2004 BLACK TERN POPULATION SURVEY AND OTHER MARSH BIRD MONITORING ACTIVITIES IN VERMONT

December 29, 2004

Submitted to:
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

TABLE OF CONTENTS

ABSTRACT

2004 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 2004. The black tern nesting population has held steady at about 65 pairs for the past five years, with 66 pairs estimated for 2004. All black tern nesting in Vermont in 2004 was found at the north end of Lake Champlain within the Missisquoi National Wildlife Refuge (NWR). For the first time since this study was initiated in 1990, no black terns nested anywhere in Vermont except within the Missisquoi National Wildlife Refuge in Swanton. With nesting confined to such a restricted area, the possibility exists for the first time, that this species could be extirpated from the state. Artificial nest platforms and perches of various designs were erected within Mud Creek Wildlife Management Area in an effort to entice black terns to nest, with no success.

Monitoring 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 also continued in 2004. Fourteen marsh bird routes situated in emergent marshes within state Wildlife Management Areas, Missisquoi NWR, or in marshes designated as "Important Bird Areas" were surveyed by volunteers. 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 management 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, David Sausville, also of VDFW, for getting the nest platform and perch materials, 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) and helping to coordinate the marshbird volunteers . 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 David 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 2004.

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 may or may not 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 2004 the entire Vermont black tern breeding population continued to be concentrated in the northern part of the Champlain Valley with all nesting in the Missisquoi National Wildlife Refuge in Swanton, VT. The Vermont breeding range of this species has gradually constricted since about 1996, when nesting still occurred at Little Otter Creek in Ferrisburg, Dead Creek WMA in Addison, and South Bay WMA in Coventry. As recently as 1998, black terns nested in eight different, discrete nesting colonies, in 2004 there were only four colonies. 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 environmental 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, in cooperation with Audubon Vermont, volunteer marshbird surveys of selected marshes in Vermont in 2004. 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 and are of conservation concern 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 2004 (see Figures 1-4 for site locations). Of the routes created after 1996, twelve were surveyed during the summer of 2004. 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), Panton Rd. (2002) in Panton, VT (Figure 11), and Berlin Pond (1999) in Berlin, VT (Figure 12). Unfortunately, the Berlin Pond and Bomoseen routes were only surveyed once so they have been excluded from the following analyses.

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. Each route was surveyed twice at least ten days apart during the month of June. 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. The American coot, while quite rare in Vermont, will at times respond to the tape, and are reported periodically by surveyors.

RESULTS AND DISCUSSION

BLACK TERN CENSUS

Based on the results of the 2004 black tern census, it is estimated that there were 66 black tern pairs nesting in Vermont in 2004 (see Table 1). Unfortunately, the area in Vermont where black terns nest continues to become more restricted each year. The only documented nesting in 2004 was within the Missisquoi National Wildlife Refuge at the northern end of Lake Champlain. No terns were found nesting in the southern half of Lake Champlain or on Lake Memphremagog or even within the Mud Creek Wildlife Management Area (WMA) near the Missisquoi NWR. Mud Creek Wildlife Management Area in Alburg was, as recently as 1995, one of the major nesting areas in Vermont for this species. The Missisquoi NWR is, fortunately, 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 2004 at Long Marsh, Cranberry Pool, and Charcoal Creek North.

Sporadic sightings of black terns in the area of Dead Creek WMA were reported in late May, so it is possible that very limited nesting occurred there in 2004. No black terns were seen during June though, so it is unlikely. The breeding range of this species has gradually constricted since about 1996, when nesting still occurred at Little Otter Creek in Ferrisburg, Dead Creek WMA in Addison, and South Bay WMA in Coventry. As recently as 1998, black terns nested in eight different, discrete nesting colonies, in 2004 there were only four such colonies. Hopefully most of this is normal fluctuations, but it is a major source of concern for the future of this species in Vermont.

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. Black terns build their nests at water level in emergent marshes, so nest site availability is very dependant on both water levels and vegetation growth. It seems that Lake Champlain water level variability from year to year may influence how many black terns nest in the Champlain valley, and which marshes they choose to nest in. In order to explore this relationship, a review of Lake Champlain lake levels was undertaken. Black terns generally start egg laying in very late May or early June, so any water level effect on nest site availability should be occurring during the several weeks before that. Therefore, 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 (see Figure 13). Figure 13 illustrates an apparent negative relationship between lake level during the second half of May and the number of terns nesting in Vermont. The higher the Lake Champlain lake level in late May, the fewer black terns we are likely to have nesting in Vermont. The mean Lake Champlain lake level for the second half of May in 2004 was 97.33 feet. Based on this predictor, the number of black tern nesting pairs should have been about 74 pairs in 2004. Since the actual number was 66 pairs, this predictor overestimated the true number of nesting pairs in 2004. This

may be because the lake level was somewhat unusual in 2004 in that it reached a minimum on May 23 and then rose almost a foot to a peak on June 4. Therefore the water level in mid to late May was not representative of the water level in early June when nesting was underway. Another possibility is that the lake level vs. nesting pair relationship no longer holds true, because nesting is so restricted. For the past three years the number of nesting black terns has been very consistent, both within individual marshes and in Vermont as a whole.

Numerous researchers (Seyler, 1991, Hickey and Malecki 1997, Shambaugh and Parren 1997, and others) have investigated the relationship between nest site selection and the surrounding habitat and nest substrate. In general, black terns seem to prefer to nest on exposed mud or floating debris in sparse vegetation, in bur-reed or bulrush rather than cattail if possible, in areas near open water, where the water is less than about one meter deep,. What has never been investigated, to my knowledge, is how the timing of appearance of nest substrate effects nest colony selection. The optimal nesting habitat for black terns appears in a given colony when water depth and/or vegetation growth changes enable nest substrate to appear with moderate density emergent vegetation around it. The window of availability for black terns to nest successfully in Vermont is about mid-May through mid July. If young have not hatched by mid-July, then they are not likely to fledge successfully. Therefore, if suitable nesting habitat is not available between about mid-May and mid-June in a given marsh, then black terns will probably not nest there (successfully).

In previous years reports (Shambaugh 2002, 2003) it had been hypothesized that black terns tended to nest in different marshes depending on water levels. The most prominent of these hypotheses were that terns nested preferentially at Charcoal Creek South in low water years and Cranberry pool in high water years. 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 the slope of the bottom in this wetland 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 by June 1st which marshes are likely to be used by black terns that year because the water level and vegetation conditions are suitable 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. Unfortunately, this relationship did not hold up in 2004. The water levels were low enough in 2004 that terns should have found suitable nesting substrate at Charcoal Creek South and nested there instead of concentrating in Cranberry pool, but there was no nesting at Charcoal Creek South and a large concentration at Cranberry Pool.

These hypothesized relationships indicate that a major limiting factor for the successful nesting of this species in a particular marsh and possibly in Vermont as a whole, may be 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 (Stern et al. 1985), 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 or will leave the state. 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: I can't drain anyway if the Lake is high –

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 Cranberry Pool, Charcoal Creek South, and Charcoal Creek North prior to the nesting season. Before nesting starts there are often few places for adults to perch because these marshes are mostly open water. The more loafing perches available, the more likely adults will stay until nesting conditions are right. Downed trees with many branches and landing spots are very attractive to fledgelings as communal loafing areas. Logs of this type are found within Missisquoi Bay and used *extensively* by adult and fledgeling black terns. A downed tree was dragged out into Cranberry Pool by the refuge staff in the winter of 2003-2004 which should supply perch sites for adults and fledgelings for several years. It was not used extensively in 2004, probably because it still had a large amount of foliage which terns avoid. Another tree put in a different part of the marsh might be useful as well.

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. Various designs of biodegradable nest platforms have been tried over the past several years at Cranberry Pool and Mud Creek. The primary aim has been to see how well the different designs survive the nesting season, but also to see if they would be used by terns. None of the recent experiments have been used for nesting, but some designs appear to show promise. The critical factors appear to be the ability of the platform to survive waves, changes in water level, be large enough to support a nest, and stable enough that nest substrate can be put on top and have it stay there. 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). Incorporating such debris into the nest platform and having it remain long enough to be used is critical.

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 (about five feet) 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 in the open pool. This shouldn't effect the cattail mat surrounding the open pool because it is largely floating and not rooted. The vegetation around the periphery of the marsh might be effected by a lowering of the water level in that the ground would dry out, but if the marsh were re-flooded later in the summer (after about July 15) then this might be limited.

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) Create/improve nesting substrate or supplement it with artificial platforms, as in Cranberry Pool #4. This should be especially useful if #1 above is undertaken and leads to a proliferation of emergent growth within the open water area of the impoundment early in the season.

MARSH BIRD SURVEYS

Sixteen marsh bird routes were surveyed in 2004, but unfortunately two routes (Berlin Pond, and Lake Bomoseen) were only surveyed once so that data is not included in the following discussion. Data from a total of 81 stations are included in this year's results. 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, and Cranberry Pool there is an inverse 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.

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 on a given day, 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'. The only other marsh which was surveyed prior to 1998, Charcoal Creek, actually had no Virginia rail or common moorhen in 1996 or 1997 (see Table 3), perhaps they all moved to Mud Creek after the cookie cutter? 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 2004 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 and least bittern, but no sora have been detected there during any surveys. On the other hand, it is clear that some marshes 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.

CONCLUSIONS

For the fourth year in a row, the entire Vermont black tern nesting population was concentrated at the north end of Lake Champlain, now restricted only to Missisquoi NWR. The 2004 estimated breeding population of 66 pairs has been essentially unchanged for the past five years. It may be that the recent restriction in nesting colonies has eliminated the ability for this species to select nesting sites based

on water level fluctuations. If this is the case, the relationships discussed earlier no longer apply. Because of the restricted nesting area and number of terns, the marsh at Charcoal Creek North takes on an ever greater importance. This marsh seems to be the only site in Vermont which has suitable nesting habitat under most water level conditions. Any alteration of this marsh, as proposed as part of the Route 78 reconstruction, must be undertaken with extreme care.

The impoundments at Mud Creek and Cranberry Pool also 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, and ability to manage the vegetation if appropriate. 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. Again, it appears extremely important that Cranberry Pool not be drained during high water years because it may be the only area with suitable nest substrate.

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

Cranberry Pool: -hold at 98ft

1) Drop water level to desired level by late May and do whatever 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.

LITERATURE CITED

Hickey, J.M., and R.A. Malecki. 1997. Nest site selection of the black tern in western New York. Colonial Waterbirds 20:582-595.

McCracken, J.D., A. Chabot, N. Hefferty, and R. Ridout. 1995. Marsh Monitoring Program, 1994 final report. Long Point Bird Observatory. Port Rowan, ON. 45pp.

Seyler, D.A. 1991. The status of the 1991 nesting population of black terns (***Chlidonias niger***) at the Tonawanda Wildlife Management Area. Unpubl. Report to New York Dept. of Environmental Conservation. 39pp.

Shambaugh, N. 1994. An investigation of black tern (***Chlidonias niger***) reproductive success in Vermont, 1993. Unpubl. report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 16pp.

Shambaugh, N. 1994. Black tern (***Chlidonias niger***) population levels and nest site selection in Vermont, 1994. Unpubl. report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 24pp.

Shambaugh, N. 1995. Black tern and other marsh bird research activities in Vermont: 1995. Unpubl. report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 22pp.

Shambaugh, N. 1998. 1997 Marsh bird monitoring activities in Vermont. Unpubl. Report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 18pp.

Shambaugh, N. 1999. 1998 Marsh bird monitoring activities in Vermont. Unpubl. Report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 17pp.

Shambaugh, N. and S. Parren. 1997. 1996 marsh bird monitoring activities in Vermont. Unpubl. report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 23pp.

Shambaugh, N. 2002. 2001 black tern population survey and other marsh bird monitoring activities in Vermont. Unpubl. report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 37pp.

Shambaugh, N. 2003. 2002 black tern population survey and other marsh bird monitoring activities in Vermont. Unpubl. report to Vermont Dept. of Fish and Wildlife. Waterbury, VT. 37pp.

Stern, M.A., R.L. Jarvis, and R. Del Caro. 1985. Mate fidelity, site tenacity, and sex dimorphic traits in black terns. Colonial Waterbirds Group Newsletter 9:52.

Weller, M.W. and C.S. Spatcher. 1965. Role of habitat in the distribution and abundance of marsh birds. Special report no. 43. Iowa State Univ. Agricultural and Home Economics Experiment Station. Ames, IA. 30pp.