

**MONITORING BLACK TERN POPULATIONS IN MINNESOTA
IN ASSOCIATION WITH THE
USFWS WATERFOWL PRODUCTION SURVEY**

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In 1990, attempts were made by the U.S. Fish and Wildlife Service (USFWS) to incorporate several nongame species, including black terns (*Chlidonias niger*), into their annual waterfowl breeding pair count. The report that was generated from this initial attempt was reviewed by USFWS and Minnesota DNR personnel, and several problems with using the waterfowl count to census nongame wetland birds were identified. Two of the major concerns with the waterfowl count were the phenology of black tern breeding biology in Minnesota, and standardization of census methodology. The 1991 study was conducted to evaluate the use of the USFWS waterfowl breeding pair counts as a viable annual index for black tern populations in Minnesota. The objectives of this study were to (1) address the interpretation of black tern observations made during the count periods by the USFWS and myself, (2) indicate whether surveys should be conducted at alternate times during the breeding season to make the black tern count meaningful, and (3) standardize and/or improve censusing methodology.

Four-square-mile study plots selected by the USFWS were surveyed in Polk and Kandiyohi counties, where black terns were counted in 1990. The first waterfowl count was conducted on 14 and 15 May, and the second count was conducted on 21-22, and 30 May. I returned to the study areas on two more occasions during the breeding season to determine breeding activity, colony locations, and tern populations. Census results from this study were compared to results from 1990.

Black terns were not seen on USFWS plots in Polk and Kandiyohi counties during the first census, but were observed flying over some of the ponds in the study plots during the second census. These individuals were not engaged in courtship or nesting activities. No black terns nested on any of the ponds included in the waterfowl census in Polk, Kandiyohi, Kittson, or Roseau counties in 1991. Two colonies of black terns were found in locations within two miles of one of the USFWS study plots in Polk County, and black terns nested in a wetland several miles from a study plot in Kandiyohi County. Black terns in these colonies were incubating eggs in mid-June, and chicks fledged by mid-July. Colonies were located in semipermanent wetlands (Class IV), with cover type 2 (open water covering 5-95 %, with dense patches or diffuse open stands of emergent cover). Terns in both areas nested in shallow wetlands characterized with patches of sedges.

Problems associated with the USFWS waterfowl count for censusing black terns included sampling design and timing of the survey. Plots for the waterfowl counts were selected for estimating duck populations in the prairie pothole region of Minnesota, and miss many actual and potential black tern nesting sites. In addition, the timing of the waterfowl count is too early to determine whether black terns are nesting on selected study plots. Although black terns were observed during the second count in late-May and early-June, they were foraging, and not displaying any courtship behaviors. Because the terns did not remain on the wetlands within study plots in Polk and Kandiyohi counties, I advised against using these results to make management recommendations, habitat evaluations, or population estimates for black terns based on the USFWS waterfowl breeding pair counts. A census in mid- to late-June would be more appropriate for monitoring breeding black terns.

INTRODUCTION

The black tern (*Chlidonias niger*) is a nongame migratory species that breeds throughout southern Canada and the northern United States. Population trends of the black tern have been declining over their entire range within the U. S. (Hands et. al 1989). Data supporting these trends have been provided primarily through the annual Breeding Bird Survey, conducted by the U. S. Fish and Wildlife Service. However, the Breeding Bird Survey is not an adequate sampling tool for many wetland bird species (Hands et. al 1989). A few states in the northcentral region of the U.S. have conducted more extensive black tern surveys that further substantiate declining populations (Tilghman 1980, Mossman 1980, 1981, 1982, Rabenold 1986, 1987, 1988). To date, Minnesota has not conducted a statewide survey of black tern breeding populations.

In 1990, attempts were made by the U. S. Fish and Wildlife Service (USFWS) to incorporate several nongame species into their annual waterfowl breeding pair count. It was thought that by including additional wetland species in the count, population indices could be established for species that have shown evidence of declining populations in recent years. Included in Minnesota's 1990 count were black terns, American bitterns (*Botaurus lentiginosus*) and least bitterns (*Ixobrychus exilis*). The American bittern is listed as a species of special concern in Minnesota, and little is known about black tern and least bittern populations within the state (Coffin and Pfannmuller 1988). The report that was generated from this initial attempt was reviewed by USFWS and Minnesota Department of Natural Resources (DNR) personnel, and several problems with using the waterfowl count to census nongame wetland birds were identified. Two of the major concerns with the waterfowl count were the phenology of black tern breeding biology in Minnesota, and standardization of census methodology. I address these concerns and give recommendations for developing a meaningful index for black tern populations in this report.

This study was conducted to evaluate the use of the USFWS waterfowl breeding pair count as a viable annual index for black tern populations in Minnesota. The objectives of this study were to (1) address the interpretation of black tern observations made during the count periods by the USFWS and myself, (2) indicate whether surveys should be conducted at alternate times during the breeding season to make the black tern count meaningful, and (3) standardize and/or improve censusing methodology.

STUDY AREAS

Study areas were chosen using two criteria; the presence of black terns on wetlands surveyed in the 1990 waterfowl count, and black tern habitat representative of northwestern Minnesota. Initially, I planned to conduct part or all of this work in the three northwestern counties (Kittson, Marshall and Roseau) that were to be surveyed for the Minnesota County Biological Survey in 1991. However, because the USFWS was still in the process of developing study plots for the waterfowl count in these counties, and to avoid duplication of other work, I did not to survey these areas. Study plots were selected in Polk County (Figure 1) to represent northwestern wetlands, and plots were selected Kandiyohi County (Figure 2) because of the large number of black terns counted there in 1990.

The USFWS established three 4-square-mile plots in Polk County for their waterfowl counts. Two of these plots (525 and 283) did not have suitable wetlands for black terns, and none were counted there in 1990. However, Plot 213 had several wetlands that were potential breeding habitat for black terns (Figure 3). Black terns were counted on five of the 22 wetlands censused on Plot 213 in 1990. Both 4-square-mile plots established in Kandiyohi County had black terns present in 1990, with 300 terns counted over one wetland (Lake Florida Slough, Pond 5) (Figures 4 and 5). After consulting with other field biologists, I also surveyed sites close to the plots in Polk and Kandiyohi Counties, and Winger Waterfowl Production Area in Mahnommen County (Larry Hanson, Steve Maxson, pers. comm.).

METHODS

Development of methodology. I consulted with Phil Arnold and other biologists at the Fergus Falls USFWS Habitat and Population Evaluation Team in early April 1991. Field methods used for the waterfowl count, maps, and aerial photographs of study plots areas were analyzed at this time. In addition, processes used by the USFWS to establish study plot for their waterfowl counts were reviewed. Later in April, I met with Minnesota DNR personnel to review the selection of study areas, and to coordinate with workers censusing black terns for the Minnesota County Biological Survey.



Figure 3. Plot # 213, Polk County.

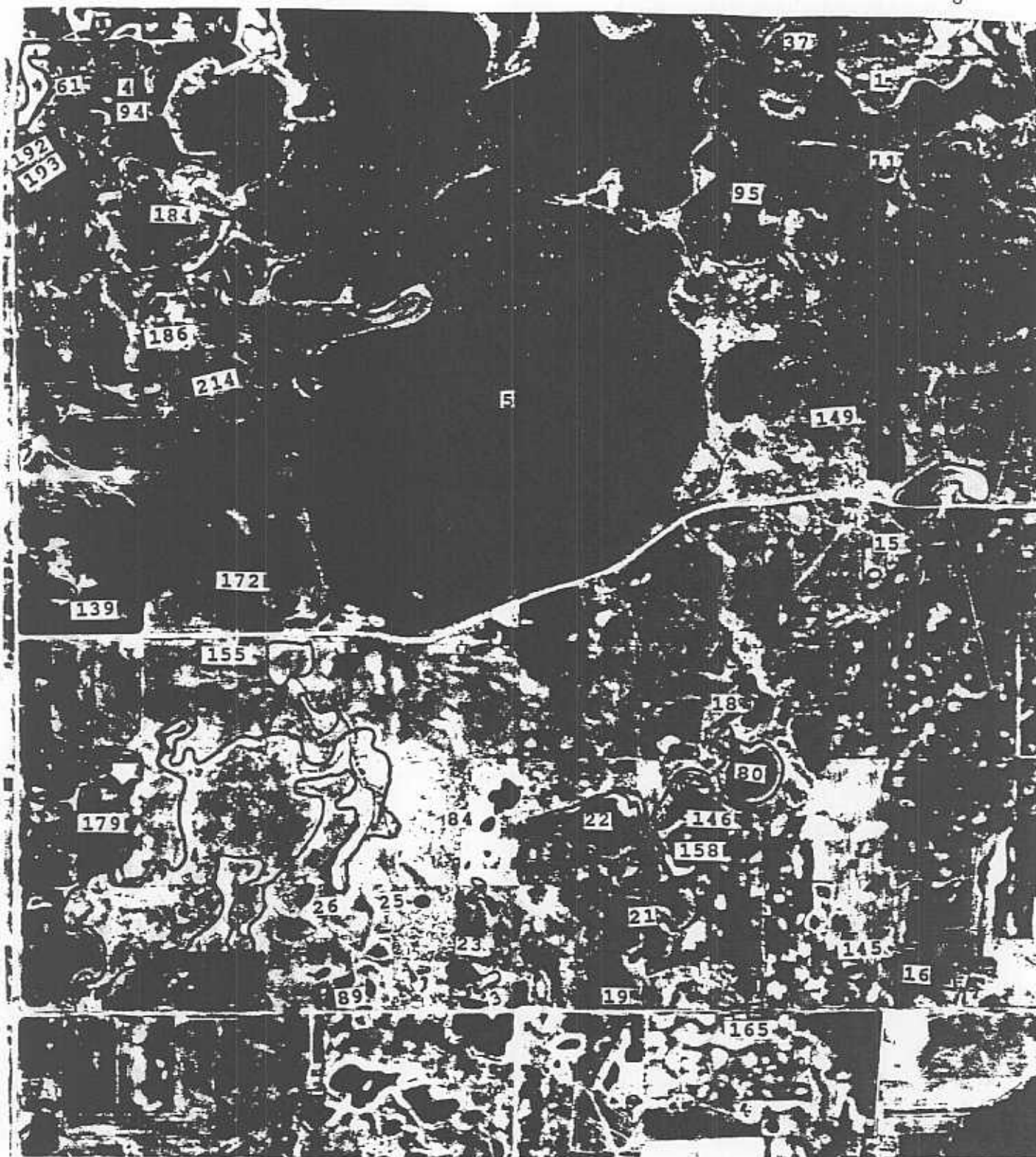


Figure 4. Plot # 309, Kandiyohi County.

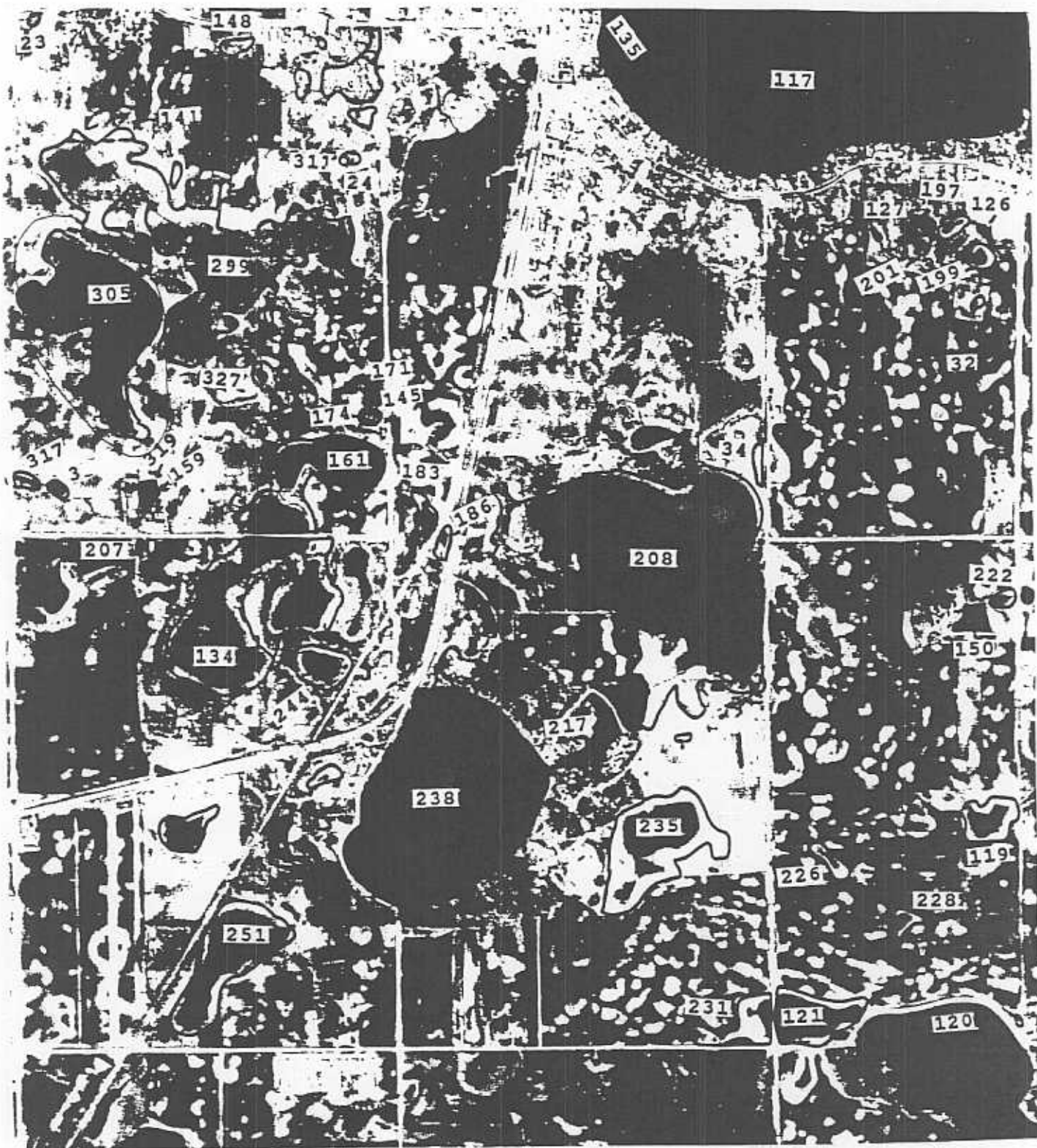


Figure 5. Plot # 288, Kandiyohi County.

USFWS waterfowl counts. I participated in the first and second USFWS waterfowl counts in Polk County. Techniques used during the counts were observed, and I assessed the applicability of these techniques for censusing black terns during this period. The timing of the two waterfowl counts were dependent on the availability of personnel, weather conditions, and the number of wetlands each district was responsible for censusing. The first count is supposed to take place between 1 May and 15 May, and the second count between 20 May and 5 June. Because of a combination of unseasonably cold weather, and the fact Polk County is the last area surveyed by Detroit Lakes Wetland District personnel, the first count was conducted on 14 May. The first survey in Kandiyohi County was also delayed due to poor weather conditions and the lack of available personnel (Steve Erickson, pers. comm.). Because of problems coordinating schedules with Litchfield Wetland District personnel, I conducted counts of black terns myself on 21 and 22 May. I did contact the Litchfield personnel beforehand to ensure that I conducted my surveys from the same sites, used the same censusing techniques, and I timed my count within 1-2 days of their surveys. The second waterfowl count was conducted in Polk County on 30 May. Again, I surveyed Kandiyohi County myself on 1 and 2 June.

Waterfowl counts were conducted by three people in Polk County (two USFWS biologists and myself), and one person in Kandiyohi County (a USFWS biologist). In Polk County, all of the ponds were surveyed by the walk - wade method (Appendix A), except for one large pond (Pond 256, Figure 3) which was surveyed by canoe. All of the wetlands in Kandiyohi County were surveyed by the walk - wade method, including Lake Florida Slough (Figure 5). The amount of time spent surveying each individual wetland depended on the distance of the plot from the wetland district office, the time required to walk or drive to each pond, the number of personnel, and the size of the wetland. Personnel conducting the surveys varied from experienced to first-time surveyors.

Black tern breeding surveys. I returned to the study areas on two more occasions during the breeding season to determine breeding activity, colony locations, and tern populations. On the third visit, I canoed all of the wetlands where I observed black tern activity to determine whether the terns were nesting there. I visited USFWS plots in Kandiyohi County on 16 June, but did not observe breeding activity on any of the ponds. Due to the absence of black terns on the USFWS

plots, I traveled to adjacent wetlands and searched for evidence of black tern nesting activity. Wetlands where terns were observed were surveyed by canoe. When Polk County study plots were censused on 26-28 June, no black terns were nesting there. I surveyed adjacent wetlands, including several Waterfowl Production Areas in Mahanomen County. The final visit to Polk and Kandiyohi counties took place between 25 and 29 July. All of the USFWS plots were visited, as well as any other sites where black terns were previously located.

Census results from this study and the USFWS waterfowl census were compared to the results reported in 1990. In addition, I consulted with other biologists working on black terns in the Midwest about nesting phenology, censusing techniques, and the status of black terns in other areas. This information was used to interpret the results reported in the 1990 waterfowl pair count and to develop recommendations for future research and censusing techniques.

RESULTS AND DISCUSSION

Black tern breeding phenology. Black terns were not seen on USFWS 4-square-mile plots in Polk and Kandiyohi counties during the first census period in mid-May. However, four black terns were observed in Kandiyohi County on Mary Lake Waterfowl Protection Area on 22 May (Figure 2). The terns appeared to be engaged in courtship activities, but did not display aggressive or territorial behaviors. Black terns were observed on the second waterfowl count in late-May and early-June. Black terns were seen flying over wetlands on Plot 213 in Polk County. Two of these wetlands were not included in the waterfowl count sample ponds. Terns were observed foraging over a third wetland between counts, so they were not recorded. Observations of these terns indicated that the same four to five individuals were flying over these wetlands to forage. There was no indication of courtship or aggressive behavior in these individuals. Black terns did not nest on the any wetlands within the USFWS plots in Polk and Kandiyohi Counties in 1991.

Polk County: On 26 June, a colony of 10 pairs of black terns was located on a wetland within a State Wildlife Management Area one mile east of Plot 213 in Polk County (Figure 1). The terns in this colony were quite aggressive in defending their nests. The nests in this wetland contained both eggs and small chicks. A colony of approximately 15 pairs of black terns was located in the

Houland State Wildlife Management Area two miles southwest of Plot 213 (Figure 1). I was unable to check all of the nests at this wetland, but three of the nests contained eggs. Since black tern eggs are usually incubated for approximately 21 days, nesting was probably initiated during the first week in June (Cuthbert 1954, Goodwin 1960, Bailey 1977, Hands et. al 1989). Given the proximity of both colonies to Plot 213, it is possible that individuals associated with these colonies were the terns observed foraging in late May.

Black terns have nested on three of the wetlands within Plot 213 (Ponds 59, 297 and 62, Figure 3) in 1985 and 1987 (Steve Maxson, pers. comm.). It is possible that vegetation characteristics and water levels of these wetlands have changed over the past four years, and the terns nested in alternate sites (Bailey 1977, Dunn 1979, Mossman 1980, Hands et. al 1989). When these ponds were checked on 28 July, no terns were observed in the area. In fact, black terns were not seen in Polk County during the entire July census. If a majority of nests hatched sometime around 28 June, it is possible that chicks fledged and left the area between the censusing periods. Black tern chicks have a rapid development of 18 to 25 days between hatching and fledging (Cuthbert 1954, Goodwin 1960, Bailey 1977, Dunn 1979). After fledging, young birds remain close to their natal wetland for several days, but then disperse and migrate (Sharon Moen and Mike Mossman, pers. comm.).

Kandiyohi County: Four pairs of black terns nested in a wetland within the Mary Lake Waterfowl Production Area (Figure 2). This wetland was easily observed from an adjacent hillside with a spotting scope. Black terns were first observed on this wetland on 22 May. On 16 June, nest building behavior and courtship were observed. None of the nests had eggs at this time. When the wetland was visited on 25 July, no terns were seen. It is possible that chicks could have fledged and left the area in during the interim between counts. Approximately five individual black terns were observed foraging on Lake Florida Slough in late May, and 16 June. A thorough search of this wetland by canoe indicated no nesting activity. However, Lake Florida Slough appeared to have high water levels in 1991, and floating emergent vegetation or mats of dead vegetation did not appear to be available for nesting substrate. Twelve black terns were observed foraging over a small pond on private property two miles southwest of Mary Lake, and 28 terns were seen flying over Church Lake, 4 1/2 miles southwest of Plot 309 (Figure 2). These wetlands were surveyed

were surveyed by canoe on 16 June. There was no evidence that terns were nesting, and they did not display territorial behaviors. Black terns were not observed in Kandiyohi County during the last week in July.

It appears that black tern nesting phenology in northwestern and central Minnesota is similar to breeding phenology in other areas in Minnesota and adjacent states. Black terns were incubating eggs in mid-June, and chicks fledged by mid-July in Roseau and Kittson Counties (Gwen Brewer, pers. comm.). The same general breeding phenology was also found in the Minnesota River Valley in 1990 and 1991 (Dulin 1990, Sharon Moen, pers. comm.). Studies conducted in Wisconsin and Michigan also indicate arrival of black terns in early- to mid-May, nest initiation from late-May through mid-June, and fledging from mid- to late-July (Cuthbert 1954, Bergman et al 1970, Bailey 1977, Mossman 1980, 1981, 1982). However, breeding phenology is variable both between years and between sites. Variables effecting the timing of breeding include weather, conditions of traditional colony sites, availability of alternate sites, and the number and timing of renesting attempts due to predation, high water levels, disturbance, or storms (Cuthbert 1956, Bergman et al 1970, Bailey 1977, Dunn 1979, Dulin 1990).

Interpretation of black tern counts made during the USFWS waterfowl counts.

There are several reasons why the USFWS Waterfowl Count is not appropriate for monitoring black tern populations in Minnesota. First, the methodology was developed specifically for estimating breeding populations of ducks in the prairie pothole region, and therefore may not be applicable for surveying other bird species (Cowardin et al. 1989, Kantrud et al 1989, Phil Arnold and Larry Hanson, pers. comm.). Four-square-mile plots were chosen by creating a grid of four-square mile blocks covering the total area of each Wetland Management District (WMD). Each block was then assigned to one of four ownership categories (National Wildlife Refuge, Waterfowl Production Area (WPA), wetland easement, private), and a sample of blocks was drawn to represent each type. Estimates of waterfowl breeding pairs and production are made for each sample plot, and the results are extrapolated to each Wetland Management District. The stratified sampling is more intense for refuges and WPAs, with refuges representing 10% and WPAs representing 5% of the plots to ensure an adequate sample size for these ownerships types, given their small representation of the total landscape. From the pool of sample plots in each WMD, a

subsample of wetlands is drawn randomly for the two waterfowl breeding surveys. Individual wetlands are selected on their likelihood of being wet during the survey period, giving more weight toward permanent and semipermanent wetlands. Another feature of the survey that may influence its utility for terns is the occurrence of portions of wetlands excluded from the survey. Because a wetland may be split by ownership boundaries, only one portion of the wetland may be included in the count (see Ponds 59 and 297, Figure 3) (Cowardin et. al 1989, Phil Arnold, pers. comm.).

Because the waterfowl count was set up to survey the prairie regions of Minnesota, some counties have no 4-square-mile plots established, and others only have two or three sampling plots. The relatively small sampling areas may miss significant black tern nesting locations altogether. For example, large colonies of black terns were located in 1991 on Lake-of-the-Woods and the Roseau River Wildlife Management Area, in Kittson and Roseau counties (Gwen Brewer, pers. comm.). Neither colony would have been included in the USFWS waterfowl count. Also, the ponds within the sample plots do not necessarily represent good black tern habitat. Most of the ponds surveyed for the waterfowl count in Polk and Kandiyohi counties were classified as cover type 3, and dominated by cattails. Although black terns have previously nested on three of the wetlands in Plot 213 in Polk County, the habitat may have become unsuitable for terns. Lake Florida Slough in Kandiyohi County appeared to be potential habitat for nesting black terns, but it appeared that substrates necessary for building nests were inundated by high water in 1991 (Table 1). It is unknown if black terns nested on Lake Florida Slough in 1990.

All black tern nesting colonies located in Polk and Kandiyohi Counties were found on semipermanent wetlands (Class IV), with cover type 2 (open water covering 5 % to 95 % of the wetland area, with dense patches or diffuse open stands of emergent cover) (Kantrud and Stewart 1971). Although exact sizes of these wetlands were unknown, I estimated from aerial photos that they were between 15 and 50 hectares in area. The vegetation around the black tern nests consisted primarily of bulrushes (*Scirpus* spp.), and nests were built on mats of dead bulrushes and cattails (*Typha* spp.). Loose colonies were located in clumps of sparse bulrushes, which were patchily distributed through the interior portion of the pond. No muskrat houses were observed on any of these wetlands. All of the nesting colonies occurred on ponds within larger wetland complexes, which afforded the terns diverse foraging habitats. Black terns were seen leaving their colonies to

Table 1. Comparison of black tern census results (second count) of the Waterfowl Production Estimate, 1990 and 1991.

	Number of Black Terns		Percent Full (Basin) ^a	
	1990	1991	1990	1991
<hr/>				
Pond #				
Polk Co.				
1	1	0	95	95
59	9	0	100	100
157	6	0	95	95
256	2	0	100	80
297	36	0	100	80
Kandiyohi Co.				
5	300	7	100	100
57	3	16	100	100
305	13	0	90	100

^a The percentage of water filling each wetland basin was estimated in the field. Percentages reported are from the second waterfowl counts (Phil Arnold, pers. comm.)

forage, but it was not determined how far these terns traveled. In general, the wetlands with black tern colonies in Polk and Kandiyohi counties were smaller in size than those in the Minnesota Valley National Wildlife Refuge. However, the vegetation characteristics of nesting sites within these wetlands were very similar. Wetlands with these physical characteristics may be under-represented in the USFWS waterfowl census plots.

The second problem with the USFWS waterfowl count is its timing. The second waterfowl count occurs early in the black tern breeding season, and counts are generally made by foot along the periphery of the wetlands. It is therefore unlikely that it can be established whether black terns are nesting in the sample ponds at the time of the second survey. It is difficult to determine which wetlands black terns will select for their nesting colonies early in the season regardless of censusing techniques (Dulin 1990). Numbers of black terns fluctuate widely during spring migration. These fluctuations may occur both temporally and spatially, which makes the standardization of sampling techniques challenging. Counts of black terns made on these wetlands were significantly different (Wilcoxon Signed Rank Test: $df = 7$, $z = -1.752$, $p = 0.079$) between 1990 and 1991 (Table 1). The most obvious difference was between the counts on Lake Florida Slough, with 300 black terns counted in 1990, and 7 counted in 1991 (Table 1). Indices of population trends are not useful unless sources of error between years can be reduced sufficiently. The large variation between counts made in 1990 and 1991 may be because the surveys were not targeted toward black terns, and the fact that black terns were not closely associated (i.e. nesting on) with these wetlands. In addition, variability in the timing of the counts each year, and in the quantity and abilities of the observers, added to the inconsistencies in the numbers of terns counted. Even if USFWS waterfowl counts included a third census in mid-June, the current methodology may not be sufficient ^{for} estimating changes in abundance of black terns in Minnesota.

Finally, the USFWS waterfowl counts should not be used to determine nesting habitat availability or preference for black terns unless terns are known to be nesting on the sample ponds. Data from the 1990 waterfowl counts indicated black tern activity on several sampled wetlands in Polk and Kandiyohi Counties. All of the black terns counted in 1990 and 1991 were observed during the second census period (20 May - 5 June). Numbers of black terns were correlated with habitat factors including wetland size, wetland class, and cover type by the USFWS as a

Table 2. Comparison of black tern habitat characteristics reported by the USFWS 1990 report and other studies. Wetland classification and cover types are from Stewart and Kantrud 1971.

1990 Waterfowl Survey		Other Studies
Wetland Size (ha)		
< 4	11.5 %	
4 - 7.7	3.2 %	
7.7 - 15.8	10.8 %	
15.8 - 23.9	6.3 %	10 % (11 - 20 ha) ^a
23.9 - 40.1	9.0 %	70 % (> 20 ha) ^a
40.1 - 81.0	2.2 %	
81.0 - 162	1.2 %	
> 162	55.9 %	
Wetland Class		
I Ephemeral	3 %	- ^b
II Temporary Pond	13 %	tr ^b
III Seasonal Pond	48 %	25 % ^b
IV Semipermanent Pond	36 %	72 % ^b
V Permanent Ponds and Lakes	-	- ^b
Cover Type		
1	0.3 %	none ^c
2	13.9 %	most ^c
3	78.9 %	some ^c
4	6.9 %	none ^c

^a (Brown and Dinsmore 1986) percentages reported represent occurrence on isolated wetlands only.

^b (Stewart and Kantrud 1984)

^c (my own observations in Minnesota, 1991)

preliminary examination of the 1990 data (USFWS 1990). Characteristics calculated for black tern habitat in the 1990 report differ significantly from characteristics reported in other studies, and from observations of black tern biologists within Minnesota (Table 2). The USFWS waterfowl count data indicate that black terns use all wetland sizes, classes, and cover types in Minnesota (Table 2). Brown and Dinsmore (1986) found that in Iowa, black terns are an area-dependent species, associated closely with hemi-marshes larger than 20 ha. Of the 30 wetlands they censused, none smaller than 5 ha had black terns, and 33 % of the wetlands 5-10.9 ha, 42 % of the wetlands 11-20 ha, and 83 % of the wetlands over 20 ha had black terns (Brown and Dinsmore 1986). Black terns were found on wetlands 5-10.9 ha in size only when these wetlands were within larger wetland complexes (Brown and Dinsmore 1986). In concurrence with the Iowa study, Stewart and Kantrud (1984) found black terns associated primarily with semipermanent wetlands in North Dakota (Table 2). My own observations indicated that black tern colonies were associated mainly with wetlands with stands of emergent cover vegetation (Table 2).

Black terns observed over wetlands during the second waterfowl count were not nesting on these wetlands. Unless it can be demonstrated that black terns are using a particular wetland for nesting, habitat characteristics should not be derived from these survey results. For example, it is possible that the record of 300 black terns observed on Lake Florida Slough during the second census in 1990 was an observation of a pre-breeding flock flight, where hundreds of terns gather and synchronize aerial glides (Cuthbert 1954, Goodwin 1960). Flock flights usually occur in the transitional phase between flocking during spring migration and the initiation of courtship behavior (Cuthbert 1954, Goodwin 1960). The timing of the waterfowl counts would be improved for black terns by adding a third count in mid-June. However, this study indicated that black terns did not use any of the wetlands located within the 4-square-mile plots in Polk and Kandiyohi counties. Preliminary analysis of the 1990 data indicated that unless it can be demonstrated that black tern colonies are located on a particular pond, it is not advisable to use results from the count to make management recommendations, habitat evaluations, or population estimates for black terns.

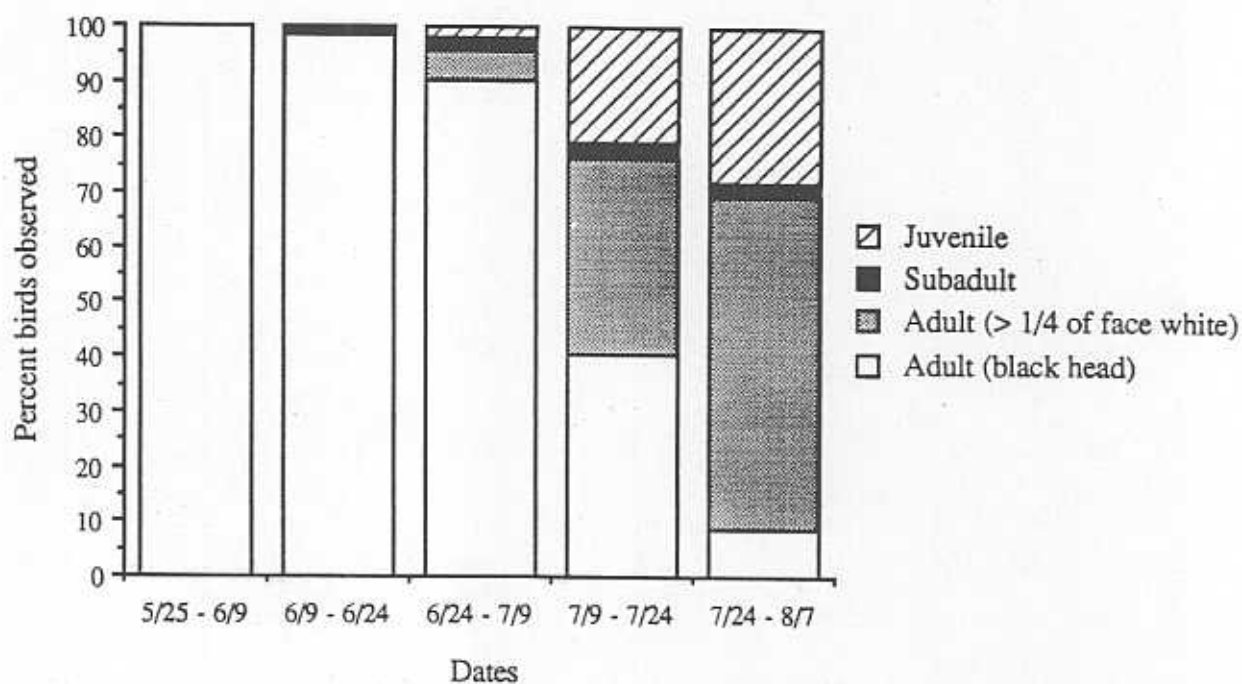
Censusing methodology for black terns in Minnesota. In the past ten years, Indiana and Wisconsin have attempted to establish standardized methods for monitoring black tern populations. Both states began by identifying historical records of black tern colonies, then

systematically censused them for black tern activity. Unfortunately, when a comprehensive survey was initiated in Indiana in 1986, viable nesting colonies were located in only two sites out of 101 historical, recent, or potential sites (Rabenold, 1986). By 1991, only one black tern colony remained in Indiana, and artificial nesting platforms have been constructed by the Indiana DNR to ameliorate the effects of fluctuating water levels (John Castrale, pers. comm.).

In contrast to Indiana, black tern habitat in Wisconsin is similar to habitat found in Minnesota, and includes Mississippi riverine habitat, prairie potholes, and abundant and diverse wetlands (Robbins 1991). Methods developed to monitor population trends of black terns in Wisconsin may be appropriate for use in Minnesota. In 1979, the Wisconsin DNR developed a comprehensive methodology for surveying black terns which consisted of a combination of two methods; a roadside transect survey (Appendix B), and more intensive surveys at several specific locations. Seventy-nine roadside transects were established in 1979, based on previous observations of black terns and proximity of the wetlands to roads, and were distributed by county (Tilghman 1980).

In 1980, 19 permanent roadside transects were selected based on the results of the previous years' census (Mossman 1980). Efforts were made to ensure that the same observer conducted the same transects each year. Each transect includes 15 stops, where 5-minute observations are made of selected wetlands. Black terns as well as other nongame bird species are counted at each stop (Mossman 1980, 1982). The statewide survey relies on the coordinated efforts of volunteers, wildlife management agencies (WI DNR, USFWS, National Park Service, etc.), and miscellaneous field biologists (university students, independent researchers, etc.) (Tilghman 1980). The Wisconsin survey was conducted over three consecutive years, which allowed for estimations of the amount and sources of error in the resulting population indices (Mike Mossman, pers. comm.). It was recommended that the 3-year black tern roadside surveys be repeated every six years, and the intensive nest surveys on four permanent study areas be conducted in the alternate 3-year period (Mossman 1982). However, continuation of black tern surveys in the future are subject to budget considerations (Mike Mossman, pers. comm.).

Censusing black terns to monitor population trends can be time consumptive. Some knowledge of black tern behavior (to determine whether terns are nesting on a particular wetland)



- Postnuptial molt of the adult may begin during breeding, with head color changing first to white.
- First-year nonbreeders are white with gray spots on the breast and belly, and a mottled head (a majority of these birds remain in the wintering areas).
- Juvenile birds are white, without ventral spotting, and have a dark ear patch. Legs of juvenile birds are lighter pink than adults (Bent 1963, National Geographic Society 1983).

Figure 6. Plumages of Wisconsin black terns observed during the summer of 1980 (n = 955) (Mossman 1980).

and morphology (to distinguish molting breeding adults from non-breeding subadults and juveniles) is necessary but easily learned (Figure 6). Minnesota has a unique opportunity for the development and implementation of a comprehensive survey. The USFWS already has personnel in the field and on Waterfowl Production Areas, the state has numerous field offices and Wildlife Management Areas, and numerous researchers are presently working on or familiar with Minnesota wetlands (Appendix C). In addition, baseline data is currently being collected by the Minnesota County Biological Survey. A roadside transect combined with several intensive surveys may also be valuable for monitoring populations of other nongame wetland birds.

Although the USFWS waterfowl count is not currently appropriate for censusing black terns, modifications could be made to improve the count to include nongame bird species. For example, sample plots could be censused a third time in mid-June where black terns were previously ^{sighted} ~~sited~~. It could be determined on the third count whether black terns are using the wetlands for nesting on sample ponds by using behavioral observations and surveys made from canoes. The use of the USFWS sample plots could be invaluable because of the enormous database available on wetland habitats. This database could be used to monitor changes in individual wetlands and wetland complexes and determine the effects of change on black tern populations and nesting biology. Results of a third count could be used in conjunction with roadside transects and intensive surveys at sample wetlands distributed throughout the state. The development of a repeatable, standardized, representative survey is necessary before black tern population trends can be sufficiently monitored in Minnesota. I believe we currently have the field personnel in the academic community, and state and federal agencies, to conduct such a survey once it is developed.

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APPENDIX A

INSTRUCTIONS FOR USE OF STANDARDIZED PAIR COUNT FIELD FORMS

PROCEDURE NOTE NO. 008

August 29, 1988

TITLE: INSTRUCTIONS FOR USE OF STANDARDIZED PAIR COUNT FIELD FORMS

ORIGINAL DATE March 25, 1988

Revision 3-15-91

PURPOSE:

These forms have been designed for obtaining data to be used in developing estimates of waterfowl production on Wetland Management Districts in Minnesota, North Dakota, South Dakota, and Montana. Breeding population estimates are essential for this purpose; data must be recorded accurately and consistently in order to be processed by computer. The techniques for counting pairs have been developed over many years and should be familiar to most wetland managers. Two important papers on estimating breeding populations appeared in the Saskatoon Wetland Seminar published in 1969. The first of these "Assessing populations of ducks by ground counts" by Alex Dzubin describes the biological basis for making and interpreting counts. The second "Notes on conducting waterfowl breeding population surveys in the north central states" by M.C. Hammond describes the methods currently in use on many Wetland Management Districts. We recommend that the user of the enclosed forms review both papers because they are the basis of many of the instructions presented here. These instructions differ from those presented by Hammond primarily because of a totally new sampling design geared to the use of predictive models.

SAMPLING UNIT

The sampling unit is an individual wetland basin. A sample of wetland basins has been drawn and wetland numbers have been assigned to each basin. This sampling system disperses the ponds to be counted and helps to avoid the problem of "roll up" which occurs on block study areas.

CONDUCTING THE COUNT

Equipment and forms: The following equipment is mandatory. We suggest that you make a check list for the vehicle:

- (1) Binoculars.
- (2) Spotting scope with window clamp or tripod.
- (3) Photographs with prenumbered sample wetlands.
- (4) 3-ring binder.
- (4) Field forms #1 yellow and #2 blue. Make sure you have adequate forms to cover the number of basins on the prenumbered photographs.
- (5) #2 pencils.

(6) Pens for marking on plastic map covers.

(7) Hip boots.

Other special and personal equipment may be useful for special cases: two way radios, canoe with paddles and life vests, insect repellent, etc.

When to make counts:

(1) First count, 1 May - 15 May.

(2) Second count, 20 May - 5 June.

(3) Counts can be made throughout the day but avoid counts before 9 A.M. and late afternoon counts on large marshes.

Weather conditions:

Avoid counts on days with strong wind or during rain.

Counting procedures:

Methods will vary depending on type of habitat, size of basin, and accessibility. Obtain permission from landowners before entering private land. Never use a vehicle on private land without the permission of the landowner. The purpose of the survey is to obtain a complete count. Use the most efficient method for the particular wetland.

(1) Walk - wade method: This method should be used whenever emergent vegetation may hide birds. Coordinate count with partner. For small ponds one observer can cover each pond. On larger ponds select landmarks and each person count one half of the pond. Pick starting and ending points to avoid duplication. See instructions for filling out forms to determine how to combine data on single form when two people count separate parts of the same pond. Move downwind with sun at back if possible. Zig-zag in heavy cover and make noise to flush birds. Cover all vegetation that is apt to conceal birds.

(2) Boat or canoe: On large lakes with open cover a boat or canoe may be necessary. If there is shoreline vegetation one person can walk the shore while the other remains in the boat.

(3) Vehicle: Can be used only from elevated shoreline or where margins are free of vegetation.

What birds to count:

The methods used are essentially those described by Hammond, but interpretation as to whether birds represent indicated breeding pairs will be done at Fergus Falls to assure consistency. Count all birds except those flying over the area. Even though final interpretation will be done later, interpretation of social groups in the field will be critical to the accuracy of the data.

(1) Always use the conventions for recording social groups that are outlined page 6 for form #1 yellow.

(2) Take your time and watch the behavior of birds long enough to interpret the groups. For example, are you observing three separate pairs (1/1, 1/1, 1/1) or a flock of three males and three females (3/3)? When translated by Hammond's method the first will be interpreted as representing three indicated breeding pairs and the second as none.

(3) Some species such as gadwalls may appear as flocks of loosely associated pairs. These birds will usually flush and fly off as a flock and should be recorded as a flock not as separate pairs.

(4) When recording information for Canada geese: record a lone bird as a lone male; a bird sitting on a nest is recorded as a lone female; any birds associated with a brood should be identified as such; a pair of birds should be recorded as 2 lone males - unless they are observed in association with a nest, then record them as a pair; any group of birds should be recorded as a flock of males.

FILLING OUT DATA FORMS

General instructions--. Write legibly with a sharp #2 pencil. All numbers must be inside the appropriate box and there can be no more than one digit per box. Blank means no data. Zero values must be filled in. Leading zeroes should not be filled in and all numbers must be right justified.

Form #1 yellow--. This form must be used for each pond where waterfowl are observed. For large wetland basins where two people count the parts of the same basin, separate forms with same pond number must be used. Immediately after the count combine the data on one form and draw a diagonal line through the duplicate form. Fill in the alphabetic code for Wetland Management District exactly as it appears on the attached list. Leave quarter section number blank. It is critical that you know the location of the pond that you are counting in the field and that you select the correct pond on the photograph because the computer will select pond data based on this code. Fill in year, month and day. Fill out all three initials for observer. This information will not be entered in the computer but will aid in correcting errors.

Select the correct basin type and cover type according to Stewart and Kantrud's pond classification. Refer to the classification card supplied with the cards if you are not familiar with their classification. For more detail on their classification refer to Classification of Natural Ponds and Lakes in the Glaciated Prairie Pothole Region. In past years, there has been confusion about wetland classes. Some cooperators are habituated to using Circular 39 where a temporary wetland is called a Type I wetland. This is not the same as a Stewart and Kantrud Class I wetland. Again, if unfamiliar with the Stewart and Kantrud classes, please review before going into the field. DO NOT use wetland types from Circular 39. This will invalidate the use of the data for ground truth information. Apply the same classification to man-made wetlands such as dugouts and impoundments and to reaches of rivers or streams that were selected in the sample. Classify riverine habitat by the deepest part of the channel within the selected reach. Estimate the percentage of the basin that is covered by water even if the water is under standing vegetation and record it on the form.

The remainder of the form is used for recording the number of birds observed. Birds are recorded by social groups according to the following convention:

For each social group record the number of males above the dotted line followed by a slash and the number of females under the dotted line. Separate all groups by commas as in the following example:

~~1/0, 0/1, 1/1, 5/0, 4/3~~-----

The groups in the example represent a lone male, a lone female, a pair, five males in a flock, and a flock of six males and three females. If there is not enough room on the front of the card, record the AOU number under species on the back of the card and continue as necessary. Species are listed in order of abundance for the 14 most common species. For other species write in the species name and record the data. There is room on the back of the card for additional unlisted species. Some biological interpretation is required to properly decide which birds constitute a group.

Leave the LM, LF, FM, FF and PRS boxes blank. The interpretation of social groups will be done at Fergus Falls to assure consistency among areas (see "What Birds To Count").

Form #2 blue--. This form must also be filled out in the field. Each line on the form is to be used for a wetland basin without ducks. An entry must be made for each pond even if the pond is dry (% full = 0). In previous years, failure to fill out an entry for each pond even if dry was the most common error. This error caused considerable delay in computer processing of the data. Some of the pond information on forms #1 and #2 also will be obtained from airborne TV data. The field data will be used as ground truth when interpreting the aerial data.

NON-GAME MIGRATORY BIRDS

As a pilot effort in 1990, black terns, American bitterns and least bitterns were counted in cooperation with the Regional Non-Game program. For 1991, this list of species has been modified to include the black tern, sandhill crane, American coot, Foresters tern, American avocet, grebe species, heron species and egret species. American and least bitterns will not be counted this year. American coot will be recorded only during the second count (20 May - 5 June). Record members of these species as numbers of individuals, not males, females or pairs. Figure 1 (attached) shows where and how to record these species on the yellow card. Even if there are no ducks, record these species on the yellow card, not the blue card.

RETURNING THE FORMS

Check all forms for completeness and accuracy. Quarter section number should not appear on the form. Make photocopies of all forms and mail forms to ATTN: Phill Arnold, Fergus Falls.

We would appreciate suggestions on how to make the instructions or system easier to use.

WETLAND MANAGEMENT DISTRICT CODES

Wetland Management
District

2 digit alphanumeric codes
as follows:

1-2

AR = Arrowwood (ND)
AU = Audubon (ND)
BL = Benton Lake (MT)
BO = Bowdoin (MT)
CB = Crosby (ND)
CR = Charles M. Russell (MT)
DE = Detroit Lakes (MN)
DL = Devils Lake (ND)
FF = Fergus Falls (MN)
*HL = Heron Lake (MN)
JC = J. Clark Salyer (ND)
KU = Kulmn (ND)
LA = Lake Andes (SD)
LF = Litchfield (MN)
LL = Long Lake (ND)
LR = Lostwood Refuge (ND)
*LT = Lonetree Bureau of Rec. (ND)
LW = Lostwood WMD (ND)
MA = Madison (SD)
ML = Medicine Lake (MT)
MO = Morris (MN)
*RO = Roseau (MN)
SL = Sand Lake (SD)
TE = Tewaukin (ND)
US = Union Slough (MN)
VC = Valley City (ND)
WB = Waubay (SD)
WD = Windom (MN)

*Cooperative units, not established Wetland Management Districts.

Figure 1

NON-GAME SPECIES LIST WITH AOU NUMBER

221 = AMERICAN COOT
 225 = AMERICAN AVOCET
 077 = BLACK TERN
 069 = FORESTER'S TERN
 206 = SANDHILL CRANE
 004 = EARED GREBE
 003 = HORNED GREBE
 005 = LEAST GREBE
 006 = PIED-BILLED GREBE
 002 = RED-NECKED GREBE
 001 = WESTERN GREBE
 202 = BLACK-CROWNED NIGHT HERON
 194 = GREAT BLUE HERON
 201 = GREEN BACKED HERON (little green)
 200 = CATTLE EGRET
 196 = GREAT EGRET
 197 = SNOWY EGRET

EXAMPLE OF NON-GAME COUNT FOR A SAMPLE WETLAND
 ONLY RECORD INDIVIDUALS - NOT PRS, LM, LF
 (back of yellow pair count form)

CONTINUATION OF SPECIES FROM FRONT

SPECIES ACTUAL COUNT OF MALES/FEMALES

OTHER SPECIES (WRITE IN)

AOU	SPECIES	ACTUAL COUNT OF MALES/FEMALES
077	BL. TERN	5, 1, 2
221	COOT	112, 6, 18
001	WEST. GREBE	11, 5

COMMENTS: _____

APPENDIX B

WISCONSIN BLACK TERN ROADSIDE SURVEY FORMS

(from Mossman 1981)

WISCONSIN BLACK TERN ROADSIDE SURVEY

Instructions for running permanent transects.

1. WHY: To monitor long term population trends of the black tern, and to collect distributional data which will help determine habitat preferences. Also, to collect similar information on other species of marsh birds.
2. WHEN: Surveys are to be run on any day between 25 May and 24 June. Do not run surveys when wind velocity is consistently above 20 mph or during rain (light drizzle is OK). Surveys may be run at any time of the day, but should be completed at least 1/2 hour prior to sunset.
3. HOW TO RUN THE TRANSECT: Each survey consists of 15 five-minute stops. Each stop is made where the road passes a wetland which is known or potential black tern habitat. It may be necessary to walk into certain sites: in these cases the observer is still restricted to a five-minute observation period (i.e., walk into site without counting terns, then spend 5 minutes counting, then return to road). If the transect has been established previously, use the permanent stops marked on the accompanying maps. If you are establishing the route, mark the stops clearly on a photocopied topographic map or plat map and outline the area to be observed at each stop. Maps will be provided at your request.
4. WHAT TO COUNT: At each stop, count all black terns seen within a five-minute period, while standing outside of your car, and using the naked eye and 7-8x binoculars. Also record the numbers of the following species if seen or heard: double-crested cormorant, great blue heron, green heron, great egret, black-crowned night heron, least bittern, American bittern, sandhill crane, king rail, Virginia rail, sora, common loon, Forster's tern, common tern, caspian tern, yellow-headed blackbird; also any waterfowl species or other herons or egrets.

In the comments section on the form, include observations such as: evidence of breeding for any species; the number of black terns in immature or molting plumage; comments on changes in bird populations or habitats from past years.

5. RETURNING FORMS: Return a copy of the data form, and a set of the maps by 15 July to:

Michael Mossman
Office of Endangered Species
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

WISCONSIN BLACK TERN ROADSIDE SURVEY

Route Description

ROUTE #16 - DANE

Stop No.

- 1 Unnamed marsh. T6N R10E S.20 SWSW. Observe pond from west on Schneider Rd. for 4 min, then observe from south on same road for 1 min.
- 2 Grass Lake - North. T6N R10E S.30 E 1/2 NE. Observe north half of lake from Sandhill Rd.
- 3 Grass Lake - South. T6N R10E S.30 E 1/2 SE. Observe south half of lake from Sandhill Rd. at bottom of hill below farm house. Indicate if any birds were probably also counted at stop #2.
- 4 Hook Lake. T6N R10E S.28 SW, 29 S 1/2, 32 N 1/2, 33 NWNW. Split time between 2 observation points: on south side and then on north side of Madison Retriever Club's Lodge.
- 5 Island Lake. T5N R10E S.3 E 1/2. Observe from roadside on northeast corner of lake.
6. Unnamed wetland. T5N R10E S.2 NE; T6N R10E S.35 S 1/2 SE. Observe from crossroads, walking back off road.
- 7 Unnamed wetland. T5N R11E S.3 NWSW. Observe from north side of wetland along roadside.
- 8 Unnamed wetland. T5N R11E S.10 S 1/2 SW, 15 N 1/2 NW. Observe from gravel road running parallel and just north of RR tracks.
- 9 Muskrat Lake. T4N R11E S.1 W 1/2 NW, 2 E 1/4 NE. Observe from Stebbensville Rd. just to east of crossroads.
- 10 Grass Lake (Stoughton). T5N R11E S.18 SW, 19 N 1/2 NW. Leave roadside, climb fence and observe from bottom of hill on south side of lake.
- 11 Bass Lake. T5N R10E S.24 N 1/2. Observe from roadside at bend in Hwy "A".
- 12 Unnamed pond. T4N R10E S.32 NWNE. Observe from roadside.
- 13 Unnamed wetland (Brooklyn). T4N R10E S.31 W 1/2 NE. Observe from roadside to west of white farm house.
- 14 Unnamed wetland. T5N R9E S.4 N 1/4; T6N R9E S.33 S 1/4. Observe from Fish Hatchery Rd.
- 15 Lake Barney. T6N R9E S.34 E 1/2 SE. Observe from Hwy "M" near northeast corner of wetland.

BLACK TERN SURVEY - MISC OBSERVATIONS

Wisconsin Department of Natural Resources
Office of Endangered and Nongame Species
Box 7921, Madison, WI 53707

Observer _____

Address _____

Phone No. _____

DIRECTIONS: Please fill in information for wetlands visited during the period 25 May - 24 June, including wetlands in which no black terns were observed. Five-minute observation periods are recommended when feasible. Use a separate line for each observation, even for repeated visits to the same area. On back of form, describe method of observation and other species seen, or include additional comments. Return to above address by 15 July.



Name of Wetland	Location				Date Mo/Day/Yr	Time of Observation		Number of Black Terns Observed
	County	Township	Range	Section		Begin	End	
EXAMPLE: Goose Pond	Col.	10N	9E	25 ne	6/20/81	0850	0855	7
EXAMPLE: Crystal Lake	Doug.	43N	13W	24	5/30/81	0920	1430	0
1.								
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APPENDIX C

Response to informal Black Tern Survey conducted through
 University of Minnesota Department of Fisheries and Wildlife
 Popmail (electronic mail system, Macintosh computers)
 Summer 1991

Location	Description
Wabasso Lake, Roseville (Ramsey Co.)	Defensive behavior in May through June, near shore on south side of the lake (in lily pads)
Vadnais Lake (Ramsey Co.)	Seen all summer
Lake of the Woods (Lake of the Woods Co.)	Seen in defensive behavior in early June
Lake Mary, 4 mi W of Alexandria (Douglas Co.)	20 July, flying over
Crane Lake (Ottertail Co.)	19 and 20 May, flying along the shoreline all day
Low Lake (Kawishiwi Ranger District, Superior Nat'l Forest)	Reported nesting colony
Linden Lake (1 mi east Hanska) (Brown Co.)	4 July, 10 birds very territorial, no juveniles sighted ^{sighted}
Willmar Area (Kandiyohi Co.)	Many black terns observed throughout the summer on Waterfowl Production Areas