2003 BLACK TERN POPULATION SURVEY AND OTHER MARSH BIRD MONITORING ACTIVITIES IN VERMONT

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The Nongame and Natural Heritage Program
Vermont Department of Fish and Wildlife
103 South Main St.
Waterbury, Vermont 05671

Nathaniel Shambaugh
2994 Chase Rd.
Berlin, VT 05602

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ABSTRACT

2003 BLACK TERN POPULATION SURVEY AND MARSH BIRD MONITORING ACTIVITIES IN VERMONT

As part of ongoing research into the status of Vermont's marsh birds, a statewide census of the black tern (***Chlidonias niger***) nesting population was undertaken again in the year 2003. The black tern nesting population showed a drop from the high of 100 pairs in 1999 to 67 pairs found in 2003. Virtually all black tern nesting in Vermont in 2003 was found at the north end of Lake Champlain, primarily within the Missisquoi National Wildlife Refuge in Swanton with only one pair found at Mud Creek Wildlife Management Area in Alburg. This is cause for concern because all nesting is in one confined area, with no nesting at the south end of Lake Champlain or on Lake Memphremagog as had occurred in the past. This constriction of the breeding range in Vermont is severe enough that the author has proposed that the status of this species in Vermont be changed from Threatened to Endangered.

In addition, the survey of selected marshes in Vermont for other marsh birds (pied-billed grebe, least bittern, American bittern, Virginia rail, sora, common moorhen, and American coot) was continued. Fifteen marsh bird routes situated in emergent marshes within state Wildlife Management Areas, Missisquoi NWR, or in marshes designated as "Important Bird Areas" were surveyed. Virginia rail is still the most common and abundant marsh bird surveyed , followed by the common moorhen, with least bittern, sora, American bittern, pied-billed grebe, and American coot being uncommon and sporadic.

These ongoing activities together have two major objectives: to look at marsh bird population trends within the marshes of Vermont, and to investigate the effect of water level and marsh vegetation changes on marsh bird numbers.

Relationships between various marsh bird nesting patterns are discussed as well as correlations between black tern nesting locations and water level. Recommendations are made for management activities which could benefit the black tern nesting population.

ACKNOWLEDGMENTS

I would like to thank Steve Parren of the Vermont Department of Fish and Wildlife (VDFW), for his overall support for this project, the staff of Missisquoi National Wildlife Refuge (MNWR) for their ongoing help, as well as Mark LaBarr of Audubon Vermont for arranging for the interns at Missisquoi National Wildlife Refuge (NWR). In addition, I would like to thank the marsh bird survey volunteers; Warren King, Don Clark, Roy Pilcher, Michele Patenaude, Susan Elliott, Mike Winslow, and Dave Sausville of the VDFW. Thank you as well to the Vermont Nongame and Natural Heritage Program, the Vermont Conservation License Plate Program, and all those who contributed to the Vermont Nongame Wildlife Fund which helped support this project in 2003.

INTRODUCTION

The black tern (***Chlidonias niger***) is a colonial nesting marsh bird which is currently on the Vermont threatened species list due to its declining numbers. In order to better understand the biology and population status of this species, statewide censuses of the Vermont black tern nesting population have been made since 1990. The black tern is a bird which nests in loose colonies within large emergent marshes, often building its nest on old muskrat lodges and floating debris. Because this nesting habitat is impermanent and the overall marsh vegetation varies each year depending on water level, colony locations vary from year to year. The transitory nature of nesting colony locations makes it important to survey all potential colony sites in Vermont each year.

The Vermont black tern nesting population has been hovering at 50-100 pairs since the start of this study in 1990, probably down from about 300 pairs in the 1970s, although this latter number is not well documented. This apparent decline in numbers has many possible causes, only some of which may be related to nesting activity in Vermont. Because of the marsh nesting behavior of this species, and the fact that the young may leave the nest soon after hatching if disturbed, it is very difficult to get an accurate estimate of nesting success for black terns. This author and others have made various attempts to determine individual nest or colony breeding success with varying degrees of success (Shambaugh 1994a).

In 2003 the entire Vermont black tern breeding population continued to be concentrated in and around the Missisquoi National Wildlife Refuge in Swanton, VT. The breeding range of this species has gradually constricted since about 1996, when nesting still occurred at Little Otter Creek in Ferrisburg and South Bay WMA in Coventry. Fortunately, the MNWR has a wide variety of marsh habitats, and it appears that there is suitable nesting habitat somewhere within the refuge under most water level conditions. Because of the gradual decline in breeding range, this species has been proposed for Endangered Species status in Vermont.

In addition to the above black tern census work, the author continued to coordinate volunteer marshbird surveys of selected marshes in Vermont in 2003. As in previous years, the following bird species were selected for monitoring: pied-billed grebe (***Podilymbus podiceps***), least bittern (***Ixobrychus exilis***), American bittern (***Botaurus lentiginosus***), Virginia rail (***Rallus limicola***), sora (***Porzana carolina***), and common moorhen (***Gallinula chloropus***). These species were selected because they are obligate, emergent marsh-nesting species. They also have limited nesting populations, or there is a

limited knowledge of their breeding habitat preferences and abundance in Vermont. In addition, the American coot (***Fulica americana***) was included starting in 1999, because it is part of the monitoring methodology used for this study (McCracken et al. 1995), and several volunteers started reporting it.

All of the above activities have two long term objectives: to look at marsh bird population trends within certain major marshes in Vermont, and to investigate the effect of water level and marsh vegetation changes on marsh bird numbers. By investigating marsh bird responses to vegetation changes this research is trying to determine habitat requirements for nongame marsh birds, investigate what habitat is created by the vegetation management undertaken, and determine what effect these management efforts have on nongame marsh bird numbers.

MATERIALS AND METHODS

BLACK TERN CENSUS

Black terns were censussed as in previous years (Shambaugh 1995). Briefly, areas where black terns have historically nested were censussed by canoe during the black tern incubation period, approximately June 1 through June 20. An estimate of nesting pairs was made by counting the number of adults flushed up from the colony while canoeing through it, then dividing by two. This estimate was verified, as much as possible without excessive disturbance, by locating actual nests. All black tern census work was undertaken by the author.

MARSH BIRD CENSUS

The four marsh bird survey routes created in 1996: Charcoal Creek at Missisquoi National Wildlife Refuge in Swanton VT, Mud Creek at Mud Creek Wildlife Management Area (WMA) in Alburg VT, Route 17 at Dead Creek WMA in Addison, VT, and Brilyea at Dead Creek WMA were all surveyed again in 2003 (see Figures 1-4 for site locations). Of the routes created after 1996, eleven were surveyed during the summer of 2003. These routes, their locations, and year that surveys began are as follows: Long Marsh (1998), Goose Bay (1998), Dead Creek (1998), and Cranberry Pool (1999) at MNWR in Swanton, VT (see Figure 1), South Bay WMA (1998) in Coventry, VT (see Figure 5), Sandbar WMA (1999) in Milton, VT (see Figure 6), Little Otter Creek (1999) in Ferrisburgh, VT (see Figure 7), West Rutland Marsh (2001) in West Rutland, VT (Figure 8), Lake Bomoseen (1999) in Hubbardton, VT (Figure 9), Herrick's Cove (1999) in Rockingham, VT (Figure 10), and Panton Rd. (2002) in Panton, VT (Figure 11).

These survey routes were set up and surveyed according to the Marsh Bird Monitoring Program protocol developed at the Long Point Bird Observatory, Ontario, Canada (McCraken et al. 1995) with modifications as described previously (Shambaugh 1998). Briefly, a survey route consists of between two and nine stations located at least 200 m apart. Each survey station is semi-permanently marked with either a post pounded into the mud or a metal rod pounded in the ground. Pre-recorded calls of least bittern, Virginia rail, sora, common moorhen, and pied-billed grebe are played at each survey station and responses are recorded for the next five minutes. The number of each species responding within a 100m radius semi-circle centered on the station are reported. This semi-circle is referred to as a survey plot. The American bittern was included in the survey without use of pre-recorded calls because they are loud, distinctive, and reliably detected without the use of a tape.

RESULTS AND DISCUSSION

BLACK TERN CENSUS

Based on the results of the 2003 black tern census, it is estimated that there were 67 black tern pairs nesting in Vermont in 2003 (see Table 1). Unfortunately, the area in Vermont where black terns nest continues to become more restricted each year. No terns were documented nesting in the southern half of Lake Champlain or on Lake Memphremagog for the fourth year in a row. Mud Creek Wildlife Management Area in Alburg was, as recently as 1995, one of the major nesting areas in Vermont for this species. In 2003, for the second year in a row, there appeared to be only one pair nesting there. This leaves the Missisquoi N.W.R. as the only significant nesting area in Vermont in 2003. Fortunately, the Missisquoi NWR is the largest wetland complex in Vermont, with large amounts of a wide variety of wetland habitats and it continues to support a healthy population of black terns, with major concentrations in 2003 at Long Marsh, Cranberry Pool, and Charcoal Creek North.

Based on the data in Table 1, it can be seen that there is a large fluctuation in the number of black tern nesting pairs in Vermont, from a low of 44 in 1996 to a high of 100 in 1999. This amount of variation seems to be greater than what could be accounted for by actual natality and mortality, and may indicate that terns are choosing to nest in Vermont or not based on some environmental cue(s). Black terns nest at water level and nest site availability is very dependant on both water levels and vegetation growth, so possible explanations for the population fluctuations include either water level and/or vegetation growth variations. In order to explore this possibility, a review of Lake Champlain lake levels was undertaken. Black terns generally start egg laying in very late May or early June, so nest site selection is presumably occurring during the several weeks before that. The mean lake level from May 15 - 31 (measured in Burlington, VT), was chosen as an indicator of the potential for suitable nesting habitat to be present.

Based on data from 1990-2002, it appears that there is a relationship between Lake Champlain lake levels, and the amount and location of black tern nesting in Vermont. The higher the Lake Champlain lake level at the end of May, the fewer black terns will be likely to nest in Vermont (see Fig. 12). Water levels in general were near normal on Lake Champlain in 2003, with no rapid rises or drops in water level during the breeding season to cause problems for nesting black terns. The late May mean water level was 98.13 feet, as compared with the long-term mean of 98.07 feet. Using this value and the linear equation on Figure 12, it is possible to come up with a predicted number of nesting pairs for 2003 of 69. This compares very well with the actual value of 67 pairs found.

Not only does it appear that one can predict about how many terns will nest in Vermont, based on water level, but also whether they will use certain marshes. As was noted in my 2002 report (Shambaugh 2003), black terns tend to concentrate in Cranberry Pool when lake levels are above average (see Figure 13) and in Charcoal Creek South when lake levels are low (see Figure 14). This can be explained as follows, the Charcoal Creek South wetland is too deep during high water years for suitable nest sites to become available in time for black tern use. The Cranberry Pool wetland, being an impoundment with relatively stable habitat, acts as a refugia during high water years when there is not very much nesting habitat elsewhere. The Charcoal Creek North wetland seems to be an exception to the relationship between water level and tern usage, for some reason this marsh is the preferred nesting area for black terns in Vermont under most water level conditions. I believe that this is at least partially due to the

gradual slope of the wetland bottom towards the north away from Route 78. This slope is so gradual that there is some portion of the wetland having optimal water depth under most water level conditions. In order for suitable nest sites to exist, the water must be shallow enough for light to penetrate and encourage emergent growth in time for it to be useable by black terns. The logical extension of this relationship between water levels and tern nesting is that it should be possible to predict on June 1st not only the approximate number of terns nesting in Vermont, but also which marshes will be used With this knowledge one can concentrate management activities where terns are most likely to nest. Based on this observed relationship, it is especially important to make sure that Cranberry Pool retains water during wetter than normal years. If a drawdown is necessary it should be timed to coincide with a normal or slightly dry year. The converse of this is that it is especially important to make sure that Charcoal Creek South is protected during drier than normal years, when it is likely to attract a significant amount of nesting activity.

These hypothesized relationships indicate that a major limiting factor for the successful nesting of this species in Vermont is the availability of suitable nest substrate when the birds are preparing to nest, and the continued suitability throughout the nesting season. I believe the process an adult black tern will go through upon returning in the spring is as follows: The bird will return to the area where it was born or nested previously, and if suitable nesting substrate is present and/or other terns are hanging around, then it will stay. If no other terns are present and/or no suitable substrate is available then the bird will expand its search area to surrounding marshes. At some point though, if no nest site is found, the urge to nest will be lost and the bird will abandon the search, and start to flock with other non-nesters. The period from about May 15 through June 20 is a critical period for this species in Vermont. If suitable nest habitat is not found during this period, then nesting will probably not be successful. This hypothesized search strategy is the reason I believe that it is such a problem that black terns are no longer nesting at the south end of Lake Champlain or Lake Memphremagog. Until or unless the black tern population expands greatly in the northern end of Lake Champlain, these birds are not likely to re-colonize other areas far from Missisquoi NWR. If the Missisquoi NWR area becomes saturated with nesting black terns (or loses habitat completely), then there would be pressure to expand, but otherwise they will continue to search out existing colonies near where they have nested previously. The goal at this point therefore should be to increase the number of successful black tern nesting pairs within and around the Missisquoi NWR and Mud Creek WMA.

The following are proposals which I believe should be undertaken to work towards reaching the above goal of maximizing nesting success within Missisquoi NWR and Mud Creek WMA:

CRANBERRY POOL:

1) Do not drain Cranberry Pool for management purposes if the Lake Champlain lake level is above 98' on June 1. When the lake level is high, this marsh is used extensively for nesting. Draining after July 15 at the earliest or after terns have completed nesting would be acceptable. On those years when Cranberry Pool is drained, it might be advisable to concentrate efforts on putting nest platforms (see #4 below) in protected marshes where managers would like to see terns nesting.

2) Whatever level is the target for this impoundment for a given year, attempt to stabilize it at that level by June 1, and keep it as close as possible to that level until July 15 or when nesting is complete. Water level fluctuations either up or down will often lead to nest loss.

3) Supplement existing perches and loafing stations for adults and fledgelings by putting posts, logs, and downed trees in the marsh prior to the nesting season. Before nesting starts there are often few places for adults to perch because the marsh is mostly open water. The more loafing perches available,

the more likely adults will be to stay until nesting conditions are right. Downed trees with many branches and landing spots are very attractive to fledgelings as communal loafing areas. There is currently no place of the sort within Cranberry Pool except sometimes large mud patches. Logs of this type are found within Missisquoi Bay and used extensively by adult and fledgeling black terns.

4) Create/improve nesting substrate or supplement it with artificial nest platforms. Artificial nest platforms (floating, anchored rafts) have been used in Vermont and elsewhere in order to either encourage terns to nest in particular marshes or add extra nest substrate which isn't susceptible to water level fluctuations. This experiment has met with mixed success, some researchers thought it improved productivity, while others thought it led to increased predation. In Vermont, platforms were put out in several marshes in the early 1990's and for five years at South Bay WMA on Lake Memphremagog, but the tern population still dwindled away to nothing at South Bay during this period. The platforms were often used for nesting, but whether young fledged successfully is unknown. So the platforms may have been of some marginal help at South Bay, or they may have sped up the elimination of this colony by attracting terns to nest at spots where they wouldn't nest successfully. The drawback to the platform design used was that the materials were not all biodegradable so it was necessary to try to retrieve them after the nesting season. Vegetation is very tall and dense in these marshes by September making this difficult. An alternative design was attempted in 2002 and 2003 in Cranberry Pool. Hay bales were staked in place using 4' wooden garden stakes within the marsh. The initial attempt in 2002 was aimed primarily at seeing if these would stay afloat and staked in place through the nesting season, no attempt was made to add nesting material to make them more attractive to terns. Of the 13 bales put out in May, one disintegrated immediately, four could not be relocated six weeks later, three did not rise or fall with the changing water levels, leaving five which seemed to have functioned adequately. As mentioned above, no nest substrate such as dead burreed stalks were put on the bales so although terns were observed to perch on bales, they weren't used for nesting. Black terns are not known to carry nesting material from long distances, they generally will only pull together debris from the immediate area of the nest. Debris from previous years emergent growth generally accumulates upwind of emergent or woody (buttonbush) vegetation patches, and this debris is the preferred nesting substrate of black terns in Vermont when it is available (see Shambaugh 1994b). In 2003, hay bales were placed in Cranberry Pool again, this time with native vegetation debris placed on top. These nest platforms looked much more natural than in 2002, and they remained that way through the season, but they were not utilized by black terns. A portion of this may be because the terns initiated nesting quite early in Cranberry Pool in 2003. The hay bales were not in place until May 31, when terns had already started nesting.

MUD CREEK

1) Lower the water level within this impoundment by one to two feet during May, if Lake Champlain levels permit. At Mud Creek, the water depth in the main open water is too deep for early emergent growth, so dropping the level by one to two feet during May, if lake levels permit, should encourage earlier emergent growth.

2) As with Cranberry pool, and along with #1 above, it is also very important to do whatever is possible to maintain a constant water level within Mud Creek during the egg phase, approximately June 1 through July 15.

3) Supplement existing perches and loafing stations for adults and fledgelings by putting posts, logs, and downed trees in the marsh prior to the nesting season as at Cranberry Pool.

4) If emergent growth proliferates within the open water area of the impoundment due to #1 above it might be useful to supplement nesting sites with artificial nest platforms as at Cranberry Pool.

MARSH BIRD SURVEYS

Fifteen marsh bird routes were surveyed in 2003 with a total of 85 stations. Berlin Pond was not surveyed in 2003. Marsh bird monitoring routes are situated in emergent marshes within state Wildlife Management Areas, Missisquoi NWR, or in marshes designated as "Important Bird Areas"(IBAs) by Audubon Vermont. IBAs are areas selected by a scientific panel as being especially important for the continued well-being of Vermonts birds. Summary data for the mean number of each species per station are listed in Table 2 for the Vermont Wildlife Management Areas, Table 3 for Missisquoi National Wildlife Refuge, and Table 4 for Vermont Important Bird Areas.

Several general observations can be made from these data. First, as in previous years, it is clear that the Virginia rail is the most common and abundant marsh bird detected by this survey. The common moorhen is also quite common, but the other species are only found sporadically. One interesting observation is apparent when looking at Table 3. That is, at Long Marsh, Goose Bay and Cranberry Pool there is a negative relationship between Virginia Rail densities and Common Moorhen and Pied-billed Grebe densities. When there are many rails there tend to be few moorhens and grebes. This is somewhat expected since rails prefer dense vegetation while moorhens and grebes prefer to be able to swim. So this may be another example of marsh bird response to fluctuating water levels, but this is not clear.

Table 5 lists the trends of marsh bird numbers within the three original Wildlife Management Area survey routes: Brilyea and Route 17 within Dead Creek WMA and Mud Creek WMA. The number listed is a sum of the maximum number of individuals detected in each marsh by year. The most common species, Virginia Rail, seems to be gradually declining over the past eight years, although it may simply be that 1996 and 1998 were especially good years.

The Common Moorhen, on the other hand, has had a very large drop in numbers from 1996 to 2003 within these Wildlife Management Areas (see Table 5). It may be that the large numbers detected in 1996 and 1997 don't correspond to the pre-1996 norm from which the population has declined, but are actually a temporary population explosion of moorhens at these marshes in response to the 'cookie cutter' vegetation management undertaken at all three of these marshes in early 1996. There was a large amount of floating, dead, chopped up vegetation present in 1996 due to the 'cookie cutter', which was solid enough for the moorhens to walk on and probably supplied abundant invertebrates and succulent roots to eat. It may be that moorhens, and Virginia Rail as well, were attracted to the temporary increase in habitat or food supply created by the 'cookie cutter'. There doesn't appear to be a parallel decline in moorhens and rails at other marshes, although no other marshes were surveyed prior to 1998, so it is possible there was an abundance of marsh birds in 1996 irrespective of 'cookie cutter' activity. Unfortunately, without pre-cookie cutter data for these marshes there is no way to know.

Looking at the marshbird data overall, the same trends in marsh bird numbers were seen in 2003 as in previous years. Each marsh seems to have its own cohort of marsh species, which doesn't vary greatly year-to-year. By combining all of the data from all the marshes and years it is possible to make some general comparisons of the preferences of the various marsh birds for the marshes surveyed. Table 6 combines all of the data to give mean numbers of individuals per station for each marsh. The overall mean for each species is listed at the bottom, the values in **bold** are those marshes greater than the mean for that species, and the underlined value shows the marsh with the highest density for each species. It can be seen that no one marsh is obviously better than the rest, each species has preferences for different marshes. For instance, Mud Creek has the highest overall density of Virginia Rail, but not of any other species. On the other hand, it is clear that some species have a greater diversity of marshbirds. For

instance, Little Otter Creek has greater than average amounts of all species surveyed except American Bittern and Virginia Rail, while West Rutland Marsh has been found to have only Virginia Rail present (Table 6).

CONCLUSIONS

For the fourth year in a row, the entire Vermont black tern nesting population was concentrated at the north end of Lake Champlain at Mud Creek WMA and Missisquoi NWR. The estimated breeding population of 67 pairs was below the fourteen year mean of 69 nesting pairs. Because of the restricted nesting area and the highly variable lake levels, the impoundments at Mud Creek and Cranberry Pool become very important to the survival of this species in Vermont. These impounded areas are critical because they can act as refugia during very high (and maybe low) water years on Lake Champlain. Other reasons for their importance include: ability to vary the water level or hold it constant, isolation from human disturbance, ability to manage the vegetation if appropriate. The black tern now meets the criteria for listing as a state endangered species and I believe it is time to move forward with this action. Because this species is concentrated in such a small area a single adverse weather event could virtually eliminate nesting for a year, especially if Cranberry Pool is unavailable due to periodic draining.

Management activities which I believe should be seriously considered for this species include:

Cranberry Pool:

1) Drop water level to desired level by late May and do whatever is possible to keep it constant until July 1, including not letting it rise, whenever environmental conditions permit.
2) Supplement perches with posts and logs.
3) Experiment further with hay bale and other style artificial nest platforms.

Mud Creek:

1) Drop water level one to two feet in May and hold it constant thru June, if weather permits.
2) Supplement perches with posts and logs.
3) Experiment with hay bale nest platforms if #1 above encourages emergent growth by early June.

Charcoal Creek South

1) Experiment with hay bale nest platforms
2) Supplement perches with posts and logs.

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FIGURE 1.MISSISQUOI NWR MARSH BIRD STATIONS

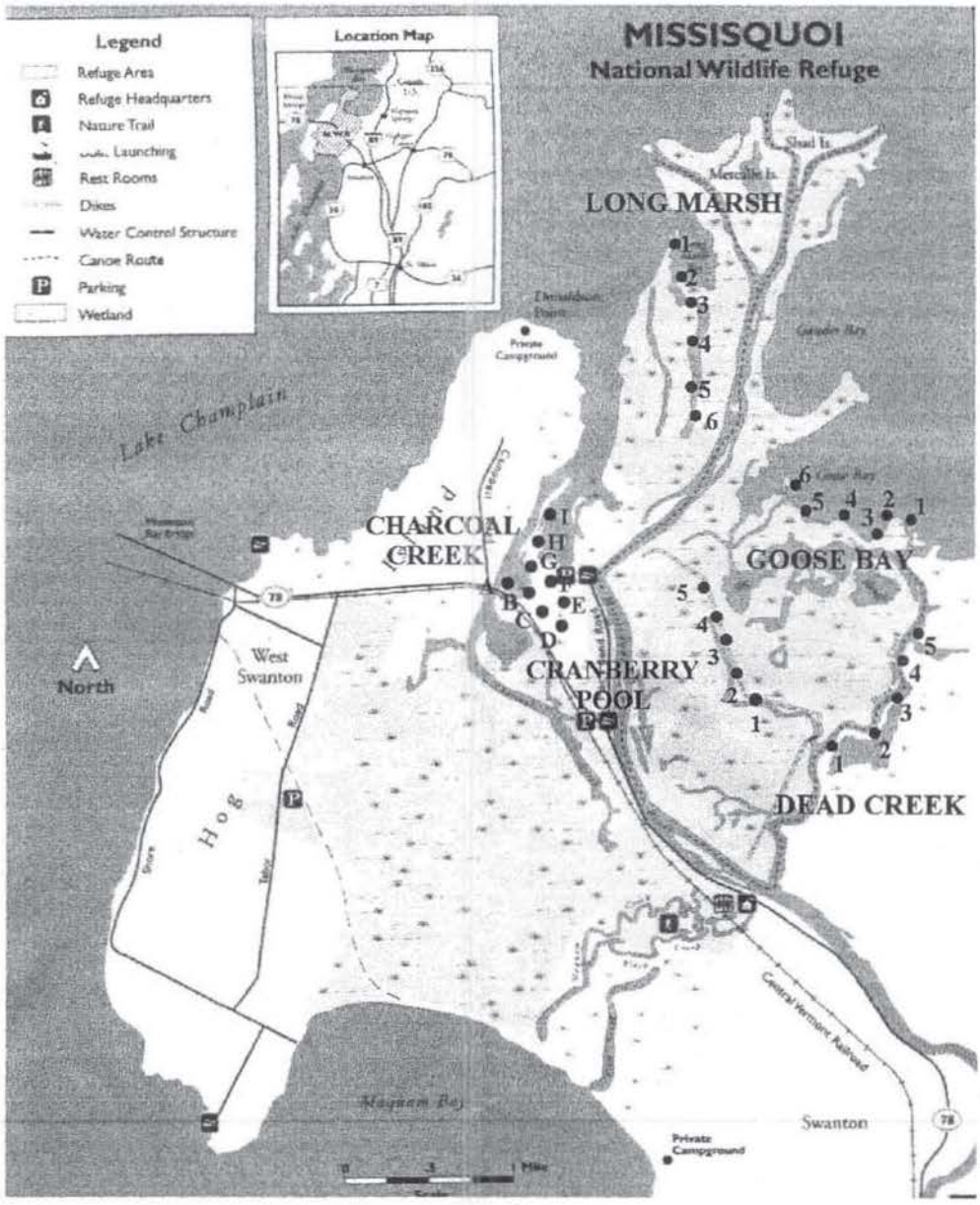
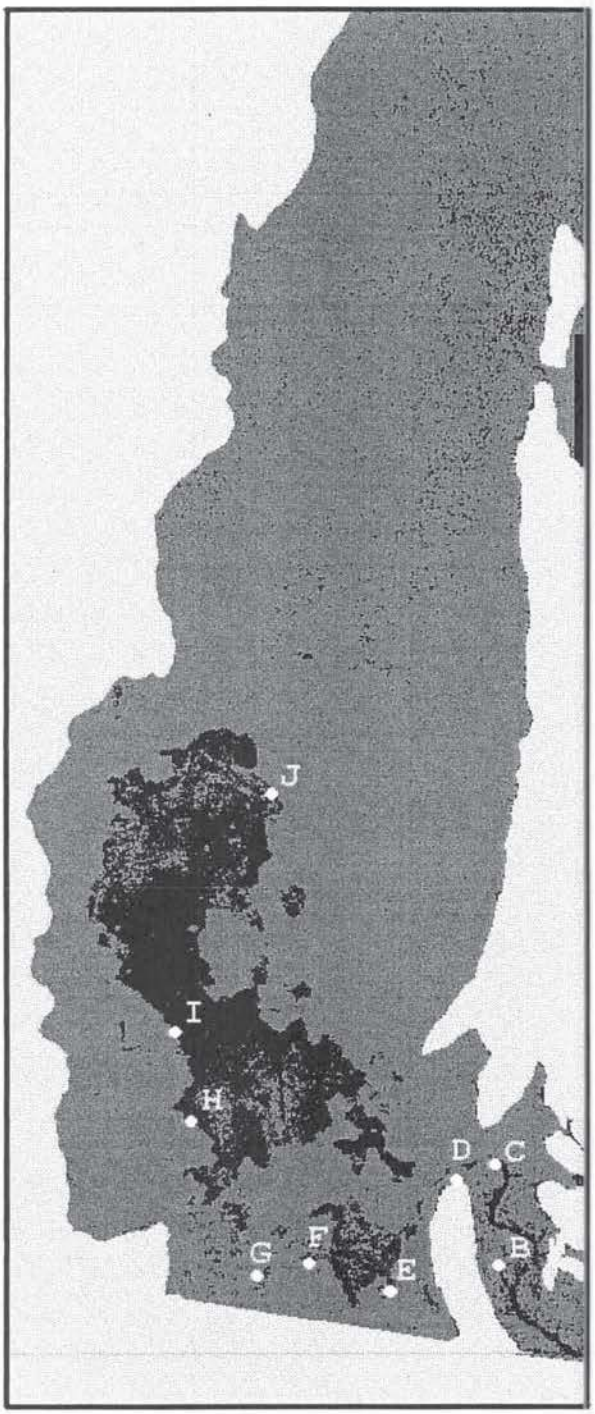


FIGURE 2. MUD CREEK MARSH BIRD STATIONS



...UPLAND

...VEGETATION

...WATER

B ...SURVEY SITES

N

FIGURE 3. DEAD CREEK MARSH BIRD STATIONS

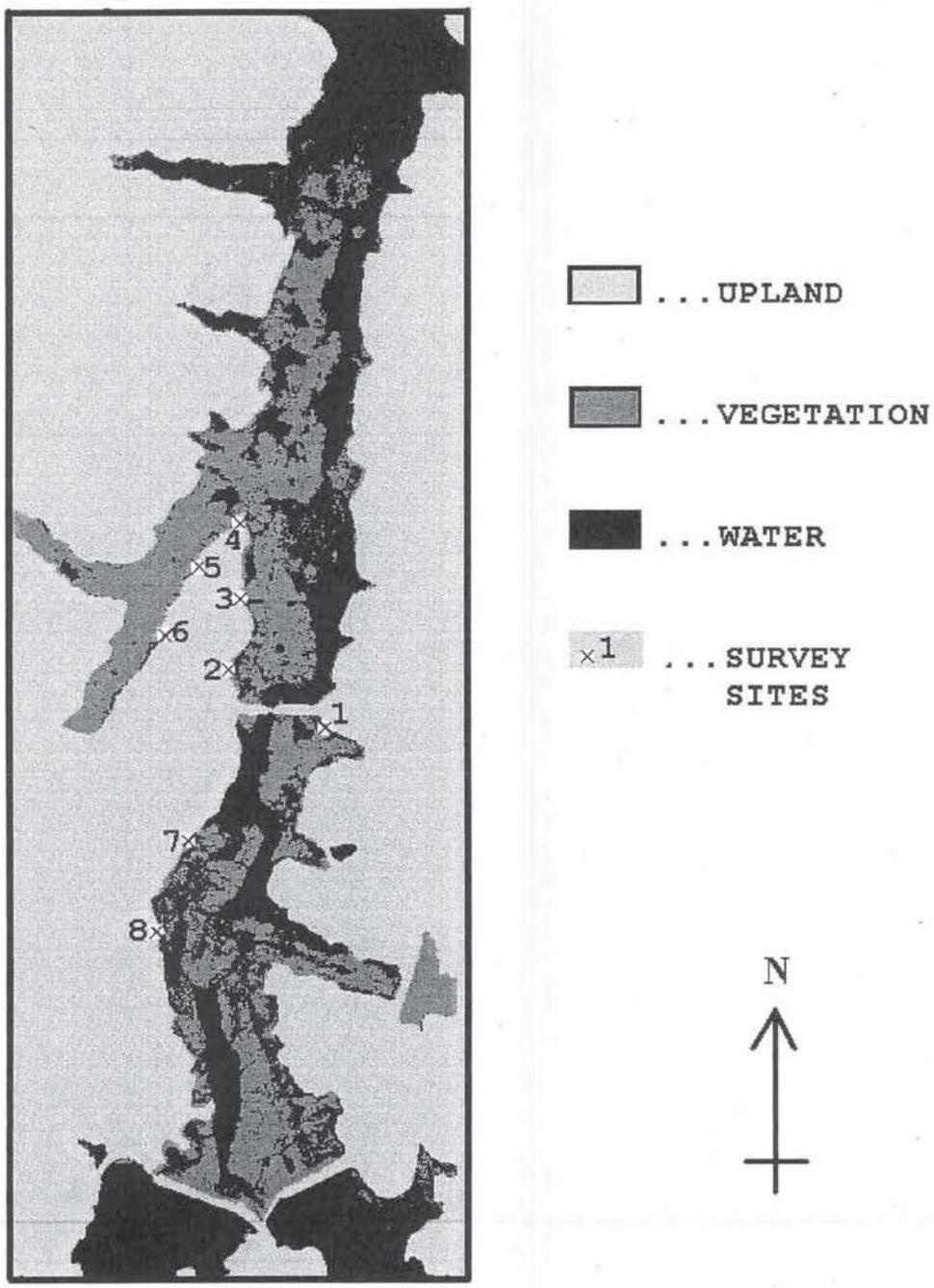


FIGURE 4. BRILYEA MARSH BIRD STATIONS

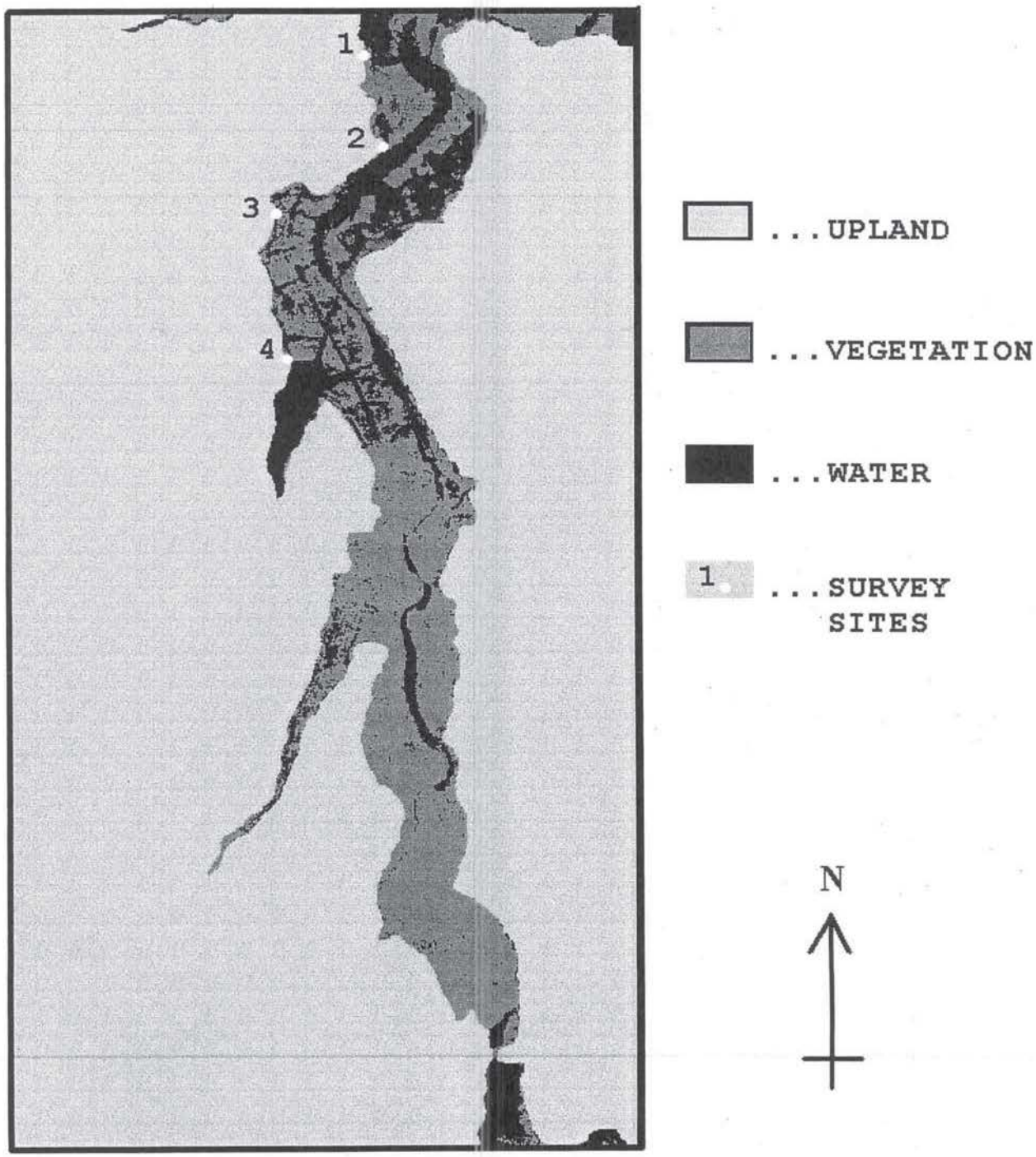


FIGURE 5. SOUTH BAY WMA MARSH BIRD STATIONS.

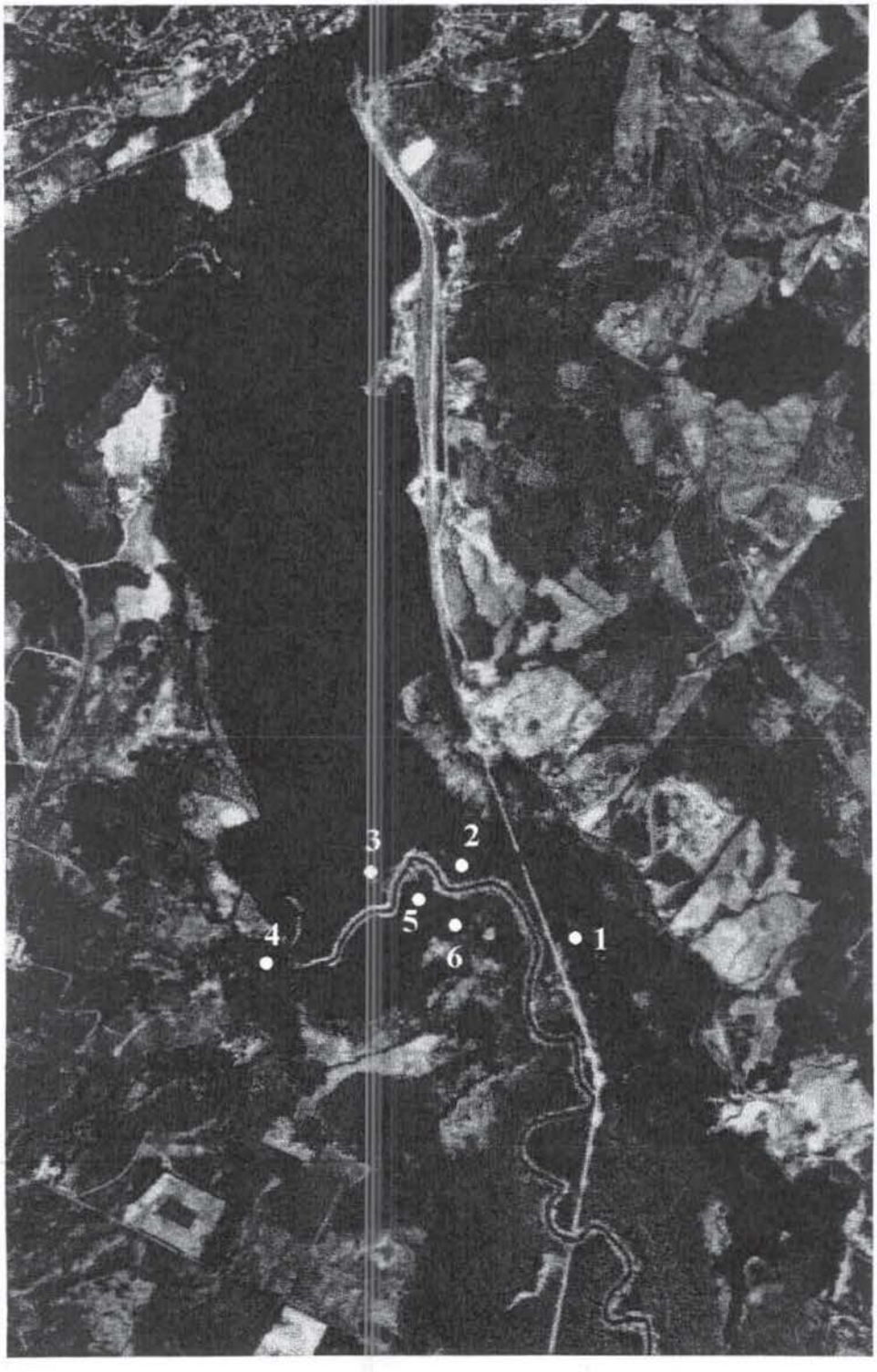


FIGURE 6. SANDBAR WMA MARSH BIRD STATIONS

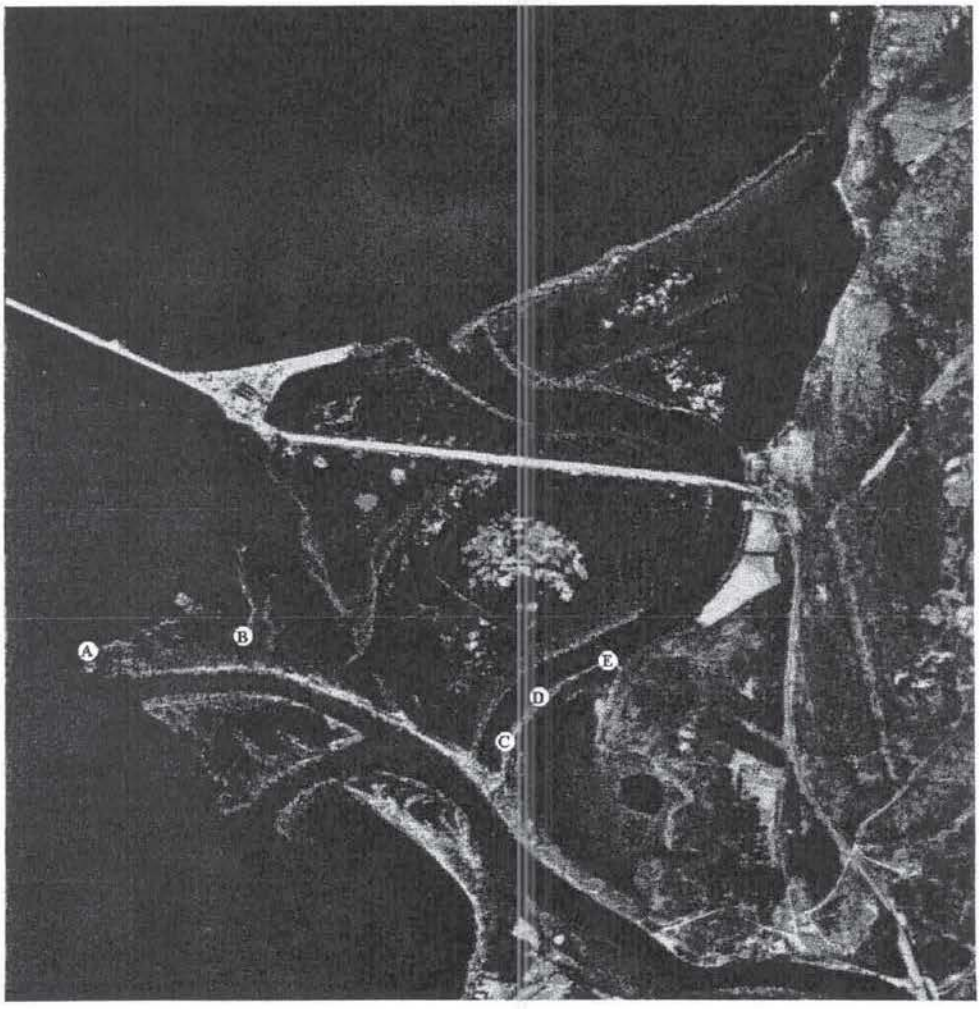


FIGURE 7. LITTLE OTTER CREEK MARSH BIRD STATIONS

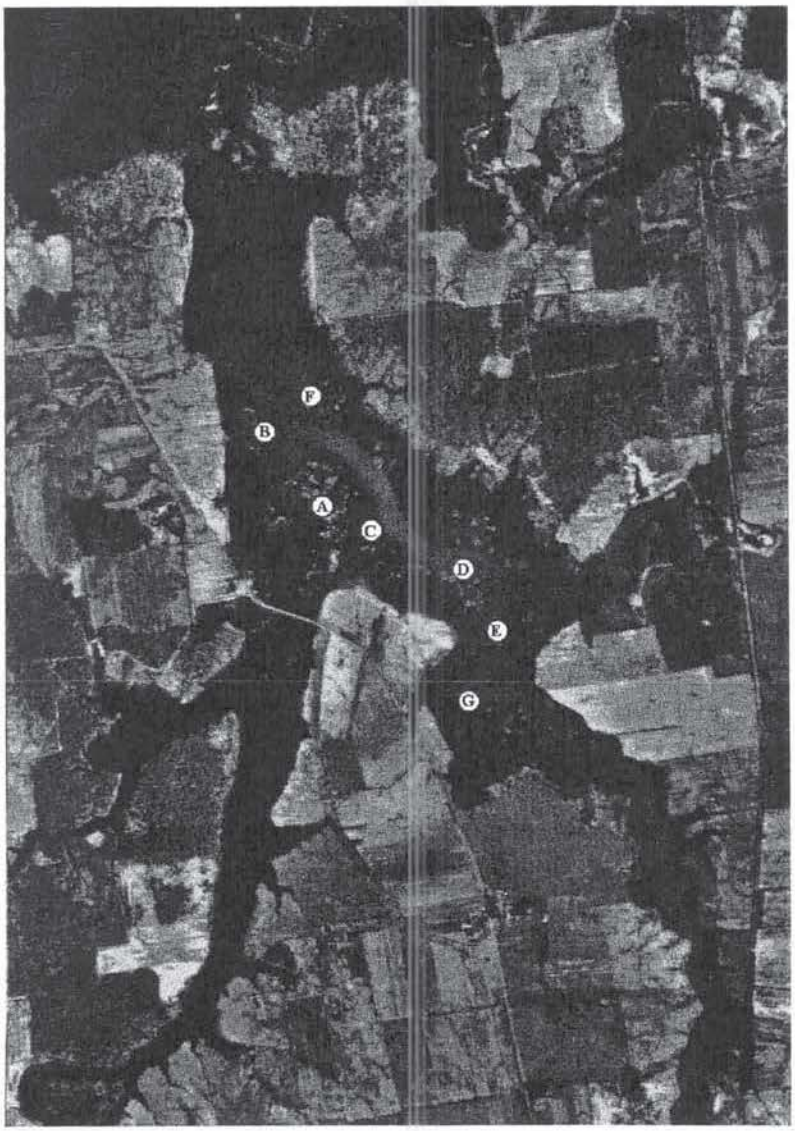


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FIGURE 8. WEST RUTLAND MARSH MARSH BIRD STATIONS

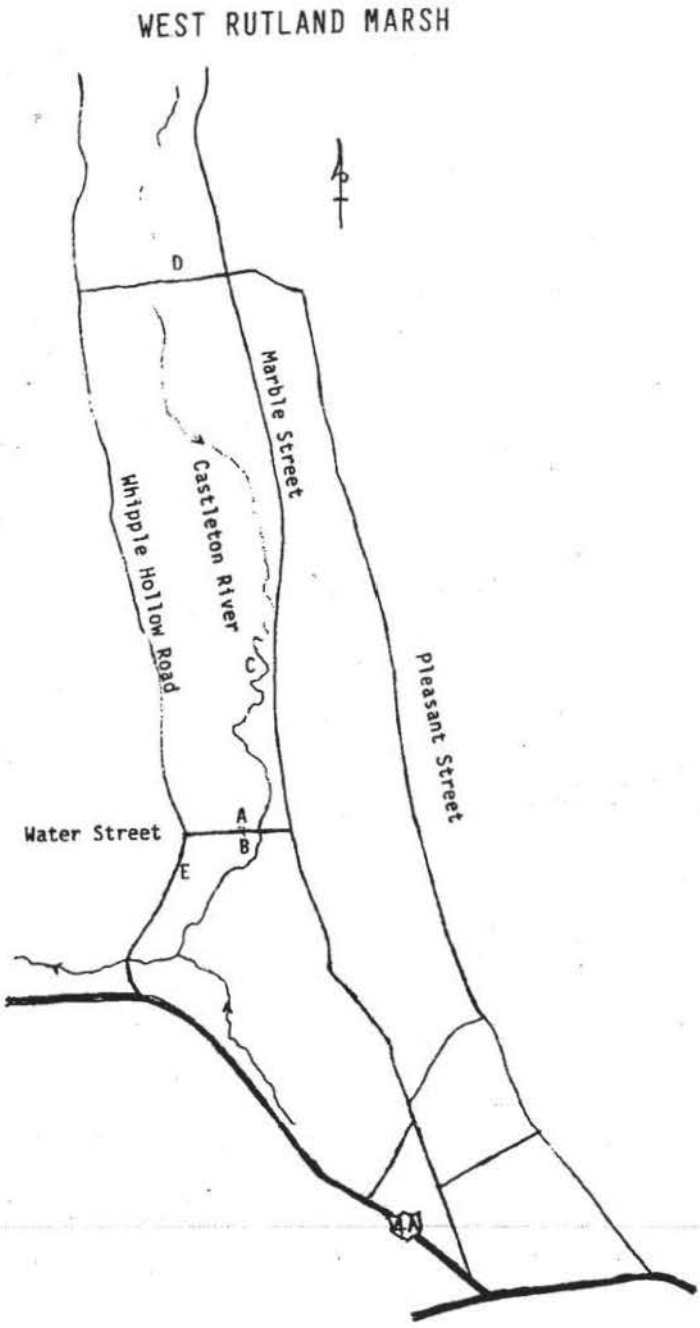

FIGURE 9. LAKE BOMOSEEN MARSH BIRD STATIONS.

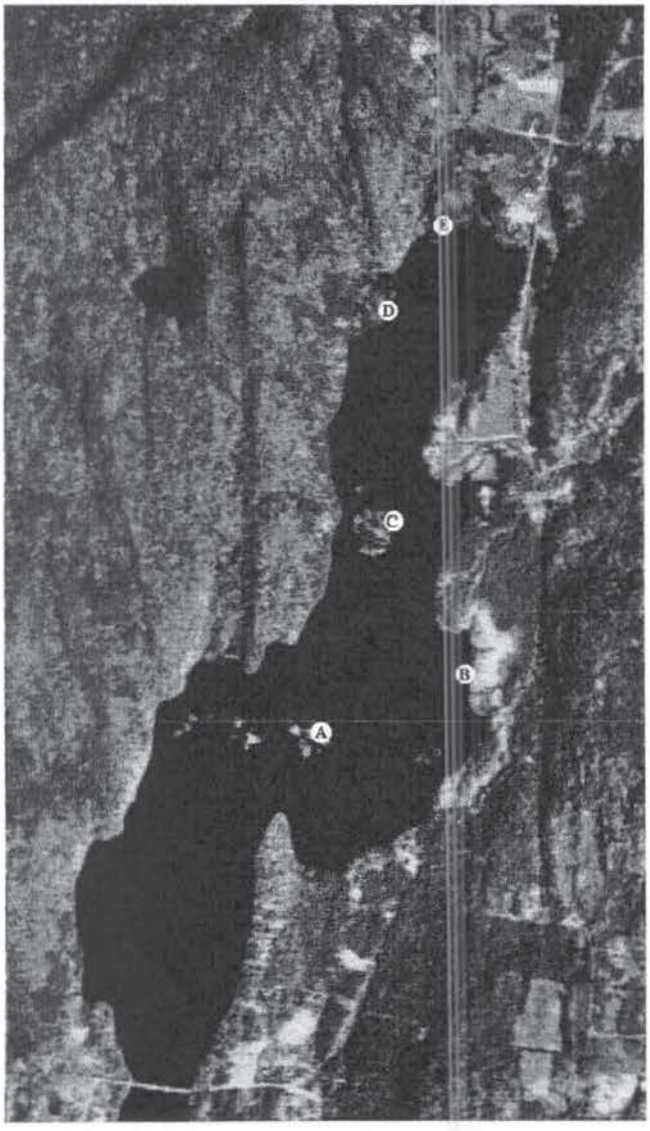

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FIGURE 10. HERRICK'S COVE MARSH BIRD STATIONS.

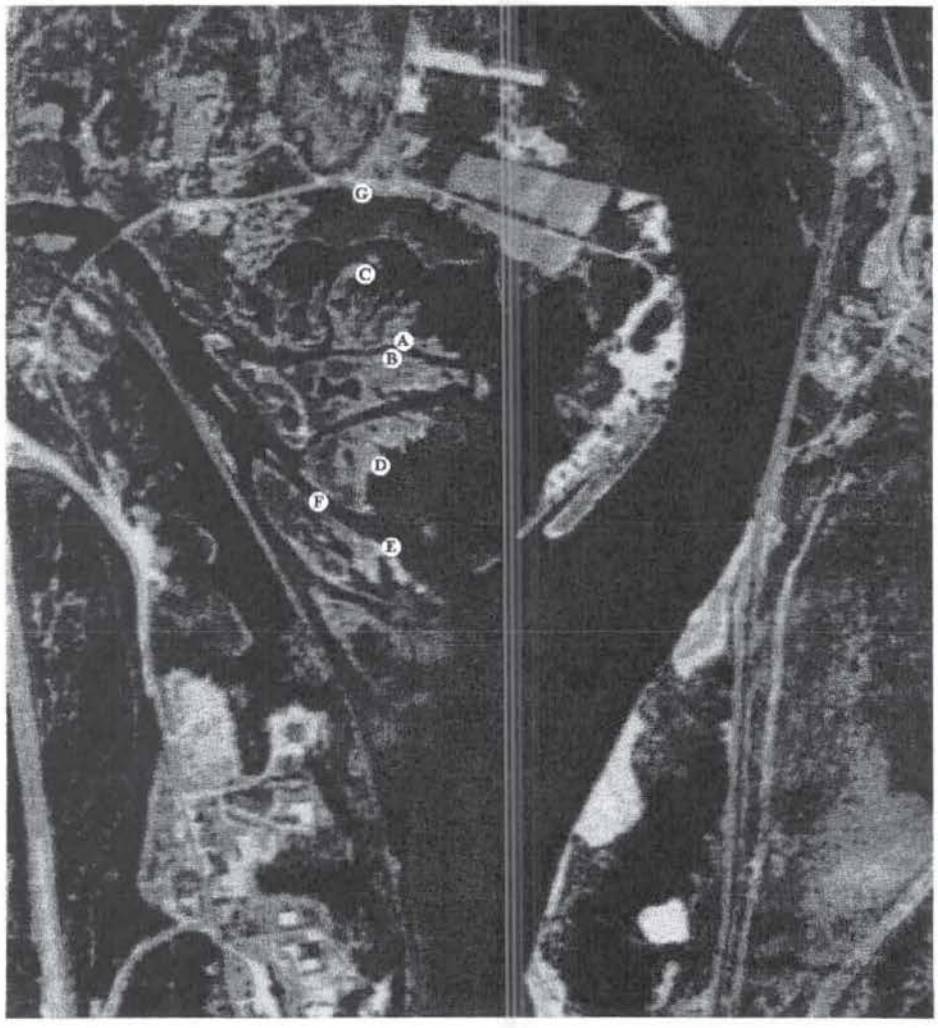

FIGURE 11. PANTON RD. MARSH BIRD STATIONS

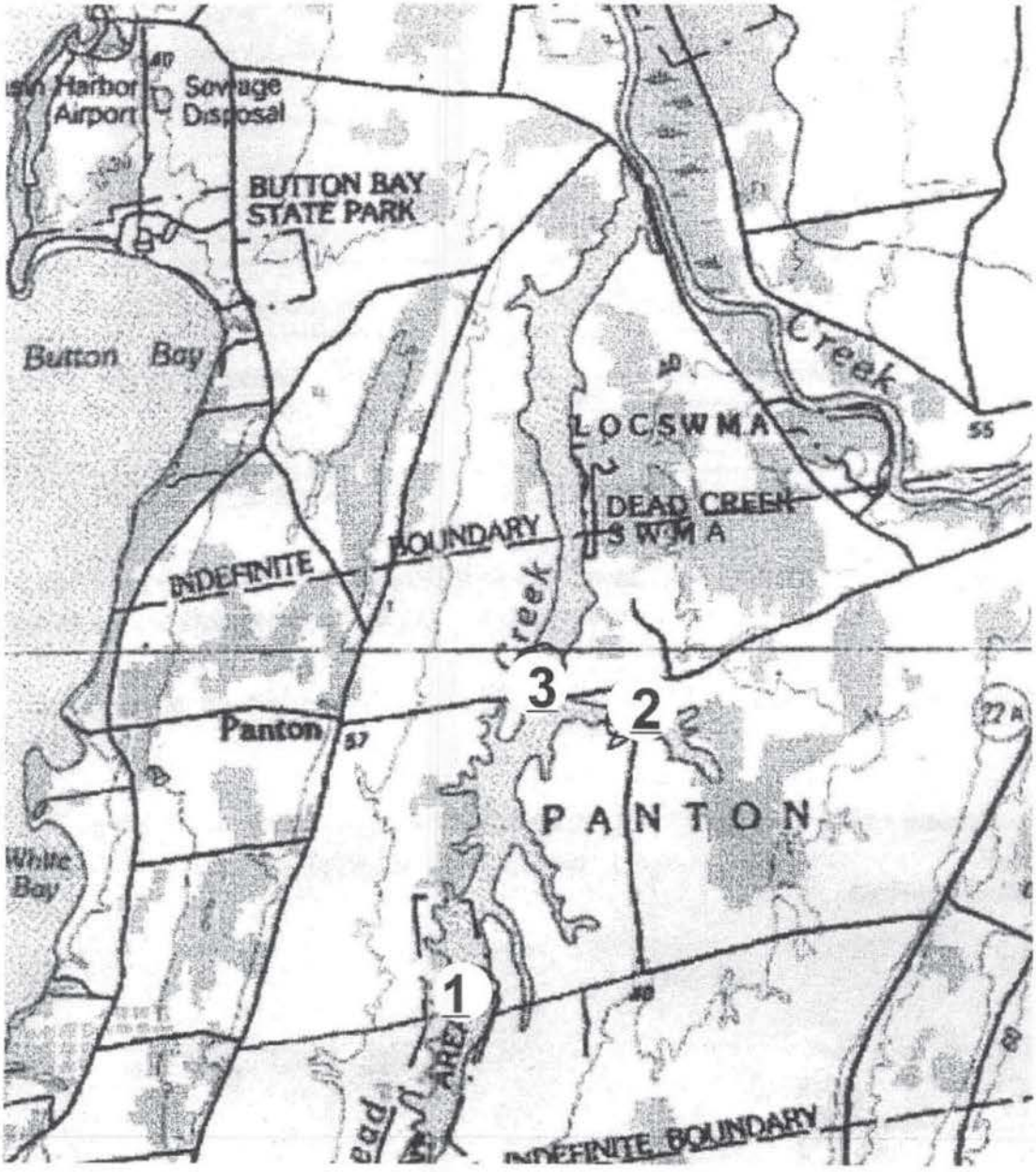

FIGURE 12. RELATIONSHIP BETWEEN LAKE LEVEL AND TERN NUMBERS, 1990-2002

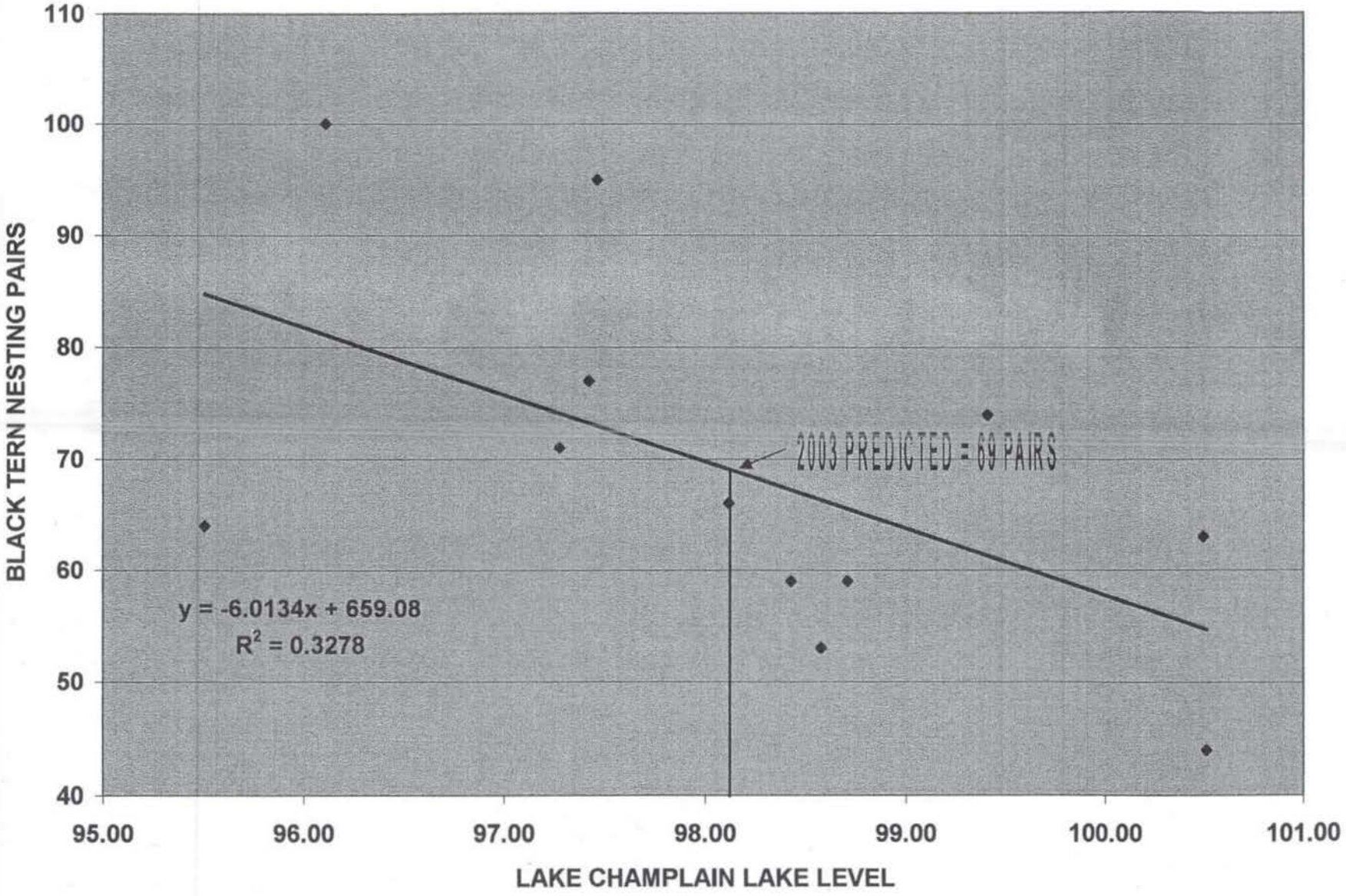

FIGURE 13. CRANBERRY POOL NESTING PATTERN

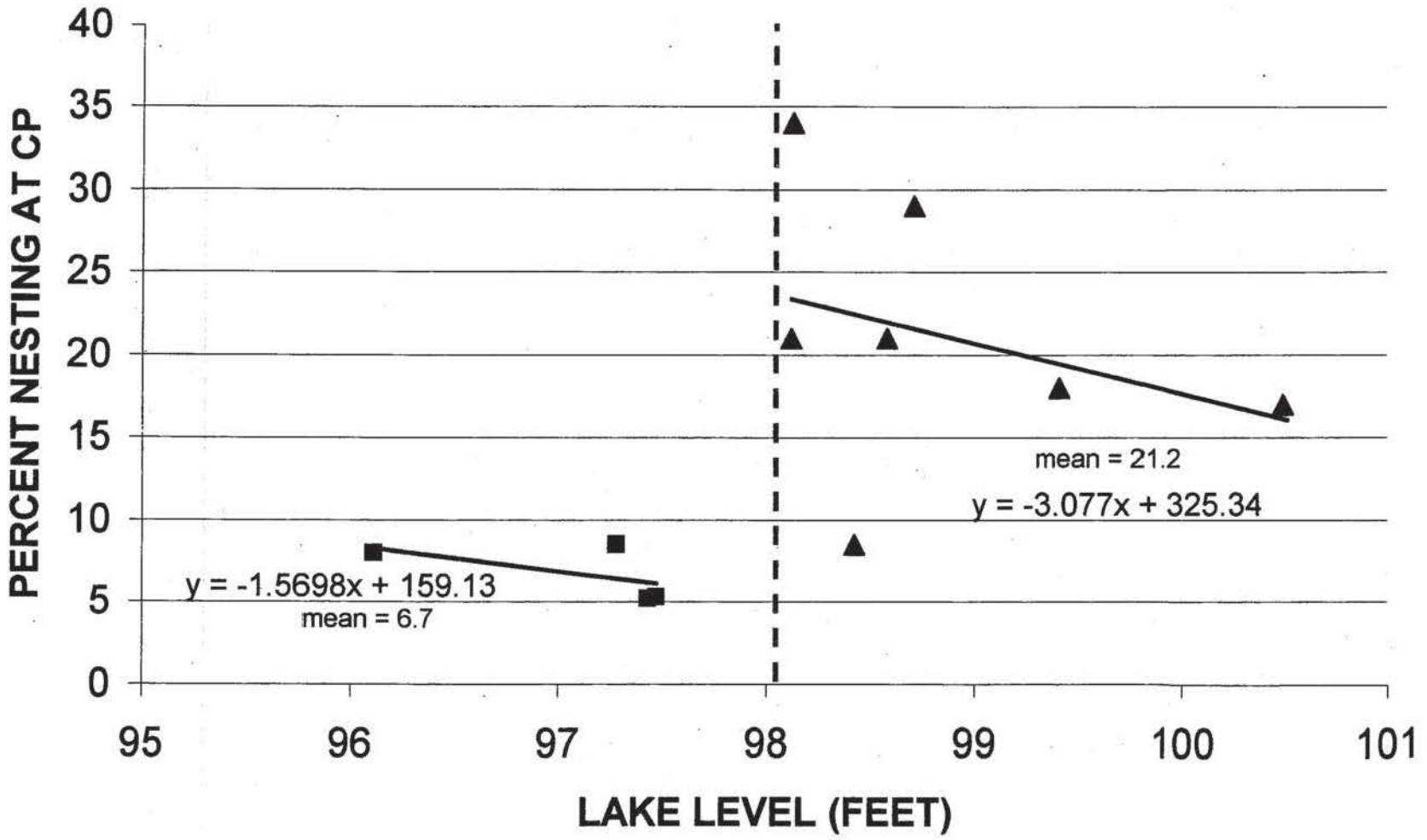

FIGURE 14. CHARCOAL CREEK SOUTH NESTING PATTERN

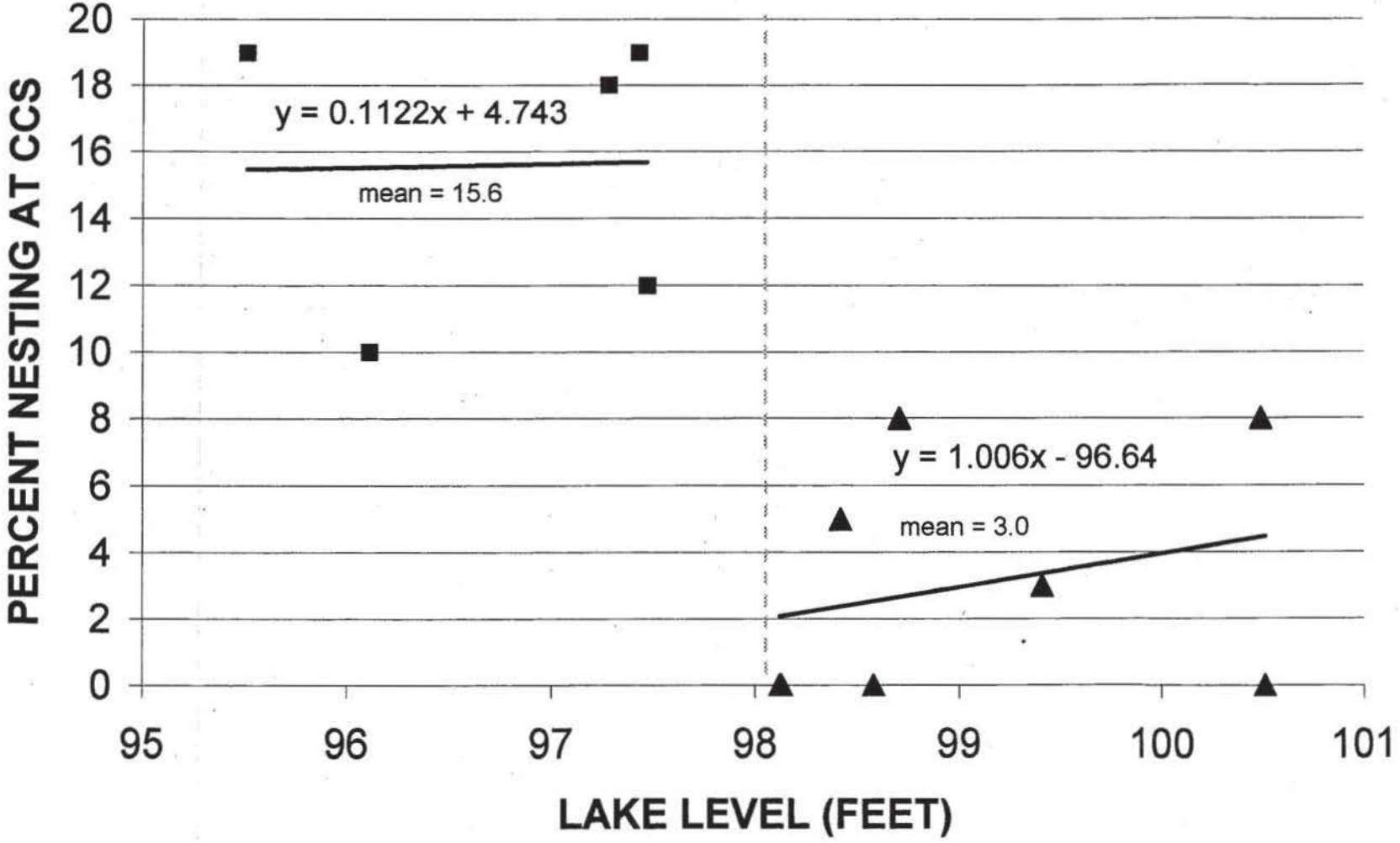

TABLE 1. VERMONT BLACK TERN POPULATION DATA, 1990-2003.

COLONY (POPULATION)	NUMBER OF BREEDING PAIRS													
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Charcoal Creek N. (Missisquoi)	15	24	22	15*	31	14	10	17	21	24	22	26	35	31
Charcoal Creek S. (Missisquoi)	5	13	11	2*	2	12	0	3	15	10	5	0	0	0
Cranberry Pool (Missisquoi)	17	6	5	5	13	0	0	5	4	8	11	11	14	23
Big Marsh (Missisquoi)	**	0	0	15	1*	**	16	17	19	33	10	0	1	0
Goose Bay (Missisquoi)	**	**	13	6	1*	7	0	0	0	10	0	0	0	2
Gander Bay (Missisquoi)	0	**	0	**	**	6	**	0	0	0	0	0	0	0
Mud Creek WMA (Missisquoi)	**	7	24	20*	15*	17*	8*	5*	8*	3	5	6	1	1
First Creek (Missisquoi)	**	**	**	**	**	**	**	6	**	0	1	2	0	0
Long Marsh (Missisquoi)	**	**	0	**	**	0	**	**	5	9	9	8	15	10
South Bay WMA (Memophremagog)	4	4	4	**	2	5	3	5	3	3	0	0	0	0
Panton Road N. (Dead Creek)	1	2	1	2*	0	3	0	0	0	0	0	0	0	0
Panton Road S.(Dead Creek)	0	4	3	**	0	0	0	0	0	0	0	0	0	0
Route 17 N(Dead Creek).	6	0	0	**	5	0	3	0	0	0	0	0	0	0
Route 17 S.(Dead Creek)	5	0	0	**	2	0	0	0	0	0	0	0	0	0
West Road(Dead Creek)	0	2	4	**	0	0	0	0	0	0	0	0	0	0
Little Otter Creek(Dead Creek)	6	9	8	**	2	0	4	1	2	0	0	0	0	0
TOTAL	**59**	**71**	**95**	**	**74**	**64**	**44**	**59**	**77**	**100**	**63**	**53**	**66**	**67**
MISSISQUOI POPULATION	37	50	75	63	63	56	34	53	72	97	63	53	66	67
MEMPHREMAGOG POPULATION	4	4	4	**	2	5	3	5	3	3	0	0	0	0
DEAD CREEK POPULATION	18	17	16	**	9	3	7	1	2	0	0	0	0	0

* estimated
** unknown

TABLE 2. VERMONT WILDLIFE MANAGENT AREA MARSH BIRD SUMMARY, 1996-2003.*

SURVEY ROUTE	VIRA	COMO	LEBI	SORA	AMBI	PBGR	AMCO
(number of stations)							
BRILYEA 1996 (4)	0.75	1.5	0	1	0	0	0
BRILYEA 1997 (4)	0.75	1.5	0	0.75	0	0	0
BRILYEA 1998 (4)	0.75	0	0	0	0	0	0
BRILYEA 1999 (4)	1	0.25	0	0.5	0.25	0	0
BRILYEA 2000 (4)	0.75	0.75	0	0.25	0	0	0.25
BRILYEA 2001 (4)	1	0	0	0.25	0	0	0
BRILYEA 2002 (4)	0.75	0	0	0	0	0	0
BRILYEA 2003 (4)	0	0	0	0	0	0	0
BRILYEA MEAN	0.719	0.5	0	0.344	0.031	0	0.031
ROUTE 17 1996 (8)	1.75	0.25	0	0.125	0	0	0
ROUTE 17 1997 (8)	1	0	0	0	0	0	0
ROUTE 17 1998 (8)	1.5	0.375	0	0.5	0	0	0
ROUTE 17 1999 (8)	0.625	0	0	0	0	0	0
ROUTE 17 2000 (8)	0.75	0.125	0	0.125	0	0	0
ROUTE 17 2001 (8)	1	0.5	0	0.25	0	0	0
ROUTE 17 2002 (8)	1.125	0	0.125	0.625	0.125	0	0
ROUTE 17 2003 (8)	1.5	0	0	0.625	0	0	0
ROUTE 17 MEAN	1.156	0.156	0.016	0.281	0.016	0	0
MUD CREEK 1996 (9)	2.22	1	0.11	0	0.11	0.11	0
MUD CREEK 1997 (9)	1.56	0.67	0.11	0	0.11	0	0
MUD CREEK 1998 (9)	2.125	0.44	0.22	0	0.11	0	0
MUD CREEK 1999 (9)	1.44	0.33	0.22	0	0	0	0
MUD CREEK 2000 (9)	1.44	0.22	0.22	0	0.11	0	0
MUD CREEK 2001 (9)	0.89	0.11	0.11	0	0	0	0
MUD CREEK 2002 (8)	1.25	0.125	0.125	0	0	0	0
MUD CREEK 2003 (8)	0.5	0.125	0.25	0	0.125	0	0
MUD CREEK MEAN	1.428	0.378	0.171	0	0.071	0.014	0
SOUTH BAY 1998 (6)	0	0	0.5	0.17	0	0.5	0
SOUTH BAY 1999 (5)	0.6	0	0.4	0	0	0.8	0.4
SOUTH BAY 2000 (6)	1.17	0	0	0.17	0.17	1.67	0
SOUTH BAY 2001 (6)	0.5	0	0	0	0.17	1.33	0.33
SOUTH BAY 2002 (no data)							
SOUTH BAY 2003 (6)	0.5	0.167	0	0	0.67	1.17	0
SOUTH BAY MEAN	0.544	0.033	0.18	0.068	0.202	1.094	0.146

* Maximum number of each species detected during a single survey in a given year, divided by the number of stations within that survey.

VIRA = Virginia rail COMO = common moorhen LEBI = least bittern SORA = sora
AMBI = American bittern PBGR = pie-billed grebe AMCO = American coot

TABLE 3. MISSISQUOI NATIONAL WILDLIFE REFUGE MARSH BIRD SUMMARY 1996-2003*

SURVEY ROUTE (number of stations)	VIRA	COMO	LEBI	SORA	AMBI	PBGR	AMCO
CHARCOAL CREEK 1996 (8)	0	0	0	0	0	0	0
CHARCOAL CREEK 1997 (8)	0	0	0.125	0	0	0.125	0
CHARCOAL CREEK 1998 (7)	0.286	0.286	0	0.143	0.143	0.286	0
CHARCOAL CREEK 1999 (7)	0.14	0.125	0.125	0.375	0	0.125	0
CHARCOAL CREEK 2000 (9)	0.44	0.11	0	0.22	0.11	0	0
CHARCOAL CREEK 2001 (9)	0.55	0.375	0	0.375	0.25	0	0
CHARCOAL CREEK 2002 (8)	0	0.125	0	0	0	0.25	0
CHARCOAL CREEK 2003 (8)	0.5	0.125	0	0.25	0.125	0	0
CHARCOAL CREEK MEAN	0.24	0.143	0.031	0.17	0.078	0.098	0
GOOSE BAY 1998 (6)	0	1	0	0	0.17	0.5	0
GOOSE BAY 1999 (6)	0	0.5	0	0	0	0.667	0
GOOSE BAY 2000 (5)	0	1.6	0	0.2	0	1.6	0
GOOSE BAY 2001 (5)	1	0.2	0.2	0	0	0.2	0
GOOSE BAY 2002 (no data)							
GOOSE BAY 2003 (5)	0	1.2	0	0.2	0.4	0.2	0
GOOSE BAY MEAN	0.2	0.9	0.04	0.08	0.114	0.633	0
DEAD CREEK (MNWR) 1998 (5)	0.2	0.2	0	0	0	0	0
DEAD CREEK (MNWR) 1999 (5)	0.8	0.2	0	0	0.8	0	0
DEAD CREEK (MNWR) 2000 (5)	1.2	0.4	0	0.2	0	0.6	0
DEAD CREEK (MNWR) 2001 (5)	0.2	0	0.2	0	0	0	0
DEAD CREEK (MNWR) 2002 (4)	0.5	0.25	0	0.25	0.5	0	0
DEAD CREEK (MNWR) 2003 (4)	0	0.2	0	0	0	0	0
DEAD CREEK (MNWR) MEAN	0.483	0.208	0.033	0.075	0.217	0.1	0
LONG MARSH 1998 (6)	0	1.7	0	0.17	0	0.17	0
LONG MARSH 1999 (5)	1	0.2	0	0.4	0	0.2	0
LONG MARSH 2000 (5)	0.6	0.2	0.2	0.8	0	0.6	0
LONG MARSH 2001 (5)	0.8	0.6	0	0.2	0	0	0
LONG MARSH 2002 (5)	0	1.2	0	0.4	0	1.2	0
LONG MARSH 2003 (5)	0.6	1	0	0.2	0	0.6	0
LONG MARSH MEAN	0.5	0.817	0.033	0.362	0	0.462	0
CRANBERRY POOL 1999 (5)	1.4	0.6	0	0	0.6	0.6	0
CRANBERRY POOL 2000 (5)	0.4	0.2	0	0.2	0	0.4	0
CRANBERRY POOL 2001 (5)	0	2.2	0	0	0.2	1.2	0
CRANBERRY POOL 2002 (no data)							
CRANBERRY POOL 2003 (5)	0	2.4	0	0	0	0.6	0
CRANBERRY POOL MEAN	0.45	1.35	0	0.05	0.2	0.7	0

* Maximum number of each species detected during a single survey in a given year, divided by the number of stations within that survey.

VIRA = Virginia rail COMO = common moorhen LEBI = least bittern SORA = sora
AMBI = American bittern PBGR = pie-billed grebe AMCO = American coot

TABLE 4. VERMONT IMPORTANT BIRD AREA MARSH BIRD SUMMARY1999-2003

SURVEY ROUTE (number of stations)	VIRA	COMO	LEBI	SORA	AMBI	PBGR	AMCO
BOMOSEEN 1999 (5)	1.6	0.2	0	0	0	0	0
BOMOSEEN 2000 (5)	0.8	0.4	0	0.2	0	0	0
BOMOSEEN 2001 (5)	1.6	0.2	0.2	0.2	0	0	0
BOMOSEEN 2002 (5)	0.6	0	0	0.2	0	0	0
BOMOSEEN 2003 (5)	1.2	0.2	0	0	0	0	0
BOMOSEEN MEAN	1.16	0.2	0.04	0.12	0	0	0
SAND BAR 1999 (5)	0.4	0	0	0	0	0.2	0
SAND BAR 2000 (5)	1.2	0	0	0	0	0	0
SAND BAR 2001 (5)	0.4	0	0	0	0	0	0
SAND BAR 2002 (5)	0	0	0	0	0	0.2	0
SAND BAR 2003 (5)	0.2	0	0	0.2	0	0	0
SAND BAR MEAN	0.44	0	0	0.04	0	0.08	0
HERRICK'S COVE 1999 (7)	0.143	0	0	0.14	0.14	0	0
HERRICK'S COVE 2000 ** no data							
HERRICK'S COVE 2001 (7)	0.286	0	0	0	0	0	0
HERRICK'S COVE 2002 (7)	0.143	0	0	0	0	0	0
HERRICK'S COVE 2003 (7)	0	0	0	0	0.14	0	0
HERRICK'S COVE MEAN	0.14	0	0	0.04	0.07	0	0
LITTLE OTTER CREEK 1999 (7)	0.86	1.57	0.14	0.14	0	0.714	0
LITTLE OTTER CREEK 2000 (7)	0.29	0.86	0	0	0	0.57	0
LITTLE OTTER CREEK 2001 (7)	0.29	1.86	0	0.14	0	0.43	0
LITTLE OTTER CREEK 2002 (7)	0.43	2	0.14	0.43	0.14	0.71	0.57
LITTLE OTTER CREEK 2003 (7)	0.29	2.43	0.43	0	0.14	0.43	0
LITTLE OTTER CREEK MEAN	0.43	1.74	0.14	0.14	0.06	0.57	0.11
BERLIN POND 1999 (3)	1.33	0	0	0	0	0	0.333
BERLIN POND 2000 (3)	1.67	0	0	0	0.33	0	0
BERLIN POND 2001 (3)	1	0	0	0	0.67	0	0
BERLIN POND 2002 (3)	0.33	0	0.33	0	0.33	0	0
BERLIN POND 2003 (no data)							
BERLIN POND MEAN	1.08	0	0.08	0	0.33	0	0.08
W. RUTLAND MARSH 2001 (5)	0.6	0	0	0	0	0	0
W. RUTLAND MARSH 2002 (5)	0.8	0	0	0	0	0	0
W. RUTLAND MARSH 2003 (5)	0.6	0	0	0	0	0	0
W. RUTLAND MARSH MEAN	0.67	0	0	0	0	0	0
PANTON ROAD 2002 (3)	0.67	0	0	0	0	0	0
PANTON ROAD 2003 (3)	0.67	0	0	0.33	0.33	0	0
PANTON ROAD MEAN	0.67	0	0	0.17	0.17	0	0

* Maximum number of each species detected during a single survey in a given year, divided by the number of stations within that survey.

VIRA = Virginia rail COMO = common moorhen LEBI = least bittern SORA = sora
AMBI = American bittern PBGR = pie-billed grebe AMCO = American coot

TABLE 5. MARSHBIRD TRENDS AT DEAD CREEK WMA AND MUD CREEK WMA, 1996-2003

YEAR	VIRA	COMO	LEBI	SORA	AMBI	PBGR
1996	37*	17	1	5	1	1
1997	25	12	1	3	1	0
1998	34	7	2	4	1	0
1999	22	4	2	2	1	0
2000	22	6	2	2	1	0
2001	20	5	1	3	0	0
2002	22	1	2	5	1	0
2003	16	1	2	5	1	0
MEAN	24.8	6.6	1.6	3.6	0.9	0.1

* Sum of the maximum individuals counted during a single survey from the three routes: Route 17, Brilyea, and Mud Creek.

VIRA = Virginia rail COMO = common moorhen LEBI = least bittern SORA = sora
AMBI = American bittern PBGR = pie-billed grebe AMCO = American coot

TABLE 6. MEAN NUMBER OF MARSHBIRDS PER STATION, BY MARSH 1996-2003.

MARSH (years of data)	VIRA	COMO	LEBI	SORA	AMBI	PBGR
BRILYEA (8)	**0.71**	**0.50**	0.00	**0.34**	0.03	0.00
ROUTE 17 (8)	**1.16**	0.16	0.02	**0.28**	0.02	0.00
MUD CREEK (8)	**1.43**	0.38	**0.17**	0.00	0.07	0.01
CHARCOAL CREEK (8)	0.24	0.14	0.03	**0.17**	0.08	0.10
GOOSE BAY (5)	0.20	**0.90**	0.04	0.08	**0.11**	**0.63**
DEAD CREEK (6)	0.48	0.21	0.03	0.08	**0.22**	0.10
LONG MARSH (6)	0.50	**0.82**	0.03	**0.36**	0.00	**0.46**
CRANBERRY POOL (4)	0.45	**1.35**	0.00	0.05	**0.20**	**0.70**
SOUTH BAY (5)	0.55	0.03	**0.18**	0.07	**0.20**	**1.09**
BOMOSEEN (5)	**1.16**	0.20	0.04	**0.12**	0.00	0.00
SAND BAR (5)	0.44	0.00	0.00	0.04	0.00	0.08
HERRICK'S COVE (4)	0.14	0.00	0.00	0.04	0.07	0.00
LITTLE OTTER CREEK (5)	0.43	**1.74**	**0.14**	**0.14**	0.06	**0.57**
BERLIN POND (4)	**1.08**	0.00	**0.08**	0.00	**0.33**	0.00
W. RUTLAND MARSH (3)	**0.67**	0.00	0.00	0.00	0.00	0.00
PANTON ROAD (2)	**0.67**	0.00	0.00	0.17	0.17	0.00
OVERALL MEAN	**0.64**	**0.40**	**0.05**	**0.11**	**0.09**	**0.23**

* bold numbers indicate greater than average density for that species.
** highest density observed for that species.

VIRA = Virginia rail COMO = common moorhen LEBI = least bittern SORA = sora
AMBI = American bittern PBGR = pied-billed grebe