bird Register Forms.

24. Age of Young: Incubation stages were estimated using the flotation method as described by Hays and LeCroy (1971). The ages given for the young are mean values derived from sampling 10 (occasionally 20) randomly selected young in each colony. $\bar{X}_t$ = mean tarsometatarsal length (mm) and $\bar{X}_w$ = mean body weight (gm). Chicks were weighed to the nearest 1.0 gram on a Welch triple-beam balance.

25. Plumage classes used in this study are those described by Kadlec and Drury (1969) for Herring Gulls. Although the ages associated with each of their classes are obviously applicable only for Herring Gulls, it was felt that the general plumage changes represented by each

class were still usable for comparing relative stages of development among the young of other species. Thus the six classes used are defined as follows:

CLASS	
class 1	immobile; stays in nest
class 2a	mobile; no pinfeathers
class 2b	pinfeathers on wings not erupted
class 3a	primary feathers erupted; tail feathers not erupted
class 3b	tail feathers erupted; down on occiput
class 4	head down lost; fully feathered; fledged

An attempt to correlate tarsal length with age class was made. Table D3 gives the mean tarsal length for each age class by species.

26. Productivity: Visual estimates of productivity are somewhat awkward for comparative purposes and subject to considerable individual interpretation. In an attempt to quantify this important variable productivity has been arbitrarily defined as a percentage, calculated from the number of living young seen divided by the total number of young (dead and alive) counted.

27. Nest Density: Nest density was determined using (a) $10m^2$ samples, (b) $100m^2$ samples, (c) area within belt transects when that censusing method was employed, or (d) total number of nests divided by the total area of the colony (used primarily for Herring Gull colonies where the nests were dispersed over an entire small island).

28. Colony Size: Measurements were taken of all major dimensions of each site visited, and an updated sketch of each island, nesting area, and/or colony site was constructed. From these drawings the area of each 1977 colony was determined. On small islands where Herring Gull nests were dispersed over the entire island the colony size was equated with the island size.

29. Increase In Available Nesting Area: This is the increase in the amount of new land exposed within a nesting site in 1977 over 1976, expressed as a percentage. Table D4 gives the mean and range of increase in the amount of available nesting area for the various colonies.

30. All the newly exposed beach areas around the natural island nesting sites were rock (gravel, cobble and/or boulder). Clay and sand substates were found only on the dredged material islands.

TABLE D3

MEAN TARSOMETATARSAL LENGTH

ARRANGED BY AGE CLASS AND SPECIES

Species	Tarsal Length (mm) Mean	(N)	S.D.	Range
Herring Gull				
class 1	33.3	(8)	3.9	25-37
class 2a	37.6	(11)	7.8	23-50
class 2b	47.5	(8)	4.4	43-56
class 3a	52.0	(23)	1.9	41-62
class 3b	61.1	(115)	2.2	52.70
Ring-billed Gull				
class 1	22.4	(7)	1.5	20-24
class 2a	26.3	(3)	5.1	22-32
class 2b	40.2	(6)	2.8	35-43
class 3a	44.8	(10)	3.1	40-49
class 3b	51.1	(42)	4.2	41-57
Common Tern				
class 1	9.0	(7)	1.2	7-10
class 2a	16.2	(13)	2.1	12-20
class 2b	18.6	(20)	0.9	16-20
class 3a	19.7	(10)	0.7	19-21
class 3b	20.2	(19)	0.8	19-22

TABLE D4

MEAN NEST DENSITY, COLONY SIZE

INCREASE IN AVILABLE NESTING AREA, AND DEGREE OF UTILIZATION

OF NEW AREA ARRANGED BY SPECIES

	Species Herring Gull	Ring-billed Gull	Common Tern
Nest Density (m^2)			
mean (N)	0.06 (24)	0.80 (8)	0.23 (7)
S.D.	0.08	0.34	0.18
range	0.01-0.38	0.13-1.03	0.08-0.50
Colony Size (ha)			
mean (N)	1.43 (24)	0.23 (8)	0.09 (7)
S.D.	4.01	0.22	0.11
range	0.01-20.30	0.01-0.55	0.003-0.31
Inc. In Available Nesting Area (%)			
mean (N)	114 (22)	160 (6)	276 (4)
S.D.	133	101	183
range	24-643	67-295	143-536
Degree Of Utilization Of New Area (%)			
mean (N)	13 (22)	47 (6)	15 (4)
S.D.	12	42	23
range	0-41	11-100	0-48

31. Degree of Utilization of New Area. The degree of utilization is expressed as a percentage and was calculated from the total number of nests located in the newly exposed areas divided by the total number of nests in the colony.

POINT LABARRE ISLAND

32. Latitude 45°50' Longitude 84°46' 4 km SW St. Ignace, Mackinac County, Michigan, visited 2 July 1977.

Species:	HERRING GULL
Active nests:	127
Census Method:	total count
Change from 1976:	9% increase
Percent Hatched:	95%
Nesting Stage:	feathered young
Age of Young:	100% 3b-4 $\bar{X}_t$ = 64.8 mm
Productivity	91%
Nest Density:	0.12 nests/m^2
Colony Size:	0.52 ha
Increase in Available Nesting Area:	643%
Degree of Utilization Of New Area	36%

Herring Gulls: The low water levels have resulted in the union of the two formerly separated islands. The 175 m long shallow (0.5m) water area between the two islands in 1976 is presently a 5 m wide rocky isthmus. Cobble beaches extending from 9-45 m further this year have increased the avilable nesting area from 0.07 ha (1976) to 0.52 ha (1977), an increase of 0.45 ha or 643 percent.

127 nests represent an increase of 11 nests (9 percent) over the 116 nests present in 1976. 46 nests (36 percent) were on newly exposed areas. There were no nests on the narrow isthmus, which is probably as of yet still awash during storms. The percent hatched was 100 percent in the preexisting area compared with 87 percent in the new area.

The nest site substrate was cobble. One-third of the nests were under a canopy of woody vegetation (*Salix interior*, *Fraxinus sp.*, *Ribes sp.*, *Prunus virginiana*, *Cornus stolonifera*, *Sambucus pubens*). The effect of the birds on the vegetation appeared negligible, although it is possible their excrement assisted the growth of the few plant species present on an otherwise quite sterile rock habitat.

GREEN ISLAND

33. Latitude 45°50' Longitude 84°45' 3.5 SW St. Ignace, Mackinac County, Michigan, visited 11 June 1977 and 2 July 1977.

Species	RING-BILLED GULL	HERRING GULL
Active Nests:	2,168	644
Census Method:	total count	total count
Change From 1976:	44% increase	9% increase
Percent Hatched:	79%	95%
Nesting Stage:	downy young	downy young
Age of Young:	50% 2b-3b (100% 3b-4)[1] $\bar{X}_t$ = 49.8mm (54.8mm)[1] $\bar{X}_w$ = 244.0gm	(100% class 3b-4)[1] ($\bar{X}_t$ = 63.9mm)[1]
Productivity:	87%	95%
Nest Density:	1.01 nests/m^2	0.019 nest/m^2
Colony Size:	0.33 ha	3.37 ha
Increase In Available Nesting Area:	83%	62%
Degree of Utilization Of New Area:	16%	13%

[1] mean values on 2nd visit 07/02/77.

Ring-billed Gulls: The two halves of the 1976 colony, formerly separated by a wet marshy area of sedges and rushes, were united this year. Although nesting did not occur throughout this newly dried land bridge new nests did encroach into it from both sub-colonies. The area of the colony increased from 0.18 ha (1976) to 0.33 ha (1977), an increase of 0.15 ha or 83%.

The 2,168 nests represent an increase of 662 nests (44%) over the 1,506 nests present in 1976. 346 nests (16%) were on newly exposed areas. The nest site substrate was sand. The effect of paddling by such large numbers of birds and the chemical strength of such quantities of excrement on the vegetation was most evident. The number of plant species present within the colony per se was restricted to primarily five (sandbar willow, curly dock, smartweed, nettles and pineapple-weed) and many of these appeared "burned". The vegetation was clumped. The soil in the colony was guano-encrusted, well-packed, yet slightly spongy.

Herring Gulls: Gravel beaches extending 5 m off the north shore and 10m off the south shore were exposed this year and two points were lengthened by over 40 m. The available nesting area increased from 2.08 ha (1976) to 3.37 ha (1977), an increase of 1.29 ha or 62%.

A total of 644 nests represents an increase of 55 nests (9%) over the 589 nests present in 1976. 82 nests (13%) were on newly exposed beaches. The nests were dispersed over the entire island. The nest site substrate was 80% cobble (50% in open/ 50% under willow and red-osier dogwood) and 20% upland grass. Paddling severely flattened the grass within $1m^2$ of the nests and puddled runways were evident.

Species:	BLACK-CROWNED NIGHT HERON
Active Nests:	10
Census Method:	total count
Change From 1976:	76% increase
Percent Hatched:	100%
Nesting Stage:	downy/feathered young
Age Of Young:	88% class 3a
Productivity:	97%
Nest Density:	0.1 $nests/m^2$
Colony Size:	100 m^2

Black-crowned Night Herons: Ten nests were located in a $100m^2$ area of small (5m) trees at the W end of the island. Nine (90%) of the nests were in white cedar and one (10%) were in a quaking aspen. Nests were 1.5 - 3.0 m above the ground with one nest per tree. All trees were climbed and nest contents observed. There were 2.9 young per nest. Nineteen young were banded. The area below nests was extremely white-washed and devoid of undercover plants.

Human Activities: The waters surrounding Green Island are heavily fished by sport fishermen; however, their visits ashore and consequent disturbances, appear to be less frequent than one would expect.

Apparently the colony's smell and the birds' aggressiveness at present are still effective deterrents to many potential intruders.

ST. MARTIN ISLAND

34. Latitude 45°58' Longitude 84°35' 12 km Southwest of Hessel, Mackinac County, Michigan, visited 13 June 1977.

Species:	COMMON TERN
Active Nests:	54
Census Method:	total count
Change From 1976:	800% increase
Percent Hatched:	2%
Nesting Stage:	late incubation
Age of Young:	class 1
Productivity:	no dead
Nest Density:	0.45 nests/m^2
Colony Size:	120m^2
Increase In Available Nesting Area:	151%
Degree of Utilization Of New Area:	0%

Common Terns: The gravel beach along both sides of the point was 10m wider this year, thereby increasing the available nesting area from 0.037 ha (1976) to 0.093 ha (1977), an increase of 0.056 ha or 151%. There were no nests on the newly exposed gravel beach. The small pond on the point was completely dried up.

Fifty-four nests represent an increase of 48 nests (800%) over the six nests present in 1976. Seventy percent of the eggs were within 4-5 days of hatching - using the flotation method and ages of Hays and LeCroy (1971). Five eggs were pipped and there were three newly hatched chicks.

The nest site substrate was 50 percent gravel and 50 percent upland grass. There was no significant effect of the birds on the vegetation.

Herring Gulls: There were two nests in the open on the preexisting gravel beach, but not within the boundaries of the tern colony. The nests contained two and three eggs, in late incubation.

Ring-billed Gulls: There was one nest in the open on the preexisting gravel beach, but not within the boundaries of the tern colony. The nest contained one egg in early incubation.

Human Activities: A summer cabin is located within 250 m of the colony and there is a small wooden boat dock on the point itself. In talking with the owner it was learned that his two young boys not infrequently enter the colony to count the eggs and chicks, but apparently do not remove or destroy any of either.

ST. MARTIN SHOALS

35. Latitude 45°57' Longitude 84°34' 12.5 km Southwest of Hessel, Mackinac County Michigan, visited 13 June and 26 July 1977.

Species:	HERRING GULL	RING-BILLED GULL
Active Nests:	439	66
Census Method:	total count	total count
Change From 1976:	30% increase	100% increase
Percent Hatched:	84%	5%
Nesting Stage:	feathered young	incubation
Age Of Young:	class 1-3b	88% class 1
	$\bar{X}_t$ = 45.9 mm	$\bar{X}_t$ = 22.8 mm
	$\bar{X}_w$ = 338.6 gm	$\bar{X}_w$ = 41.0 gm
Productivity:	96%	100%
Nest Density:	0.095 nests/m^2	1.03 nests/m^2
Colony Size:	0.83 ha	64 m^2
Increase in Available Nesting Area:	295%	295%
Degree Of Utilization Of New Area:	32%	100%

Herring Gulls: The low water levels resulted in the union of the two islands comprising the shoals in 1976. Boulder beaches extending 5-28m were exposed in 1977 increasing the available nesting area from 0.21 ha (1976) to 0.83 ha (1977), an increase of 0.62 ha or 295%.

A total of 439 nests on the shoals in 1977 represent an increase of 133 nests (30%) over the 306 nests present in 1976. A total of 141 nests (32%) were on newly exposed beach. Thus it appears that the newly exposed land could have accommodated the full increase of nesting birds. The influx of birds may have come from nearby Goose Island which lost several hundred nesting pairs this year.

The nest site substrate was 50% cobble/boulder and 50% shrub/herbaceous vegetation. The nests were dispersed over the entire island. Puddling severely flattened the herbaceous species in the immediate vicinity of nests under vegetative cover, and puddled runways through the vegetation were evident. Half of the gulls nested on the open boulder beach areas which were devoid of vegetation at this date.

A comparison was made between the nesting in the preexisting area and the newly exposed beach area using 4-100m^2 samples. The following table shows the retarded stage of nesting (i.e. lower percent hatched; younger mean age of chicks) and the lower nesting density in the newly exposed area.

HERRING GULLS

	PREEXISTING AREA	NEWLY EXPOSED AREA
Active Nests:	298	141
No. Eggs:	66	80
No. Young:	616	116
No. Dead Young	21	6
Clutch Size:	2.36	1.43
Percent Hatched:	91%	60%
Age Of Young:	100% class 2b-3b	100% class 1-2a
	$\bar{X}_t$ = 57.6 mm	$\bar{X}_t$ = 38.6 mm
	$\bar{X}_w$ = 564.8 gm	$\bar{X}_w$ = 112.4 gm
Nest Density:	0.16 nests/m^2	0.03 nests/m^2

Ring-billed Gulls: There were no Ring-billed Gulls on the shoals in 1976. This year 66 nesting pairs were located within a 64 m^2 area on the newly exposed boulder beach, which was devoid of vegetation. This small colony appeared to be approximately three weeks retarded relative to other previously established colonies that had been active during 1976, such as the Green Island colony which on 11 June was 79 percent hatched with downy young. Historically, St. Martin Shoals has been a significant Ring-billed Gull colony, with as many as 1000 pairs present (1962). As the lake levels continue to drop, the trend back to such a status could quite likely also continue.

Human Activities: There was no evidence of any disturbing human activities.

GOOSE ISLAND

36. Latitude 45°55' Longitude 84°26' 8.5 km south of Hessel, Mackinac County, Michigan, visited 31 May 1977 and 15 June 1977.

Species:	HERRING GULL	
Active Nests:	561	
Census Method:	total count	
Change From 1976:	28% decrease	
Percent Hatched:	38%	
Nesting Stage:	Hatching	
Age Of Young:	class 1-2a	(80% class 3b)[1] ($\bar{X}_t$ = 56.2 mm) ($\bar{X}_w$ = 601.4 gm)
Productivity:	(80%)[1]	
Nest Density:	0.05 nests/m^2	
Colony Size:	20.3 ha	
Increase in Available Nesting Area:	51%	
Degree Of Utilization Of New Area:	6%	

[1] 2nd visit 06/15/77.

Herring Gulls: The cobble/boulder beaches on the east and west shores were 7.5 - 15 m wider. There was a 60 m extension of a point on the west shore and a 50 m extension effectively filling in the bay at the Southeast. The north and south points extended up to 30 m further. All ponds and low, marshy interior areas were dried up. The size of the island colony thus increased from 13.4 ha (1976) to 20.3 ha (1977), an increase of 6.9 ha or 51%.

The 561 nests represent a decrease of 218 nests (28%) from the 779 nests present in 1976. From 1972-76 (the high water period) an average of 735 nests (676-797) had been counted on the island each year. The influx of 100+ birds into the Goose Island colony during 1973 was most likely from neighboring low-lying islands (such as St. Martin Shoals) that were inundated by the high water levels. With 1977 lower water levels and the reemergence of these low-lying islands, it appears that some of the birds are returning to these former nesting sites instead of to Goose Island. St. Martin Shoals (10.5 km to the West) experienced an increase of 133 nests this year and so could account for over half of the reduced nest count.

A total of 32 nests (6%) were on the newly exposed beaches. The percent hatched in the new areas was only 2% compared with 38% in preexisting areas. The mean clutch size was 2.15 and 2.34 in the new and preexisting areas, respectively.

On 29 May 1976, two aggregations of 36 and 19 Herring Gull eggs were found on the north point. They did not have the appearance of having been "piled up" by a human intruder. This season out of 74 nests on the open gravel beach of the north point, 5 nests (7%) with abnormally large clutches were found. The nest contents were 6 eggs, 10 eggs, 8 eggs (one of which was pipped) with one newly hatched chick, 12 eggs, and 13 eggs. The cause of such abnormal clutches, let alone the high incidence (7%) of their occurence, remains open to speculation.

The nest site substrates were 70% cobble (60% on open beach and 40% under woody shrubs, predominantly *Cornus stolonifera*) and 30% dirt (under *Thuja occidentalis*). The effect of the birds on the vegetation was practically negligible since most of the nests were either on the open beach or under dogwood or cedar canopies that were dense enough to preclude much of any herbaceous under-story. What herbaceous vegetation there was within the immediate vicinity (1 m^2) of nests was usually well flattened by puddling. The birds' excrement possibly assisted the growth of several species (*Geranium robertianum*, *Pastinaca sativa*, *Rhus* radicans) growing on the otherwise sterile rock beaches.

Species:	GREAT BLUE HERON	BLACK-CROWNED HERON
Active Nests:	67	13
Census Method:	total count	total count
Change From 1976:	11% decrease	30% increase
Percent Hatched:	81%	69%
Nesting Stage:	hatching/downy young	hatching/downy young
Age Of Young:	class 1	class 2a
Productivity:	98%	no dead
Nest Density:	0.01 nests/m^2	0.007 nests/m^2
Colony Size:	0.5 ha	0.2 ha

Great Blue Herons: The 67 nests represented a decrease of eight nests (11%) from the 75 nests present in 1976. Two newly-leafed out Populus balsamifera with ten nests in them were blown down this spring. If the number of breeding pairs present was the same as in 1976, it would appear that only two pair had renested, either rebuilding (although none of the nests looked like scant, first-year nests) or reclaiming formerly abandoned nest platforms.

Ninety-seven percent of the nest trees were deciduous (42% Populus balsamifera, 38% Betula alba, 15% Populus tremuloides, 3% Ulmus americana, 2% Pyrus americana) and 3% were confierous (100% Thuja occidentalis). Forty-two nest trees supported from 1-5 nests, with an average of 1.6 nests per tree.

The ground and herbaceous vegetation directly under the nests were heavily whitewashed, however, there was no readily apparent effect (either stunting or stimulating) of the excrement on the plant growth.

Black-crowned Night Herons: The 13 nests represented an increase of 3 nests (30%) over the 10 nests present in 1976. All the nest trees were conifers (Thuja occidentalis). The nest trees were relatively well spaced from each other and only supported one nest each. Except for some whitewashing of the lower branches and the sparse ground cover there did not appear to be any outstanding effects of the nesting birds on the vegetation.

Human Activities: The waters around Goose Island have been stocked with lake trout over the past four years and are heavily fished by sport fishermen. Undoubtedly some of these fishermen and other recreational boaters go ashore. The remains of a recent campfire was seen on one of the beaches.

BUSH BAY ROCKS

37. Latitude 45°59' Longitude 84°15' 7.5 km ESE Cedarville, Chippewa County, Michigan, visited 18 June 1977.

Common Terns: The eight nests present represented a decrease of 11 nests (58%) from the 19 nests present in 1976. All eight nests were empty. Twelve eggs, all with tooth puncture marks or broken, were found in a crevice under a short overhanging slab of rock. Back in the crevice was what appeared to be a nest of dried grasses of some small rodent or insectivore. Three of the eggs were in this nest material. Three of the eggs were empty, four were apparently infertile, one contained a half-term embryo, and four contained chicks fully developed (three of these eggs were even pipped). It appears the entire colony failed because of this predation. Adult terns were overhead.

Herring Gulls: There was one nest containing two eggs in 1977. Two nests were present in 1976. The nest was located on the top of a boulder under a balsam poplar sapling, one of the two locations used in 1976.

CROW ISLAND

38. Latitude 45°58' Longitude 84°14' 9 km ESE Cedarville, Mackinac County, Michigan, visited 13 June 1977.

Species:	HERRING GULL	GREAT BLUE HERON
Active Nests:	196	11
Census Method:	total count	total count
Change From 1976:	19% decrease	no change
Percent Hatched:	81%	70%
Nesting Stage:	feathered young	feathered young
Age of Young:	80% class 3a-3b $\bar{X}_t$ = 63.7 mm $\bar{X}_w$ = 561.2 gm	class 3a-3b
Productivity:	81%	83%
Nest Density:	0.13 nests/m^2	0.03 nests/m^2
Colony Size:	1.11 ha	400m^2
Increase in Available Nesting Area:	102%	38% decrease
Degree Of Utilization Of New Area:	10%	0%

Herring Gulls: The entire island was surrounded by a much wider boulder beach in 1977. The north shore was 5-7 m wider, the south shore was 10 m wider, the north point extended an additional 42 m and the south end of the island was 60 m longer and 50 m wide at the end. This doubled the size of the island colony from 0.55 ha (1976) to 1.11 ha (1977), an increase of 0.56 ha or 102 percent.

The 196 nests represent a decrease of 45 nests (19 percent) from the 141 nests present in 1976. Bear Island (0.5 km to the Northeast) experienced an increase of 26 nesting pair this year and so could account for over half of the reduced nest count. The 20 nests (10 percent) on newly exposed areas were on the two points (three on the north and 17 on the south). The percent hatched was only 35 percent for nests in the new areas compared with 81 percent in the preexisting areas.

The nest site substrates were 70 percent boulder and 30 percent soul (under woody and herbaceous vegetation). The nests were dispersed over the entire island. Herbaceous vegetation in the immediate vicinity of the nests (especially those nests in the clearing) was well puddled and runways were evident.

Great Blue Herons: One class 3b young (primaries 3 cm erupted; rectrices 1 cm erupted) was captured on the ground and banded. There was no overall change in the number of nests present this year. The nest trees were 55 percent coniferous (100% white spruce) and 45 percent deciduous (60% balsam poplar, 20 % quaking aspen, 20% white birch). Three 1976 nests were not active this year (one in spruce, one in cedar, one in birch). However, there were three new nests in three balsam poplars this year, which accounted for the change in percent composition of nest trees over last year's. The abandonment and relocation of several nests in effect reduced the overall size of the area over which the heronry was spread from 650 m^2 (1976) to 400 m^2 (1977), a decrease of 250 m^2 or 38 percent. The nest trees were spaced 2-18 m apart (mean= 7 m) and supported only one nest each. Except for whitewashing of the shrubs and herbaceous ground cover below there did not appear to be any significant effect of the nesting birds on the vegetation.

Human Activities: On the northwestern end of the island is a 7 m navigational tower and light and a wooden dock (3.3m x 10.5m). In the past the dock was used by local commercial fishermen but to the best of the author's knowledge its current use is very infrequent, if at all.

BEAR ISLAND

39. Latitude 45°58' Longitude 84°14' 9.5 km ESE Cedarville, Mackinac County, Michigan, visited 13 June 1977.

Species:	HERRING GULL
Active Nests:	113
Census Method:	total count
Change From 1976:	30 percent increase
Percent Hatched:	86 percent
Nesting Stage:	
Age Of Young:	80 percent class 3a-3b
Productivity:	92 percent
Nest Density:	0.09 nests/m^2
Colony Size:	0.21 ha
Increase In Available Nesting Area:	91 percent
Degree Of Utilization Of New Area:	7 percent

Herring Gulls: The boulder-strewn shores of the island were 3-5m wider in 1977. The north and south points were 20m and 30m longer in 1977. The total area of the island was almost doubled, from 0.11 ha (1976) to 0.21 ha (1977), an increase of 0.10 ha or 91 percent.

The 113 nests represent an increase of 26 nests (30 percent) over the 87 nests present in 1976. The influx of birds may have come from Crow Island (0.5 km to the Southwest) which experienced a loss of 45 pairs in 1977. The eight nests (7 percent) on newly exposed areas were on the two points (one on the north, seven on the south).

The nest site substrate was boulder. The nests were dispersed over the entire island. Twenty percent of the nests were under red-osier dogwood, red-berried elder and/or brambles. There was no significant effect of the nesting birds on this vegetation.

LITTLE SADDLEBAG ISLAND

40. Latitude 45°57' Longitude 84°03' 12 km WSW DeTour, Chippewa County, Michigan, visited 20 June 1977.

Species:	HERRING GULL
Active Nests:	96
Census Method:	total count
Change From 1976:	25 percent increase
Percent Hatched:	88 percent
Nesting Stage:	feathered young
Age of Young:	100 percent class 3b $\bar{X}_t = 60.2$ mm
Productivity:	88 percent
Nest Density:	0.035 nests/m^2
Colony Size:	0.52 ha
Increase In Available Nesting Area:	108 percent
Degree Of Utilization Of New Area:	8 percent

Herring Gulls: The boulder-strewn shore was 4-10 m wider this year. The north and east points were 10 m and 30 m longer, respectively. The total area of the island was doubled, from 0.25 ha (1976) to 0.52 ha (1977), an increase of 0.27 ha or 108 percent.

The 96 nests represent an increase of 19 nests (25 percent) over the 77 nests present in 1976. The influx of birds probably came from Saddlebag Island (1.2 km to the Southeast) which experienced a loss of 25 pairs this year. Eight nests (8 percent) were on the newly exposed beach and had a percent hatched of 25 percent compared with the 91 percent on preexisting areas.

The nests were dispersed over the entire island. The nest site substrates were 80 percent boulder and 20 percent soil (under cedars). The cedar area was essentially devoid of any ground cover; however, runways through the adjacent touch-me-nots were evident.

SADDLEBAG ISLAND

41. Latitude 45°57' Longitude 84°02' 11 km WSW DeTour, Chippewa County, Michigan, visited 20 June 1977.

Species:	HERRING GULL	GREAT BLUE HERON
Active Nests:	309	15
Census Method:	total count	total count
Change From 1976:	7 percent decrease	53 percent decrease
Percent Hatched:	78 percent	87 percent
Nesting Stage:	feathered young/ renesting	feathered young
Age Of Young:	70 percent class 3a-3b $\bar{X}_t = 49.6$ mm	class 3b
Productivity:	84 percent	no dead
Nest Density:	0.05 nests/m^2	0.012 nests/m^2
Colony Size:	1.11 ha	0.13 ha

Increase In Available Nesting Area:	73 percent	18 percent decrease
Degree Of Utilization Of New Area:	3 percent	0 percent

Herring Gulls: The cobble beach surrounding the island was 4-7 m wider this year and the north point was 18 m longer. The total size of the island increased from 0.64 ha (1976) to 1.11 ha (1977), an increase of 0.47 ha or 73 percent.

The 309 nests represent a decrease of 25 nests (7 percent) from the 334 nests present in 1976. Little Saddlebag Island (1.2 km to the northwest) experienced an increase of 19 nesting pair this year and may account where these birds went. Fifty-three nests, all within a continuous strip on the west side of the north half of the island, were renesting attempts in late incubation. This area was in the immediate vicinity of a summer cabin and the possibility seems great that the initial nesting attempts failed because of human intrusion. Renesting was insignificant throughout the remainder of the colony at this date. The mean clutch size of the renesting attempts was 2.30 (N=53).

Eight nests (3 percent) were in the newly exposed areas. The percent hatched in the new areas was 63 percent compared to 78 percent in the preexisting areas (even including renesting).

The nests were dispersed over the entire island. The nest site substrates were 75 percent cobble and 25 percent soil (under woody vegetation). Except for puddling of the soil and very sparse ground cover in the immediate area of the nest the effect of the nesting birds on the vegetation was negligible.

Great Blue Herons: The 15 nests represent a decrease of 17 nests (53 percent) from the 32 nests present in 1976. Numerous dead quaking aspen, white birch and white spruce were blown down throughout the heronry. Six of the lost nests were accounted for in these blown down trees. Two of the nests had dead adults in them. All of the current nest trees were deciduous, either white birch or quaking aspen. The loss of over half of the colony's nests reduced the size of the area over which the heronry was spread from 0.15 ha (1976) to 0.13 ha (1977), a reduction of 0.02 ha or 13 percent.

The woody shrubs (current, brambles, round-leafed dogwood) and herbaceous plants (yellow bead-lily, bunchberry, starflower) below the nests were heavily whitewashed. There apparently was a stimulating effect of the excrement on the growth of several of the plant species. At least the yellow bead-lily and bunchberry were tallest ever seen on any of the islands, and larger than on other non-heronry parts of the island.

Human Activities: The disruptive presence of the habitation on the north end of the island to 17 percent of the nesting Herring Gulls was discussed above. Also noteworthy was the pile of fish packing crates on the narrow portion of the island. Within 10 m of these boxes were four dead Red-necked Grebes and 2 dead Common Loons. Possibly these birds were casualties of commercial netting operations.

SOUTH ISLAND

42. Latitude 45°57' Longitude 83°58' 6.5 km SW DeTour, Chippewa County, Michigan, visited 20 June 1977.

Species:	HERRING GULL
Active Nests:	104
Census Method:	total count
Change From 1976:	6 percent
Percent Hatched:	92 percent
Nesting Stage:	featherd young
Age of Young:	75 percent 3b $\bar{X}_t$ = 56.7 mm
Productivity:	92 percent
Nest Density:	0.06 nests/m^2
Colony Size:	0.46 ha
Increase In Available Nesting Area:	188 percent
Degree Of Utilization Of New Area:	13 percent

Herring Gulls: The cobble beach surrounding the island was 10-14 m wider in 1977 and the north and south points were 15 m and 20 m longer, respectively. This increased the size of the island from 0.16 ha (1976) to 0.46 ha (1977), an increase of 0.30 ha or 188 percent.

The 104 nests represent an increase of six nests (6 percent) over the 98 nests present in 1976. North Island (0.3 km to the northeast) lost five nesting pairs this year and so may have been the source of most of the new birds. The 14 nests (13 percent) on the newly exposed beach areas were all on the southern point. The percent hatched of these nests was 50 percent compared with 99 percent for nests in the preexisting areas.

The nest site substrate was 70 percent cobble and 30 percent soil. There was essentially no ground cover under the woody vegetation, except spotted touch-me-not which was well puddled into runways.

NORTH ISLAND

43. Latitude 45°58' Longitude 83°58' 6 km Southwest DeTour, Chippewa County, Michigan, visited 20 June 1977.

Species:	HERRING GULL
Active Nests:	26
Census Method:	total count
Change From 1976:	16 percent decrease
Percent Hatched:	81 percent
Nesting Stage:	feathered young
Age Of Young:	class 3b
Productivity:	80 percent
Nest Density:	0.043 nests/m^2
Colony Size:	0.006 ha
Increase In Available Nesting Area:	54 percent
Degree Of Utilization Of New Area:	12 percent

Herring Gulls: The boulder beach surrounding the island was 5 m wider on the east, 10 m wider on the west, and the north and south points were 25 and 30 m longer, respectively. The size of the island increased from 0.775 ha (1976) to 1.194 ha (1977), an increase of 0.419 ha or 54 percent.

The 26 nests represent a decrease of five nests (16 percent) from the 31 nests present in 1976. The South Island colony (0.3 km to the southwest) count. Three nests (12 percent) were on newly exposed areas. None of these nests had hatched any young, while the percent hatched for nests in the preexisting areas was 91 percent.

The nest site substrate was boulder. The nests were dispersed over the entire open boulder beach. There was no observable effect of the nesting birds on the vegetation.

CARLTON BAY ROCK

44. Latitude 45°58' Longitude 83°56' 3.5 km southwest DeTour, Chippewa County, Michigan, visited 20 June 1977.

Species:	COMMON TERN
Active Nests:	13
Census Method:	number of adults overhead/1.5
Change From 1976:	48 percent decrease
Percent Hatched:	78 percent
Nesting Stage:	downy young
Age Of Young:	90 percent class 2a-2b $\bar{X}_t$ = 17.8 mm
Productivity:	84 percent
Nest Density:	0.5 nests/m^2
Colony Size:	26 m^2
Increase In Available Nesting Area:	no change
Degree Of Utilization Of New Area:	N/A

Common Terns: The 13 nests represent a decrease of 12 nests (48 percent) from the 25 nests present in 1976. It is not known where the terns relocated, if indeed they did. Other tern colonies in the area experienced similar population declines, with no new colonies becoming established.

The nest site substrate was the top of the boulder, devoid of vegetation except for one clump of Kentucky bluegrass (*Poa pratensis*) at the very north edge. The young were dispersed over the entire upper surface of the boulder. The top of the boulder is 2.5 m above the water level and is now approachable from the mainland by wading.

Herring Gulls: The one pair of Herring Gulls that nested in the only clump of vegetation on the boulder in 1976 was not present in 1977.

POINT DETOUR ISLAND ROCKS

45. Latitude $45^{o}57'$ Longitude $83^{o}55'$ 4 km SSW DeTour, Chippewa County, Michigan visited 23 June 1977.

Herring Gulls: No birds in 1977. This site was abandoned with the probable cause being availability of nesting sites in large colonies nearby, such as South Island (3.5 km to the West). Two pairs were present in 1976.

GRAVEL ISLAND

46. Latitude $45^{o}56'$ Longitude $83^{o}46'$ 10 km South Drummond, Chippewa County, Michigan, visited 29 June 1977.

Species:	GREAT BLUE HERON
Active Nests:	3
Census Method:	total count
Change From 1976:	25 percent decrease
Percent Hatched:	100 percent
Nesting Stage:	feathered young
Age Of Young:	est. class 3a-3b
Productivity:	no dead
Nest Density:	0.1 nests/m^2
Colony Size:	$30m^2$
Increase In Available Nesting Area:	50 percent decrease
Degree Of Utilization Of New Area:	N/A

Great Blue Herons: The three nests represent a decrease of one nest (25 percent) from the four nests present in 1976. One nest had blown out of the nest tree. The loss of this nest reduced the size of the heronry from 60 m^2 (1976) to 30 m^2 (1977), a decrease of 50 percent. The three nest trees were quaking aspen. The only visible effect of the nesting birds on the vegetation was the whitewashing of the understory, primarily *Ribes* sp. and *Rubus* sp.

Herring Gulls: The one pair of gulls that nested on the open gravel beach on the south point in 1976 was not present in 1977. The cobble beach was 20 m wider on the east, 4 m wider on the west and the north and south points were 20 m and 25 m longer, respectively. The size of the open beach habitat as a potential gull nesting area increased from 0.23 ha (1976) to 0.76 ha (1977), an increase of 0.53 ha or 230 percent.

Ospreys: The active Osprey nest at the south end of the island was attended by one adult at this date. A green sprig was visible in the nest.

Human Activities: Gravel Island is currently for sale as part of the Cream City Subdivision being developed by Glen Bailey Developers of Drummond Island. The future looks dim for both the herons and the Osprey.

SCAMMON POINT

47. Latitude $45^{o}56'$ Longitude $83^{o}38'$ 2 km south Johnswood, Chippewa County, Michigan, visited 29 June 1977.

Species:	GREAT BLUE HERON
Active Nests:	40
Census Method:	total count
Change From 1976:	33 percent increase
Percent Hatched:	100 percent
Nesting Stage:	feathered young
Age Of young:	est. class 3b
Producitivity:	96 percent
Nest Density:	0.01 nests/m^2
Colony Size:	0.42 ha

Great Blue Herons: The 40 nests represent an increase of 10 nests (33 percent) over the 30 nests present in 1976. The 1977 apparent large increase may actually be less. A total nest count from the ground was not conducted in 1976, rather the 30 nests was an aerial estimate and some of the lower nests and/or nests in evergreens or leafed-out deciduous trees may have been hidden from view. Adjacent to the present heronry was a 0.2 ha area of blown over trees. Four blown-down nests were found among the fallen trees. The nest trees were 50 percent coniferous (white spruce, eastern hemlock) and 50 percent deciduous (balsam poplar, quaking aspen). The woody vegetation (current, brambles, red-berried elder) under the nest trees was heavily whitewashed.

GOETZ SHOALS

48. Latitude 46°04' Longitude 83°34' 15 km northeast Drummond, Chippewa County, Michigan, visited 15 July 1976.

Species:	HERRING GULL
Active Nests:	17
Census Method:	no. adults/1.5
Change From 1976:	new colony
Percent Hatched:	-
Nesting Stage:	feathered young
Age Of Young:	class 3b-4
Productivity:	-
Nest Density:	0.34 nests/m^2
Colony Size:	0.005 ha
Increase In Available Nesting Area:	totally new
Degree Of Utilization Of New Area:	100 percent

Herring Gulls: Goetz Shoals is located in the North Channel of Lake Huron 400 m northwest of Shoal Point on the east shore of Drummond Island, Chippewa County. The nest site substrate was cobble and boulder, devoid of vegetation. Talking with members of the Goetz Hunting Club, which owns the adjacent beach area, it appears that the shoals has a past history as a colony site. Gulls (and possibly terns) have nested on the shoals in the past in much greater numbers, during lower water years when more land was exposed.

CABLE ISLAND

49. Latitude 45°59' Longitude 83°53' 1.5 km southeast DeTour, Chippewa County, Michigan, visited 22 June 1977.

Species:	HERRING GULL
Active Nests:	23
Census Method:	total count
Change From 1976:	no change
Percent Hatched:	0 percent
Nesting Stage:	egg laying
Age Of Young:	no young
Productivity:	no young
Nest Density:	0.014 nests/m^2
Colony Size:	0.23 ha
Increase In Available Nesting Area:	109 percent
Degree Of Utilization Of New Area:	35 percent

Herring Gulls: The boulder strewn shore was extended by 4-20 m. The area of the island increased from 0.11 ha (1976) to 0.23 ha (1977), an increase of 0.12 ha or 109 percent.

The same number of nests (23) was present as in 1976. However, the breeding cycle of the entire colony was retarded 5-6 weeks relative to other gull colonies in the area. Almost all nests consisted of empty, newly constructed nest cups. Only three nests contained a total of six eggs. The probably cause for such a disruption was the fact that heavy equipment had recently been on the island the the northwestern point between the shore and the high tension wire poles was excavated for cable repair. This area of the island remained barren earth with tire treadmarks clearly visible.

Eight nests (35 percent) were on the newly exposed areas. All of these nests were on the east shore of the island opposite the disturbance. The nest site substrate was 50 percent boulder and 50 percent soil (under woody vegetation, primarily cedar). As there was essentially no understory beneath the cedars, the effect of the nesting birds on any vegetation was negligible.

Human Activities: The disturbance of the excavation and cable repair work to the colony has been discussed above. Another man-related effect on the birds has been discussed above. Another man-related effect on the birds is electrocution by the high tension wires. Seven recently dead adults were found at the base of the poles. Nineteen adults and immatures were found electrocuted in 1976.

WATSON REEF RUINS

50. Latitude 46°00' Longitude 83°54' 1.k km north DeTour, Chippewa County, Michigan, visited 22 June 1977.

Species:	COMMON TERN
Active Nests:	20
Census Method:	total count
Change From 1976:	62 percent decrease
Percent Hatched:	45 percent
Nesting Stage:	downy young/renesting
Age of Young:	all age class (1-3b)
	$\bar{X}_t$ = 16.0 mm
Productivity:	no dead
Nest Density:	0.16 nests/m^2
Colony Size:	126 m^2
Increase In Available Nesting Area:	143 percent increase
Degree Of Utilization Of New Area:	0 percent

Common Terns: The 20 nests represent a decrease of 33 nests (62 percent) from the 53 nests present in 1976. It is not known where the terns relocated, if indeed they did. Other colonies in the area have also experienced similar declines, with no new colonies becoming established. (at least that could be found). None of the nests were on any newly exposed land. The nest site substrate was rock on a man-made timber/rock lattice (i.e. ruins). No vegetation appeared to be effected by the terns' nesting activities.

An additional 237 m^2 of land, primarily boulders, was exposed out to the north (7m x 11m) and to the south (8m x 20m) of the western-most extreme of the ruins. Also the open water under the wooden beams at the eastern end of the ruins was dry. (143 m^2). This increase of 380 m^2 (1977) from the preexisting 265 m^2 (1976) was an increase of 143 percent to a total area of 645 m^2.

Human Activities: A 60 m long land bridge connecting the ruins to the mainland at a resort area has been created by the low water levels, thereby opening up the colony to frequent human intrusion. There is a kid's playhouse built of driftwood on the west end of the ruins, and children have been seen playing on the island. Seven broken eggs were found (unassociated with nests) at the west edge of the colony. Human disturbance was probably the cause for the renesting and resulted in very poor breeding success for the colony in 1977.

LITTLE CASS ISLAND

51. Latitude 46°04' Longitude 83°54' 7.5 km north DeTour, Chippewa County, Michigan, visited 21 June 1977.

Species:	RING-BILLED GULL	HERRING GULL
Active Nests:	2,063	5
Census Method:	2 m belt transects	total count
Change From 1976:	100 percent increase	29 percent decrease
Percent Hatched:	77 percent	-
Nesting Stage:	feathered young	young
Age Of Young	90 percent class 3b	-
	$\bar{X}_t$ = 46.6 mm	-
	$\bar{X}_t$ = 376.5 gm	-
Productivity:	96 percent	-
Nest Density:	0.825 nests/m^2	0.1 nests/m^2
Colony Size:	0.25 ha	50 m^2
Increase In Available Nesting Area:	260 percent	decrease
Degree Of Utilization Of New Area:	100 percent	0 percent

Ring-billed Gulls: During 1976 Little Cass Island consisted of 0.0743 ha of half, submerged red-osier dogwood and sandbar willow, and 50 m^2 of exposed boulders. The woody vegetation was continually awash. The low water levels this season created 0.2675 ha of dry land, an increase of 0.1935 ha or 260 percent. The island was composed of cobble and boulders. Besides the previously established dogwood and willow there were 3 clumps (50 m^2, 4 m^2, 1 m^2) of common reed over 1 m tall. The Ring-billed Gull colony occupied 0.25 ha, or 93 percent, of the island's available land area. The nest site substrate was primarily cobble and boulder. The central portion of the island, and colony, was a spongy mass of mud and guano.

The 2,063 nests were determined form two 2 m wide belt transects established through the long axis of the colony. The number and contents of each nest in each transect were recorded. A total of 132 nests were counted within these two sample areas (combined area= 160 m^2). A sample density of 0.825 nests/m^2 was calculated and multiplied by the total area of the colony (2500 m^2) to determine from an analysis of the nest contents within these two sample areas.

There were no Ring-billed Gulls present in 1976. The 2,063 pairs present this year apparently came from the abandoned Andrews pairs present this apparently came from the abandoned Andrews Island colony (1 km to the southeast) which consisted of 1,815 nesting pairs in 1976 (see Andrews Island report for possible reasons for abandonment). The Little Cass colony had 248 more nests (14 percent) than were formerly on Andrews Island. However, part of this increase may simply have been due to errors inherent in the censusing methods. The 1976 Andrews Island nest count was a total ground count and on 8 June (date of count) some early nests may have been obliterated by nest material robbing and the extensive puddling common to such dense colonies, and thus not counted. Population size based on the belt transects established in the Little Cass colony, like any sample, assumed equal nest density throughout the area covered by the colony, when in fact it may not have been. Thus, while the Andrews Island colony was surely a minimal count the Little Cass colony may have been slightly exaggerated. On the other hand, if the Andrews Island site was less favorable or its dense woody vegetation limited the size of the colony several hundred potential breeding pairs may not have bred.

Another question is where the 192 pairs of Ring-billed Gulls came from that nested on the newly-created Harbor Island Reef, 7 km to the east southeast. Their presence enlarges the difference between the 1976 and 1977 breeding populations even more, and further suggests the insufficiency of the Andrews Island site. In 1976 the Andrews Island site was the only Ring-billed Gull colony in the entire Potagannissing Bay/Lower St. Mary's River Area. Thus the 1976 breeding population in this whole area of 1,820 pairs (including five nests in one small, peripheral colony) increased by 24 percent (435 pair) to the 1977 population of 2,255 pair. And apparently this increase was primarily due to the lowered water levels and the resultant creation (or "re-emergence") of new, more suitable nesting habitats.

Herring Gulls: In 1976 seven pairs were nesting on the tops of boulders at the southeast tip of the island (5 nests) and on the exposed roots of fallen willow and ash (2 nests). The two nest sites on the tree roots were not in use this year. These sites were well within the Ring-billed Gull colony. The five 1977 nests were in teh same 50 m^2 area of boulders and represented a decrease of two nests (29 percent) from the seven nests present in 1976.

All five nests were empty and well-used, with guano and fish remains all around. All nests seemingly produced some young, although no young were seen and so could not be aged. Adults were present overhead.

ANDREWS ISLAND

52. Latitude 46°03' Longitude 83°53' 7 km north DeTour, Chippewa County, Michigan, visited 21 June 1977.

Ring-billed Gulls: No birds were nesting in 1977, but 1,815 pair were there in 1976. The colony was abandoned (probable cause: availability of two newly re-emerged islands: Little Cass Island (1 km to the northwest) and Harbor Island Reef (7 km to the east southeast).

There are several possible contributing causes for the abandonment of the Andrews Island site: (1) the island is large enough (6 ha) to support mammalian predators the year around, (2) the colony was located in close proximity (34 m) to a large summer residential complex, (3) the woody vegetation under which the birds nested was growing denser, (4) possibly the site was sort of a "last resort" when Little Cass Island and/or Harbor Island Reef were inundated by the rising lake levels during the early 1970's. With their "re-emergence" the birds returned. (Harbor Island Reef is listed in the literature as a former Ring-billed Gull colony site, although Little Cass Island was not).

During the 21 June 1977 visit I noted that the barren, puddled earth of the former (1976) nesting area was being rapidly covered by herbaceous species such as smartweed, red clover, sweet clover, cinquefoil, yellow rocket, evening primrose, mullein, dandelion, and bluegrass. All plants appeared large and vigorous.

MACOMB ISLAND

53. Latitude 46°04' Longitude 83°52' 9 km north DeTour, Chippewa County, Michigan, visited 21 June 1977.

Ring-billed Gulls: No birds were present in 1977, but five pairs were present in 1976. The birds nested on a concrete and rock pier and were merely a small, temporal colony peripheral to the main colony on Andrews Island 2 km to the south. The birds were probably assimilated into one of the large colonies on Little Cass Island or Harbor Island Reef.

BACON ISLAND

54. Latitude 46°03' Longitude 83°50' 7.5 km northwest Drummond, Chippewa County, Michigan, visited 21 June 1977.

Species:	HERRING GULL
Active Nests:	192
Census Method:	total count
Change From 1976:	2 percent decrease
Percent Hatched:	98 percent
Nesting Stage:	feathered young
Age Of Young:	80 percent class 3b $\bar{X}_t$ = 57.6 mm
Productivity:	88 percent
Nest Density:	0.02 nests/m^2
Colony Size:	1.14 ha
Increase In Available Nesting Area:	24 percent increase
Degree Of Utilization Of New Area:	0 percent

Herring Gulls: The gravel/cobble beach surrounding the island was 3-7.5 m wider on the east, 4 m wider on the west and the north and south points were 2 m and 10 m longer, respectively. The size of the island increased from 0.92 ha (1976) to 1.14 ha (1977), an increase of 0.22 ha or 24 percent.

The 192 nests represent a decrease of four nests (2 percent) from the 196 nests present in 1976. There were no nests on any of the newly exposed land. The nest site substrate was 50 percent boulder and 50 percent soil (between boulders). Puddling and excreta prevented any vegetation from growing in the immediate area of the nest site.

BOW ISLAND

55. Latitude 46°02' Longitude 83°50' 6.5 km northwest Drummond, Chippewa County, Michigan, visited 21 June 1977.

Herring Gulls: No birds were present in 1977 but seven pair were present in 1976. These birds may have been part of the 1977 increase of 12 nests on Arrow Island 1 km to the south.

ARROW ISLAND

56. Latitude 46°01' Longitude 83°49' 6 km west Drummond, Chippewa County, Michigan, visited 21 June 1977.

Species:	HERRING GULL
Active Nests:	33
Census Method:	total count
Change From 1976:	57 percent increase
Percent Hatched:	88 percent
Nesting Stage:	feathered young
Age Of Young:	80 percent class 3a-3b
	$\bar{X}$ = 44.0 mm
Productivity:	94 percent
Nest Density:	0.01 nests/m^2
Colony Size:	0.4 ha
Increase In Available Nesting Area:	67 percent
Degree Of Utilization Of New Area:	9 percent

Herring Gulls: The boulder beach was 5 m wider on both sides of the island and the north and south points were 12 m and 6 m longer, respectively. The size of the island increased from 0.16 ha or 67 percent.

The 33 nests represent an increase of 12 nests (57 percent) over the 21 nests present in 1976. The influx of birds may have come from the Bow and/or Bacon Island colonies to the north, both of which experienced declines in population size. There were three nests (9 percent) on newly exposed areas. The percent hatched of these nests was 67 percent compared to 90 percent for nests in preexisting areas.

The nest site substrate was 50 percent boulder and 50 percent soil (between boulders). Puddling and excreta prevented the growth of any vegetation in the immediate area of the nest.

PROPELLER ISLAND

57. Latitude 46°05' Longitude 83°45' 6.5 km north Drummond, Chippewa County, Michigan, visited 22 June 1977.

Species:	HERRING GULL
Active Nests:	52
Census Method:	total count

Change From 1976:	24 percent decrease
Percent Hatched:	67 percent
Nesting Stage:	feathered young/renesting
Age Of Young:	90 percent class 3b
	$\bar{X} = 59.9$ mm
Productivity:	94 percent
Nest Density:	0.02 nests/m^2
Colony Size:	0.45 ha
Increase In Available Nesting Area:	125 percent
Degree Of Utilization New Area:	4 percent

Herring Gulls: The low water levels have resulted in the union of the two formerly separated parts of the island with a 12 m cobble isthmus. The small red-osier dogwood island that was awash in 1976 is now above water and surrounded by a 3.5 m cobble beach. The larger island on which the gulls nested in 1976, was surrounded by a 6-9 m wider cobble/boulder beach with north, east and south points extended 11, 15 and 12 m further, respectively. The size of the island increased from 0.2 ha (1976) to 0.45 ha (1977), an increase of 0.25 ha or 125 percent. The predominant plant species encroaching over the newly exposed beach was nightshade. Also present were smartweed, nettle, lamb's-quarters, spotted touch-me-not, red clover and bluegrass.

The 52 nests represent a decrease of 16 nests (24 percent) from the 68 nests present in 1976. One-third of the nests (17) were still with eggs in late incubation. These renesting attempts may be attributable to human intrusion as suggested by the presence of a circular, stone "fort" that someone had obviously constructed earlier this spring.

Two nests (4 percent) were on newly exposed areas. None of the eggs in these nests had hatched, compared with the 70 percent hatched for nests in preexisting areas. The nest site substrate was 60 percent cobble and 40 percent soil (between boulders). Extensive puddling of the vegetation occured in the area of the nest site and puddled runways in the spotted touch-me-not were evident.

HARBOR ISLAND REEF

58. Latitude 46°03' Longitude 83°47' 4 km northwest Drummond, Chippewa County, Michigan, visited 22 June 1977.

Species:	RING-BILLED GULL	HERRING GULL
Active Nests:	192	2
Census Method:	total count	total count
Change From 1976:	100 percent increase	100 percent increase
Percent Hatched:	79 percent	-
Nesting Stage:	feathered young	young
Age Of Young:	90 percent class 3a-3b	-
	$\bar{X}_t = 48.5$ mm	-
	$\bar{X}_w = 379.5$ gm	-
Productivity:	98 percent	-
Nest Density:	0.93 nests/m^2	0.02 nests/m^2
Colony Size:	0.032 ha	0.01 ha
Increase In Available Nesting Area:	totally new	totally new
Degree Of Utilization Of New Area:	100 percent	100 percent

<u>Ring-billed Gulls</u>: There was no island in 1976. Harbor Island Reef is located in the central portion of Potagannissing Bay. It is 80 m long, 15 m at its widest, 7.5 m at its narrowest, and oriented along a north northeast-south southwest axis. The substrate is cobble and boulder. There were three clumps (each approximately 15 m^2) of 1 m tall common reed, and smartweed was growing up on the south half of the island. Smartweed, nettles, lamb's-quarters and red clover were present on the northern part. Bulrushes were growing in the waters off the east and northeast shores. The Ring-billed Gulls occupied 0.032 ha, or 30 percent, of the island's 0.107 ha total area.

The 192 nesting pairs probably came from the abandoned Andrews Island colony (see reports on Andrews Island and Little Cass Island). The percent hatched and nest density were calculated from three random 10 m^2 samples. The nest site substrate was cobble/boulder. The birds were nesting within the clumps of common reed. The smartweed was still only a few centimeters tall at this date and did not appear effected by the nesting birds.

<u>Herring Gulls</u>: There were two nests on the north end of the island, 30 m from the north edge of the Ring-billed Gull colony. One nest

contained one rotten egg with a dead, 2 cm-long embryo and there was one dead, class 2a chick flattened in the bottom of the other nest. The nests appeared well-used (presence of guano and food remains) suggesting other young were produced, although no other young were seen. Adults were overhead.

The two nests were 10 m apart. The nest density was based on the amount of land within 5 m radiuses of the nests. The nest site substrate was cobble. The vegetative growth was sparse and appeared uneffected by the nesting birds.

EAST PIPE ISLAND TWIN

59. Latitude 46°01' Longitude 83°54' 4 km north DeTour, Chippewa County, Michigan, visited 21 June 1977.

Species:	HERRING GULL
Active Nests:	100
Census Method:	total count
Change From 1976:	27 percent increase
Percent Hatched:	92 percent
Nesting Stage:	feathered young
Age Of Young:	100 percent class 3b
	$\bar{X}_t$ = 61.0 mm
Productivity:	72 percent
Nest Density:	0.07 nests/m^2
Colony Size:	0.25 ha
Increase In Available Nesting Area:	92 percent
Degree Of Utilization Of New Area:	11 percent

Herring Gulls: The cobble beach was 4 m wider on the east, 6 m wider on the west and the north and south points were 15 m and 20 m longer, respectively. The size of the island increased from 0.13 ha (1976) to 0.25 ha (1977), an increase of 0.12 ha or 92 percent. Smartweed, yellow rocket and nettles were growing up in the new cobble beach areas.

The 100 nests represent an increase of 21 nests (27) over the 79 nests present in 1976. Eleven nests (11 percent) were on the newly exposed areas, and had a percent hatched of only 36 percent compared to the 99 percent of nests in the preexisting areas.

The nest site substrate was cobble. Puddling prevented nettles and wild parsnip from growing in the immediate vicinity of the nest, and runways through the spotted touch-me-not were evident.

WEST PIPE ISLAND TWIN

60. $46^{o}01'$ Longitude $83^{o}54'$ 4 km north DeTour, Chippewa County, Michigan, visited 21 June 1977.

Species:	HERRING GULL
Active Nests:	145
Census Method:	total count
Change From 1976:	5 percent increase
Percent Hatched:	97 percent
Nesting Stage:	feathered young
Age Of Young:	100 percent class 3a-3b $\bar{X}_t = 56.3$ mm
Productivity:	79 percent
Nest Density:	0.06 nests/m^2
Colony Size	0.23 ha
Increase In Available Nesting Area:	64 percent
Degree Of Utilization Of New Area:	14 percent

Herring Gulls: The cobble beach surrounding the island was 4-8 m wider on the east, 6-8 m wider on the west and the north and south points were 5 m and 2 m longer, respectively. The size of the island increased from 0.14 ha (1976) to 0.23 ha (1977), an increase of 0.09 ha or 64 percent. Smartweed, yellow rocket and nettles were growing up on the newly exposed cobble beach areas.

The 145 nests represent an increase of seven nests (5 percent) over the 138 nests present in 1976. Twenty nests (14 percent) were on newly exposed areas. The percent hatched of these nests was 80 percent compared to 99 percent for nests in preexisting areas.

The nest site substrate was cobble. Puddling prevented the growth of nettles and wild parsnip in the immediate area of the nest.

SQUAW ISLAND

61. Latitude $46^{o}02'$ Longitude $83^{o}54'$ 5 km north DeTour, Chippewa County, Michigan, visited 21 June 1977.

Species:	HERRING GULL
Active Nests:	91
Census Method:	total count
Change From 1976:	16 percent decrease
Percent Hatched:	99 percent
Nesting Stage:	feathered young
Age Of Young:	100 percent class 3b $\bar{X}_t = 60.6$ mm
Productivity:	94 percent
Nest Density:	0.02 nests/m^2
Colony Size:	0.54 ha
Increase In Available Nesting Area:	29 percent
Degree Of Utilization Of New Area:	3 percent

<u>Herring Gulls</u>: The boulder beach surrounding the island was 6 m wider on the east, 4 m wider on the west and the north and south points were 20 m and 10 m longer, respectively. The size of the island increased from 0.42 ha (1976) to 0.54 ha (1977), an increase of 0.12 ha or 29 percent. Smartweed, yellow rocket and nettles were growing up on the newly exposed beach areas.

The 91 nests represent a decrease of 17 nests (16 percent) from the 108 nests present in 1976. Both Pipe Island Twins experienced increases in the number of breeding birds this year, possibly accounting for the Squaw Island colony's losses.

Three nests (3 percent) were on the newly exposed beach area of the southern point. The percent hatched was 100 percent for these three nests and 98 percent for all nests in the preexisting areas.

The nests site substrate was 70 percent boulder and 30 percent soil (between boulders). Puddling prevented the growth of nettles in the immediate area of the nest itself and puddled runways were evident throughout the patches of spotted touch-me-not.

BASS REEF ISLAND

62. Latitude $46^{o}06'$ Longitude $84^{o}00'$ 5.5 km east northeast Raber, Chippewa County, Michigan, visited 22 June 1977.

Species:	HERRING GULL
Active Nests:	43
Census Method:	total count
Change From 1976:	9 percent decrease
Percent Hatched:	98 percent
Nesting Stage:	feathered young
Age Of Young:	100 percent class 3a-3b $\bar{X}_t = 58.8$ mm
Productivity:	71 percent
Nest Density:	0.02 nests/m^2
Colony Size:	0.45 ha
Increase In Available Nesting Area:	88 percent
Degree Of Utilization Of New Area:	12 percent

Herring Gulls: The cobble beach averaged 4 m wider all around the island and the northeast point extended 30 m further this year. That central portion of the island that was awash in 1976 was now dry land. The size of the island increased from 0.24 ha (1976) to 0.45 ha (1977), an increase of 0.21 ha or 88 percent. Smartweed, yellow rocket, nettles and spotted touch-me-not were growing up on the newly exposed beach areas.

The 43 nests represent a decrease of four nests (9 percent) from the 47 nests present in 1976. Five nests (12 percent) were on newly exposed land, and were 80 percent hatched compared to the 100 percent hatched for nests in preexisting areas.

The nest site substrate was cobble. There was no outstanding effect of the birds on the vegetation except puddling in the immediate area of the nests.

ROUND ISLAND

63. Latitude $46^{o}06'$ Longitude $84^{o}01'$ 4 km northeast Raber, Chippewa County, Michigan, visited 22 June 1977.

Species:	GREAT BLUE HERON
Active Nests:	39
Census Method:	total count
Change From 1976:	no change
Percent Hatched:	100 percent
Nesting Stage:	feathered young
Age Of Young:	est. class 3a-3b
Productivity:	no dead
Nest Density:	0.003 nests/m^2
Colony Size	1.4 ha
Increase In Available Nesting Area:	no change
Degree Of Utilization Of New Area:	N/A

Great Blue Herons: There was no change in the overall size of the colony (39 nests) from 1976 to 1977. However, the percent composition of nest trees did change, as there were some minor relocations of nests. The 1977 nest trees were all deciduous (72 percent American elm, 18 percent white birch, 10 percent sugar maple) and supported from 1-10 nests per tree.

The understory vegetation (primarily American yew, poison ivy and spotted touch-me-not) was heavily whitewashed. The fertilizing effect of the heron excrement may be responsible for stimulating the vigorous growth of poison ivy, most of which was over a meter tall.

TWO TREE ISLAND

64. Latitude 46°12' Longitude 84°05' 19.5 km east northeast Pickford, Chippewa County, Michigan, visited 14 June 1977.

Species:	HERRING GULL
Active Nests:	46
Census Method:	total count
Change From 1976:	10 percent increase
Percent Hatched:	83 percent
Nesting Stage:	feathered young
Age Of Young:	90 percent class 3a-3b $\bar{X}_t = 54.4$ mm
Productivity:	95 percent
Nest Density:	0.05 nests/m^2
Colony Size:	0.17 ha
Increase In Available Nesting Area:	89 percent

Degree Of Utilization Of New Area:	0 percent

Herring Gulls: The boulder beach surrounding the island was 4 m wider on the east, 7 m wider on the west and the north and south points were both 8 m longer. The size of the island increased from 0.09 ha (1976) to 0.17 ha (1977), an increase of 0.08 ha or 89 percent.

The 46 nests represent an increase of four nests (10 percent) over the 42 nests present in 1976. There were no nests on the newly exposed boulder beach. The nest site substrate was soil between the boulders. The nettles and spotted touch-me-not were puddled in the immediate area of the nests and puddled runways were evident.

STEAMBOAT ISLAND

65. Latitude $46^{o}10'$ Longitude $84^{o}12'$ 12 km east northeast Pickford, Chippewa County, Michigan, visited 14 June 1977.

Species:	HERRING GULL
Active Nests	16
Census Method:	total count
Change From 1976:	27 percent decrease
Percent Hatched:	72 percent
Nesting Stage:	downy/feathered young
Age Of Young:	50 percent class 2a; 50 percent 3a-3b $\bar{X}_t = 43.3$ mm
Productivity:	93 percent
Nest Density:	0.05 nests/m^2
Colony Size:	0.07 ha
Increase In Available Nesting Area:	133 percent
Degree Of Utilization Of New Area:	0 percent

Herring Gulls: The boulder beach surrounding the island was 3 m wider on the south, 6 m wider on the north and the west point was 8 m longer. The east point extended 3 m beyond last year's point and then, making a 90^{o} angle, extended 18 m due south. The size of the island more than doubled, from 0.03 ha (1976) to 0.07 ha (1977), an increase of 0.04 ha or 133 percent.

The 16 nests represent a decrease of 6 nests (27 percent) from the 22 nests present in 1976. There were no nests on any of the newly exposed areas. The nest site substrate was soil between the boulders. Puddling prevented the growth of nettles in the immediate area of the nests.

ROCK ISLAND

66. Latitude $46^{o}23'$ Longitude $84^{o}09'$ 18 km south southeast Sault Ste. Marie, Chippewa County, Michigan, visited 28 June 1977.

Species:	HERRING GULL	GREAT BLUE HERON
Active Nests:	48	27
Census Method:	total count	total count
Change From 1976:	9 percent decrease	17 percent increase
Percent Hatched:	56 percent	100 percent (1-3/nest)
Nesting Stage:	feathered young/ renesting	feathered young
Age Of Young:	100 percent class 3a-3b $\bar{X}_t = 56.2$ mm	est. 3b-4
Productivity:	86 percent	93 percent
Nest Density:	0.014 nests/m^2	0.11 nests/m^2
Colony Size:	0.4 ha	250 m^2
Increase In Available Nesting Area:	38 percent	25 percent
Degree Of Utilization Of New Area:	13 percent	7 percent

Herring Gulls: The boulder beach along the north shore averaged 3.5 m wider this year. The southeast point, middle of east bay, south point, middle of west bay and southwest point were extended 5, 13, 6, 8 and 12 m further, respectively. Spotted touch-me-not was rapidly growing out into the former bay areas. The size of the island increased from 0.29 ha (1976) to 0.4 ha (1977), an increase of 0.11 ha or 38 percent.

The 48 nests represent a decrease of five nests (9 percent) from the 53 nests present in 1976. Fifteen (36 percent) of the 42 nests in the preexisting areas of the colony contained eggs or were empty, newly constructed nest cups that were renesting attempts. Six nests (13 percent) were on newly exposed areas. The percent hatched of these nests was 0 percent compared to the 64 percent for nests in preexisting areas.

The nests were dispersed over the entire island. The nest site substrate was boulder (and soil between the boulders). Herbaceous vegetation was puddled in the immediate area of the nests and puddled runways through the spotted touch-me-not were evident.

Great Blue Herons: The 27 nests represent an increase of four nests (17 percent) over the 23 nests present in 1976. There were two new nests in the 30-35 m tall American elm that contained the entire colony in 1976. Plus another, smaller (20 m) American elm, 10 m to the southwest, also supported two new nests. These four new nesting pairs probably came from the Gem Island colony (5.5 km to the north northwest) which experienced a loss of 10 (23 percent) of its nests this season. The presence of an additional nest tree increased the colony size (i.e. area of ground over which the nests covered) from 200 m^2 (1976) to 250 m^2 (1977), an increase of 50 m^2 or 25 percent.

The large, annual quantities of heron excrement effectively restricted any plant growth within about 3 m of the base of the nest tree. The cow parsnip and nettles were progressively shorter the closer to the open area they were. Over a distance of only 3-5 m the height of the cow parsnip was reduced by half. And many individuals of both species had "burned"leaves (i.e. brown and curled).

GEM ISLAND

67. Latitude 46°26' Longitude 84°11' 13.5 km southeast Sault Ste. Marie, Chippewa County, Michigan, visited 28 June 1977.

Species:	HERRING GULL	GREAT BLUE HERON
Active Nests:	29	33
Census Method:	total count	total count
Change From 1976:	7 percent increase	23 percent decrease
Percent Hatched:	62 percent	100 percent (2-3/nest)
Nesting Stage:	feathered young	feathered young
Age Of Young:	80 percent class 3a-3b $\bar{X}_t$ = 56.1 mm	est. class 3b-4
Productivity:	92 percent	94 percent
Nest Density:	0.02 nests/m^2	0.037 nests/m^2
Colony Size:	1.18 ha	0.089 ha
Increase In Available Nesting Area:	40 percent	7 percent decrease
Degree Of Utilization Of New Area:	41 percent	N/A

Herring Gulls: The northeast shore was 9 m wider this year, the northwest shore 3 m wider, the southwest shore 3.5 m wider, and the southeast bay had become cobble/boulder beach out to a distance of 22 m. The southeast, northeast, northwest and southwest points were 8, 12, 9 and 19 m longer, respectively. The size of the island increased from 0.84 ha (1976) to 1.18 ha (1977), an increase of 0.34 ha or 40 percent.

The 29 nests represent an increase of two nests (7 percent) over the 27 nests present in 1976. The low percent hatched (62 percent) for the colony as a whole was due to the retarded nesting of the large number of birds utilizing the newly exposed beach areas. Forty-one percent (12 nests) of the 29 total nests were in new areas. The percent hatched was 42 percent for nests in these new areas compared to 76 percent for nests in preexisting areas.

The nests were dispersed over the entire island. The nest site substrate was boulder (and soil between the boulders). The soil and any herbaceous vegetation was well puddled in the immediate vicinity of the nest and puddled runways through the spotted touch-me-not were evident.

Great Blue Herons: The 33 nests represent a decrease of 10 nests (23 percent) from the 43 present in 1976. Four of the 10 missing nests were accounted for. They had been blown down essentially intact. Four pairs possibly relocated on Rock Island (5.5 km to the south southeast) thereby accounting for the increase experienced by that colony this year.

The nest trees were all deciduous (94 percent American elm, 6 percent white birch) and supported from 1-16 nests per tree. The disuse of one former nest tree reduced the size of the colony (i.e. area of ground covered by the nest trees) from 0.096 ha (1976) to 0.089 ha (1977), an decrease of 0.007 ha or 7 percent.

The ground area under the nest trees was essentially devoid of vegetation. However, the boulders under one nest tree did have nightshade growing on them. Otherwise the brambles, cow parsnip and nettles were restricted to the perimeter of this barren area and were heavily whitewashed and frequently appeared "burned".

SOUTHWEST NEEBISH ISLAND

68. Latitude 46°13' Longitude 84°10' 14.5 km northeast Pickford, Chippewa County, Michigan, visited 14 June 1977 and 19 July 1977.

Species:	RING-BILLED GULL ISLAND I	RING-BILLED GULL ISLAND II
Active Nests:	451	1,947
Census Method:	2 m belt transects & total count	point-quarter method & total count
Change From 1976:	109 percent increase	92 percent increase
Percent Hatched:	67 percent	58 percent
Nesting Stage:	feathered young	feathered young
Age Of Young:	100 percent class 3a-3b $\bar{X}_t$ = 47.9 mm $\bar{X}_w$ = 340.3 gm	80 percent class 3a-3b $\bar{X}_t$ = 46.5 mm $\bar{X}_w$ = 376.2 gm
Productivity:	90 percent est.	90 percent est.
Nest Density:	0.93 nests/m^2	0.78 nests/m^2
Colony Size:	0.1134 ha	0.5 ha
Increase In Available Nesting Area:	163 percent	67 percent
Degree Of Utilization Of New Area:	11 percent	33 percent

Ring-billed Gulls: Although the lowered water levels have made the two islands of this dredged material area 20 m closer, they still remain as two separate subcolonies. Also, different censusing techniques were employed on each and so they will be discussed separately. The data of these two subcolonies were combined and presented in a third table.

Subcolony I: The east and west shores of Island I had 10 m wider clay flats exposed and its north and south ends each extended out 15 m. This increased the overall size of the island from 0.0432 ha (1976) to 0.1134 ha (1977), an increase of 0.0702 ha or 163 percent.

The size of the nesting colony more than doubled. The 451 nests represent an increase of 235 nests (109 percent) over the 216 nests present in 1976. A 2 m wide belt transect was established through the long axis of the colony (10° west of north). The number and contents of each nest were recorded. The total number of nests was estimated using the formula:

$$\frac{\text{number nests in sample}}{\text{area of sample } (m^2)} \times \text{ total area of colony } (m^2)$$

Earlier visits to other colonies had shown nesting densities to be less in newly exposed areas, therefore, to avoid biases and probably an exaggerated estimate, the density of nests within the belt transect sample was used only to determine the number of nests in that portion of the colony nesting in the pre-existing areas. A total nest count was used to determine the size of that portion of the colony nesting on the newly exposed clay beach area. The total nest count was the sum of these two censuses. Forty-nine nests (11 percent) were on the newly exposed clay beach. The percent hatched was 55 percent for these nests compared with 69 percent for nests in the preexisting area.

The nest site substrate was clay. On the preexisting area of last year's colony site only five plant species were growing (common reed, sandbar willow, red-osier dogwood, red-berried elder, and nettles). The birds nested throughout clumps of these species. The guano-encrusted clay was puddled into a well-packed surface. Lamb's-quarters and nettles were encroaching onto the newly exposed clay "flats". (See following section on vegetation analysis for further details).

Subcolony II: The clay beach was 8 m wider on the east shore of the colony site and 10 m wider on the west. The pond at the north end of the colony was dried up and this new area, along with the adjacent sandy area which lacked any nests in 1976, were both dense nesting sites this year. The beach around the remainder of the island averaged 20 m wider and the marshy area on the west shore was dry. The area of the colony increased from 0.3 ha (1976) to 0.5 ha (1977), an increase of 0.2 ha or 67 percent.

The size of the nesting colony almost doubled. The 1,947 nests represent an increase of 932 nests (92 percent) over the 1,015 nests present in 1976. A 125 m line transect was established through the long, north-south axis of the colony. Fifty random points on the transect were picked and the distance from the center point to the center of the closest nest in each 90° quarter was measured. The total number of nests was estimated using the formula: $\frac{\text{total area of colony}}{(\text{mean distance})^2}$

Herbaceous Species	Relative Density	Relative Coverage	Relative Frequency	Three-Way Importance Value
common reed	73.2	53.3	60.9	187.4
nettle	26.8	46.7	39.1	112.6
Woody Species				
sandbar willow	88.0	82.6	50.0	220.6
red-berried elder	11.1	11.6	25.0	47.7
red-osier dogwood	0.9	5.8	25.0	31.7

Earlier visits to other colonies had shown nesting densities to be less in the newly exposed areas, therefore, to avoid biases and probably an exaggerated estimate, the point-quarter method was used only in the pre-existing areas of the colony. A total nest count was used to determine the size of that portion of the colony nesting on the newly exposed beach areas. The total number of active nests was the sum of these two censuses.

652 nests (33 percent) were in new areas. The low, overall percent hatched for the colony as a whole was due to the retarded nesting of those birds utilizing the new areas. Hatching was only 21 percent for these nests compared to 83 percent for nests in pre-existing areas.

The nest site substrate was clay. The clay was heavily guano-encrusted and well-puddled. The number of plant species present was restricted (predominant species same as on Island I). The birds nested throughout the dense stands of common reed (shich was 2 m tall on 14 June) and under the elder, dogwood and willow.

Species:	RING-BILLED GULL TOTAL (both subcolonies)
Active Nests:	2,398
Census Method:	belt transect, point-quarter method & total count
Change From 1976:	90 percent increase
Percent Hatched:	59 percent
Nesting Stage:	feathered young
Age Of Young:	90 percent class 3a-3b $\bar{X}_t = 47.2$ mm $\bar{X}_w = 321.4$ gm
Productivity:	90 percent est.
Nest Density:	0.81 nests/m^2
Colony Size:	0.6134 ha
Increase In Available Nesting Area:	79 percent
Degree Of Utilization Of New Area:	29 percent

Vegetation Analysis: This was conducted on 19 July 1977. As the vegetation was essentially the same in both subcolonies, the detailed analysis conducted on Island I was considered representative for the colony as a whole. A line transect was established through the north-south axis of the colony. The herbaceous species were sampled in 1 m^2 plots every other meter, for a total of 15 sample plots. Woody species were sampled in two 16 m^2 plots 4 m apart along the transect. The number of individual plants of each species and a visual estimation of the area covered by each species were recorded. Relative density, coverage and frequency were calculated and importance values were assigned to each species. These values are presented in the table on the following page. Of the total area sampled (47 m^2) 62 percent was bare and 38 percent had vegetative cover (herbaceous and/or woody). The maximum heights of the five predominant species on 19 July were: sandbar willow= 3 m, red-osier dogwood= 2.5 m, red-berried elder= 2 m , and nettles= 2 m.

MOON ISLAND

69. Latitude 46°13' Longitude 84°10' 14.5 km northeast Pickford, Chippewa County, Michigan, visited 14 June 1977 and 19 July 1977.

Species:	RING-BILLED GULL
Active Nests:	1,673
Census Method:	point-quarter method & total count
Change From 1976:	70 percent increase
Percent Hatched:	69 percent
Nesting Stage :	feathered young
Age Of Young:	90 percent class 2b-3b $\bar{X}_t$ = 44.5 mm $\bar{X}_w$ = 265.5 gm
Productivity:	90 percent est.
Nest Density:	0.73 nests/m^2
Colony Size:	0.5538 ha
Increase In Available Nesting Area:	72 percent
Degree Of Utilization Of New Area:	19 percent

Ring-billed Gulls: In 1976 the edges of the colony site were 0.5-1.0 m clay bluffs dropping directly to the water. This year there were 10 m clay beaches around the entire area, although the birds only nested in the inland third of this new area. The former inlet and marshy area (with scattered willow) at the northwest corner of the colony site were dry and being utilized by the birds for nesting. Also, the island's resident beaver population continued to open up new nesting areas. Additional quaking aspen (15-20 cm diameter) were cut down in the main, pre-existing area of the colony site. Also, the beaver cut down all the young balsam poplar (average diameter= 5 cm) and many of the willow saplings over a 15 m^2 area in the very dense willow growth at the northeast corner of the colony. This "thinned-out" area contained nests this year. The beavers' lodge was half way up the east shore of the island, 300 m from the north end of the colony. Thus a total of 0.2325 ha of newly available nesting area (newly exposed clay beaches, dried up marsh, beaver-cleared area) was added to the pre-existing 0.3213 ha of the colony, increasing the size of the colony to 0.5538 ha, an increase of 72 percent.

The 1,673 nests represent an increase of 691 nests (70 percent) over the 982 nests present in 1976. Two line transects 20 m apart were established perpendicular to an east-west base line across the north end of the colony. Fifty random points on the transects were picked and the distance from the center point to the center of the closest nest in each 90° quarter was measured. The total number of nests was estimated using the formula: $\frac{\text{total area of colony}}{(\text{mean distance})^2}$

Earlier visits to other colonies had shown nesting densities to be considerably less in newly exposed areas, therefore, to avoid biases and possibly an exaggerated estimate, the point-quarter method was used only in the pre-existing areas of the colony. A total nest count was used to determine the size of that portion of the colony nesting in the new areas. The total number of active nests was the sum of these two censuses. A total of 318 nests (19 percent) were in the new areas. The percent hatched was only 10 percent for these nests, compared to 84 percent for nests in the pre-existing areas.

The nest site substrate was clay, which was heavily guano-encrusted. There were large, heavily-puddled areas devoid of vegetation. The number of plant species in the main area of the colony was restricted to seven herbaceous species (common reed, quackgrass, brambles, lamb's-quarters, nettles, milkweed, and white sweet clover) and three woody species (quaking aspen, red-berried elder and red-osier dogwood). The birds nested throughout the dense stands of common reed (1.5 m tall on 14 June). Nesting also occured under the fallen (i.e. beaver-cut) aspen and the elder and dogwood. Clumps of quack-grass, lamb's-quarters and nettles appeared to be "thriving" and were up to 75 cm tall. A few scattered brambles and milkweed appeared wilt-ed and burned. The new nesting area in the northwest portion of the colony supported a greater variety (17) of species, with peach-leaf willow being dominant. (See following section on vegetation analysis for further details).

Vegetation Analysis: This was conducted on 19 July 1977. An eastwest line transect was established across the entire width and through the center of the main colony nesting on the pre-existing colony site. This was to distinguish this area from the new nesting area through which a second line transect was run. The herbaceous species were sampled in 1 m^2 plots every other meter, for a total of 24 sample plots. Woody species were sampled in two 16 m^2 plots along the tran-sect. The number of individual plants of each species and a visual estimation of the area covered by each species were recorded. Relative density, coverage and frequency were calculated and importance values were assigned to each species. These values are presented in the fol-lowing table. Of the total area sampled (56 m^2) 63 percent was bare and 37 percent had vegetation cover (herbaceous and/or woody). The gulls' excrement appeared to have a stimulating effect on those species capable of withstanding, or possibly growing tall quickly enough to avoid, severe puddling. The maximum heights of the predominant species on 19 July were: common reed= 224 cm, lamb's quarters= 180 cm, and quackgrass= 90 cm.

A second eastwest line transect was established through the new nesting area in the northwest portion of the colony. In 1976 this area was inundated, with only scattered shrubs above water. The herbaceous species were sampled in 1 m^2 plots every other meter, for a total of nine sample plots. Woody species were sampled in four 16 m^2 plots every 4 m along the transect. The number of individual plants of each species and a visual estimation of the area covered by each species were recorded. Relative density, coverage and frequency were calculated and importance values were assigned to each species. These values are presented in the following table. Of the total area sampled (73 m^2) 35 percent was bare and 65 percent had vegetation cover (herbaceous and/or woody).

Herbaceous Species	Relative Density	Relative Coverage	Relative Frequency	Three-Way Importance Value
(Pre-existing Area)				
Lamb's quarters	20.8	50.3	34.3	105.4
Quackgrass	57.2	18.2	22.9	98.3
Common reed	19.4	21.2	28.6	69.2
White sweet clover	1.5	8.0	2.9	12.4
Nettle	0.9	1.2	5.7	7.8
Milkweed	0.2	1.2	5.7	7.1
Woody Species (Pre-existing Area)				
Red-berried elder	86.4	84.2	33.0	203.6
Quaking aspen	13.6	15.8	67.0	96.4
(New Area)				
Common reed	17.4	64.4	23.3	105.1
Manna grass	44.6	5.2	6.7	56.5
Nettle	12.0	7.5	13.3	32.8
Bluegrass	12.0	1.7	6.7	20.4
Lamb's-quarters	2.5	4.0	10.0	16.5
Bone-set	1.2	1.7	10.0	12.9
Plantain	1.7	5.7	3.3	10.7
Red clover	1.7	1.1	6.7	9.5
Mullein	0.4	5.7	3.3	9.4
Rush	3.7	0.6	3.3	7.6
Sedge	1.7	0.6	3.3	5.6
Touch-me-not	0.4	0.6	3.3	4.3
Pineapple-weed	0.4	0.6	3.3	4.3
Tall cinquefoil	0.4	0.6	3.3	4.3
Woody Species (New Area)				
Peachleaf willow	82.3	83.3	75.0	240.6
Red-osier dogwood	17.6	16.7	25.0	59.3

Herring Gulls: There were seven nests in the upland vegetation in the central portion of the island. This was 11 fewer nests (61 percent) than the 18 nests present in 1976. Four nests were empty newly-constructed nest cups, two nests had one egg, and one nest had two eggs. No young were seen. About 15 adults were overhead.

The area of this upland situation was 1 ha. Beavers had felled nine 15-25 cm diameter quaking aspen at the edge of this open field.

SOUTHEAST NEEBISH ISLAND

70. Latitude 46°14' Longitude 84°07' 19.5 km northeast Pickford, Chippewa County, Michigan, visited 14 June 1977 and 19 July 1977.

Species:	RING-BILLED GULL	COMMON TERN
Active Nests:	55	45
Census Method:	total count	total count
Change From 1976:	15 percent increase	67 percent decrease
Percent Hatched:	1 percent	9 percent
Nesting Stage:	incubation	late incubation
Age Of Young:	class 1 (N=1)	80 percent class 1 (N=5) $\bar{X}_t$ = 10.2 mm $\bar{X}_w$ = 16.2 gm
Productivity:	no dead	67 percent
Nest Density:	0.13 nests/m^2	0.15 nests/m^2
Colony Size:	0.0421 ha	0.312 ha

Ring-billed Gulls: The rock-faced walls of the island are nearly vertical, thus the lower water levels had no effect on the size of the available nesting area on the top. The 55 nests represent an increase of six nests (12 percent) over the 49 nests present in 1976. The nesting cycle of this small colony was 3-4 weeks retarded relative to the larger colonies southwest of Neebish Island. Also, the colony's nest density was less than one-sixth those found in the other colonies.

The nest site substrate was upland grass. The grass appeared taller within the colony. Apparently the birds' excrement had a stimulating effect. Only the area immediately around the nest itself was puddled to any extent.

Vegetation Analysis: This was conducted on 19 July 1977. A line transect was established perpendicular to the long axis of the island and ran through the center of the colony. The herbaceous species were sampled in 1 m^2 plots every other meter, for a total of 10 sample plots. The number of individual plants and a visual estimation of the area covered by each species was recorded. Relative density, coverage and frequency were calculated and importance values were assigned for each species. These values are presented in the following table. Of the total area sampled (10 m^2) 29 percent was bare and 71 percent had vegetation cover (herbaceous).

Herbaceous Species	Relative Density	Relative Coverage	Relative Frequency	Three-Way Importance Value
(RGB Colony)				
Bluegrass	80.6	48.9	21.3	150.8
Black mustard	7.9	23.8	14.9	46.6
Timothy	6.8	16.2	19.1	42.1
Sheep sorrel	3.0	3.2	10.6	16.8
Yellow rocket	0.4	2.8	6.4	9.6
Field daisy	0.7	2.0	6.4	9.1
Dandelion	0.3	1.5	6.4	8.2
Shepard's-purse	0.1	0.4	6.4	6.9
Smartweed	0.05	0.4	2.1	2.6
Penny cress	0.05	0.3	2.1	2.5
Lamb's-quarters	0.02	0.3	2.1	2.4
Fleabane	0.02	0.1	2.1	2.2

Common Terns: The 45 nests represent a decrease of 91 nests (67 percent) from the 134 nests present in 1976. Flotation of the third egg from ten randomly selected nests showed 70 percent of the clutches to be within one week of hatching.

A smaller percentage (20 percent) of the nests were on the bare rock substrate this year. A total of 80 percent of the nests were in the upland grass (predominantly Kentucky bluegrass). The effect of the nesting birds on the vegetation was essentially negligible.

Vegetation Analysis: This was conducted on 19 July 1977. A line transect was established perpendicular to the long axis of the island and through the approximate center of the colony. The herbaceous species were sampled in 1 m^2 plots every other meter, for a total of 10 sample plots. The number of individual plants of each species and a visual estimation of the area covered by each species were recorded. Relative density, coverage and frequency were calculated and importance values were assigned to each species. These values are presented in the following table. Of the total area sampled (10 m^2) 27 percent was bare and 73 percent had herbaceous cover.

Herbaceous Species	Relative Density	Relative Coverage	Relative Frequency	Three-Way Importance Value
(CT Colony)				
Bluegrass	88.2	66.2	36.4	190.8
Timothy	9.5	11.7	13.6	34.8
Red clover	0.6	9.6	18.2	28.4
Field daisy	0.9	7.6	13.6	22.1
Black mustard	0.6	3.4	9.1	13.1
Yellow clover	0.1	1.4	4.5	6.0
Penny cress	0.02	0.1	4.5	4.6

Herring Gulls: The one pair formerly nesting in the upland grass at the north end of the island was not present in 1977.

WEST SUGAR ISLAND I

71. Latitude 46°26' Longitude 84°15' 9.5 km southeast Sault Ste. Marie, Chippewa County, Michigan, visited 28 June 1977 and 12 July 1977.

Species:	COMMON TERN
Active Nests:	116
Census Method:	total count
Change From 1976:	17 percent decrease
Percent Hatched:	22 percent
Nesting Stage:	hatching
Age Of Young:	class 1-3b $\bar{X}_t = 19.2$ mm
Productivity:	99 percent
Nest Density:	0.13 nests/m^2
Colony Size:	0.1725 ha
Increase In Available Nesting Area:	275 percent
Degree Of Utilization Of New Area:	48 percent

Common Terns: The west shore of the island was 6 m wider, the east was 2 m wider, the bay shore on the northeast was 9 m wider, and the north and south ends extended 14 m and 35 m further, respectively. Smartweed, yellow rocket, tumble-mustard, lamb's-quarters and some sandbar willow were encroaching onto the new sand beaches. The pond was dried up and grown over with cattail, arrowhead, willow, smartweed and yellow rocket. The size of the island almost tripled, from 0.046 ha (1976) to 0.1725 ha (1977) , an increase of 0.1265 ha or 275 percent.

The 116 nests represent a decrease of 23 nests (17 percent) from the 139 nests present in 1976. Most of the missing pairs probably nested on west Sugar Island II, 1 km to the north northwest, which was a new colony with 44 nests in 1977. With only 22 percent of the colony hatched on 28 June the colony appeared two weeks retarded, at least relative to the northwest Sugar Island colony which was 90 percent hatched at this date with 80 percent of its young class 3a or 3b.

A total of 56 nests were on the newly exposed sand beach and in the area of the dried up pond (six nests). The percent hatched was 11 percent for nests in the new areas compared to 33 percent for nests in pre-existing areas. In 1976, 20 percent of the nests were under the rather dense growth of willow. This year there were practically no nests in the densest areas of willow. The nest site substrate was sand and the effect of the birds on the vegetation was neligible.

On 28 June the 10 randomly selected young aged were 30 percent Class 2b, 30 percent Class 3a, and 40 percent Class 3b. However, numerous nests also contained pipped eggs and/or newly hatched Class 1 chicks. On 12 July an estimated 25 percent of the young were in the air.

Vegetation Analysis: This conducted on 12 July 1977. An east-west line transect was established across the width of the island and through the approximate center of the colony. The 25 m transect included the rocks on the east shore, the sand and herbaceous vegetation east of the center, the willow area in the center of the island, and the newly exposed sand beach area on the west. The herbaceous species were sampled in 0.5 m^2 plots every other meter, for a total of 12 sample plots. Willow was the only sizable (2 m tall) woody species (the others were seedlings) and so was sampled in the same plots with the herbaceous species. The number of individual plants of each species and a visual estimation of the area covered by each species were recorded. Relative density, coverage and frequency were calculated and importance values were assigned to each species. These values are presented in the following table. Of the total area sampled (6 m^2) 61 percent was bare and 39 percent had vegetation cover (herbaceous and/or woody). The maximum heights of the five predominant species on 12 July were: sandbar willow= 2 m, smartweed= 50 cm, lamb's-quarters= 40 cm, spotted touch-me-not= 30 cm, and bluegrass= 10 cm.

Species	Relative Density	Relative Coverage	Relative Frequency	Three-Way Importance Value
Sandbar willow	34.1	79.3	37.0	150.4
Bluegrass	20.9	3.0	11.1	35.0
Touch-me-not	13.8	5.6	7.4	26.8
Lamb's-quarters	10.9	0.9	7.4	19.2
Smartweed	2.9	3.7	11.1	17.7
Field sowthistle	7.4	3.2	3.7	14.3
Balsam poplar (seedlings)	7.4	1.3	3.7	12.4
Sedge	0.6	1.5	3.7	5.8
Nightshade	0.6	0.6	3.7	4.9
Yellow rocket	0.6	0.4	3.7	4.7
Dandelion	0.6	0.2	3.7	4.5
Sugar maple (seedling)	0.3	0.2	3.7	4.2

WEST SUGAR ISLAND II

72. Latitude 46°26' Longitude 84°15' 8 km southeast Sault Ste. Marie, Chippewa County, Michigan, visited 28 June 1977 and 12 July 1977.

Species: COMMON TERN
Active Nests: 44
Census Method: total count
Change From 1976: new colony
Percent Hatched: 52 percent

Nesting Stage:	hatching
Age Of Young:	class 1-3b $\bar{X}_t = 18.6$ mm
Productivity:	97 percent
Nest Density:	0.08 nests/m^2
Colony Size:	0.0512 ha
Increase In Available Nesting Area:	totally new
Degree Of Utilization Of New Area:	100 percent

Common Terns: West Sugar Island II located 1 km off the west shore of Sugar Island and 1 km north northeast of Six Mile Point on the mainland. It is over 1 km north of Island I and so the two are treated as separate colonies. Northwest Sugar Island is 1.8 km to the north northwest and is also treated separately. Besides it is composed primarily of clay rather than sand. Island II is roughly figure eight shaped, oriented along a north-south axis that is 142 m long, 54 m at its widest and 23 m at its narrowest. The area of the island was 0.495 ha. A total of 95 percent of the colony (42 nests) was within a 0.0512 ha area on the north point. The other two nests were at the southeast end of the island.

The central portion of the island (831 m^2) supported a thick growth of upland vegetation including balsam poplar (max. ht. 3-4 m), sandbar willow, dandelion, yellow rocket, orange hawkweed, king devil, common buttercup, common yarrow, field bedstraw, fleabane, evening primrose, red clover, yellow clovers, sweet clover, horsetail rush, timothy and bluegrass. Smartweed, yellow rocket and bluegrass were growing on the sand beaches and points.

The entire colony of 44 nests was new. The birds probably came from the Northwest Sugar Island I colony, which lost 23 nests.

All of the nests were on sand. The 20 random young aged on 28 June were of all ages: 20 percent Class 2a, 20 percent Class 2b, 20 percent Class 3a, 35 percent Class 3b. Several newly hatched Class I chicks were also seen. On 12 July an estimated 30 percent of the young were flying. On 19 July, from the air, most adults and young appeared to be at the south end of the island. At this date the south end was fairly open and relatively unvegetated, while the north end was densely covered with smartweed.

Vegetation Analysis: This was conducted on 12 July 1977. As this colony was new and situated entirely on the north end of the newly exposed sand beach, an east-west line transect was established 10 m south of the north point. This put the 30 m long transect through the approximate center of the colony. The herbaceous species were sampled in 0.5 m^2 plots every other meter, for a total of 15 sample plots. The number of individual plants of each species and a visual estimation of the area covered by each species were recorded. Relative density, coverage and frequency were calculated and importance values were assigned to each species. These values are presented in the following table. Of the total area sampled (7.5 m^2) 64 percent was bare and 36 percent had herbaceous cover. The maximum heights of the five predominant species on 12 July were: smartweed= 90 cm, lamb's-quarters= 70 cm, white sweet clover= 15 cm, bluegrass= 10 cm, and rush= 10 cm.

Species	Relative Density	Relative Coverage	Relative Frequency	Three-Way Importance Value
Smartweed	61.6	67.9	19.1	148.6
Bluegrass	12.2	7.3	13.2	32.7
White sweet clover	4.0	6.4	11.8	22.2
Lamb's-quarters	3.3	6.4	10.3	20.0
Rush	9.4	1.6	7.4	18.4
Sedge	4.0	1.9	8.8	14.7
Red clover	2.6	2.8	8.8	14.2
Tumble-mustard	1.8	3.3	8.8	13.9
Yellow rocket	0.4	0.9	5.9	7.2
Plantain	0.4	0.5	1.5	2.4
Canada thistle	0.1	0.5	1.5	2.1
Yellow clover	0.1	0.3	1.5	1.9
Dandelion	0.2	0.2	1.5	1.9

Herring Gulls: One nest containing one egg was located in the upland vegetation in the center of the island.

NORTHWEST SUGAR ISLAND

73. Latitude 46°27' Longitude 84°16' 6 km southeast Sault Ste. Marie, Chippewa County, Michigan, visited 28 June 1977 and 12 July 1977.

Species:	COMMON TERN
Active Nests:	21
Census Method:	total count
Change From 1976:	74 percent decrease
Percent Hatched:	90 percent
Nesting Stage:	feathered young
Age Of Young:	80 percent class 3a-3b $\bar{X}_t = 20.1$ mm
Productivity:	96 percent
Nest Density:	0.168 nests/m^2
Colony Size:	0.07 ha
Increase In Available Nesting Area:	536 percent
Degree Of Utilization Of New Area:	10 percent

Common Terns: The newly exposed clay beach surrounding the island averaged 9 m wide. The size of the island increased from 0.011 ha (1976) to 0.07 ha (1977), an increase of 0.059 ha or 536 percent. Plant species encroaching onto the clay beach included smartweed, yellow rocket, lamb's-quarters, common yarrow, red clover and horsetail rush.

The 21 nests represent a decrease of 60 nests (74 percent) from the 81 nests present in 1976. Some of the missing pairs probably nested on West Sugar Island II 1.8 km to the south southeast, which was a new colony with 44 nests this year. With 90 percent of its clutches hatched and 80 percent of its young Class 3a or 3b on 28 June, the colony's stage of nesting was 2-3 weeks ahead of the other two islands' tern colonies to the south. On 12 July an estimated 90 percent of the young were flying.

The nest site substrate was upland grass and herbaceous vegetation on clay. All except two of the nests were in the thickly vegetated, pre-existing central area of the island. The other two nests were on the newly exposed, open, clay "flats". The percent hatched for these two nests was 0 percent compared with 89 percent for nests on the pre-

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COLONIAL BIRDS NESTING ON MAN-MADE AND NATURAL SITES IN THE U. --ETC(U)
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existing colony site. The grass and herbaceous vegetation in the immediate area of the nests was flattened.

Herring Gulls: One nest containing two eggs was located among the tern nests in the upland vegetation. The grass in the immediate vicinity of the nest was puddled and there was a muddy (from the wet clay), extremely well-puddled path (25 cm wide) between the nest and the 1 m bluff at the edge of the vegetation. No gulls were present in 1976.

Vegetation Analysis: This was conducted on 12 July 1977. As the island sloped from the north up to the south a north-south line transect 28 m long was established through the center of the colony. The herbaceous species were sampled in 0.5 m^2 plots every other meter, for a total of 14 sample plots. The number of individual plants of each species and a visual estimation of the area covered by each species were recorded. Relative density, coverage and frequency were calculated and importance values were assigned to each species. Of the total sampled (7 m^2) 33 percent was bare and 67 percent had herbaceous cover. The maximum heights of the five predominant species on 12 July were: glodenrod= 120 cm, field sowthistle= 100 cm, bluegrass= 75 cm, smartweed= 70 cm, and horsetail rush= 50 cm.

Herbaceous Species	Relative Density	Relative Coverage	Relative Frequency	Three-Way Importance Value
Bluegrass	55.8	24.1	12.0	91.9
Smartweed	16.7	22.3	7.6	46.6
Horsetail rush	12.4	20.6	7.6	40.6
Goldenrod	4.5	9.5	7.6	21.6
Field sowthistle	2.2	4.4	7.6	14.2
Canada thistle	1.1	2.9	6.5	10.5
Yellow rocket	0.8	2.9	6.5	10.2
Red clover	1.2	1.0	7.6	9.8
Tumble-mustard	0.2	0.4	3.3	9.3
White sweet clover	0.6	1.6	6.5	8.7
Common yarrow	1.1	1.4	5.4	7.9
Field daisy	0.3	2.1	4.3	6.7
Plantain	0.6	1.3	3.3	5.2
Lamb's-quarters	0.6	0.8	3.3	4.7
Timothy	0.8	1.0	2.2	4.0
Orange hawkweed	0.4	0.3	3.3	4.0
Moss (unid.)	0.04	2.6	1.1	3.7
Dandelion	0.7	0.5	1.1	2.3
Yellow clover	0.1	0.2	1.1	1.4
Fireweed	0.04	0.1	1.1	1.2
Sedge	0.04	0.1	1.1	1.2

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APPENDIX E: COLONIAL SEABIRD NESTING COLONIES OF THE BEAVER ISLANDS ARCHIPELAGO NORTHERN LAKE MICHIGAN

Introduction

1. Thirteen nesting sites in the Beaver Island were censused in 1977. The orientation of the islands harboring these sites and distances from the mainland are indicated on Figure E1. The total number of active nests is summarized below:

	Great Blue Heron	Herring Gull	Ring-billed Gull	Common Tern	Caspian Tern
Grape Islands	0	4	1278	11	0
East West	3	6	3660	0	0
Gull Island	0	1750	440	0	0
Hat Island	0	603	0	0	686
High Island	0	7	3442	87	116*
High Island Shoals	0	0	0	0	42*
Ile aux Galets	0	131	2870	0	312
Pismire Island	0	238	0	0	0
Second reef west of Pismire	0	2	0	30	0
Squaw Island west	0	72	0	0	0
Shoe Island	0	6	0	0	53*
Trout Island	0	105	0	0	0
Whiskey Island	0	13	0	0	0
	3	2937	11690	128	998

* Most if not all of these nests were pairs renesting after an abortive initial attempt and are not included in the total.

2. An initial census of this area was done in 1976 and published in "Nesting and migration areas of birds in the U. S. Great Lakes", by W. C. Scharf, M. Erdman, M. Chamberlin and G. W. Shugart, 1977. Information from Scharf et al. (1977) is not repeated in the 1977 report unless

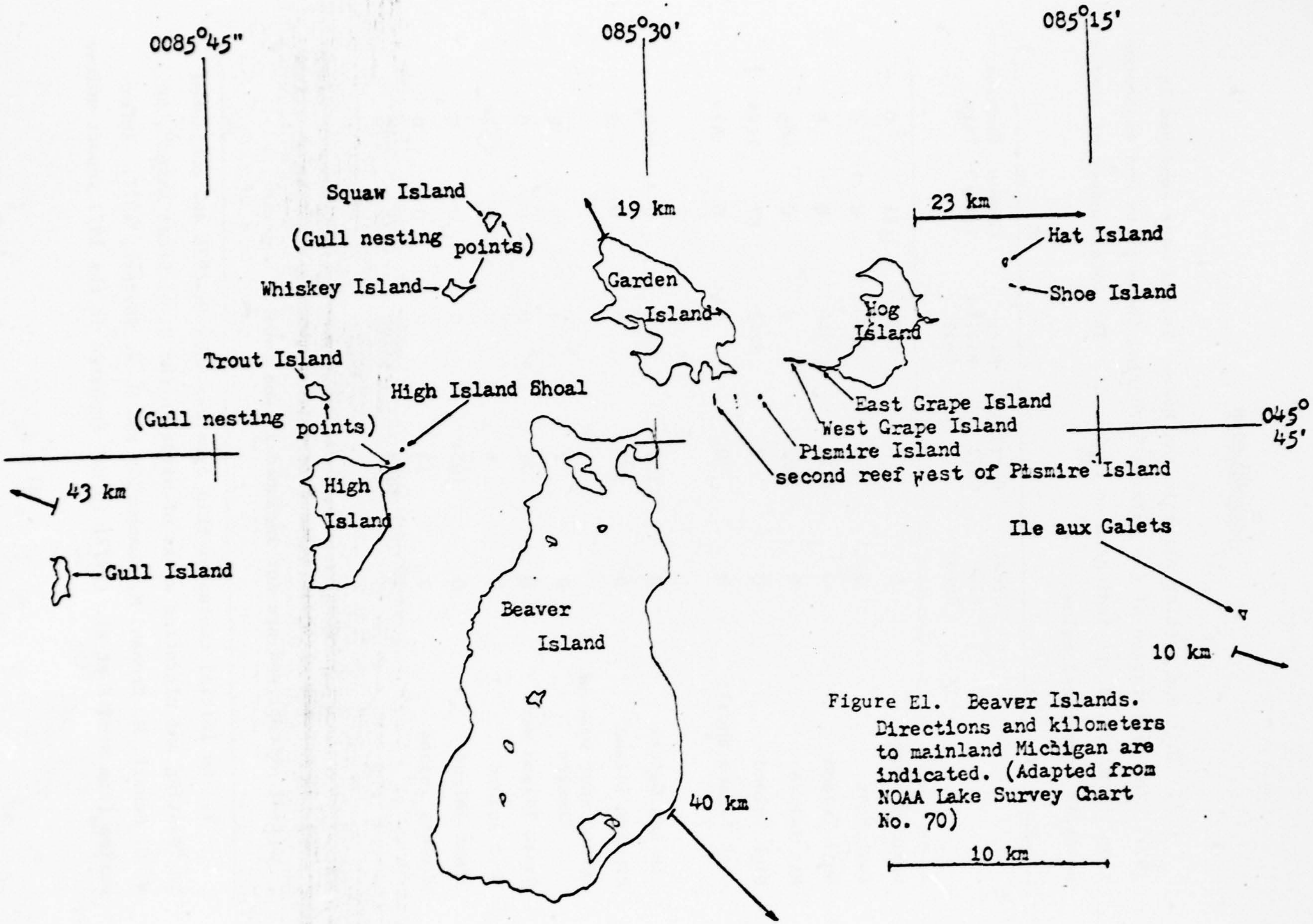


Figure E1. Beaver Islands. Directions and kilometers to mainland Michigan are indicated. (Adapted from NOAA Lake Survey Chart No. 70) new developments at any particular site deemed it necessary. The format followed is similar to 1976.

METHODS

3. As in 1976, I was interested in obtaining for each colony the number of active nests and an indication of breeding chronology based on the number of eggs hatched. Techniques include (a) total direct counts of nests, eggs and chicks, or (b) if the colony was too large for direct count, I counted at least 10 percent of the nests and contents. In large Herring Gull colonies, the contents of every tenth nest was recorded. While all nests were still counted, this method saves considerable time because the nests are widely dispersed and the census taker need not walk to every nest. In large Ring-billed Gull colonies, I established 3 m wide strips every 30 m through the nesting area and recorded the number of nests and contents of each in this sample area. The total number of nests was determined by extrapolating from the number of nests per meter square in the sample area. All tern nest were counted.

4. The census methods were the same as those used in 1976. In the individual island accounts unless otherwise stated, the direct count method was used. On several occasions I used results of direct counts by observers Francesca J. Cuthbert (FJC) and Elizabeth Howard (EH) instead of repeating counts which would have perturbed the birds unnecessarily.

5. Vegetation was sampled on six of the 13 sites. Upon arriving at a nesting site, I first identified areas of different vegetation associations in the nesting area. I then randomly placed transects through each vegetation type from the edge to the central nesting area or across the island if it was narrow. Herbaceous vegetation was sampled by determining for each species the percent coverage and number of individuals in meter square quadrats at every other meter along this transect line. A 16 m^2 quadrat was used for sampling woody vegetation (shrubs and small trees). Quadrats 4m x 4m were placed consecutively

along the same line used for herbaceous vegetation. Percent coverage and number of individuals were recorded for each shrub. Plant species and importance values are indicated in Table E1. (page E37). Locations of the transects are indicated on island maps. Some factors worthy of note in the 1977 study are:

6. Changes in Great Lakes water levels. One is tempted to hypothesis that the high water in 1973 through 1976 limited the amount of available nesting space and the number of nesting pairs. This may be partially true.

7. Water levels in Lake Michigan and Lake Huron were 0.7 m above the mean 1900-1976 levels in 1976. Water had been at this level since 1973 (USACE, Detroit, 1977b). Water levels had declined to the average 1900-1976 level by April and May 1977 and continued a slow decline. By the time nesting activity commenced in April additional land area around nesting sites on all islands except Hat, Trout and Whiskey was exposed. Apparently adequate nesting space on the remainder of the islands, except High Island, increased from 20 to 50 percent of the 1976 size (see individual island reports for actual sizes). The addition to High Island was sand beach which was not prime nesting substrate of any species nesting in the area. Areas on the other islands were judged adequate if they were above and beyond the reach of storm waves as indicated by the 1977 high water line, and if the substrate of the newly exposed area was nested upon by birds at other sites.

8. Only on Gull Island can a correlation between increased nesting area and increased gull nesting numbers be seen. The number of nesting Herring Gulls increased by 40 percent and a new or revived Ring-billed Gull colony appeared on cobble than was 80 percent under water in 1976. The nesting area increased by approximately 30 percent.

9. On East and West Grape Islands, Ile aux Galets and Pismire Island the nesting population remained the same or decreased. All had large Ring-billed Gull nesting colonies except for Pismire, which was exclusively Herring Gulls.

10. In summary, there was some correlation between increased nesting area and the number of pairs nesting at one Herring Gull colony and

no correlation between increased nesting area and the number of pairs nesting at Ring-billed Gull colonies. This trend suggests that the Ring-billed Gull population in at least this area of Lake Michigan is not limited in size by available nesting space. The opposite may be true for Herring Gulls.

11. Individual site selection by Ring-billed Gulls. Ring-billed Gulls on East and West Grape Islands nested totally in vegetated areas in 1976 because this was the only area available. In 1977, the newly exposed cobble beach gave returning birds a choice between heavily vegetated areas and unvegetated areas. In 1977, 30 percent of the nests on West Grape Island and over 50 percent on East Grape Island were constructed on the newly exposed cobble. The same number of pairs present in both years suggests the same birds returned and many chose to nest in the open despite good nesting success in 1976 in vegetated areas. This percentage probably indicates that Ring-billed Gulls are not particularly tenacious to their previous nesting sites even when successful. This apparent lack of site tenacity in some Ring-billed Gulls could allow this species to move into new areas more rapidly than Herring Gulls.

GRAPE ISLANDS

12. In 1976 portions of a peninsula extending west from the southwest corner of Hog Island were inundated by high water creating East and West Grape Islands. West Grape Island was separated from East Grape by 600 m of water and East Grape from Hog Island by 150 m of water. Lower water levels in 1977 have exposed a cobble and gravel bar which connects East Grape to Hog Island, but for purposes of this report it will still be referred to as East Grape Island.

East Grape Island

13. Lat. 45°47: Long. 085°24'. Size 7.520 ha

Visit 1: 27 May, 16:30-18:00. Clear sky, 21°C, 16 kph west wind.

(a) Total count of gull nests and eggs, (b) updated map.

Visit 2: 26 June, 11:00-13:00. Clear, 21°C, 24 kph south.
(a) Sampled vegetation, (b) counted Common Tern nests and eggs,
(c) mapped Common Tern nesting area.
Visit 3: 8 July, 17:00-17:30. Partly cloudy, 18°C, 24 kph west.
(a) Visually surveyed productivity, (b) collected plants,
(c) counted Common Tern Nests and eggs.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Dead chicks
Herring Gull	--	4	12	0	0	0
Ring-billed Gull	0.210	1278	3234	0	0	0
Common Tern	0.010	11	(see discussion below)			

Herring Gull. Nests were not aggregated.

Ring-billed Gull. Of the 1278 nests present in 1977, 744 (58 percent) were placed in areas that were covered by water in 1976. Of these nests, 20 (2 percent) were placed in dead red osier dogwood shrubs on the cobble beach at the west end of the island, and 724 (56 percent) were immediately to the south of the 1976 nesting area on cobble that was practically devoid of vegetation. Only 534 (42 percent) of the pairs present selected the 1976 area that had abundant vegetation. On 27 May 1977, I inspected eggs from 50 different nests for signs of hatching and found shells of eggs in 7 nests were started. This indicated pipping would occur in 1-2 days and hatching in 3-4 days. Flotation of eggs from 20 other nests indicated hatching was 5-10 days away (development stages extrapolated from Hays and LeCroy 1971). Using this evidence hatching commenced about 1 June and peaked about 6 June. About 1/3 of the chicks could fly on 8 July which indicates a similar hatching date. Productivity appeared to be very good on 8 July. The number of pairs increased 1.1 percent (1188 active nests in 1976) from 1976 and hatching was similar to 1976 as 3.3 percent of eggs present had hatched by 28 May 1976.

Common Tern. Contents of nests:				
	4 eggs	3 eggs	1 chick, 1 egg	new scrapes
29 June	1	3	1	5
8 July	0	7	0	3

The chick present on 29 June could not be found on 8 July. The stages of incubation for the 3-egg clutches present on 8 July were four within one week of laying and three within 3-5 days of hatching. These nests were probably not very successful. The nests were in an area 20 m x 5 m that was underwater in 1976.

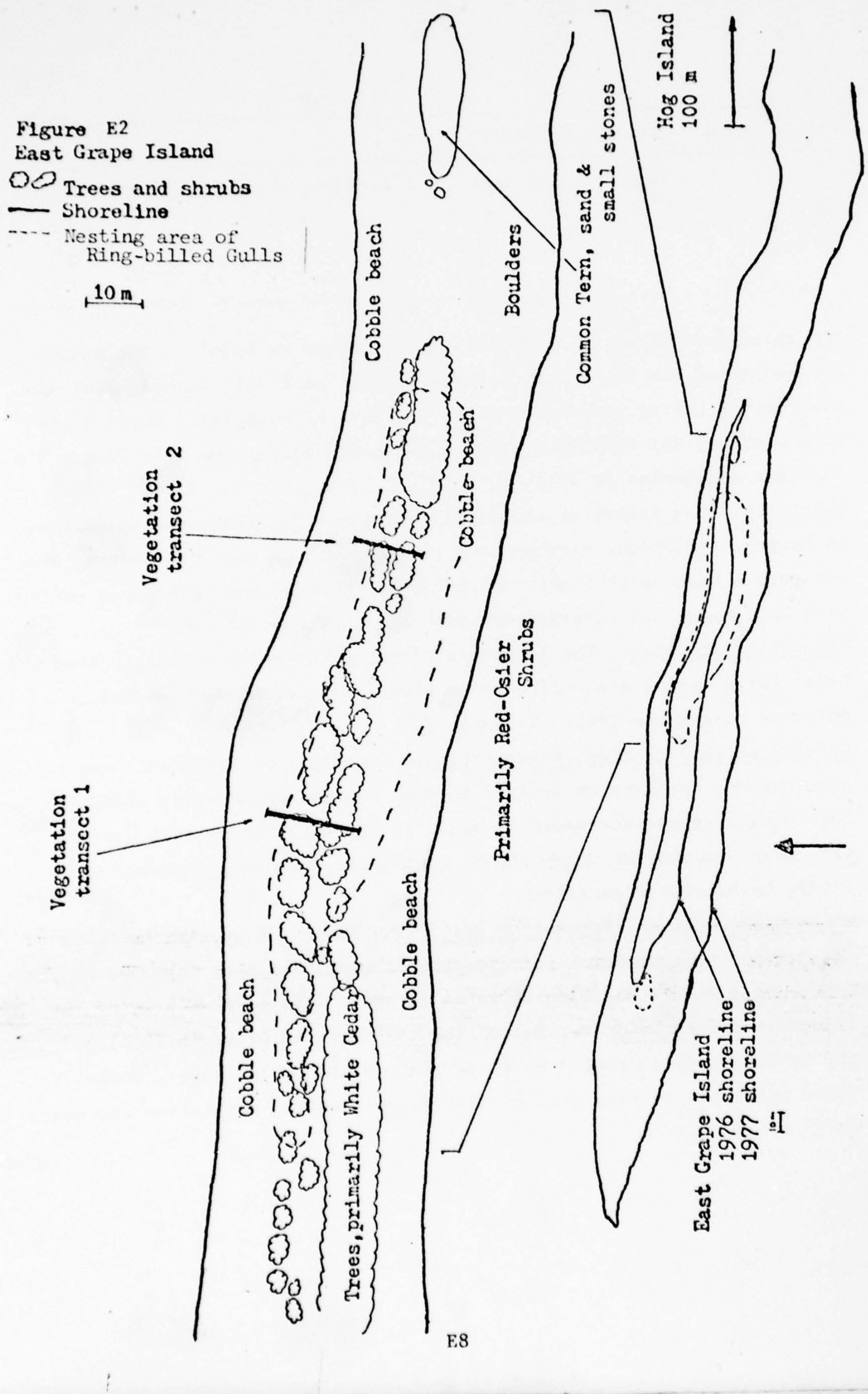
Substrate. See Scharf et al. (1977). The nesting area used in 1976 was unchanged. Additinal nesting area to the south of the 1976 nesting area was cobble beach with scattered boulders. Much of the cobble was covered with dead algae and interspersed with small patches of sand.

Vegetation sampling. The locations of two north-south transects used as bases for sampling are indicated on Figure E2. Plant species and importance values are listed in Table 1.

Effects of gull nesting on vegetation. Trampling of herbaceous vegetation was not as heavy as in 1976 because the number of pairs using the vegetated area had decreased by about 58 percent. As in 1976 most of the areas between the woody shrubs (primarily red osier dogwood) had little herbaceous vegetation.

Effects of water on the nesting area. The impact of erosion by waves and ice and the potential for flooding of nests has been lessened by the lower water levels and wider beaches in 1977. The surface area of the island increased by 50 percent of the 1976 size (5.02 ha in 1976) and the nesting area increased by 42 percent (0.150 ha in 1976). While there was ample nesting area available, the nesting population increased only one percent.

Figure E2
East Grape Island



West Grape Island

14. Lat. 45°47' Long. 085°25' Size 9.10 ha

Visit 1: 27 May, 13:00-16:00. Clear sky, 21°C, 10 kph southwest wind. (a) Censused gull nests and contents, (b) counted Great Blue Heron nests, (c) updated maps.

Visit 2: 24 June, 11:00-17:00. Cloudy, foggy, 18°C, 25-40 kph west. (a) Sampled vegetation, (b) counted Great Blue Heron chicks.

Visit 3: 8 July, 18:00-18:20. Partly cloudy, 18°C, 25 kph west. (a) Visually surveyed productivity, (b) collected plants.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Dead chicks
Great Blue Heron	--	3	ND	ND	ND	0
Herring Gull	--	6	18	ND	ND	ND
Ring-billed Gull	0.860	3660				
Sample area	0.096	410	1135	9	1.0	0

Great Blue Heron. Two inactive nests were in white ash, and three active nests in another. A sixth nest had fallen to the ground. On 8 July I observed three almost fully feathered chicks (1 in 1 nest, 2 in another).

Herring Gull. The nests were not aggregated but scattered among the Ring-billed Gull nests.

Ring-billed Gull. The nests and contents were recorded in six 3 m wide strips that were 30 m apart and oriented north-south across the island. Total nesting population was estimated by extrapolation of the number of nests in the sample area to total area. The total nesting pairs decreased by about 8 percent from 1976. This is probably not significant and could be attributed to sample error. If this is correct, the population remained stable from 1976 to 1977. The gulls nested on 44 percent greater area in 1977 (0.559 ha in 1976). Of the pairs present in 1977, 977 (27 percent) built nests on the new nesting area. This new area was cobble beach immediately to the south of the 1976 nesting area, where 950

(26 percent) nests were constructed, and sand beach to the north, where 47 (1 percent) nests were built. Both new areas were devoid of vegetation. Only 1 percent of the total eggs present had hatched on 27 May 1977 which was about two or three days later than a 26.6 percent hatch on 28 May 1976. Productivity appeared to be good on 8 July, when the majority of the chicks could fly. Only 19 dead chicks were counted in 50 percent of the nesting area.

Substrate. See Scharf et al. (1977). Newly exposed beaches were cobble to the south, and sand and stone to the north.

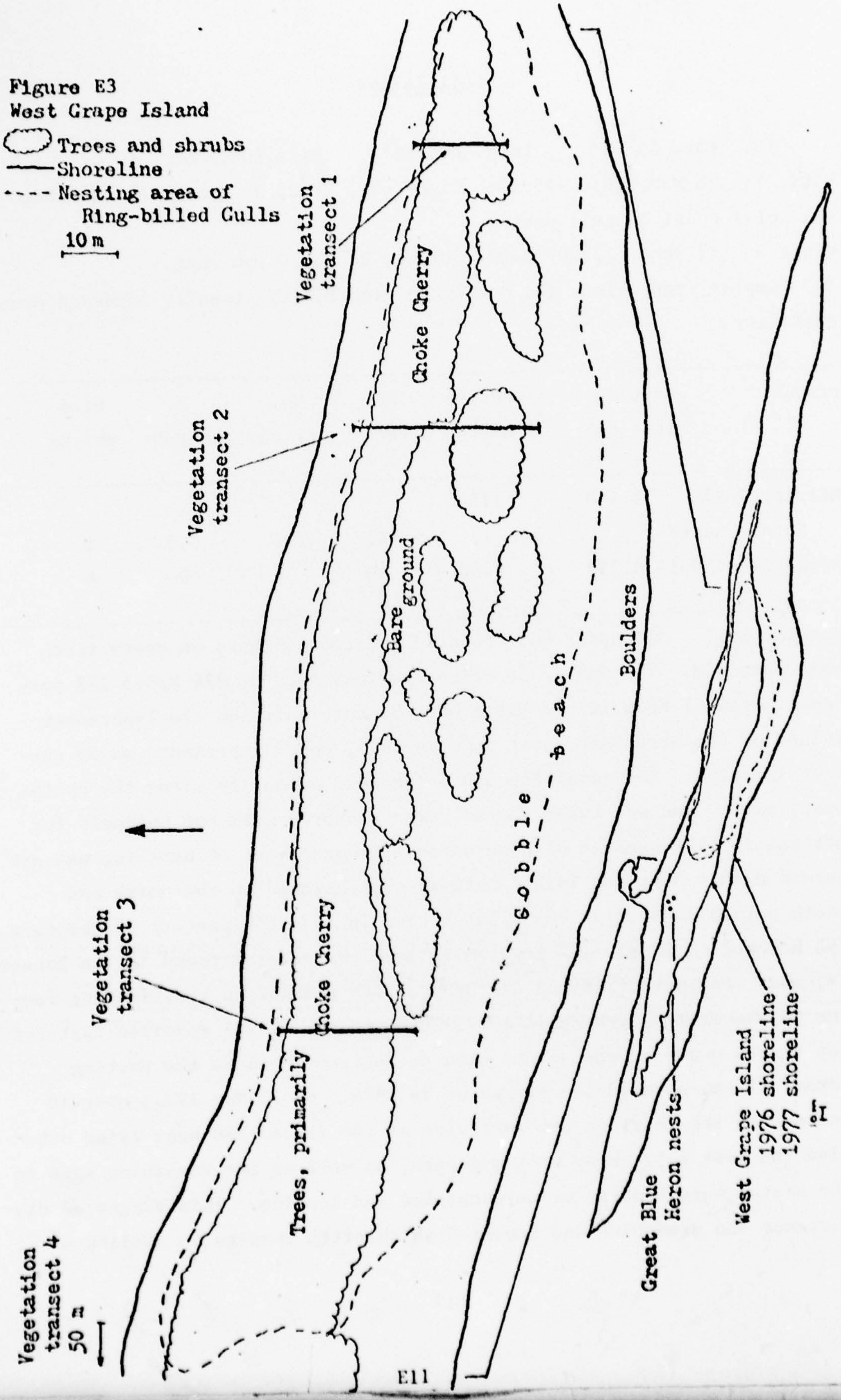
Vegetation sampling. Sampling was done on 26 June. Tree transects were placed in the nesting area and a fourth transect was sampled 50 m west of the nesting area (Figure E3). The fourth transect allows quantification of the effect of gull nesting on the vegetation. Plants and importance values are indicated in Table E1.

Effects of gull nesting on vegetation. See Scharf et al. (1977). Little herbaceous vegetation grew in the vegetated nesting area in 1977 because of trampling and overfertilization.

Effects of water on the nesting area. The lower water levels have exposed broad beaches to the north and south which buffered the vegetated area from wave and ice action. The island increased by 38 percent and the nesting area increased by 44 percent. The number of pairs nesting here remained stable or decreased slightly.

Historical aspects and potential threats to the nesting birds (East and West Grape). See Scharf et al. (1077). Lower water levels in 1977 connected East Grape to Hog Island. If this trend continues, West Grape will be connected in 1978. There are no records of quadruped predators on Hog Island but I assume that either red fox or coyotes are present as they are on other large island in the Beaver Islands. Probably the loss of protection afforded the islands by high water will lead to abandonment or reduced nesting numbers at the Grape Island colonies in the future. Gulls have probably nested on the Grape Islands in high water years and moved elsewhere when the island became connected to Hog Island (Hatt et al. 1948).

Figure E3
West Grape Island



Gull Island

15. Lat. 45°42' Long. 085°50' Size 104.2 ha

Visit 1: 28 May, 10:00-16:00. Clear sky, 21°C, 25 kph southwest wind.

(a) Total count of gull nests.

Visit 2: 25 June, 13:00-18:00. Clear, 24°C, 16 kph west.

(a) Sampled vegetation, (b) collected plants, (c) visually surveyed productivity.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Dead chicks
Herring Gull	12.660	1750				
Sample nests		175	440	46	9.5	5
Ring-billed Gull	0.230	440	ND	0	0	0

Herring Gull. All nests were counted and the contents of every tenth nest recorded. The number of pairs has increased by 324 pairs (23 percent increase) from 1976. There were 84 more pairs on the lighttower island of the northwest point than in 1976, which represents an 88 percent increase. The remaining 330 pairs were primarily along the southeast, south, and southwest shores. These shores were not suitable for nesting in 1976 because of high water. Commencement of hatching was not spread evenly over the island but was concentrated on the north and south points. Hatching began later than in 1976 (50 percent of the eggs had hatched on 29 May 1977) which follows the general trend in the Beaver Islands. Fox predation and disturbance was probably a contributing factor in the later hatching in 1977. Hatt et al. (1948) reported that red fox tracks wound between nests with no apparent harm to the nesting birds. I saw no evidence of canids in 1976. On 27 May 1977, over 10 percent of the nests on the east side of the island had eggs lying outside the nest cup. Many of these eggs, as well as the remaining eggs in the nests, were broken, or were cracked and leaking. This suggested disturbance and predation had occurred which often results in addling of eggs after exposure to environmental stress while the adults were off their eggs. In this eastern area on 25 June, I found four dead adults and 20+ dead chicks. Most of the carcasses were badly decomposed, but five birds that were freshly killed had been punctured numerous times by canine teeth. Fox tracks were also evident in mud of a drying pond. Possible explanation for the change in predation pressure include a scarcity of other prey on the island and immigration of foxes across the ice in the winter of 1976-77.

Ring-billed Gull. The number of active nests on 28 May is taken as the population estimate. On 25 June the following number of nests, eggs and chicks were present:

Nests with 3 eggs	-- 53	Nests with 1 chick, 1 egg	-- 1
" 2 eggs	-- 44	" 1 chick	-- 3
" 1 egg	-- 75	Empty nests	-- 176
" 1 chick, 2 eggs	-- 1	Eggs out of nests	-- 45
" 2 chicks, 1 egg	-- 1	Dead chicks	-- 75

It is evident from this list that the breeding cycle did not progress normally. Of eight living chicks on 24 June, one was two weeks old and the other seven were less than three days old. A normal colony should have hatched the majority of the chicks by at least 10 June and would have been relatively synchronous. No chicks could have flown from this colony by 25 June since no eggs were hatched 27 days earlier on 28 May. Normally Ring-billed Gulls take at least 35 days to attain the flight stage of life. Possible reasons for the abnormal progression of breeding include (a) flooding of the nesting area and (b) fox predation and disturbance. About 80 percent of the Ring-billed Gull nests were constructed on rocks and cobble beach that were covered by water in 1976. About one-half of these nests were less than 0.3 m above the lake and within 20 m of the lake edge when it was calm. It is conceivable that storm waves from the south could have flooded these nests. Fox disturbance to this area surely was a contributing factor to the poor success of the Ring-billed Gulls as it was for Herring Gulls. Approximately 200 of the nests were above the reach of storm waves, but they differed little in the number of eggs, chicks, or empty nests. Chick carcasses could not be inspected for evidence of canine tooth punctures because they were badly decomposed. Parts of six recently killed and eaten adults were scattered about the nesting area indicating that fox visiting the colony. Eggs from 10 3-egg nests were floated on 24 June to determine the stage of incubation and all were in the first two weeks of incubation (developmental stages were extrapolated from Hays and Lecroy 1971).

Substrate. See Scharf et al. (1977) for Herring Gull area. The Ring-billed Gulls nested on stone and cobble beach in an area that was 80 percent under water in 1976.

Vegetation sampling. The locations of two transects through the Herring Gull nesting area are indicated on Figure E4. Plant species and importance values are listed in Table E1.

Effects of gull nesting on vegetation. See Scharf et al. (1977). There was little obvious effect in 1976 or 1977 other than possible retardation of successional stages in the Herring Gull nesting areas. The principal plants in the Ring-billed Gull nesting area included red-berried elder, red osier dogwood, stinging nettle and Chinese mustard. Many of the woody shrubs were partially dead. This cannot be interpreted as entirely an effect of gull nesting since a large stand of dead arbor vitae inland from the Ring-billed Gull nesting area suggests that waves or ice either caused or contributed to the dead vegetation. The vegetation could have been killed by Ring-billed Gull nesting activity prior to 1976.

Effects of water on the nesting area. The light-tower island was connected to Gull Island by a narrow gravel bar. This island was increased by 53 percent of its 1976 size (from 0.258 has to 0.410 ha) while the number of nests increased 88 percent (from 96 to 182). Nesting area on Gull Island proper increased about 17 percent and nesting pairs increased 25 percent. See also effects of gull nesting on vegetation.

Historical aspects and potential threats to the nesting birds. See Scharf et al. (1977) and discussion for each species.

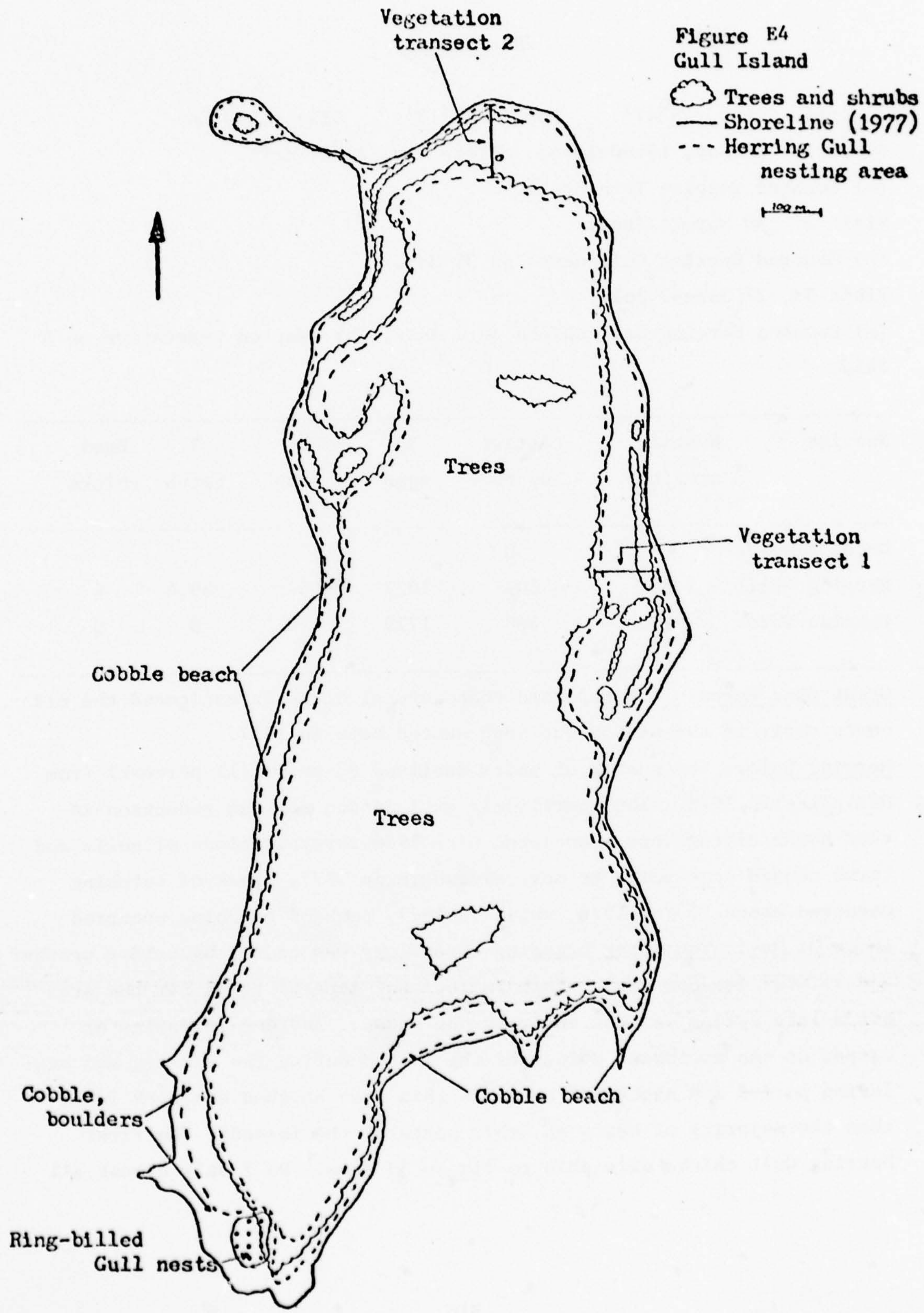


Figure E4
Gull Island
Trees and shrubs
Shoreline (1977)
Herring Gull nesting area
100 m
Vegetation transect 2
Trees
Vegetation transect 1
Cobble beach
Trees
Cobble, boulders
Cobble beach
Ring-billed Gull nests

Hat Island

16. Lat. 45°47' Long. 085°18' Size 5.500 ha

Visit 1: 26 May, 18:00-18:45. Clear sky, 21°C, calm.

(a) Counted Caspian Tern nests.

Visit 2: 30 May-24 June.

(a) Counted Herring Gull nests on 30 May.

Visit 3: 27 June-7 July.

(a) Counted Herring Gull chicks on 7 July, (b) sampled vegetation on 5 July.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Dead chicks
Great Blue Heron	--	0				
Herring Gull	2.304	603	1027	667	39.4	6
Caspian Tern	--	686	1729	0	0	0

Great Blue Heron. FJC reported that several birds investigated the old nests early in the season but none nested here in 1977.

Herring Gull. The number of pairs declined 83 pairs (11 percent) from 690 pairs in 1976. The most likely explanation for the reduction is that human disturbance associated with 1976 investigations of gulls and terns caused some pairs to move elsewhere in 1977. Peak of hatching occurred about 25 May 1976, while in 1977, peak of hatching occurred about 31 May. The later breeding chronology was caused by colder weather and a later ice-out date. This follows the general trend for the area but a late spring was not entirely the cause. Another investigator camped on the northeast corner of the island during the pre-egg and egg-laying period and about 100 nests in this area hatched one week later than the majority of nests on other parts of the island. The first Herring Gull chicks were able to fly on 30 June. On 7 July almost all young birds left the island and sat on the water as I walked around the island. I counted 457 young, almost all of which would live to the flying stage.

Caspian Tern. The tern colony decline by 44 pairs (6 percent) from 730 pairs in 1976. This may have been attributable to a wash-out of 140 nests on 10 June 1976 or to disturbance from investigators working with the terns in 1976. Cannon netting by FJC on 31 May and 1, 2, and 3 June 1977 led directly to the abandonment of 442 nests (65 percent of the total) on Hat Island as determined by a total count of nests on 13 June. This is not unusual behavior for birds of the crested tern group and can be expected when a colony is subjected to cannon netting and prolonged disturbance necessary for processing captured birds. There were 360 3-5 week-old chicks on 7 July. Almost all of these would live to fly from the colony. Productivity was very poor if calculated using the original colony size, but normal using the original colony size, but normal using the number of nests remaining after cannon netting.

Renesting. After the abandonment of 65 percent of the nests on Hat Island in late May and early June, renesting began at the following sites:

a. Hat Island. I observed the first renests on 2 June at the edge of and among the abandoned nests. Eggs were laid in 15 nests after 31 May. Only one chick hatched (on 2 July) from the replacement clutches and 8 of the renests had been abandoned by 7 July.

b. Shoe Island. About 50 pairs renested on this small Island. Hatching began on 6 July.

c. Ile aux Galets. There were 56 nests with 2 or 3 eggs or chicks on 9 July. The majority of these were undoubtedly renesting attempts from Hat Island since FJC reported no widespread abandonment on Ile aux Galets in May or June.

d. High Island. FJC and EH counted about 116 nests on 9 July. They felt not all of the nests here were renests because hatching began on 30 June. Peak of hatching occurred about 7 July which would have been adequate time for the birds to move from Hat Island and initiate renesting.

e. High Island Shoal. Originally 120 birds renested here, but only 42 nests remained on 9 July. The original total was determined from the number of eggs that had been piled in two windrows by waves. Hatching began 9 July.

Desertion of a Caspian Tern colony and subsequent establishment of colonies elsewhere have been described by Vaisanen (1973).

Substrate. See Scharf et al. (1977). There has been little change from 1976.

Vegetation sampling. The location of 4 transects used for sampling are indicated on Figure E5. Plant species found and importance values are listed in Table E1.

Effects of nesting gulls on vegetation. Effects unchanged from 1976 (see Scharf et al. 1977).

Effects of water on the nesting area. The only change noted was that 200 m^2 of cobble shore were exposed on the southwest and northwest corner.

High Island

17. Lat. 45°45' Long. 085°40' Size 1530 ha

Visit 1: 29 May, 11:00-14:00. Cloudy, 18°C, 25-40 kph northeast wind. (a) Censused gull nests and contents, (b) counted tern nests.

Visit 2: 9 July, 11:00-14:00. Clear, 21°C, 15-20 kph northwest. (a) Sampled vegetation, (b) visually surveyed productivity.

Species	Nesting area(ha)	No. nests	No. eggs	No. chicks	% hatch	Dead chicks
Herring Gull	--	7	21	0	0	0
Ring-billed Gull	0.616	3422				
Sample area	0.069	384	1037	0	0	0
Common Tern(29 May)	0.152	87	221	0	0	0
Caspian Tern	0.060	116	241			

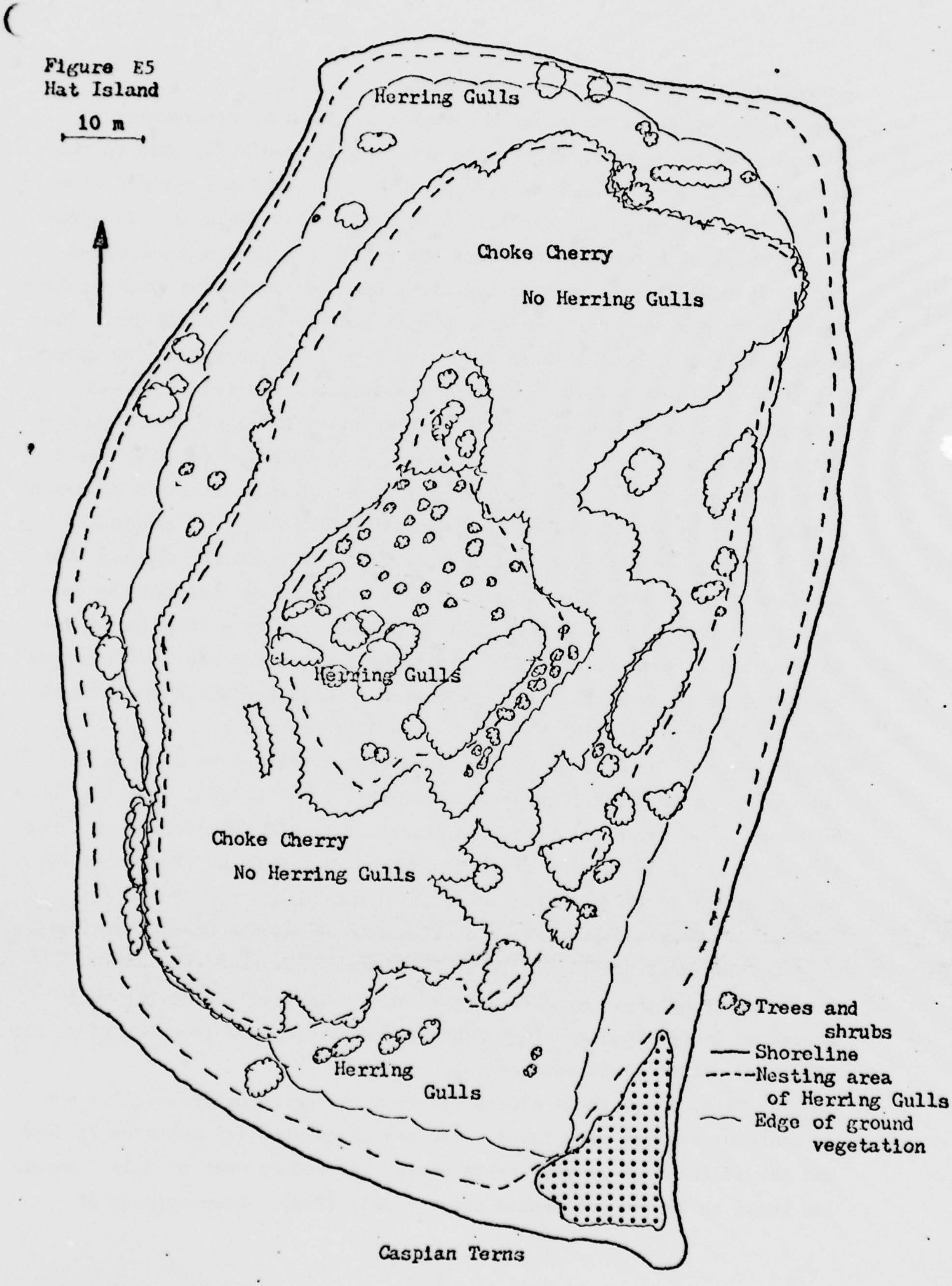


Figure E5
Hat Island
10 m
Herring Gulls
Choke Cherry
No Herring Gulls
Herring Gulls
Choke Cherry
No Herring Gulls
Herring
Gulls
Caspian Terns
Trees and shrubs
Shoreline
Nesting area of Herring Gulls
Edge of ground vegetation

Herring Gull. Nests were not aggregated.

Ring-billed Gull. I estimated the number of nests by determining an average area per nest in the sample area and extrapolating this to the total nesting area. The nesting population increased one percent from 1976 when I estimated the population at 3313 pairs. This is well within the sampling error and therefore the population remained unchanged from 1976 to 1977. I approximated the length of incubation from development of 27 eggs opened in connection with another study on 29 May. The embryos in these eggs had been incubated from 12-22 days with the majority about 16-18 days (development stages extrapolated from Hays and LeCroy 1971). This would place the beginning of hatching on 2 June with the peak about 8 June. Breeding chronology was similar to 1976 when I estimated peak of hatching occured on 9 June. Reproduction was good but probably not as successful as in an undisturbed colony. I counted 64 dead 3-4 week old Ring-bill chicks on 8 July. FJC and EH reported that many young ran toward the tip of the point when humans entered the colony. They felt the young were killed by adults while attempting to return to their territories. The dead young I inspected had been "scalped" by adults which supports their conclusion. Canid predation and disturbance were unimportant in 1977 (see potential threats).

Common Terns. The 87 nests (only 47 had eggs) present on 29 June 1977 represented a 79 percent reduction from this time in 1976, when 441 nests had eggs. The number of nests had increased to 160 by mid-June (EH) but this is still a 36 percent reduction from 1976. FJC and EH counted 87 chicks on 9 July 1977 ranging in age from hatchlings to almost fully feathered. This indicates lack of synchrony among the Common Terns since no extensive destruction of first clutches was observed that could account for renesting. Mortality from canid predation and disturbance played an insignificant role in chick survival in 1977 (see Scharf et al. 1977, and potential threats below).

Caspian Tern. I saw three adults fly from the point on 29 May 1977 but no nests or scrapes were found. FJC and EH counted 116 nests on 21 June and the addition of 21 more nests during the second week of July. Hatching began on 29 May and peaked about 7 July (FJC). Commencement of hatching on 29 June makes it unlikely that all the pairs nesting on High Island were renesting pairs from Hat Island. Approximately 26 days is required for average incubation which would only allow two or three days to produce a replacement clutch which is not possible. About 10-15 days are required to initiate renesting which would allow hatching by 7 July. Probably a few pairs had initiated nesting on High Island when the majority of the pairs arrived from Hat Island. EH counted 127 chicks on 16 July which was fairly good production for a renesting attempt. None were older than 2½ weeks and most were about 1½ weeks. All of these chicks would not live to fly from the colony.

Substrate. No change from 1976 (see Scharf 1977).

Vegetation sampling. Transects used as base lines for sampling are indicated on Figure E6. Plant species and importance values are listed in Table E1.

Effects of gull and tern nesting on vegetation. The Ring-billed Gulls have extended their nesting territory about 15 m further toward the tip of the point. The *Ammophila breviliguata* growing in the new nesting area and in last year's nesting area was heavily trampled and yellow-green in color. I saw very few florets on the grass growing in the nesting area. The woody shrubs on the gull point were also in poor condition, but this was caused by a combination trampling and over-fertilization by gulls and wind erosion.

Effects of water levels on the nesting area. The beaches on either side of the point are 4-5 m wider than in 1976. This will reduce erosion by waves, currents, and ice.

Historical aspects and potential threats to the nesting birds. See Scharf et al. (1977). The High Island larid colony is unique in that all four species of common Great Lakes larids nest here. In 1976 the colony also had one of the largest Common Tern nesting colony in the Great Lakes. This colony is also somewhat unique in that it receives the greatest amount of human disturbance of the 13 colonies in the Beaver Islands. Disturbance is primarily from pleasure boaters and campers. Pleasure boaters are attracted to the island because of the deep natural harbor protected by the gull nesting point, and the broad

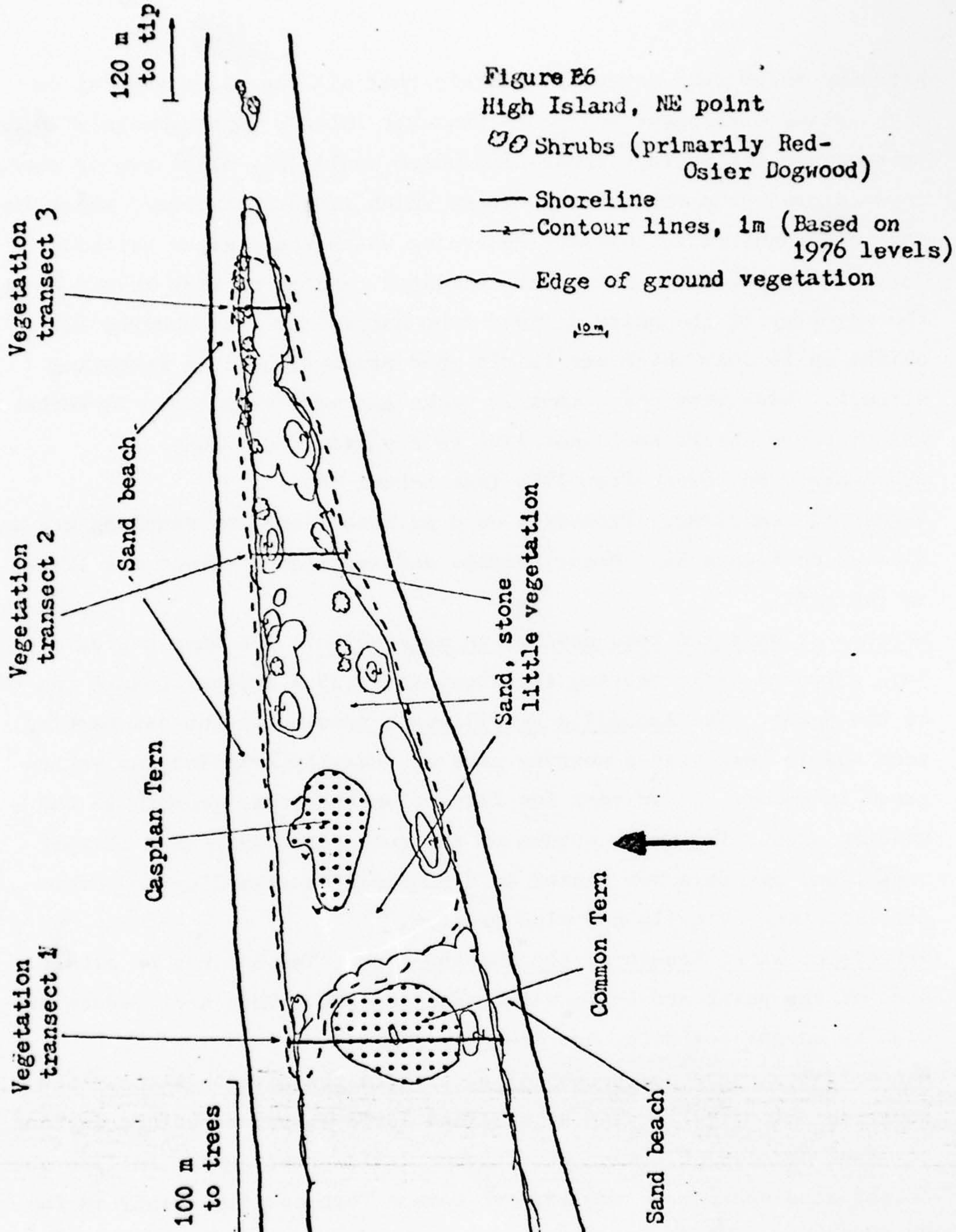


Figure E6
High Island, NE point

sandy beaches. The relatively isolated nature of the island and lack of people make the island a camping area which is growing in popularity. The gull and tern colony attracts the attention of island visitors whether they are simply curious or calicious. The island and colony will undoubtedly receive greater people pressure in the future which will result in abandonment of the colony by the terns and possibly the gulls. The larid colony is about 500 m from two Michigan Department of Natural Resources cabins which make excellent bases for investigators. The cabins were used by FJC, EH and a group from Andrews University in 1977. This adds additional pressure to the colony and makes it imperative that responsible research is conducted at this colony taking into consideration the requirements and tolerances of all species nesting here. Canid predation and disturbance resulted in essentially total failure of the colony in 1975, and very poor success of the Common Terns and Caspian Terns in 1976. In 1977 I saw four sets of tracks going into the colony on 29 May but in June, FJC and EH found tracks indicating a fox or coyote had entered the colony only on a few nights. There were very few birds killed in 1977, and canid predation and disturbance did not account for appreciable mortality. FJC and EH suggested their presence around and near the colony in the first half of May and all of June may have kept canids away from the colony.

High Island Shoal

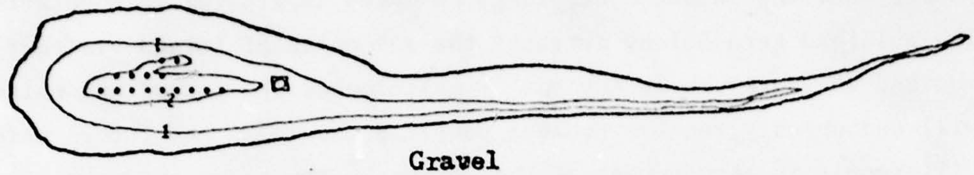
18. Lat. 45°45' Long. 085°40' Size 0.0815 ha

Visit 1: 9 July, 14:30-15:10. Clear, 21°C, 25-30 kph north wind. (a) Counted Caspian Tern nests and eggs, (b) mapped island (Figure E7).

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Eggs out of nest
Caspian Tern	0.0150	42	91	1	1.1	200

Caspian Tern. All nests were renesting attempts from Hat Island. Ori-

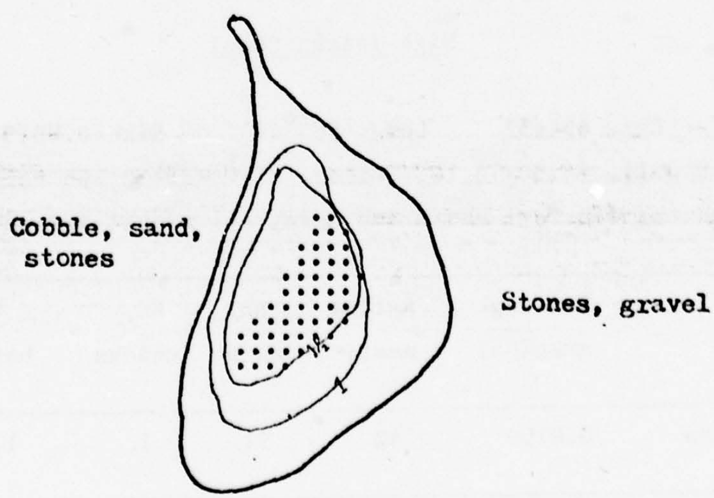
Figure E7 High Island Shoals and Shoe Island, 1977.



Shoe Island

::: Caspian Tern nesting area
— Shoreline
-1- Contour lines, 1 m
10 m

High Island Shoals



ginally there were 120 nests but about 80 were washed out about two weeks after laying. The eggs were piled in two windrows and 25 of these eggs were opened to determine the age the eggs were when washed out. The 42 nests that remained were just beginning to hatch on 9 July.

Substrate. Sand and stone.

Effects of tern nesting on vegetation. No vegetation present.

Historical aspects and potential threats to the nesting birds. This shoal has been under water or washed with water since 1974. Also see Scharf et al. (1977).

Ile aux Galets

19. Lat. 45°41' Long. 085°11' Size 1.3060 ha

Visit 1: 26 May, 12:00-14:00. Clear, 21°C, 15 kph south wind. (a) Counted Herring Gull and Caspian Tern nests and contents, (b) censused Ring-billed Gulls, (c) updated map.

Visit 2: 9 July, 15:00-18:00. Clear, 24°C, 25 kph northwest. (a) Sampled vegetation, (b) counted Caspian Tern chicks and visually surveyed gull productivity.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Dead chicks
Herring Gull						
NE point & E shore	0.049	91				
Scattered among Ring-bills		48				
Total		131	331	30	9.0	0
Ring-billed Gull	0.600	2870[1]				
Sample area	0.056	269	769	7	0.9	0
Caspian Tern	0.060	312	ND	ND	ND	0

[1] FJC and EH directly counted 2445 nests on 23 May (This represents about 15 percent sampling error).

Herring Gull. As in 1976, Herring Gulls concentrated on the northeast point and also along the east shore. Many of the pairs on the east shore were at 1976 waterline. The remainder of the nests were scattered through the Ring-billed Gulls and around the perimeter of the Ring-billed Gull nesting area.

Ring-billed Gull. The nesting population was estimated by determining the number of nests in a sample area and extrapolating this to the total nesting area. In 1976 I used point-center-quarter to estimate the number of pairs and arrived at an erroneous figure because of the unsuitability of this method for estimating gull nesting populations. The actual number of nests was between 3500 and 4000 based on a visual estimate and a count of birds in photographs. The number of birds has decreased from 1976 but the degree of change cannot be determined with my data. The most obvious change occurred in the central nesting area where few Ring-billed Gull nests in several areas was partially caused by the presence of Herring Gulls nesting in the central region. The peak of hatching occurred about five days later in 1977 than in 1976. On 29 May 1976 49 percent of the eggs present had hatched while on 27 May 1977, 0.9 percent had hatched. Productivity appeared to be good on 9 July.

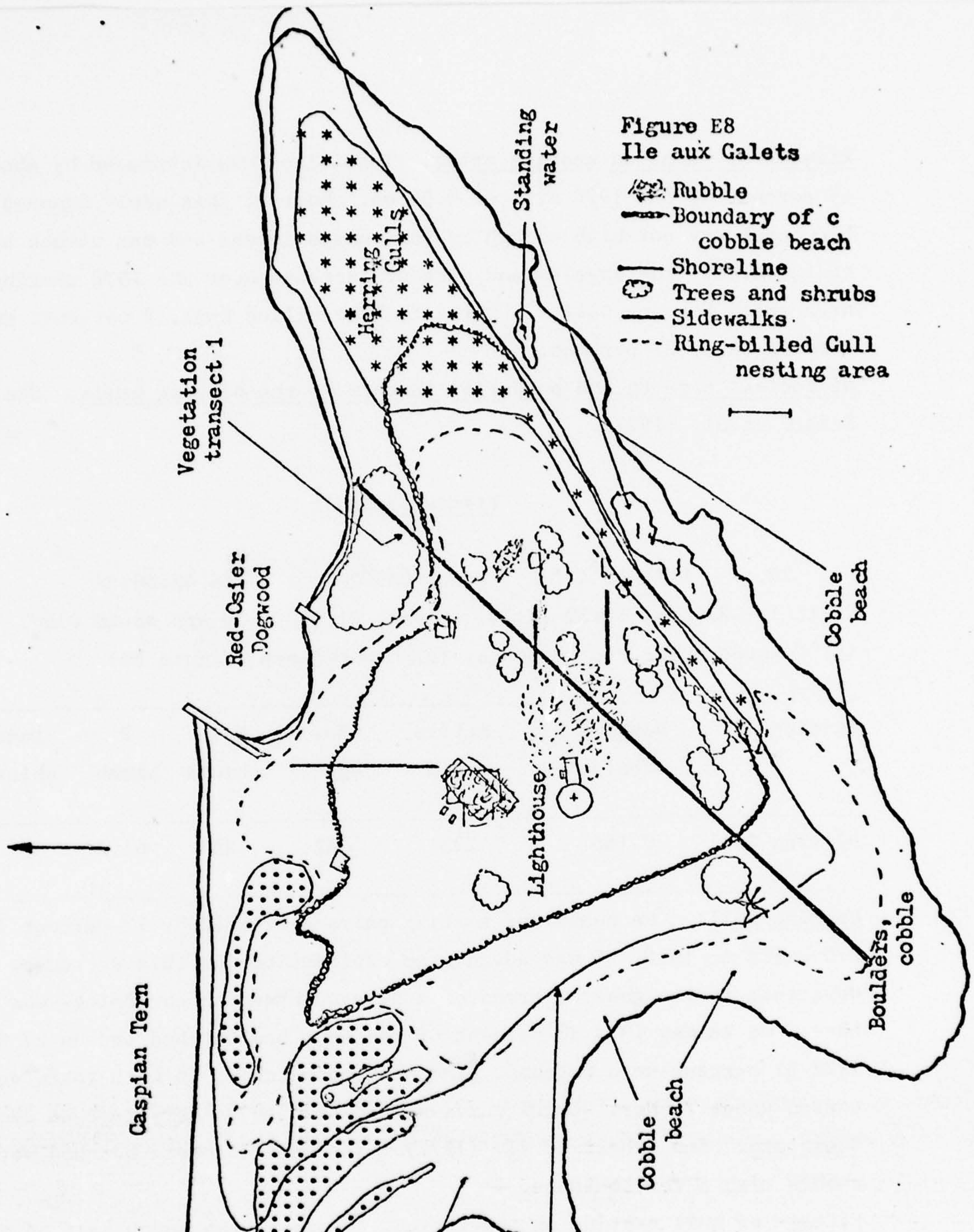
Caspian Tern. The terns nested in roughly the same areas as in 1976. Additional nesting areas on the northwest point and west shore were exposed by lower water levels. Terns that nested on the northwest point in 1975 and 1976 were usually washed out, but lower water levels and exposed rocky shoal to the south and west protected this area and allowed successful nesting in 1977. I counted 260 chicks 3-5 weeks old on 9 July which indicated productivity was good.

Vegetation sampling. The transect used as a base for a sample plot is indicated on Figure E8. Plant species and importance values are indicated in Table E1.

Substrate. See Scharf et al. (1977). The newly exposed areas along the east and west shores were primarily cobble covered with stone and pebble. An exception is the southern point of exposed boulders.

Effects of gulls and terns on vegetation. See Scharf et al. (1977).

Figure E8
Ile aux Galets



Effects of water on nesting areas. The island was increased by about 48 percent of the 1976 size of 0.55 ha. Most of this newly exposed cobble beach was not high enough or far enough inland and was washed by storm waves. The species and percent increase over the 1976 nesting area are: Herring Gull, 23 percent; Ring-billed Gull, 9 percent; and Caspian Tern, 27 percent.

Historical aspects and potential threats to the nesting gulls. See Scharf et al. (1977).

Pismire Island

20. Lat. 45°47' Long. 085°27' Size 42.60 ha

Visit 1: 27 May, 10:30-12:30. Clear, 21°C, 15-20 kph south wind. (a) Counted nests and contents, (b) updated map (Figure E9).

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Dead chicks
Herring Gull	0.166	238	432	263	61.0	3

Herring Gull. The number of nesting pairs decreased by 12 percent from 270 pairs in 1976. I can advance no explanation for this decrease. A departure in the general trend of a delayed breeding chronology was noted here. On 28 May 1977 70 percent of the eggs had hatched and on 27 May 1976 61 percent were hatched. The peak of hatching in both years occurred about 26 May. Chick survival appeared to be very good on 27 May.

Substrate. See Scharf et al. (1977). The newly exposed beaches were cobble with a few boulders.

Effects of gull nesting on vegetation. Grass on the north half of the vegetated area was moderately trampled in 1976 and 1977.

Effects of water on the nesting area. The island increased by 37 percent of the 1976 size (0.311 ha). Only 10 pairs nested on the newly exposed cobble beach.

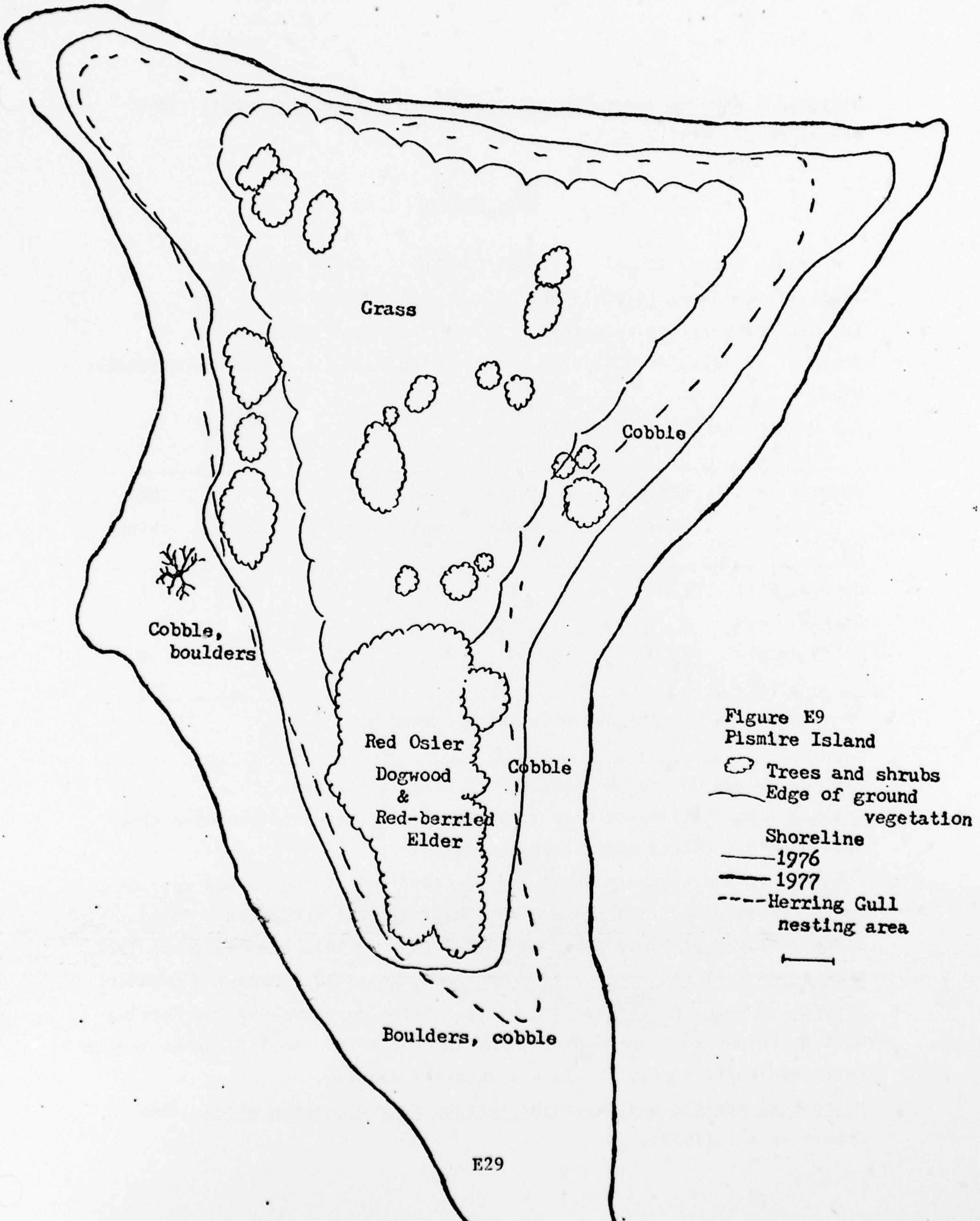


Figure E9
Pismire Island

Historical aspects and potential threats to the nesting birds. See Scharf et al. (1977).

Shoe Island

21. Lat. 45°48' Long. 085°18' Size 0.093 ha

Visit 1: 13 June, 18:00-19:30. Clear, 21°C, calm.

(a) Counted gull and tern nests, (b) mapped island (Figure E7).

Visit 2: 9 July, 14:00-14:20. Partly cloudy, 23°C, 15-20 kph northwest wind.

(a) Counted nests, eggs and chicks.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	% hatch	Dead chicks
Herring Gull	--	6[1]	5	2	40.0	1
Caspian Tern						
(9 July)	0.007	53	102	14	12.1	0

[1] Four nests were empty but were being attended.

Herring Gull. One chick lived to fly from the island.

Caspian Tern. All nests were replacement clutches laid by pairs that abandoned Hat Island after cannon netting.

Substrate. The southern shore and the east end of the island were 5-30 cm stones piled in a ridge. The Caspian terns nested on a drift ridge that was probably piled up in the fall of 1976 and winter of 1977.

Effects of gull and tern nesting on vegetation. No vegetation present.

Effects of water on the nesting birds. Storm waves washed two Herring Gull nests and 20 Caspian nests away in June 1976. In 1977 water levels decreased sufficiently to allow successful nesting.

Historical aspects and potential threats to the nesting birds. See Scharf et al. (1977).

Squaw Island

22. Lat. $45^{\circ}51'$ Long. $085^{\circ}36'$ Size 45.000ha

Visit 1: 26 May, 19:00-20:00. Clear, $21^{\circ}C$, calm.

(a) Counted Herring Gull nests and eggs.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	Percent hatch	Dead chicks
Herring Gull	0.134	72	182	0	0	0

Herring Gull. The number of nests increased 44 percent from 1976 when 50 pairs nested here. The nesting area remained the same. On 28 May 1976, 36.6 percent of the eggs had hatched. Squaw was about 7 days later than in 1976.

Substrate. See Scharf et al. (1977).

Effects of nesting gulls on vegetation. None. See Scharf et al. (1977).

Effects of water on nesting area. The nesting area was not influenced by water in 1976 or 1977.

Trout Island

23. Lat. $45^{\circ}47'$ Long. $085^{\circ}42'$ Size 49.000 ha

Visit 1: 29 May, 16:00-17:00. Partly cloudy sky, $15^{\circ}C$, 10-15 kph northeast wind.

(a) Counted gull nests, eggs and chicks.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	Percent hatch	Dead chicks
Herring Gull	0.134	105	157	121	43.5	

Herring Gull. In 1977, 116 pairs nested in the same area as 1976. Percent hatch on 30 May 1976 was 50.5 which is equivalent to 43.5 percent on 29 May 1977.

Substrate. See Scharf et al. (1977).

Effects of water on the nesting area. None.

Historical aspects and potential threats to the nesting birds. See Scharf et al. (1977).

Whiskey Island

24. Lat. 45°45' Long. 085°37' Size 51.000 ha

Visit 1: 26 May, 20:30-21:00. Clear sky, 21°C, calm.

(a) Counted gull nests, eggs and chicks.

Species	Nesting area(ha)	Active nests	No. eggs	No. chicks	Percent hatch
Herring Gull	0.003	13	35	4	10.3

Herring Gull. The number of pairs and percent of hatching were the same as 1976. Eggs in the 13 nests were 27 percent hatched on 28 May 1976.

Substrate. See Scharf et al. (1977).

Effects of gull nesting on vegetation. None.

Effects of water on the nesting area. None.

Historical aspects and potential threats to the nesting birds. See Scharf et al. (1977).

CHRONOLOGY OF USE

25. In 1973-74 I recorded the percentage of eggs hatched per day in the Herring Gull and Ring-billed Gull colony on South Manitou Island, Lake Michigan. Since this colony was fairly normal during incubation and was located approximately 70 km south of the Beaver Island colonies, the percentage of eggs hatched per day (or rate of hatching) is applicable to the Beaver Island colonies. Peak of hatch for the Beaver Island colonies was determined by placing the percent hatch at any particular colony on curves drawn with the South Manitou data and counting the

number of days to or past peak of hatching. Peak of hatching is defined as the day that 50 percent of the viable eggs have hatched. About 70 to 90 percent of eggs present at hatching are viable.

26. After peak of hatch is determined the lengths of various stages of the breeding cycle given below are used to determine when eggs were laid and when chicks will fly. Chronology from laying to hatching is by species:

Herring Gull	27 days (Shugart, unpubl. data for the Great Lakes)
Ring-billed Gull	26 days (Vermeer 1970, Shugart unpubl. data)
Common Tern	20 days (Hays and LeCroy 1971)
Caspian Tern	26 days (Shugart, unpubl. data for Great Lakes)

From hatching to flight stage for:

Herring Gull	42 days (Paynter 1949)
Ring-billed Gull	37 days (Vermeer 1970)
Common Tern	30 days (Palmer 1941)
Caspian Tern	37 days (Shugart, unpubl. data for Great Lakes)

	Peak of laying	Peak of hatching	Peak of flying
East Grape Island			
Ring-billed Gull	11 May	6 June	13 July
West Grape Island			
Ring-billed Gull	7 May	2 June	9 July
Gull Island			
Herring Gull	5 May	2 June	14 July
Ring-billed Gull	11 May	7 June	14 July
Hat Island			
Herring Gull	30 April	28 May	10 July
Caspian Tern	17 May	11 June	17 July
High Island			
Ring-billed Bull	12 May	8 June	15 July
Common Tern	3rd-4th week May//2nd-3rd week June//July		
Caspian Tern	12 June	7 July	13 Aug

Chronology of use (cont.)

	Peak of laying	Peak of hatching	Peak of flying
High Island Shoal			
Caspian Tern	16 June	12 July	18 Aug
Ile aux Galet			
Herring Gull	5 May	2 June	14 July
Ring-billed Gull	10 May	6 June	13 July
Caspian Tern	18 May	13 June	20 July
Pismire Island	2 Apr	26 May	7 July
Shoe Island	16 June	12 July	18 Aug
Trout Island	11 May	7 June	19 July
Whiskey Island	1 May	28 May	9 July

NESTING SITES NOT USED IN 1977

27. Tim's Island. As in 1976 this island was almost identical to East Grape Island but no birds nested here in either year.

28. Two islands 800 m southeast of Hog Island. No nests in 1977.

THE IMPORTANCE OF THE BEAVER ISLANDS TO MIGRATING BIRDS

29. There are no records documenting the role the Beaver Island play in migration over Lake Michigan. The larger islands probably are important in providing foraging and resting areas for passerines while flying over Lake Michigan.

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ADDENDUM

Grassy Island

31. Lat. Long. Size 0.03 ha

This the second shoal west of Pismire Island. This shoal was completely awash in 1976.

I visited Grassy Island on 27 May 1977 and found two Herring Gull nests: one contained three eggs, the other was empty. The exposed area was 220 m long (north-south) and 20 m at the widest point and composed of boulder and rocks with sand and gravel between. The shoreline was irregular and probably changed daily depending on wash from waves. No vegetation was present on 27 May.

I saw two Common Terns on 27 May 1977 but found no nests. On a subsequent visit on 8 August 1977, there were 36 chicks and 17 eggs present indicating that about 30 pairs of Common Terns had nested here. Chicks ranged in age from hatchling to almost fledged. The shoal was 20 percent covered by smartweed that was up to 0.7 m in height.

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TABLE E1

Plant Species and Importance Values

Plant Species	Transect 1 RD	RC	RF	IV	% cov.*	Transect 2 RD	RC	RF	IV	% cov.*	Transect 3 RD	RC	RF	IV	% cov.*	Transect 4 RD	RC	RF	IV	% cov.*
<u>EAST GRAPE ISLAND</u> (16 m^2)*																				
Serviceberry (<u>Amelanchier laevis</u>)						4	5	11	20	2.5										
Red-osier dogwood (<u>Cornus stolonifera</u>)	63	57	38	158	38.8	32	64	33	129	31.3										
Ninebark (<u>Physocarpus opulifolius</u>)	7	7	13	27	5.0															
Sandbar willow (<u>Salix interior</u>)						14	8	22	44	3.8										
Red-berried elder (<u>Sambucus pubens</u>)	3	4	13	20	2.5															
Bittersweet (<u>Solanum dulcamara</u>)						4	5	11	20	3.8										
White cedar (<u>Thuja occidentalis</u>)	17	22	25	64	15.0															
Frostgrape (<u>Vitis riparia</u>)	10	9	13	32	6.3	46	18	22	86	8.8										
<u>EAST GRAPE ISLAND</u> (1m^2)																				
Common milkweed (<u>Asclepias syriaca</u>)						21	22	25	68	3.1										
<u>Poa</u> sp.						13	13	13	39	1.9										
Potentilla (<u>Potentilla norvegica</u>)						3	4	6	13	0.6										
Poison ivy (<u>Rhus radicans</u>)						15	13	13	41	1.9										
Yellow-cress (<u>Rorippa islandica</u>)						3	1	6	10	0.1										

Table E1
(continued)

Plant Species	Transect 1 RD	RC	RF	IV	% cov.*	Transect 2 RD	RC	RF	IV	% cov.*	Transect 3 RD	RC	RF	IV	% cov.*	Transect 4 RD	RC	RF	IV	% cov.*
Raspberry (*Rubus idaeus*)						10	18	13	41	2.5										
Yellow dock (*Rumex crispus*)						3	1	6	10	0.3										
False Solomon's seal (*Smilacina stellata*)						33	27	19	79	3.8										
WEST GRAPE ISLAND ($16m^2$)																				
Red-osier dogwood	33	14	8	55	6.3	3	2	5	10	1.4	7	10	6	23	8.3	4	3	4	11	2.1
White ash (*Fraxinus americana*)	3	14	8	25	6.3	5	2	5	12	1.4	6	18	12	36	13.3	6	18	12	36	13.3
Morning glory (*Ipomoea* sp.)											22	11	17	50	3.7					
American mountain ash (*Pyrus americana*)	18	19	15	52	8.8															
Choke cherry (*Prunus virginiana*)	33	14	8	55	6.3	52	42	32	127	25.9	35	62	28	125	50.2	71	56	44	171	42.5
Staghorn sumac (*Rhus typhina*)											8	5	11	24	4.3					
Gooseberry (*Ribes hirtelum*)	3	1	8	12	0.3	4	5	16	25	3.0						1	1	4	6	0.8
Raspberry																1	+	4	5	0.8
Red-berried elder	18	17	23	58	7.8	10	13	11	34	7.9	6	3	11	20	2.5	8	11	16	35	0.3
White cedar	18	25	23	66	1.8	16	30	16	62	18.6	11	4	17	32	3.3	6	10	12	28	7.5
Frostgrape	10	11	15	36	5.3	8	6	16	30	3.9	11	5	11	27	8.5	3	1	4	8	0.8

Table E1
(continued)

Plant Species	Transect 1 RD	RC	RF	IV	% cov.*	Transect 2 RD	RC	RF	IV	% cov.*	Transect 3 RD	RC	RF	IV	% cov.*	Transect 4 RD	RC	RF	IV	% cov.*
WEST GRAPE ISLAND (1m^2)																				
Common burdock (Arctium minus)																1	1	1	3	0.5
Warmwood (Artemisia absinthium)						56	71	20	147	2.9						17	21	11	49	11.5
Sedge (Carex sp.)						6	4	20	30	0.1										
Cleavers (Galium aparine)																8	4	10	22	2.4
Herb-robert (Geranium robertianum)						11	4	20	34	0.1						18	13	17	48	7.4
Rough ovens (Geum virginianum)						22	18	20	60	0.7										
Acute-lobed hepatica (Hepatica acutiloba)																4	3	4	11	1.8
Cow parsnip (Heracleum maximum)																1	1	1	3	0.5
Jewelweed (Impatiens sp.)																8	5	7	20	2.9
Choke Cherry																21	29	67	17	16.4
Poison ivy																2	2	1	5	1.1
Yellow dock																6	4	20	30	0.1
Gooseberry																1	1	2	4	1.1
Raspberry																3	5	6	14	2.8
Red-berried elder																3	8	4	15	4.5
False Solomon's-seal																3	1	7	11	0.7

Table E1
(Continued)

Plant Species	Transect 1 RD	RC	RF	IV	% cov.*	Transect 2 RD	RC	RF	IV	% cov.*	Transect 3 RD	RC	RF	IV	% cov.*	Transect 4 RD	RC	RF	IV	% cov.*
Unidentified grass																11	3	24	10	1.7
Unidentified fern																1	1	2	4	0.7
GULL ISLAND (16 m^2)																				
Red-osier dogwood	97	65	40	202	11.9	92	40	50	182	3.1										
Choke cherry	1	1	20	22	0.6	8	60	50	118	4.7										
GULL ISLAND (1 m^2)																				
Witch grass (Agropyron dasystachyum)	3	1	8	12	0.3															
Witch grass (Agropyron repens)						8	2	12	22	0.8										
Wormwood	7	9	12	28	4.9	22	30	29	81	10.1										
Common milkweed						1	1	1	4	0.1										
Downy chess (Bromus tectorum)	22	9	12	43	5.6															
Pickpocket (Capsella bursa-pastoris)						1	1	2	4	0.2										
Red-osier dogwood	4	5	3	12	2.9	2	6	5	13	1.9										
Creeping juniper (Juniperus horizontalis)	30	46	13	89	25.3															
Poa sp.	10	2	17	29	3.9	31	18	15	64	6.1										
Poison ivy	7	12	12	31	6.6															
Tumble-mustard (Sisymbrium altissimum)	1	1	1	3	0.1															

Table E1
(Continued)

Plant Species	Transect 1 RD	RC	RF	IV	% cov.*	Transect 2 RD	RC	RF	IV	% cov.*	Transect 3 RD	RC	RF	IV	% cov.*	Transect 4 RD	RC	RF	IV	% cov.*
False Solomon's seal	8	5	17	30	3.0															
Stinging nettle	7	10	8	25	5.6	35	44	32	111	14.9										
<u>HIGH ISLAND</u> (1 m^2)																				
Beachgrass (*Ammophila breviligulata*)	36	39	15	90	21.1	88	71	57	216	18.9	94	63	83	240	21.3					
Witchgrass	37	24	30	91	1.7															
Wormwood	4	8	19	31	4.6															
Harebell (*Campanula rotundifolia*)	1	2	8	11	1.1															
Red-osier dogwood	1	3	1	4	0.5	12	29	43	84	7.8	6	37	17	60	12.5					
grass (*Elymus canadensis*)	20	18	14	52	9.7															
Sand cherry (*Prunus pumila*)	1	5	7	13	2.6															
Poison ivy	1	1	1	3	1.4															
Wild rose (*Rosa* sp.)	1	1	4	6	0.5															
<u>ILE AUX GALETS</u> (16 m^2)																				
Red-osier dogwood	93	53	38	184	9.7															
Black ash (*Fraximus nigra*)	1	13	13	27	2.4															
Ninebark	2	2	13	17	0.3															
Apple (*Pyrus malus*)	1	11	13	25	0.3															

Table E1
(concluded)

Plant Species	Transect 1 RD	RC	RF	IV	% cov.*	Transect 2 RD	RC	RF	IV	% cov.*	Transect 3 RD	RC	RF	IV	% cov.*	Transect 4 RD	RC	RF	IV	% cov.*
Gooseberry	1	4	13	17	0.3															
Common lilac (<u>Syringa vulgaris</u>)	1	17	13	31	3.1															
<u>ILE AUX GALETS</u> (1 m^2)																				
Witchgrass	26	46	20	92	2.6															
Chinese mustard (<u>Brassica juncea</u>)	26	24	20	70	1.4															
Pigweed (<u>Chenopodium album</u>)	39	25	40	104	1.4															
Common smartweed (<u>Pericaria hydropiper</u>)	4	3	13	20	0.2															
Tumble-mustard	4	1	7	12	0.1															

Note: RD = relative density; RC = relative coverage; RF = relative frequency; IV = importance value; % Cov. = percent coverage of the sample area. Plant names except those in parentheses are taken from <u>Gray's Manual of Botany</u>, 8th ed. (Fernald 1950).