QUANTIFICATION OF HABITAT ALTERATIONS AND BIRD USE OF IMPOUNDMENTS IN THE PRUDHOE BAY OIL FIELD, ALASKA, 1994

Final Report

Prepared by

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for

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29 March 1996

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EXECUTIVE SUMMARY

Impoundments are water bodies created by changes to natural drainage patterns. Gravel roads and pads supporting oil field operations can cause impoundments by acting as dams. Impoundments alter bird habitats, and this study evaluates the types and amounts of natural habitats that have been altered due to impoundments. The objectives of this study were to: 1) determine the area covered by impoundments within the entire Prudhoe Bay oil field (PBOF); 2) determine the habitat types altered by impoundments; 3) estimate the numbers of birds which historically used habitats that have been altered by impoundments; 4) survey a subsample of impoundments for bird use; and 5) compare estimated historical use and current bird use of impoundment areas.

Current impoundment flood areas were mapped from July 1993 natural color aerial photographs, and historic habitats were mapped from July 1955 black and white aerial photographs. A Geographic Information System (GIS) was used to calculate the area by habitat type within current impoundment flood areas. One hundred forty-four impoundments were identified and mapped. The area within the PBOF temporarily and permanently flooded by impoundments in mid- to late July 1993 was 11.3 km^2. Of this total, 5.3 km^2 was open water, and 6.0 km^2 was temporarily flooded tundra during July 1993. Of the 5.3 km^2 open water in July 1993, 3.3 km^2 was open water prior to oil field development, based on 1955 aerial photography. Therefore, a total of 8.0 km^2 of tundra was permanently or temporarily flooded by impoundment in 1993 (11.3 km^2 maximum flood minus 3.3 km^2 pre-development water equals 8.0 km^2 flooded tundra). This area represents 0.8% of the entire PBOF unit area (968 km^2).

Fifty-one impoundments covering 7.1 km^2 were censused for bird use in summer 1994. Open water during July 1993 within the 7.1 km^2 flood area was 3.8 km^2. Prior to any oil field development, open water within this flood area was 2.6 km^2. Therefore, a total of 4.5 km^2 of tundra was temporarily or permanently flooded for these 51 sites. Pre-development tundra habitats affected by flooding for the 4.5 km^2 area of flooded tundra were aquatic tundra 59%, wet tundra 37%, and moist tundra 4%. Extrapolating these percentages to the 8.0 km^2 tundra area altered by all 144 mapped impoundments suggests 4.7 km^2 aquatic tundra , 3.0 km^2 wet tundra, and 0.3 km^2 moist tundra were affected by impoundments. Most impoundments generally occur in areas with natural lakes and ponds, specifically drained lake basins, and their effect is to cause a retention of additional melt water.

A total of 2477 sightings of 5135 birds was recorded during four census periods on the 51 impoundments censused for bird use. Thirty-seven species were recorded at impoundments and

17 species nested at impoundments. Shorebird density (135 birds per km^2) was the highest, comprising 59% of all birds combined. Waterfowl density was the next highest with 53 birds per km^2 and 23% of all birds combined. Ducks comprised the majority of waterfowl, with 34.89 birds per km^2 or 15% of the total bird density. Mean densities in impoundment areas for 14 of the most common species were compared to estimated pre-development mean densities. Pre-development mean densities were empirically determined by mapping pre-development bird habitats and then extrapolating bird density-habitat relationships.

Using Mann-Whitney U and Wilcoxon signed rank tests, we made statistical comparisons of pre-development expected bird densities versus 1994 observed bird densities in the 51 impoundments. Impoundments generally supported higher waterfowl and lower shorebird densities than pre-development habitats, but bird habitat density relationships are highly variable and these trends were not statistically significant. Although the eight-fold difference in Red-necked Phalarope density was probably biologically significant, the statistical tests indicated that differences in pre- and post-development bird densities were not statistically significant. The most substantial change from pre-development conditions was the eight-fold increase in Red-necked Phalaropes in impounded areas.

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INTRODUCTION

Impoundments are water bodies created by changes to natural drainage patterns. Elevated gravel roads and pads supporting oil field operations can cause temporary and permanent flooding by acting as dams when they intersect natural drainage patterns. In many cases, culverts within the roadbed at the tundra surface can prevent permanent ponding. However, culverts are ineffective when clogged by gravel, deformed within the roadbed, or blocked by snow or ice. Improvements in culvert design, placement, and maintenance have reduced flooding and eliminated some impounded areas (Klinger et al. 1983; Walker et al. 1986). Impoundments in the Prudhoe Bay oil field (PBOF) are principally caused by roads crossing drained thaw-lake basins (Walker et al. 1987). In many instances, the flooded areas drain before mid-summer and the temporary increase in moisture produces a noticeable greening of the graminoid vegetation within the impoundment area. Areas of permanent impoundments retain water throughout the year.

Within oil fields in arctic Alaska, water impounded beside gravel roads and pads has been cited as one of the major indirect, human–induced landscape disturbances in terms of area affected (Walker et al. 1987). In 1983, in an intensively developed portion of the PBOF, impoundments were found to cover approximately 22% of the landscape, compared with 11% covered by gravel roads and pads. These estimates were based on 1:6000 scale mapping from 4 July 1983 natural color 1:18000 scale aerial photography (Walker et al. 1986). From 1:24000 scale mapping based on the 4 July 1983 aerial photography, Walker et al. (1987) estimated that 2.8% (14 km^2 of 500 km^2) of the entire PBOF was covered by impoundments. The actual area covered by impoundments within the PBOF will vary in extent and duration of flooding due to variations in snow pack and precipitation levels in combination with temperature the regime during spring thaw.

Concerns have been expressed by the U.S. Fish and Wildlife Service (USFWS) about the potential loss of bird habitat due to indirect habitat alteration by impoundments, and the resulting effects on bird populations. It has also been suggested (NRDC 1991) that, because of the loss of habitat due to direct and indirect impacts, approximately 15,300 birds have been displaced from the PBOF, based on nesting densities reported in Meehan (1986). Indirect impacts (primarily impoundments) have been implicated as the primary cause for displacement of nesting birds because, in flat thaw-lake plains, indirect impacts can represent over twice the area covered by gravel fill (Walker et al. 1987).

Because of these concerns, BP Exploration (Alaska) Inc. (BPXA) and LGL Alaska Research Associates, Inc. (LGL) conducted a three–year study to determine productivity and waterbird use of impoundments by comparing impoundments and natural ponds in the PBOF

(Kertell and Howard 1992; Kertell 1993; Kertell 1994). Study objectives were guided by the need to maintain "wildlife habitat productivity," a major goal of the USFWS (USFWS 1989), and because waterbirds are of special interest to state and federal regulatory agencies. Both waterfowl and their macroinvertebrate food source (plecopterans, trichopterans, and gastropods) were generally more abundant on impoundments than on natural ponds, but high variability in bird and invertebrate abundance data resulted in few statistically significant differences between natural ponds and impoundments (Kertell and Howard 1992; Kertell 1993; Kertell 1994). The results of these studies indicate that impoundments do not represent a total loss of habitat for birds but may in fact be equivalent to natural tundra ponds in terms of value to waterfowl. This study is an evaluation of the types and amounts of bird habitats that have been altered due to the presence of impoundments.

OBJECTIVES

The objectives of this study were to:

- determine the area covered by impoundments within the entire PBOF;
- determine the historical habitat types altered by impoundments for a subsample of impoundments, and estimate the area by habitat type covered by all impoundments in the oil field;
- estimate the numbers of birds which used historical habitats that have been altered by impoundments by using values of bird densities based upon empirical bird/habitat relationships;
- survey a representative subsample of impoundments for current bird use; and
- compare historical and current bird use of impoundment areas.

METHODS

Impoundment Identification and Mapping

All 1:6000 scale map sheets covering the entire unit boundary of the PBOF (968 km^2) were reviewed to identify water bodies greater than 0.0002 km^2 next to roads and gravel pads. Areas with potential impoundments were compared to impoundments identified on the "Cumulative Development of the Prudhoe Bay Field" map prepared by Lederer et al. (1984) and "Eileen West

End-Hydrology" maps prepared by Moses (1983). Topographic information from 1:6000 scale basemaps was used to evaluate drainage patterns. Areas with possible impounding were then delineated on the 1:6000 scale base maps and labeled with the map identification (township, range, and upper right-hand section number, e.g., 111329) and a letter, such that each impoundment was assigned a unique identifier (e.g., 101401A, 101403D, etc.). A database of impoundments was compiled with impoundment numbers, general location description, cross reference data, the 3 and 12 July 1993 natural color 1:18000 scale photo number, and the 24 July 1955 black and white 1:18000 scale photo number. Aerial photography was not orthorectified. Acetate overlays of impoundment locations were prepared for the 26x26 inch 1955 photos to facilitate relocation of impoundment areas for mapping.

Focusing on impoundments with more than 0.0002 km^2 of open water allowed inclusion of all major permanent additions of open water, but omitted many small impoundment areas between roadways and intersections. The July photography also does not include many temporary impoundments that drain completely by early to mid-July. Two areas with impounded water were omitted from this study due to the nature of their occurrence. Pump Station One is located in a lake basin which was drained prior to construction. This lake basin is beginning to refill with water. Because this area was originally covered by open water, refilling of the lake basin may not be caused by alterations of the natural drainage patterns, so this area was not mapped as an impoundment. In addition, the area impounded behind the flood-prevention dike near Kuparuk Reservoirs 5 and 6 was not mapped as an impoundment. This area was similarly not included in the previous impoundment mapping (Lederer et al. 1984).

After all areas of possible development-related impounding were identified, an estimated flood area was delineated and areas of open water within the estimated flood area were calculated using 1:6000 scale digital base maps updated with 1991 and 1992 aerial photography. These areas of open water within the estimated maximum flood areas were then used to stratify sampling for bird use study sites. As flooding progressed, several impoundments identified during map review were evaluated and removed from consideration as it became apparent that there was no addition of flood water. Although all impoundments were not specifically visited, most questionable areas were visited during selection of bird use sites and throughout the census periods.

Once impoundments were identified, 1:6000 scale base maps were prepared to scale projections of the 1:18000 scale 1955 pre-development and 1993 post-development photographs. Acetate overlays delimiting open water, general wetness categories, flood area as determined by the extent of lush vegetation, and field survey flood areas were prepared from projected images of the aerial photography and field prepared flood maps. For each impoundment, one pre-development habitat overlay and one post-development impoundment overlay were prepared. If post-development water areas were the same on 1993 aerial photography and 1:6000 scale base maps, which were based on 1991 and 1992 aerial photography, the base map water polygons were used. Acetate overlays were digitized by Aeromap U.S., Inc. Polygons were completed for flood areas and most water bodies, and then converted to MapInfo® files. These files were then used to construct a Geographic Information System (GIS) database of impoundments, which includes impoundment polygons as defined by flood areas, and the following information fields: 1) ID–bird use study site number; 2) ImpNo–impoundment number; 3) prewater–area in km^2 of open water prior to construction; 4) postwater–area in km^2 of open water after construction; 5) area–flood polygon area in km^2; 6) source–data used for maximum flood polygon (p=photo interpretation, f=field observations, w=post-development water area, s=area sampled for bird use); 7) impact–calculated field in km^2 (impact=area-prewater).

Pre-development habitat types were assessed from 1955 aerial photographs and classified using the habitats defined in Troy (1988), for the 51 impoundments sampled for bird use (Fig. 1). Pre-development vegetation line work and water polygons were used in combination with flood area polygons to create pre-development habitat maps for each study site. To calculate areas for habitat types, vegetation line work and water polygons were used to construct polygons within the impoundment flood area. Either field identified flood areas or photo-interpreted flood areas were used as the habitat map boundary. The pre-development habitat polygons were constructed in a GIS database with fields for 1) ID-bird use study site number, 2) Veg-habitat type number (Fig. 1), and 3) Area-area in km^2 for each habitat polygon.

Post-development impoundment area was evaluated for the 51 bird study sites using the same flood area polygons used for pre-development habitat mapping. Lakes and ponds within the flood boundary were summed to give the area of current open water within each flood polygon. Tundra area was calculated by subtracting the open water area from the flood polygon area. To indicate habitat complexity within the flood area, water edge was calculated as the sum of the perimeter of all water bodies and islands within the flood area.

Pre-development habitat type maps, color coded by thematic mapping (Fig. 1), were prepared for the 51 sites censused for bird use. Visual comparison of the pre-development habitat maps overlain by post-development water illustrates the changes in water boundaries. Area summaries by habitat type for each study site were computed.

PRE-DEVELOPMENT HABITAT CLASSIFICATIONS

Class	Pre-development habitat	Source classifications
1	Moist High-centered Polygons	Moist Tundra/Low-relief HCP Moist Tundra/Mixed High- and Low-centered Polygons
2	Moist Smooth Tundra	Moist Tundra/Frostscars Moist Tundra/Non-patterened Ground
3	Moist, Wet LCP, Strangmoor	Moist Tundra/Low-relief LCP Moist Tundra/Strangmoor Moist, Wet Tundra/Low-relief LCP Wet, Moist Tundra/Low-relief LCP
4	Wet LCP	Wet Tundra/Low-relief LCP
5	Wet Strangmoor	Wet Tundra/Strangmoor Wet, Moist Tundra/Strangmoor
6	Wet Smooth Tundra	Wet Tundra/Non-patterned Ground
7	Aquatic Strangmoor	Aquatic Tundra/Strangmoor Aquatic Tundra/Non-patterned Ground Aquatic, Moist Tundra/Strangmoor
8	Pond-No Emergents	Water/Ponds Without Emergent Vegetation Water/Lakes
9	Pond-Emergents	Water/Ponds With Emergent Vegetation
4&5	Mix Wet LCP, Strangmoor	Mixture of Classes 4 and 5
4&7	Mix Wet, Aquatic LCP, Strangmoor	Mixture of Classes 4 and 7

Figure 1. Classifications used for pre-development habitat mapping at 51 impoundment sites sampled for bird use in the Prudhoe Bay oil field during 1994 (Troy 1988). Pre-development habitats were mapped from 1:6000 scale projections of 1:18000 scale, 24 July 1955 black and white aerial photographs.

Current Bird Use of Impoundments

From the complete set of possible impoundments, a sample of 51 sites was randomly selected for bird use censuses during the 1994 nesting season. Sampling was stratified by five size categories with at least 10 impoundments in each category. Size categories were determined as the area of open water on 1:6000 scale base maps. The size categories were: 0.20-0.49, 0.50-1.49, 1.5-4.99, 5.00-9.99 and >10.00 hectares. This stratification resulted in the inclusion of nearly all large impoundments. Stratified random selection based on these size categories of impoundments ensured that 1) a large proportion of the areas previously designated as impounded were sampled, and 2) extrapolated results are unbiased.

Selected impoundments were censused during four nesting season sampling periods: Period 1—29 May to 3 June, Period 2—12 to 18 June, Period 3—27 June to 4 July, and Period 4—14 to 21 July. These sampling periods occur during the primary nesting season and coincide with Troy's (1988) censuses, which were the basis for historical bird use estimates. For analysis of bird use in 1994, periods 2, 3 and 4 were used because 1) most impoundments were completely frozen during period 1, and 2) estimates of historical bird use do not include late May/early June data. We censused each impoundment in the same order during each sampling period. Impoundments near Deadhorse became ice-free first and were sampled first, while impoundments west of the Kuparuk River remained frozen longer and were sampled last.

At peak flooding during Period 2, the maximum extent of melt water for each impoundment was marked on site maps. The perimeter of the maximum flood zones defined the outer edge of bird use census zones, regardless of flood duration. All bird observations within these maximum flood zones were recorded during each census period. Bird census data included areas which were both permanently and temporarily flooded.

All bird observations within the impounded areas were recorded. Data recorded for each observation included species, number of individuals, activity and habitat. Shorebird and passerine nests were recorded opportunistically, but we attempted to locate all waterfowl, gull, and loon nests. Large impoundments were censused by two observers and small impoundments were censused by a single observer. Shorelines of all water bodies and tundra segments in pond complexes were walked and scanned to locate birds. Islands were scanned with binoculars from both sides when high water prevented wading out to them. Some islands were visited in the later periods when water levels had dropped and they could be reached on foot. In areas of emergent vegetation with shallow water and in open tundra areas between water bodies, a zig-zag pattern was followed by the observer(s) in an attempt to locate cryptic species. Birds flying over the sampling area were recorded but were not included in our analyses. Likewise, birds drawn from surrounding areas by the observer's presence (mobbing) were not counted. Down and contour feather samples were collected from all depredated waterfowl nests.

We computed average bird density (birds per km^2) for each impoundment by totaling the number of birds by species recorded during sampling periods 2, 3 and 4, and dividing by three (3) times (3x) the area (km^2) of maximum flood for each impoundment. This computation gives the mean number of birds sited during the three sampling periods divided by the area of the impoundment resulting in the density (number of birds per km^2) of birds for the impoundment. We then calculated both a true mean density and standard error by averaging the densities for the 51 impoundments; and a weighted average density for each species in all impoundments combined. The weighted average was weighted by the area of each impoundment and therefore gives greater weight to larger impoundments.

Nest locations for waterfowl, loons and gulls, were digitized and entered in a GIS database with fields for species identification abbreviations as recorded in field records, site number, and notes including dates and depredation observations. Field mapped nest locations and recorded nest observation records were compared to account for each nest. The number of nests for each species was then divided by the total flood area to calculate density (nests per km^2).

Comparison of Current and Pre-Development Bird Use of Impoundments

To quantify changes in bird habitats resulting from impounding in the PBOF, bird densities observed during the summer 1994 were compared to pre-development bird densities for a set of 14 common nesting species: Pacific Loon (*Gavia pacifica*), Red-throated Loon (*Gavia stellata*), King Eider (*Somateria spectabilis*), Greater White-fronted Goose (*Anser albifrons*), Oldsquaw (*Clangula hyemalis*), Red-necked Phalarope (*Phalaropus lobatus*), Red Phalarope (*Phalaropus fulicaria*), Pectoral Sandpiper (*Calidris melanotos*), Semipalmated Sandpiper (*Calidrus pusilla*), Dunlin (*Calidris alpina*), Stilt Sandpiper (*Calidris himantopus*), Lapland Longspur (*Calcarius lapponicus*), Lesser Golden Plover (*Pluvialis dominica*), and Buff-breasted Sandpiper (*Tryngites subruficollis*). Pre-development or historical bird densities were calculated using historical habitat types from mapping and species-habitat relationships documented for the North Slope of Alaska in Troy (1988) and Troy (pers. comm.). Troy's data are from study plots located > 100 m from any roads or oil field facilities and are thought to represent bird densities relatively unaffected by development in the PBOF (TERA 1993). These data include bird study plots in the Eileen West End area (one year study, Troy et al. 1983), in the PBOF (one year study, Troy 1988), and study plots in the more coastally located Point McIntyre area (3-4 years study, Troy 1988; Troy pers. comm.).

These natural bird densities, therefore, are biased towards more coastally-influenced areas. In our discussion, we evaluate the possible effects of this bias, and the more serious bias associated with extreme year-to-year variations in bird densities (TERA 1993).

Natural bird densities in each of the nine habitat types (Fig. 1) were multiplied by the total aerial coverage of each pre-development habitat type to calculate the number of birds expected in each habitat prior to impoundment. Combined categories 4&5 and 4&7 (Fig. 1) were considered to represent equal parts of the individual habitat types for calculating expected bird numbers. Pre-development bird densities were computed by summing all the expected bird numbers for each pre-development habitat type and then dividing by the total impoundment flood area, resulting in an expected pre-development density for each of the 14 common species. Weighted mean densities for each bird species were computed for pre- and post-development, and only these overall mean densities were used in our analyses. Analyses were not based on individual impoundments because of the well-documented high spatial variability in bird densities, even within similar habitat types (TERA 1993b, Declan Troy, pers. comm.). Regression analysis and nonparametric paired-sample tests were used to compare pre- and post-development bird densities.

The bird data were analyzed in two ways: 1994 data corrected for inter-year variation, and 1994 data not-corrected. To correct for inter-year variation, the 1994 data for each of the 14 species were adjusted to reflect the proportional change from the multi-year averages for the same 14 species on the Point McIntyre study plots (TERA 1992) in 1994. These reference data were supplied by Declan Troy (pers. comm.).

RESULTS

Impoundment Area Calculations

One hundred forty-four impoundments were identified and flood lines were mapped. A large format map of all 144 impoundments identified in this study with bird use study sites labeled is included in a pocket at the end of this report (Fig. 2). The area impacted by impoundments with more than 0.0002 km^2 of open water in July within the Prudhoe Bay oil field is presented in Appendix A. A total of 11.3 km^2 was covered by flooding. Of this maximum flood area, 5.3 km^2 was open water in July, and 6.0 km^2 was tundra that had been temporarily flooded in June. Of the 5.3 km^2 of open water in July, 3.3 km^2 consisted of open water prior to any construction, based on 1955 pre-development aerial photography. Impoundments have resulted in the addition of 2.0 km^2 of open water in July (Appendix A). Therefore, a total of 8.0 km^2 of tundra was permanently (open water in July) or temporarily flooded by impoundments in 1993 (11.3 km^2 maximum flood minus 3.3 km^2 pre-development water equals 8.0 km^2 flooded tundra, Appendix A).

For the 51 impoundments censused for bird use, the total area covered by flooding was 7.1 km^2 (Table 1). Maps of pre-development habitat types were constructed for the 51 impoundment sites censused for bird use. Open water in July within the maximum flood areas was 3.8 km^2 (Table 1). Prior to any construction, open water within the maximum flood areas was 2.6 km^2 (Table 2), based on July 1955 aerial photography. For these sites, the total maximum flood area of 7.1 km^2 consisted of 2.6 km^2 pre-existing open water, 1.2 km^2 permanently flooded tundra and 3.3 km^2 of temporarily flooded tundra (Tables 1 and 2)

The predominant pre-development habitats (defined in Fig. 1) covered by the maximum flood area for the 51 bird use study sites were 7-Aquatic Strangmoor (2.6 km^2, 37%), 9-Pond-Emergents (1.6 km^2, 22%), and 8-Pond-No Emergents (1.0 km^2, 14%) (Table 3, Fig. 3). Using these proportions to calculate the habitat areas covered by the total 11.3 km^2 maximum flood area for all 144 mapped impoundments results in affected pre-development habitat areas of 7-Aquatic Strangmoor 4.2 km^2, 9-Pond-Emergents 2.5 km^2, and 8-Pond-No Emergents 1.6 km^2 (Table 3). This extrapolation calculates the pre-development open water area as 4.2 km^2. However, mapping from 1955 aerial photography for open water within the 144 impoundments resulted in a total of 3.3 km^2 pre-development open water. Therefore, the extrapolation over estimates the amount of pre-development open water. To account for this discrepancy and accurately characterize the total 8.0 km^2 area of pre-development tundra habitat affected by flooding, the proportional area of tundra covered by habitat type was calculated (Table 3). Of the 4.5 km^2 area of tundra flooded in the 51 bird use study sites 59 % was aquatic tundra, 37% was wet tundra and 4% was moist tundra. Extrapolating these proportions to the 8.0 km^2 of tundra flooded by all 144 impoundments results in areas of 4.7 km^2 aquatic tundra, 3.0 km^2 wet tundra, and 0.3 km^2 moist tundra (Table 3).

Bird Abundance On Impoundments

A total of 2477 sightings of 5135 birds were recorded during the four sampling periods in 1994 (Table 4 and Appendix B, Table B-1). Of this total, 97% (2395) of sightings and 95% (4870) of birds were recorded during sampling periods 2, 3 and 4 (Table 4). Consequently, results presented hereafter are based only on sampling periods 2, 3 and 4, the periods when most impoundments and adjacent tundra habitats were relatively free of ice and snow.

Table 1. Physical characteristics of impoundments sampled for bird use in the Prudhoe Bay oil field, Alaska, summer 1994.

Site Number	Impound. Number	Impound. Area (ha)	Impound. Area (sq km)	Area of Open Water (ha)	Area of Open Water (sq km)	Area of Tundra (ha)	Area of Tundra (sq km)	Perimeter of Waterbodies (m)
2	111205A	0.855	0.009	0.512	0.005	0.342	0.003	393.7
3	111215G	61.520	0.615	41.149	0.411	20.371	0.204	26727.4
6	111203E	1.038	0.010	0.201	0.002	0.837	0.008	370.1
7	121225B	0.558	0.006	0.359	0.004	0.199	0.002	440.6
8	121225C	4.957	0.050	3.004	0.030	1.953	0.020	2947
9	111315F	6.081	0.061	3.287	0.033	2.793	0.028	2779.7
10	111315C	11.639	0.116	9.987	0.100	1.653	0.017	2339.4
11	111315A	3.732	0.037	1.637	0.016	2.095	0.021	1518.2
12	111303C	46.210	0.462	25.621	0.256	20.589	0.206	7338.7
13	111301C	19.910	0.199	9.592	0.096	10.318	0.103	4029.1
14	111301A	37.010	0.370	17.940	0.179	19.071	0.191	6731.9
17	111313I	4.084	0.041	2.655	0.027	1.429	0.014	2239.4
18	111313A	88.356	0.884	7.212	0.072	81.423	0.814	2575.5
19	111301F	2.458	0.025	1.467	0.015	0.991	0.010	1076.7
20	111405B	3.895	0.039	0.564	0.006	3.331	0.033	1202.6
21	121427D	1.756	0.018	0.384	0.004	1.372	0.014	872
22	121427A	0.951	0.010	0.897	0.009	0.055	0.001	482.3
23	121425A	9.763	0.098	5.235	0.052	4.528	0.045	2595.1
24	111401A	1.404	0.014	0.284	0.003	1.120	0.011	719
25	111401D	4.403	0.044	3.940	0.039	0.463	0.005	1505.9
27	111417C	47.780	0.478	41.580	0.416	6.200	0.062	4837.5
28	111417B	47.230	0.472	19.500	0.195	27.731	0.277	8909.4
29	111417F	8.874	0.089	5.574	0.056	3.134	0.031	3936.5
30	101405A	10.370	0.104	7.120	0.071	3.250	0.033	1673.4
31	111427D	3.758	0.038	3.533	0.035	0.225	0.002	1530.7
32	111427B	4.240	0.042	1.301	0.013	2.939	0.029	1554.2
33	111427A	24.310	0.243	21.210	0.212	3.100	0.031	3186
34	111425D	0.841	0.008	0.512	0.005	0.329	0.003	794.6
35	101505E	23.480	0.235	16.061	0.161	7.419	0.074	9062.4
36	101505A	2.952	0.030	0.904	0.009	2.048	0.020	746.3
37	101503G	5.885	0.059	2.344	0.023	3.544	0.035	1787.6
38	111527D	14.860	0.149	4.678	0.047	10.182	0.102	9343.7
40	111525D	10.010	0.100	9.164	0.092	0.846	0.008	2404.9
41	111525A	13.370	0.134	8.514	0.085	4.856	0.049	5290.5
42	111513A	0.756	0.008	0.237	0.002	0.519	0.005	393.9
43	101503C	1.372	0.014	0.644	0.006	0.728	0.007	1284.9
44	101501A	5.944	0.059	4.838	0.048	1.106	0.011	1626.1
45	101515G	4.805	0.048	3.721	0.037	1.084	0.011	3522.3
46	101515C	1.701	0.017	1.079	0.011	0.622	0.006	562.9
47	101515D	3.122	0.031	2.972	0.030	0.150	0.002	3775.8
48	101515E	4.457	0.045	2.898	0.029	1.559	0.016	4101.4
49	101501B	0.814	0.008	0.605	0.006	0.209	0.002	490.5
50	101517C	13.400	0.134	8.549	0.085	4.851	0.049	3078.3
51	101517B	42.640	0.426	35.217	0.352	7.423	0.074	3385.5
52	101517A	58.590	0.586	17.462	0.175	41.128	0.411	6109.9
53	101413E	6.125	0.061	5.409	0.054	0.716	0.007	1380.9
54	101413A	27.050	0.271	19.054	0.191	7.996	0.080	5654.3
55	101413D	0.986	0.010	0.879	0.009	0.107	0.001	404.3
56	101401B	0.705	0.007	0.238	0.002	0.467	0.005	470.5
57	101505G	1.751	0.018	0.000	0.000	1.751	0.018	0
59	111401B	3.222	0.032	0.510	0.005	2.712	0.027	723
Total Area		705.980	7.060	382.234	3.822	323.864	3.239	160906.5

Table 2. Pre-development habitat type calculations (square kilometers) for 51 bird use study sites at areas affected by impoundments, Prudhoe Bay oil field, Alaska, 1994. Predevelopment habitats after Troy (1988) were evaluated and mapped from 24 July 1955 black and white 1:18000 scale aerial photographs, projected and scaled to 1:6,000 basemaps (Fig. 1).

Site Number	Habitat Type											Open Water (Type 8+9)	Total Area
	1	2	3	4	5	6	7	8	9	4&5	4&7		
2				0.004				0.005				0.005	0.009
3	0.001					0.067	0.289	0.107	0.052	0.098		0.160	0.615
6							0.0104					0.000	0.010
7		0.0056										0.000	0.006
8			0.026					0.012	0.012			0.024	0.050
9		0.008					0.027	0.011	0.015			0.026	0.061
10	0.002		0.009		0.008		0.014	0.083				0.083	0.116
11				0.003			0.023	0.012				0.012	0.037
12	0.004		0.008	0.004			0.181	0.029	0.236			0.266	0.462
13			0.008				0.142		0.049			0.049	0.199
14			0.003				0.217		0.149			0.149	0.370
17						0.005	0.030	0.006				0.006	0.041
18						0.052	0.751	0.081				0.081	0.884
19			0.001	0.007			0.008		0.009			0.009	0.025
20		0.009					0.029		0.001			0.001	0.039
21	0.003				0.006		0.008	0.001				0.001	0.018
22	0.007		0.002					0.001				0.001	0.010
23									0.019	0.078		0.019	0.098
24		0.002			0.011			0.000				0.000	0.014
25						0.025	0.019					0.000	0.044
27							0.045	0.415		0.017		0.415	0.478
28							0.194	0.200		0.078		0.200	0.472
29							0.056			0.033		0.000	0.089
30				0.042			0.061	0.000				0.000	0.104
31			0.001					0.001		0.036		0.001	0.038
32			0.014				0.016			0.013		0.000	0.042
33			0.013		0.042		0.041			0.147		0.000	0.243
34			0.002				0.004		0.002			0.002	0.008
35			0.006	0.015					0.155		0.059	0.155	0.235
36			0.004	0.018					0.007			0.007	0.030
37				0.035					0.024			0.024	0.059
38									0.038		0.111	0.038	0.149
40				0.066			0.022		0.012			0.012	0.100
41									0.057	0.077		0.057	0.134
42								0.001		0.002	0.004	0.001	0.008
43								0.001			0.012	0.001	0.014
44			0.010			0.049						0.000	0.059
45								0.019			0.029	0.019	0.048
46			0.001			0.015	0.001					0.000	0.017
47				0.008				0.013			0.010	0.013	0.031
48								0.009			0.042	0.009	0.051
49						0.004	0.004					0.000	0.008
50			0.008	0.033			0.007		0.086			0.086	0.134
51			0.009	0.063			0.010		0.345			0.345	0.427
52			0.001	0.075			0.328		0.182			0.182	0.586
53			0.004			0.041	0.017					0.000	0.061
54			0.003	0.067			0.069		0.132			0.132	0.271
55	0.000						0.000	0.010				0.010	0.010
56				0.003			0.003	0.001				0.001	0.007
57			0.018									0.000	0.018
59					0.032							0.000	0.032
Total Area*	0.017	0.024	0.150	0.442	0.100	0.260	2.626	1.019	1.583	0.579	0.268	2.602	7.067

* Difference in total area of 7.060 in Table 1 is due to map corrections, rounding and map calculation errors.

Table 3. Summary of pre-development habitat types following Troy (1988) classifications, for 51 impoundments censused for bird use during 1994, and extrapolated to the total area affected by all 144 impoundments mapped, Prudhoe Bay oil field, Alaska. Pre-development habitat types were evaluated and mapped from 1:18000 scale black and white 24 July 1955 aerial photographs projected and scaled to 1:6000 scale basemaps.

		Bird Use Sites (n=51)				All Impoundments (n=144)	
	Habitat Type	Total Area (sq km)	Percent of Total Area	Total Tundra Area (sq km)	Percent of Tundra Area	Total Area (sq km)	Total Tundra Area (sq km)
1	Moist High-centered Polygons	0.017	0.2	0.017	0.4	0.03	0.03
2	Moist Smooth Tundra	0.024	0.3	0.024	0.5	0.03	0.04
3	Moist, Wet Low-centered Polygons, Strangmoor	0.150	2.1	0.150	3.4	0.24	0.27
4	Wet Low-centered Polygons	0.442	6.3	0.442	9.9	0.71	0.79
5	Wet Strangmoor	0.100	1.4	0.100	2.2	0.16	0.18
6	Wet Smooth Tundra	0.260	3.7	0.260	5.8	0.42	0.47
7	Aquatic Strangmoor	2.626	37.1	2.626	58.8	4.19	4.70
8	Pond-No Emergents	1.019	14.4			1.63	
9	Pond-Emergents	1.583	22.4			2.54	
4&5	Mix Wet Low-centered Polygons, Strangmoor	0.579	8.2	0.579	13.0	0.93	1.04
4&7	Mix Wet, Aquatic Low-centered Polygons, Strangmoor	0.268	3.8	0.268	6.0	0.43	0.48
8+9	Open Water	2.602	36.9			4.17	
Total Area*		7.067		4.465		11.3	8.0

* Difference from Table 1 total is due to map corrections, rounding and map calculation errors.

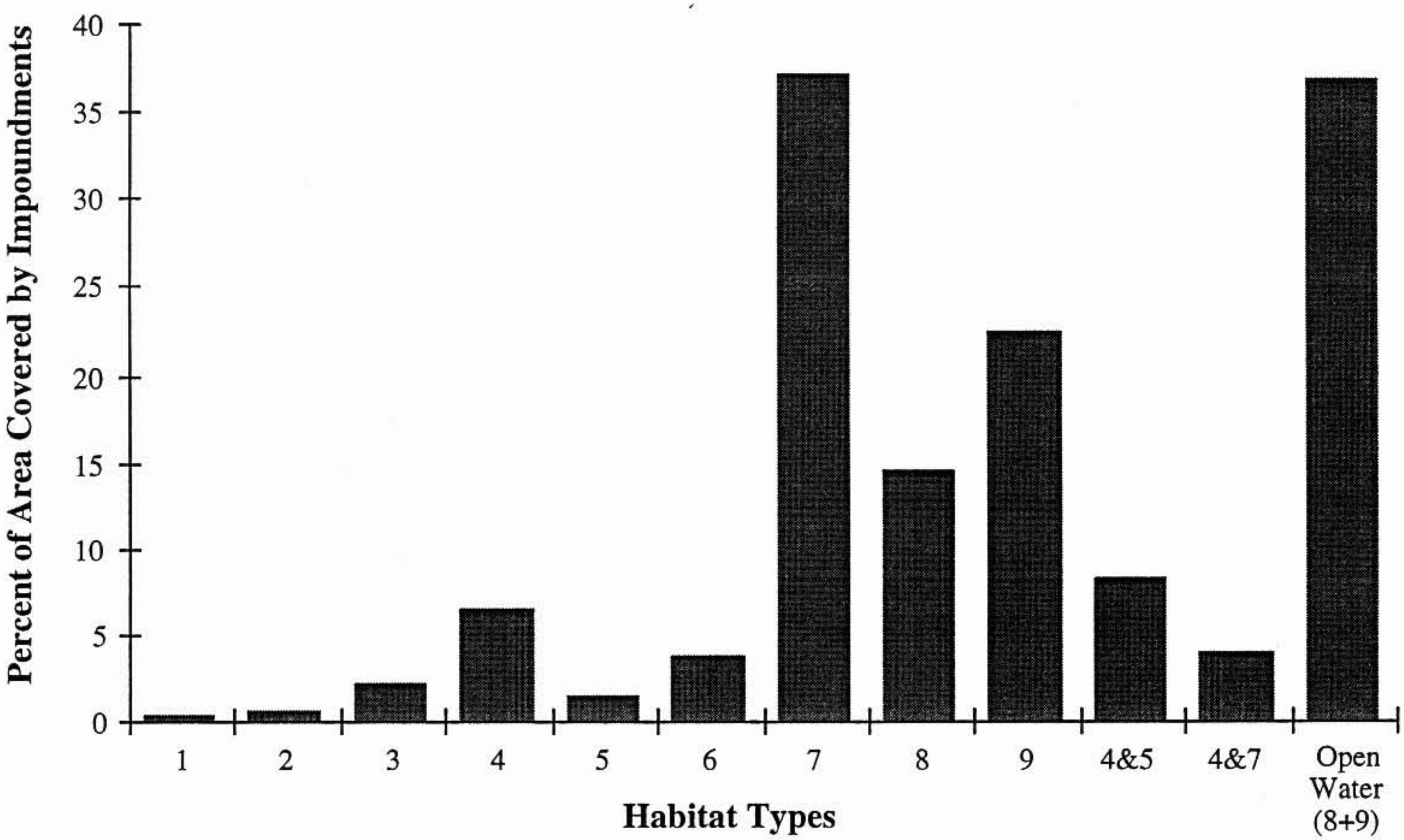


Figure 3. Percent of pre-development habitat types covered at 51 impoundment sites sampled for bird use during 1994, Prudhoe Bay oil field, Alaska. Pre-development habitat types were evauated and mapped from 1:18000 scale black and white 24 July 1955 aerial photographs projected and scaled to 1:6000 scale base maps.

Table 4. Numbers and densities of major species groups of birds and bird nests recorded on impoundments in the Prudhoe Bay area, Alaska, during 1994.

		All Birds									Loons				
Site Number	Impound. Number	n	Total Periods 1-4	Rank	n	Total Periods 2-4	%	Rank	Mean # /sq km	Rank	n	Total	#/ sq km	Total # Nests	Nests/ sq km
2	111205A	6	15	44	6	15	0.31	43	584.80	9	0	0	0.00	0	0.00
3	111215G	305	514	1	297	506	10.39	1	274.17	25	21	27	14.63	6	9.75
6	111203E	10	16	42	10	16	0.33	41	513.81	13	0	0	0.00	0	0.00
7	121225B	18	28	37	15	25	0.51	37	1493.43	1	0	0	0.00	0	0.00
8	121225C	54	78	20	54	78	1.60	20	524.51	11	0	0	0.00	0	0.00
9	111315F	16	22	39	16	22	0.45	38	120.59	46	5	7	38.37	1	16.44
10	111315C	23	35	35	23	35	0.72	35	100.24	48	5	5	14.32	1	8.59
11	111315A	27	40	32	27	40	0.82	32	357.27	20	4	5	44.66	1	26.80
12	111303C	124	216	6	123	214	4.39	6	154.37	42	13	17	12.26	2	4.33
13	111301C	33	60	25	27	54	1.11	26	90.41	49	4	6	10.05	1	5.02
14	111301A	90	202	7	90	202	4.15	7	181.93	39	12	14	12.61	2	5.40
17	111313I	36	56	27	36	56	1.15	25	457.07	16	3	4	32.65	1	24.49
18	111313A	70	341	4	70	341	7.00	4	128.65	44	7	8	3.02	1	1.13
19	111301F	59	110	12	59	110	2.26	12	1491.73	2	4	3	40.68	1	40.68
20	111405B	10	17	41	10	17	0.35	40	145.49	43	0	0	0.00	0	0.00
21	121427D	19	39	33	17	37	0.76	33	702.35	6	0	0	0.00	0	0.00
22	121427A	1	1	51	1	1	0.02	51	35.05	51	0	0	0.00	0	0.00
23	121425A	50	81	19	50	81	1.66	17	276.55	24	8	10	34.14	2	20.49
24	111401A	6	10	46	6	10	0.21	46	237.42	31	0	0	0.00	0	0.00
25	111401D	31	45	30	31	45	0.92	29	340.68	21	0	0	0.00	0	0.00
27	111417C	111	322	5	111	322	6.61	5	224.64	35	9	20	13.95	1	2.09
28	111417B	81	181	10	81	181	3.72	10	127.74	45	16	21	14.82	3	6.35
29	111417F	23	47	28	21	45	0.92	29	169.03	41	0	0	0.00	0	0.00
30	101405A	65	83	17	63	81	1.66	17	260.37	29	5	4	12.86	1	9.64
31	111427D	40	92	15	40	92	1.89	15	816.04	3	1	1	8.87	0	0.00
32	111427B	20	27	38	20	27	0.55	36	212.26	37	0	0	0.00	0	0.00
33	111427A	56	74	22	56	74	1.52	21	101.47	47	7	8	10.97	1	4.11
34	111425D	5	5	50	5	5	0.10	50	198.18	38	0	0	0.00	0	0.00
35	101505E	109	169	11	108	167	3.43	11	237.08	32	10	11	15.62	2	8.52
36	101505A	26	57	26	24	53	1.09	27	598.46	8	2	2	22.58	0	0.00
37	101503G	19	65	24	19	65	1.33	24	368.17	19	0	0	0.00	0	0.00
38	111527D	61	83	17	59	79	1.62	19	177.21	40	6	7	15.70	0	0.00
40	111525D	29	75	21	25	71	1.46	22	236.43	33	4	5	16.65	0	0.00
41	111525A	78	109	13	75	106	2.18	13	264.27	27	0	0	0.00	0	0.00
42	111513A	2	6	47	2	6	0.12	47	264.55	26	0	0	0.00	0	0.00
43	101503C	13	16	42	13	16	0.33	41	388.73	17	0	0	0.00	0	0.00
44	101501A	27	47	28	27	47	0.97	28	263.57	28	1	1	5.61	0	0.00
45	101515G	54	90	16	53	88	1.81	16	610.48	7	2	2	13.87	1	20.81
46	101515C	18	41	31	18	41	0.84	31	803.45	4	0	0	0.00	0	0.00
47	101515D	27	36	34	27	36	0.74	34	384.37	18	2	1	10.68	1	32.03
48	101515E	38	71	23	37	70	1.44	23	523.52	12	2	2	14.96	0	0.00
49	101501B	16	22	39	14	19	0.39	39	778.05	5	0	0	0.00	0	0.00
50	101517C	95	190	9	94	184	3.78	9	457.71	15	4	7	17.41	1	7.46
51	101517B	101	428	3	88	368	7.56	3	287.68	22	3	7	5.47	0	0.00
52	101517A	213	510	2	194	387	7.95	2	220.17	36	10	10	5.69	2	3.41
53	101413E	37	108	14	36	102	2.09	14	555.10	10	0	0	0.00	0	0.00
54	101413A	96	198	8	94	195	4.00	8	240.30	30	5	6	7.39	1	3.70
55	101413D	11	14	45	11	14	0.29	44	473.29	14	0	0	0.00	0	0.00
56	101401B	4	6	47	4	6	0.12	47	283.69	23	0	0	0.00	0	0.00
57	101505G	10	31	36	4	12	0.25	45	228.44	34	0	0	0.00	0	0.00
59	111401B	4	6	47	4	6	0.12	47	62.07	50	0	0	0.00	0	0.00
All	All	2477	5135		2395	4870	100.00		229.94		175[a]	221[c]	10.43[d]	33[g]	4.67[h]
Site no's	Imp no's				0.97	0.95			373.08		51[b]		9.23[e]		5.12[i]
									42.26				1.64[f]		1.30[j]

[a]total number of observations,[b] total number of birds, [d] mean weighted density of all birds (#birds/3x7.06 sq km), [e] average density, [f] SE, [g] total number of nests, [h] density of nests (#nests/7.06 sq km), [i]average sendity, [j]SE

Table 4. Continued.

Site Number	Gulls, Terns, and Jaegers n	Total	#/ sq km	Total # Nests	Nests/ sq km	Waterfowl n	Total	#/ sq km	Total # Nests	Nests/ sq km	Geese n	Total	#/ sq km	Total # Nests	Nests/ sq km
2	0	0	0.00	0	0.00	1	1	38.99	0	0.00	0	0	0.00	0	0.00
3	12	20	32.73	0	0.00	79	95	51.47	19	30.88	51	61	33.05	13	21.13
6	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
7	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
8	0	0	0.00	0	0.00	23	26	174.84	1	20.17	0	0	0.00	0	0.00
9	0	0	0.00	0	0.00	3	4	21.93	1	16.44	3	4	21.93	1	16.44
10	0	0	0.00	0	0.00	4	7	20.05	0	0.00	1	1	2.86	0	0.00
11	2	2	31.82	0	0.00	4	4	35.73	0	0.00	0	0	0.00	0	0.00
12	5	6	9.71	0	0.00	44	73	52.66	9	19.48	20	30	21.64	5	10.82
13	2	6	19.38	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
14	4	8	13.98	0	0.00	19	59	53.14	0	0.00	8	17	15.31	0	0.00
17	1	1	23.33	0	0.00	8	19	155.08	0	0.00	3	7	57.13	0	0.00
18	1	1	0.41	0	0.00	10	106	39.99	0	0.00	1	1	0.38	0	0.00
19	1	1	33.64	0	0.00	14	14	189.86	2	81.37	5	5	67.81	0	0.00
20	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
21	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
22	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
23	5	7	51.53	2	20.49	13	22	75.11	2	20.49	11	20	68.29	2	20.49
24	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
25	1	1	71.99	0	0.00	6	10	75.71	0	0.00	2	5	37.85	0	0.00
27	6	11	59.14	0	0.00	18	55	38.37	1	2.09	3	6	4.19	0	0.00
28	7	11	13.22	1	2.12	13	19	13.41	1	2.12	10	16	11.29	1	2.12
29	0	0	0.00	0	0.00	1	1	3.76	0	0.00	0	0	0.00	0	0.00
30	0	0	0.00	0	0.00	16	17	54.64	2	19.29	6	7	22.50	2	19.29
31	0	0	0.00	0	0.00	20	25	221.75	0	0.00	0	0	0.00	0	0.00
32	0	0	0.00	0	0.00	8	10	78.62	1	23.58	4	4	31.45	1	23.58
33	2	3	32.26	0	0.00	11	13	17.83	2	8.23	10	11	15.08	2	8.23
34	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
35	7	22	98.85	1	4.26	13	15	21.29	4	17.04	6	5	7.10	1	4.26
36	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
37	0	0	0.00	0	0.00	5	9	50.98	0	0.00	0	0	0.00	0	0.00
38	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
40	2	26	1024.43	0	0.00	5	6	19.98	0	0.00	0	0	0.00	0	0.00
41	1	2	13.73	0	0.00	23	32	79.78	1	7.48	2	2	4.99	0	0.00
42	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
43	0	0	0.00	0	0.00	3	3	72.89	0	0.00	0	0	0.00	0	0.00
44	1	2	60.28	0	0.00	3	3	16.82	0	0.00	0	0	0.00	0	0.00
45	1	1	30.75	0	0.00	12	19	131.81	1	20.81	0	0	0.00	0	0.00
46	0	0	0.00	0	0.00	5	5	97.98	0	0.00	0	0	0.00	0	0.00
47	3	4	888.89	0	0.00	5	5	53.38	1	32.03	0	0	0.00	0	0.00
48	0	0	0.00	0	0.00	8	12	89.75	0	0.00	0	0	0.00	0	0.00
49	0	0	0.00	0	0.00	3	1	40.95	1	122.85	3	1	40.95	1	122.85
50	1	1	6.87	0	0.00	36	76	189.05	0	0.00	11	31	77.11	0	0.00
51	0	0	0.00	0	0.00	55	236	184.49	0	0.00	15	70	54.72	0	0.00
52	2	2	1.62	0	0.00	50	66	37.55	3	5.12	12	15	8.53	2	3.41
53	5	19	884.54	0	0.00	4	6	32.65	0	0.00	2	2	10.88	0	0.00
54	1	2	8.34	0	0.00	14	32	39.43	1	3.70	8	26	32.04	1	3.70
55	0	0	0.00	0	0.00	3	3	101.42	0	0.00	0	0	0.00	0	0.00
56	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
57	1	1	19.04	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
59	1	2	24.58	0	0.00	2	3	31.04	0	0.00	2	3	31.04	0	0.00
All	75	162	7.65	4	0.57	564	1112	52.50	53	7.51	199	350	16.53	32	4.53
Site no's	51		67.75		0.53	51		53.02		8.89	51		13.30		5.03
			30.81		0.41			8.23		3.00			2.94		2.51

Table 4. Continued.

Site Number	Swans n	Swans Total	Swans #/ sq km	Swans Total # Nests	Swans Nests/ sq km	Ducks n	Ducks Total	Ducks #/ sq km	Ducks Total # Nests	Ducks Nests/ sq km
2	0	0	0.00	0	0.00	1	1	38.99	0	0.00
3	4	3	1.63	1	1.63	24	31	16.80	5	8.13
6	0	0	0.00	0	0.00	0	0	0.00	0	0.00
7	0	0	0.00	0	0.00	0	0	0.00	0	0.00
8	0	0	0.00	0	0.00	23	26	174.84	1	20.17
9	0	0	0.00	0	0.00	0	0	0.00	0	0.00
10	0	0	0.00	0	0.00	3	6	17.18	0	0.00
11	0	0	0.00	0	0.00	4	4	35.73	0	0.00
12	2	4	2.89	0	0.00	22	39	28.13	4	8.66
13	0	0	0.00	0	0.00	0	0	0.00	0	0.00
14	0	0	0.00	0	0.00	11	42	37.83	0	0.00
17	0	0	0.00	0	0.00	5	12	97.94	0	0.00
18	0	0	0.00	0	0.00	9	105	39.61	0	0.00
19	0	0	0.00	0	0.00	9	9	122.05	2	81.37
20	0	0	0.00	0	0.00	0	0	0.00	0	0.00
21	0	0	0.00	0	0.00	0	0	0.00	0	0.00
22	0	0	0.00	0	0.00	0	0	0.00	0	0.00
23	0	0	0.00	0	0.00	2	2	6.83	0	0.00
24	0	0	0.00	0	0.00	0	0	0.00	0	0.00
25	0	0	0.00	0	0.00	4	5	37.85	0	0.00
27	0	0	0.00	0	0.00	15	49	34.18	1	2.09
28	0	0	0.00	0	0.00	3	3	2.12	0	0.00
29	0	0	0.00	0	0.00	1	1	3.76	0	0.00
30	0	0	0.00	0	0.00	10	10	32.14	0	0.00
31	0	0	0.00	0	0.00	18	23	204.01	0	0.00
32	2	2	15.72	0	0.00	4	6	47.17	0	0.00
33	0	0	0.00	0	0.00	1	2	2.74	0	0.00
34	0	0	0.00	0	0.00	0	0	0.00	0	0.00
35	0	0	0.00	0	0.00	7	10	14.20	3	12.78
36	0	0	0.00	0	0.00	0	0	0.00	0	0.00
37	0	0	0.00	0	0.00	5	9	50.98	0	0.00
38	0	0	0.00	0	0.00	0	0	0.00	0	0.00
40	0	0	0.00	0	0.00	5	6	19.98	0	0.00
41	0	0	0.00	0	0.00	16	16	39.89	1	7.48
42	5	14	617.28	0	0.00	0	0	0.00	0	0.00
43	0	0	0.00	0	0.00	3	3	72.89	0	0.00
44	0	0	0.00	0	0.00	3	3	16.82	0	0.00
45	0	0	0.00	0	0.00	12	19	131.81	1	20.81
46	0	0	0.00	0	0.00	5	5	97.98	0	0.00
47	0	0	0.00	0	0.00	5	5	53.38	1	32.03
48	0	0	0.00	0	0.00	8	12	89.75	0	0.00
49	0	0	0.00	0	0.00	0	0	0.00	0	0.00
50	0	0	0.00	0	0.00	25	45	111.94	0	0.00
51	0	0	0.00	0	0.00	40	166	129.77	0	0.00
52	0	0	0.00	0	0.00	38	51	29.02	1	1.71
53	0	0	0.00	0	0.00	2	4	21.77	0	0.00
54	0	0	0.00	0	0.00	6	6	7.39	0	0.00
55	0	0	0.00	0	0.00	3	3	101.42	0	0.00
56	0	0	0.00	0	0.00	0	0	0.00	0	0.00
57	0	0	0.00	0	0.00	0	0	0.00	0	0.00
59	0	0	0.00	0	0.00	0	0	0.00	0	0.00
All	13	23	1.09	1	0.14	352	739	34.89	20	2.83
Site no's	51		12.50		0.03	51		38.61		3.83
			12.10		0.03			6.95		1.78

Table 4. Continued.

Site Number	Shorebirds n	Shorebirds Total	Shorebirds #/ sq km	Shorebirds Total # Nests	Shorebirds Nests/ sq km	Passerines n	Passerines Total	Passerines #/ sq km	Passerines Total # Nests	Passerines Nests/ sq km
2	4	11	428.85	0	0.00	1	3	116.96	0	0.00
3	155	318	172.30	3	1.63	30	46	24.92	2	1.08
6	10	16	513.81	0	0.00	0	0	0.00	0	0.00
7	7	13	776.58	0	0.00	8	12	716.85	0	0.00
8	25	44	295.88	1	6.72	6	8	53.80	0	0.00
9	5	8	43.85	0	0.00	3	3	16.44	0	0.00
10	10	18	51.55	0	0.00	4	5	14.32	0	0.00
11	12	22	196.50	0	0.00	5	7	62.52	0	0.00
12	57	114	82.23	0	0.00	4	4	2.89	0	0.00
13	21	42	70.32	1	1.67	0	0	0.00	0	0.00
14	48	114	102.67	1	0.90	7	7	6.30	0	0.00
17	16	23	187.72	1	8.16	8	9	73.46	0	0.00
18	48	221	83.37	0	0.00	4	5	1.89	0	0.00
19	36	87	1179.82	0	0.00	4	5	67.81	0	0.00
20	10	17	145.49	0	0.00	0	0	0.00	0	0.00
21	16	36	683.37	0	0.00	1	1	18.98	0	0.00
22	1	1	35.05	0	0.00	0	0	0.00	0	0.00
23	22	40	136.57	0	0.00	2	2	6.83	0	0.00
24	6	10	237.42	0	0.00	0	0	0.00	0	0.00
25	18	27	204.41	0	0.00	6	7	52.99	0	0.00
27	55	207	144.41	3	2.09	23	29	20.23	0	0.00
28	38	69	48.70	0	0.00	7	61	43.05	0	0.00
29	15	37	138.98	1	3.76	5	7	26.29	0	0.00
30	30	47	151.08	0	0.00	12	13	41.79	0	0.00
31	15	61	541.07	0	0.00	4	5	44.35	0	0.00
32	7	10	78.62	0	0.00	5	7	55.03	0	0.00
33	26	38	52.10	0	0.00	10	12	16.45	0	0.00
34	3	3	118.91	0	0.00	2	2	79.27	0	0.00
35	65	102	144.80	1	1.42	13	17	24.13	0	0.00
36	18	47	530.71	0	0.00	4	4	45.17	0	0.00
37	13	55	311.53	0	0.00	1	1	5.66	0	0.00
38	27	40	89.73	0	0.00	26	32	71.78	0	0.00
40	10	29	96.57	0	0.00	4	5	16.65	0	0.00
41	37	56	139.62	2	4.99	14	16	39.89	0	0.00
42	2	6	264.55	0	0.00	0	0	0.00	0	0.00
43	6	8	194.36	0	0.00	4	5	121.48	0	0.00
44	13	27	151.41	0	0.00	9	14	78.51	0	0.00
45	23	47	326.05	0	0.00	15	19	131.81	2	13.87
46	12	35	685.87	0	0.00	1	1	19.60	0	0.00
47	7	12	128.12	0	0.00	10	14	149.48	0	0.00
48	19	47	351.51	0	0.00	8	9	67.31	0	0.00
49	8	15	614.25	0	0.00	3	3	122.85	0	0.00
50	38	85	211.44	0	0.00	15	15	37.31	0	0.00
51	22	111	86.77	1	0.78	8	14	10.94	0	0.00
52	82	244	138.82	1	0.57	50	65	36.98	0	0.00
53	27	77	419.05	1	5.44	0	0	0.00	0	0.00
54	58	133	163.89	2	2.46	16	22	27.11	0	0.00
55	8	11	371.87	0	0.00	0	0	0.00	0	0.00
56	2	4	189.13	0	0.00	2	2	94.56	0	0.00
57	2	10	190.37	0	0.00	1	1	19.04	0	0.00
59	1	1	10.35	0	0.00	0	0	0.00	0	0.00
All	1216	2856	134.85	19	0.90	365	519	24.50	4	0.19
Site no's	51		249.26		0.80	51		52.62		-0.29
			32.13		0.26			14.38		0.27

The largest proportions of birds recorded during the ice-free sampling periods were shorebirds (59%, 2856 birds) and waterfowl (23%, 1112 birds), with smaller proportions of passerines (11%, 519 birds), loons (5%, 221 birds), and gulls-terns-jaegers (3%, 162 birds) (Table 4). Red-necked Phalaropes comprised the largest proportion (35%, 1721 birds) of the 37 species recorded (Appendix B, Table B-1). Semipalmated Sandpiper, Lapland Longspur, and Northern Pintail (*Anas acuta*) also comprised notable proportions (9%, 452 birds; 7%, 328 birds; 6%, 312 birds, respectively; Appendix B, Table B-1). No other species represented more than 5% of the total number of birds recorded on impoundments. Nevertheless, 54 Spectacled Eiders (*Somateria fischeri*) (1% of total birds, Appendix B, Table B-1), currently listed as Threatened under the Endangered Species Act (58 Federal Register 27474-27480), were recorded in areas affected by impoundments. Impoundments where Spectacled Eiders were recorded were generally larger than the average size of the 51 bird use impoundments (Table 5). These impoundments also contained a slightly higher proportion of temporarily flooded tundra (53% versus 46%) and may be more spatially complex, as indicated by the impoundment area divided by the total perimeter of water within the impoundment (Table 5). The percent coverage of the predominant pre-development habitat for the impoundments where Spectacled Eiders were observed, 7-Aquatic Strangmoor, was higher than for all 51 impoundments (46% versus 37%, Table 6).

Shorebird density (134.85 birds per km^2) was the highest of the bird groups, comprising 59% of the density of all birds combined. Waterfowl followed with 52.50 birds per km^2 and 23% of all birds combined, with ducks contributing to the majority of waterfowl density with 34.89 birds per km^2 or 15% of the total bird density (Table 7).

Systematic searches were made only for nests of waterfowl, gulls and loons; all other nests were found incidentally. A total of 114 sightings of nests of 20 species or species groups of birds was recorded in areas affected by impoundments (Table 8). Nests of Pacific Loon, Canada Goose, and Greater White-fronted Goose accounted for 60 (53%) of all nests found (Table 8). Of the remaining species, only Red-necked Phalarope (11 nests, 10%) and Spectacled, King, and unidentified eiders (17 nests, 15%) represented notable proportions of the total (Table 8). Impoundments with Spectacled Eider nests were generally larger than the average size of the 51 bird use impoundments (Table 5). These impoundments contained a slightly higher proportion of temporarily flooded tundra (65% versus 46%) and may also be more spatially complex (Table 5). The predominant pre-development habitat for impoundments with Spectacled Eider nests, 7-Aquatic Strangmoor, was higher than for all 51 impoundments (59% versus 37%, Table 6).

Table 5. Physical characteristics of impoundments where Spectacled Eiders were observed and nested compared to all impoundments sampled for bird use in the Prudhoe Bay oil field, Alaska, summer 1994.

	Impound. Area (sq km)	Impound. Area (ha)	Percent of Area Open Water	Area of Open Water (sq km)	Percent of Area Tundra	Area of Tundra (sq km)	Index of Complexity	Perimeter of Water Bodies (m)
Impoundments with Spectacled Eider Sightings (n=11)								
Total Area	3.598	359.831	47.15%	1.697	52.92%	1.904	5.240	68675.5
Average	0.327	32.712		0.154		0.173		6243.2
Standard Deviation	0.292	29.212		0.140		0.246		7294.8
Minimum	0.010	0.986		0.009		0.001		404.3
Maximum	0.884	88.356		0.411		0.814		26727.4
Impoundments with Spectacled Eider Nests (n=4)								
Total Area	2.319	231.946	35.30%	0.819	64.82%	1.503	5.215	44475.2
Average	0.580	57.987		0.205		0.376		11118.8
Standard Deviation	0.266	26.620		0.145		0.324		10738.3
Minimum	0.235	23.480		0.072		0.074		2575.5
Maximum	0.884	88.356		0.411		0.814		26727.4
All Impoundments Sampled for Bird Use (n=51)								
Total Area	7.060	705.980	54.14%	3.822	45.87%	3.239	4.388	160906.5
Average	0.138	13.843		0.075		0.064		3155.0
Standard Deviation	0.194	19.400		0.103		0.133		4139.2
Minimum	0.006	0.558		0.000		0.001		0.0
Maximum	0.884	88.356		0.416		0.814		26727.4

Complexity = Area of Impoundment (ha) divided by the Perimeter of Water Bodies (km).

Table 6. Summary of pre-development habitat types following Troy (1988) classifications, for impoundment bird use study sites comparing impoundments with Spectacled Eider observations and nests to all bird use study site impoundments. Pre-development habitat types were evaluated and mapped from 1:18000 scale black and white 24 July 1955 aerial photographs projected and scaled to 1:6000 scale base maps.

	Habitat Type	Area (sq km)	Percent of Total Area	Percent of Total Area with Spectacled Eider observations	Percent of Total Area with Spectacled Eider nests
1	Moist High-centered Polygons	0.017	0.2	0.2	0.1
2	Moist Smooth Tundra	0.024	0.3	0.0	0.0
3	Moist, Wet Low-centered Polygons, Strangmoor	0.150	2.1	0.8	0.3
4	Wet Low-centered Polygons	0.442	6.3	6.4	3.9
5	Wet Strangmoor	0.100	1.4	0.0	0.0
6	Wet Smooth Tundra	0.260	3.7	3.5	5.2
7	Aquatic Strangmoor	2.626	37.1	46.2	59.0
8	Pond-No Emergents	1.019	14.4	6.7	8.1
9	Pond-Emergents	1.583	22.4	30.8	16.8
4&5	Mix Wet Low-centered Polygons, Strangmoor	0.579	8.2	2.7	4.2
4&7	Mix Wet, Aquatic Low-centered Polygons, Strangmoor	0.268	3.8	2.8	2.5
8+9	Open Water	2.602	36.9	37.5	24.9
Total Area*		7.067			

* Difference from Table 1 total is due to map corrections, rounding and map calculation errors.

Table 7. Densities of birds and bird nests recorded at 51randomly selected areas affected by impoundments (total area = 7.1 sq km) in the Prudhoe Bay oil field, Alaska,1994.

Species Group	Mean no. birds/sq km	% of Total	Mean no. nests/sq km	% of Total
Loons	10.43	4.5	4.67	33.7
Gulls, Terns, Jaegers	7.65	3.3	0.57	4.1
Waterfowl	52.50	22.8	7.51	54.3
Swans	1.09	0.5	0.14	1.0
Geese	16.53	7.2	4.53	32.7
Ducks	34.89	15.2	2.83	20.4
Shorebirds	134.85	58.6		
Passerines	24.50	10.7		
All Birds	229.94	100.0	12.75	92.1

Table 8. Nests recorded at 51 randomly selected areas affected by impoundments (total area = 7.1 sq km) in the Prudhoe Bay oil field, Alaska, 1994.

Species	Total Nests	% of Total	Nests/ km sq
Pacific Loon	31	27.2	4.39
Red-throated Loon	2	1.8	0.28
Tundra Swan	1	0.9	0.14
Canada Goose	16	14.0	2.27
Greater White-fronted Goose	13	11.4	1.84
Unidentified Goose	3	2.6	0.43
Greater Scaup	1	0.9	0.14
King Eider	4	3.5	0.57
Spectacled Eider	4	3.5	0.57
Unidentified Eider	9	7.9	1.28
Oldsquaw	1	0.9	0.14
Unidentified Duck	1	0.9	0.14
Glaucous Gull	4	3.5	0.57
Red-necked Phalarope*	11	9.6	
Red Phalarope*	1	0.9	
Pectoral Sandpiper*	1	0.9	
Semipalmated Sandpiper*	3	2.6	
Semipalmated Plover*	3	2.6	
Lapland Longspur*	4	3.5	
Snow Bunting*	1	0.9	
All Species/Groups	114	100.0	

* These species represent opportunistic nest observations; because these data do not represent systematic nest searches, density calculations are not included.

Aggregations on Specific Impoundments

Some impoundments supported exceptionally large numbers of birds. In fact, over 70% of all birds were seen on only 15 of the 51 impoundments (Table 4). Impoundments varied considerably in size, however, and only four of the 15 impoundments that supported large numbers of birds also supported high densities of birds (Table 4). High variability in densities of birds on study plots in the PBOF is typical (Troy 1988). Thus, comparisons of bird abundance in this report are based on overall weighted mean densities of birds on all 51 impoundments, (mean number of birds per km^2), rather than on comparisons of bird densities on individual impoundments (Table 7). Figures 4 through 15 are impoundment maps for 21 of the 51 bird study sites. These 21 study sites account for 75% of all bird observations for periods 2, 3, and 4. Figures 4 through 15 illustrate historic habitat types within the maximum impoundment flood area, current open water levels, and waterfowl nest locations.

Bird Densities on Pre-Impoundment versus Impoundment Areas

Based on weighted mean densities of the 14 most common species of birds typically found on study plots in the PBOF (Troy 1988; Declan Troy unpub. data), we computed the expected number and densities of birds in areas affected by impoundments (Table 9). Impoundments generally supported lower densities than pre-impoundment areas. For 10 species (Table 9), weighted mean densities in impoundment areas were lower than in the same area before it was influenced by impoundment. For one species (Oldsquaw), there was no difference, and for three species (Pacific Loon, Greater White-fronted Goose, and Red-necked Phalarope), impounded areas supported higher densities than the same areas prior to impoundment (Table 9). Densities of Red-necked Phalaropes were eight times higher in areas affected by impoundments compared to the same area prior to impoundment.

Using regression analysis, Mann-Whitney U test, and the Wilcoxon signed rank test, we compared expected pre-impoundment bird densities with observed bird densities for the 51 impoundments sampled in 1994 (Table 9). For Mann-Whitney U test, and the Wilcoxon signed rank test, we found no statistically significant differences in weighted mean bird densities in areas affected by impoundments versus the same area prior to impoundment (Table 10). Regression analysis resulted in a non-significant regression of impoundment bird density on pre-impoundment bird density (Fig. 16). We also computed correction factors to adjust for 1994 variation from the multi-year weighted mean bird density (Fig. 17, Table 10). Even after such corrections, there

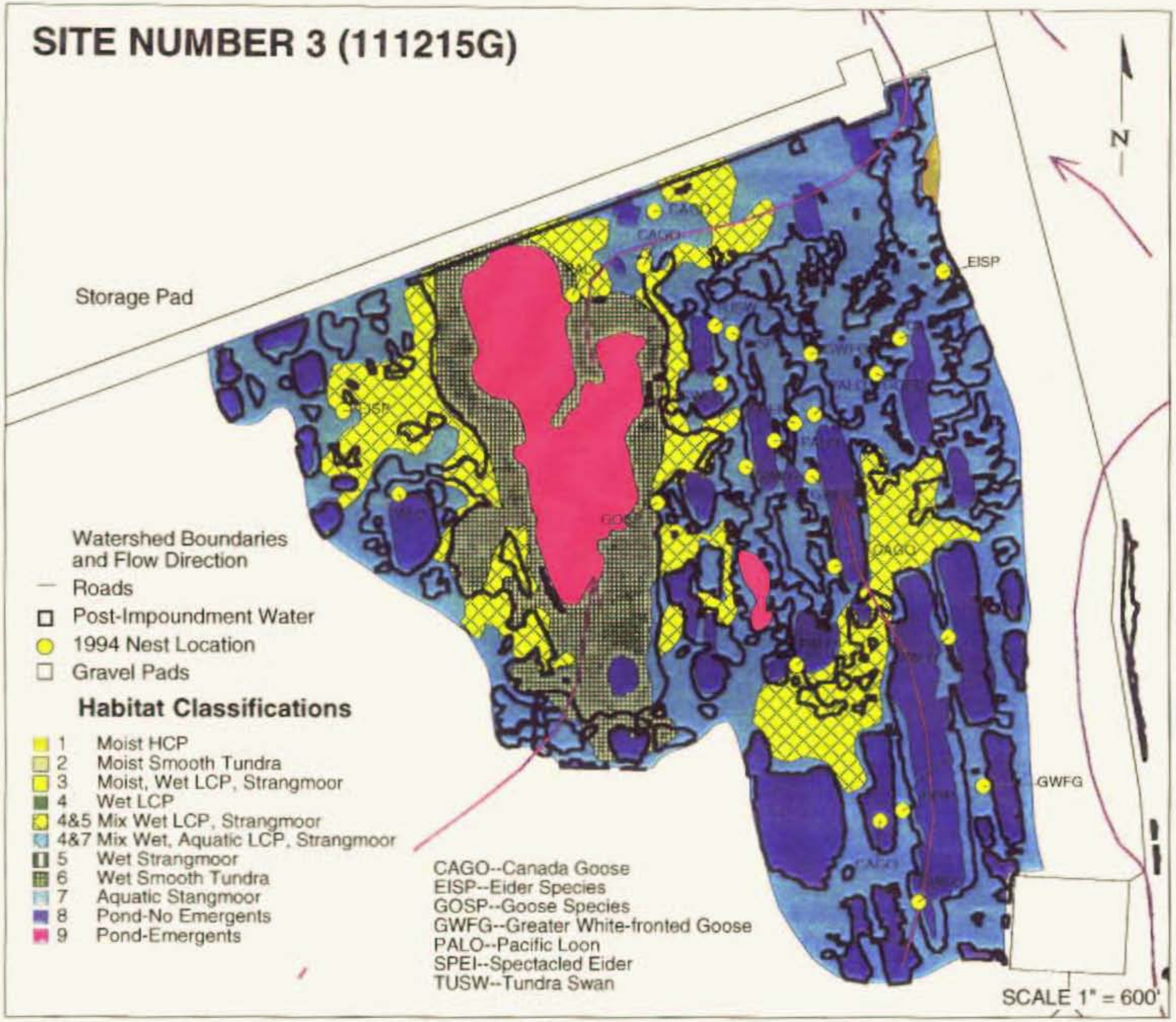


Figure 4. Study Site 3 (Impoundment 111215G) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 506 birds of 24 species were recorded at Site 3 during periods 2, 3 and 4, summer 1994.

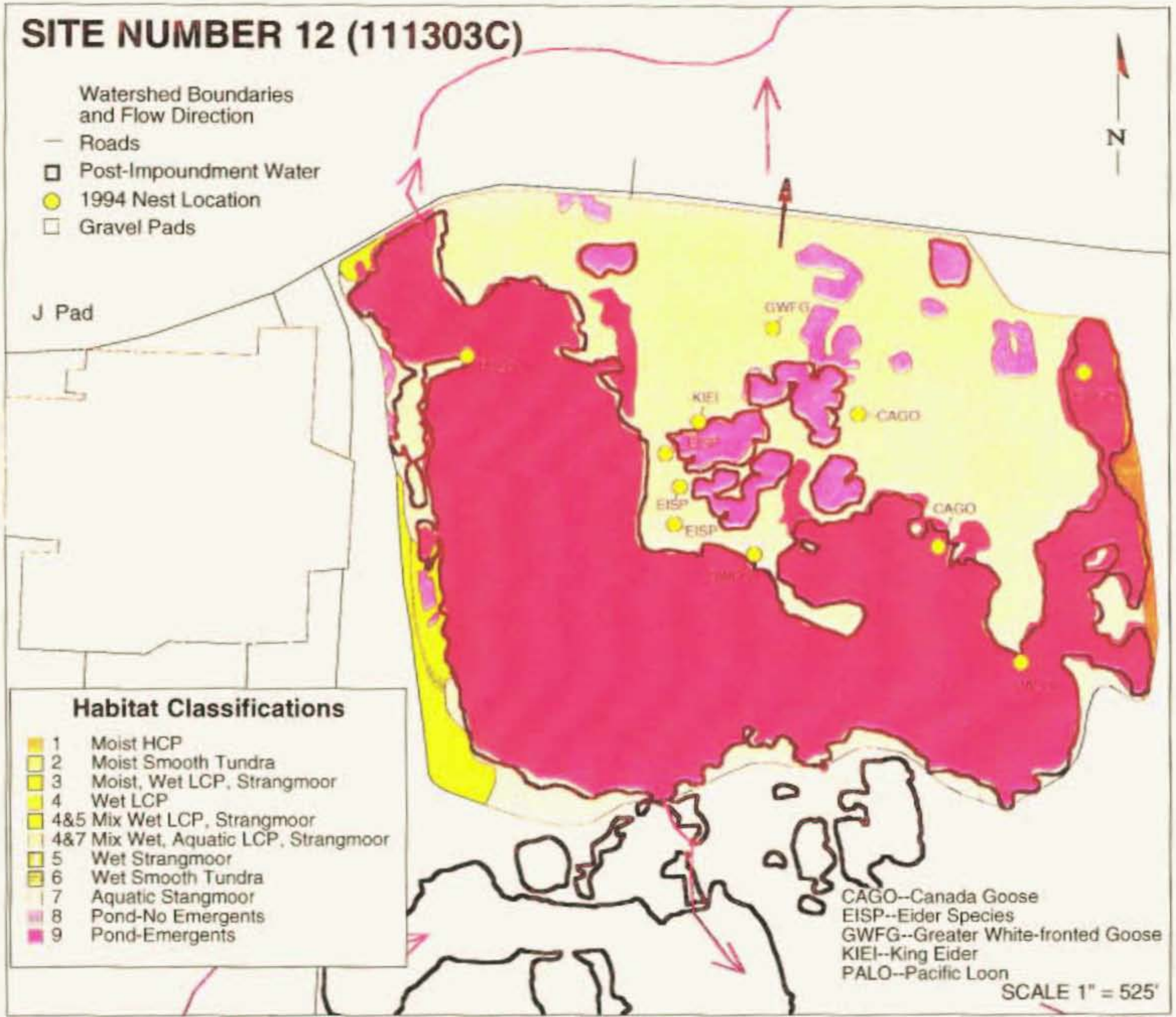


Figure 5. Study Site 12 (Impoundment 111303C) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 214 birds of 20 species were recorded at Site 12 during periods 2, 3 and 4, summer 1994.

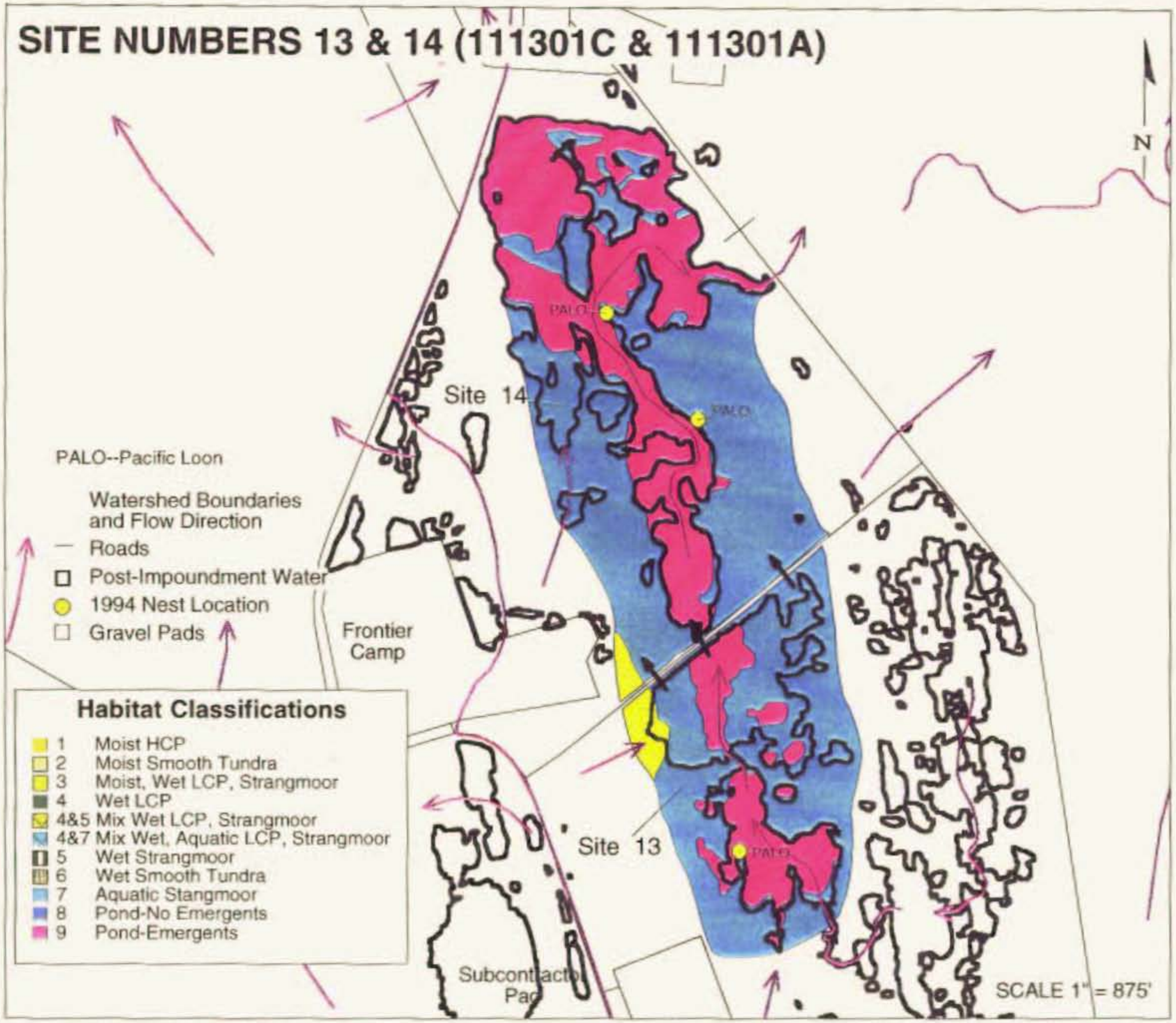


Figure 6. Study Sites 13 and 14 (Impoundments 111301C and 111301A) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 256 birds of 13 species were recorded at Sites 13 and 14 during periods 2, 3 and 4, summer 1994.

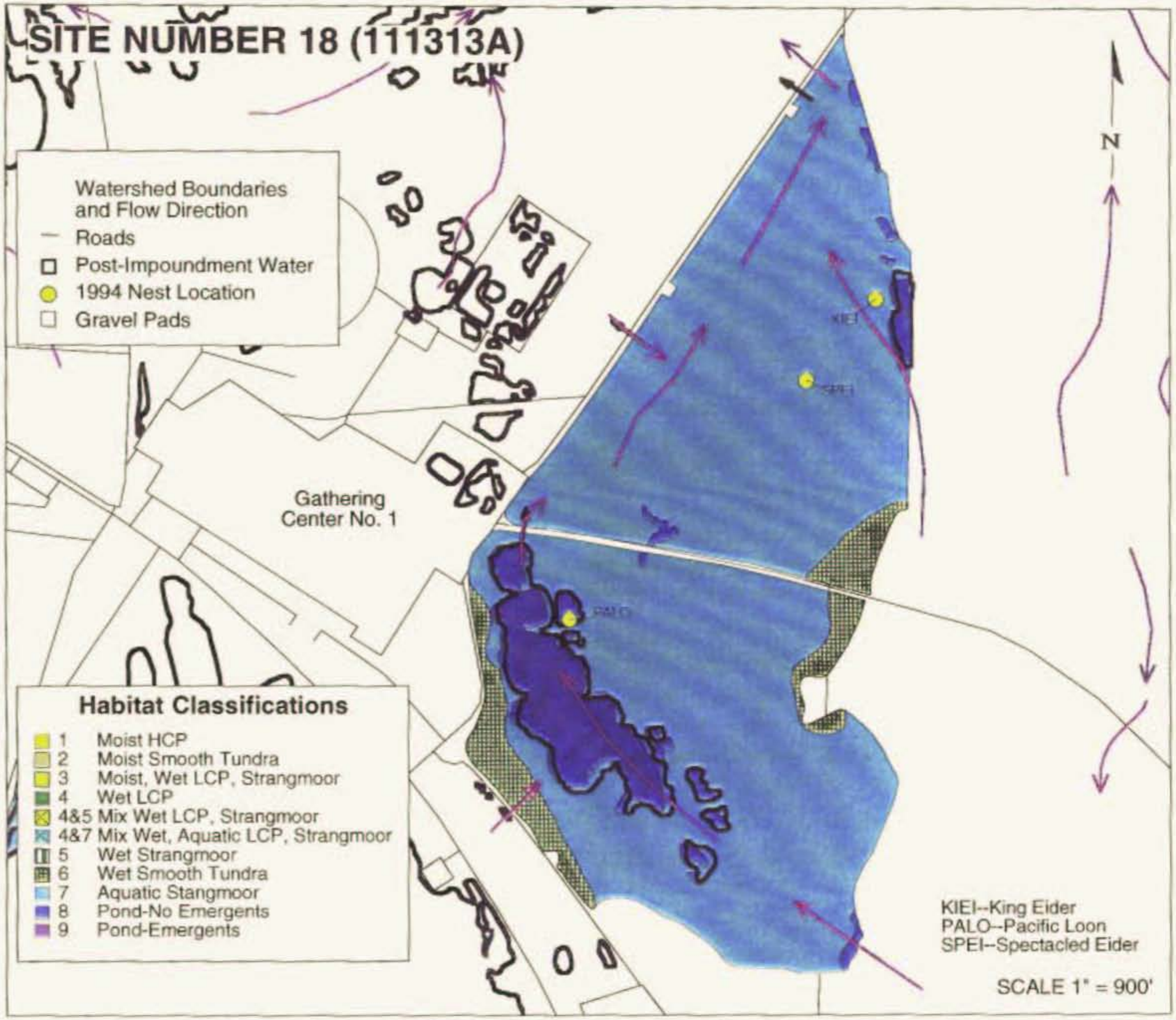


Figure 7. Study Site 18 (Impoundment 111313A) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 341 birds of 13 species were recorded at Site 18 during periods 2, 3 and 4, summer 1994.

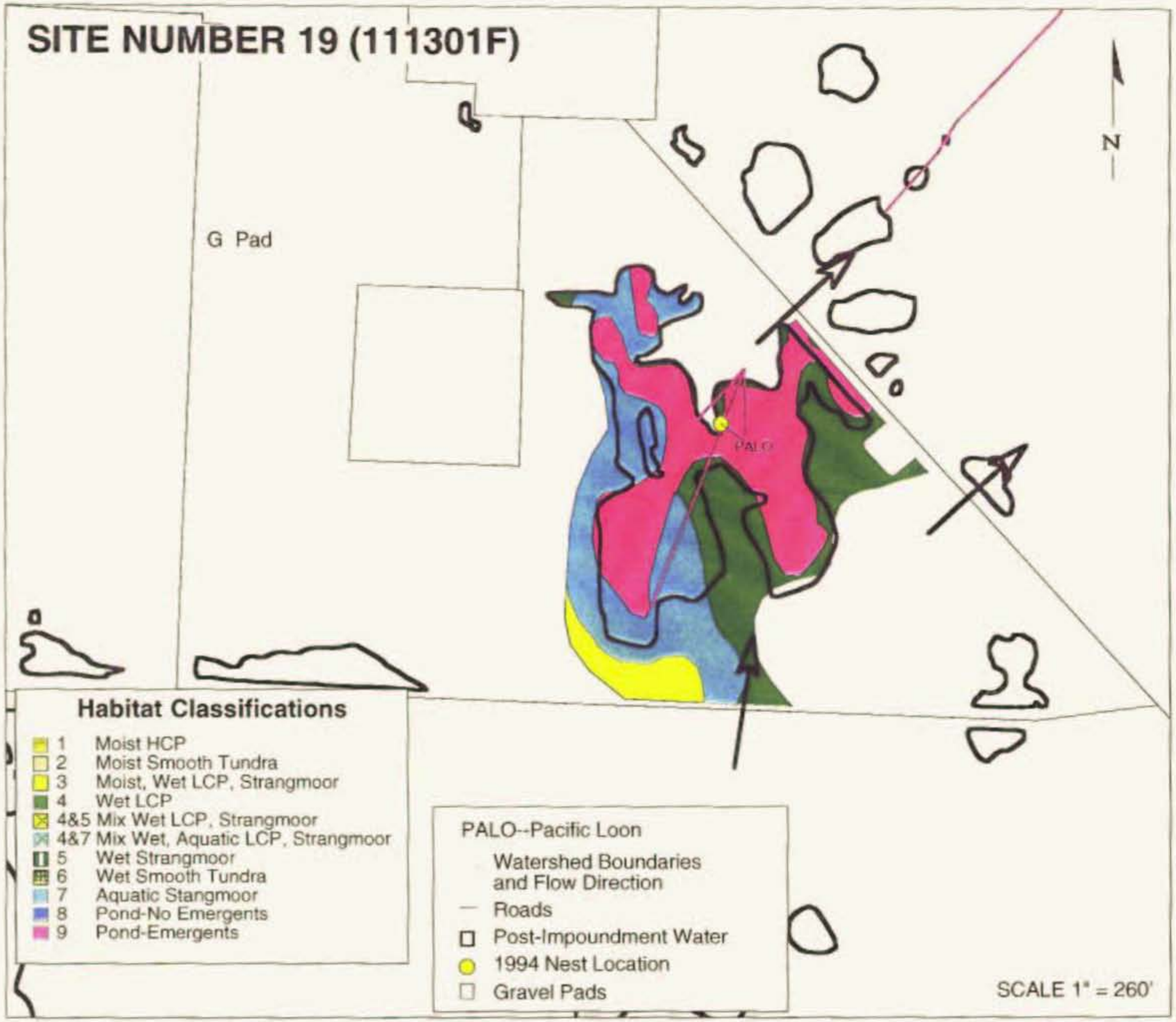


Figure 8. Study Site 19 (Impoundment 111301F) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 110 birds of 13 species were recorded at Site 19 during periods 2, 3, and 4, summer 1994.

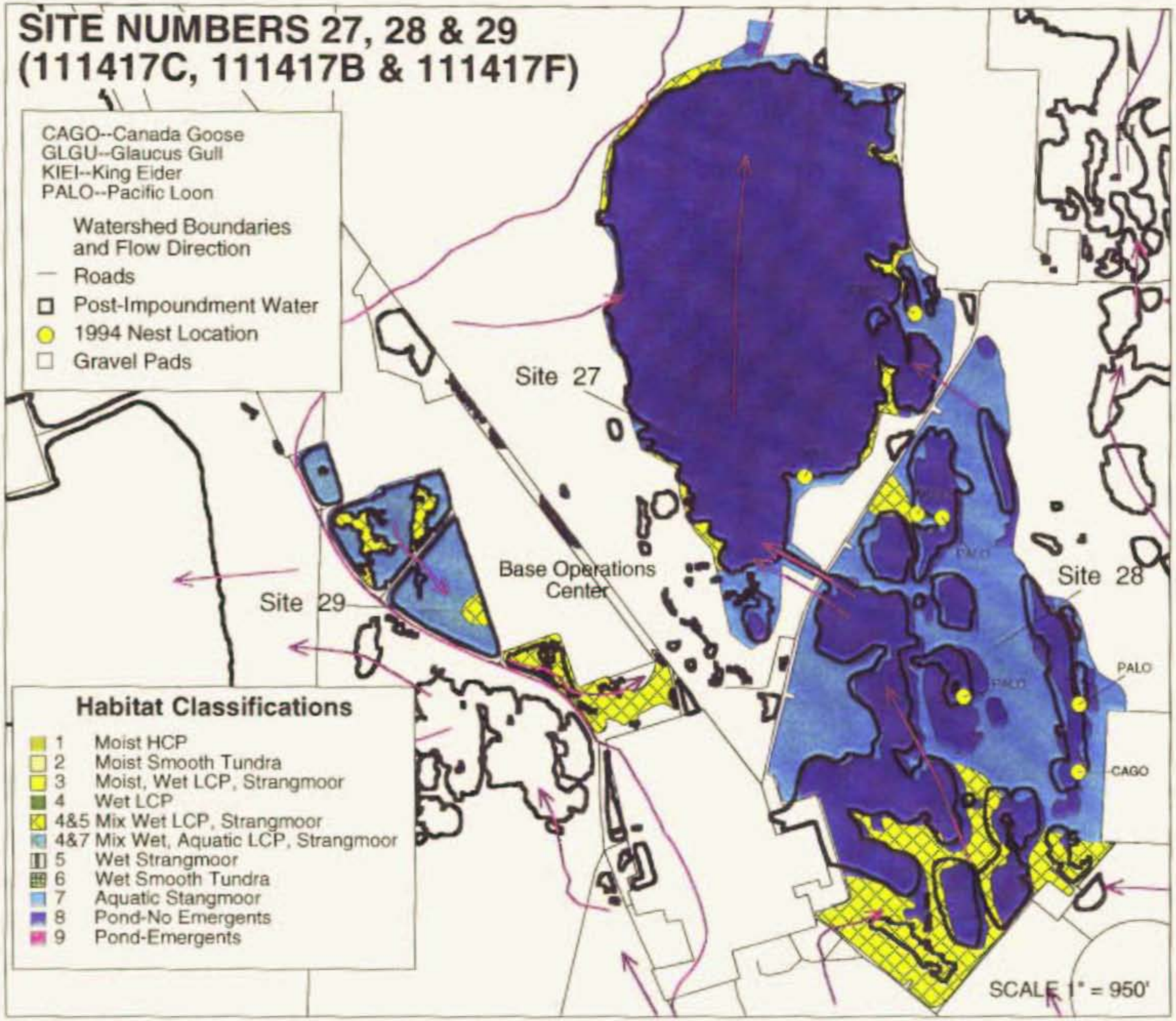


Figure 9. Study Sites 27, 28 and 29 (Impoundments 111417C, 111417B and 111417F) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 548 birds of 21 species were recorded at Sites 27, 28 and 29 during periods 2, 3 and 4, summer 1994.

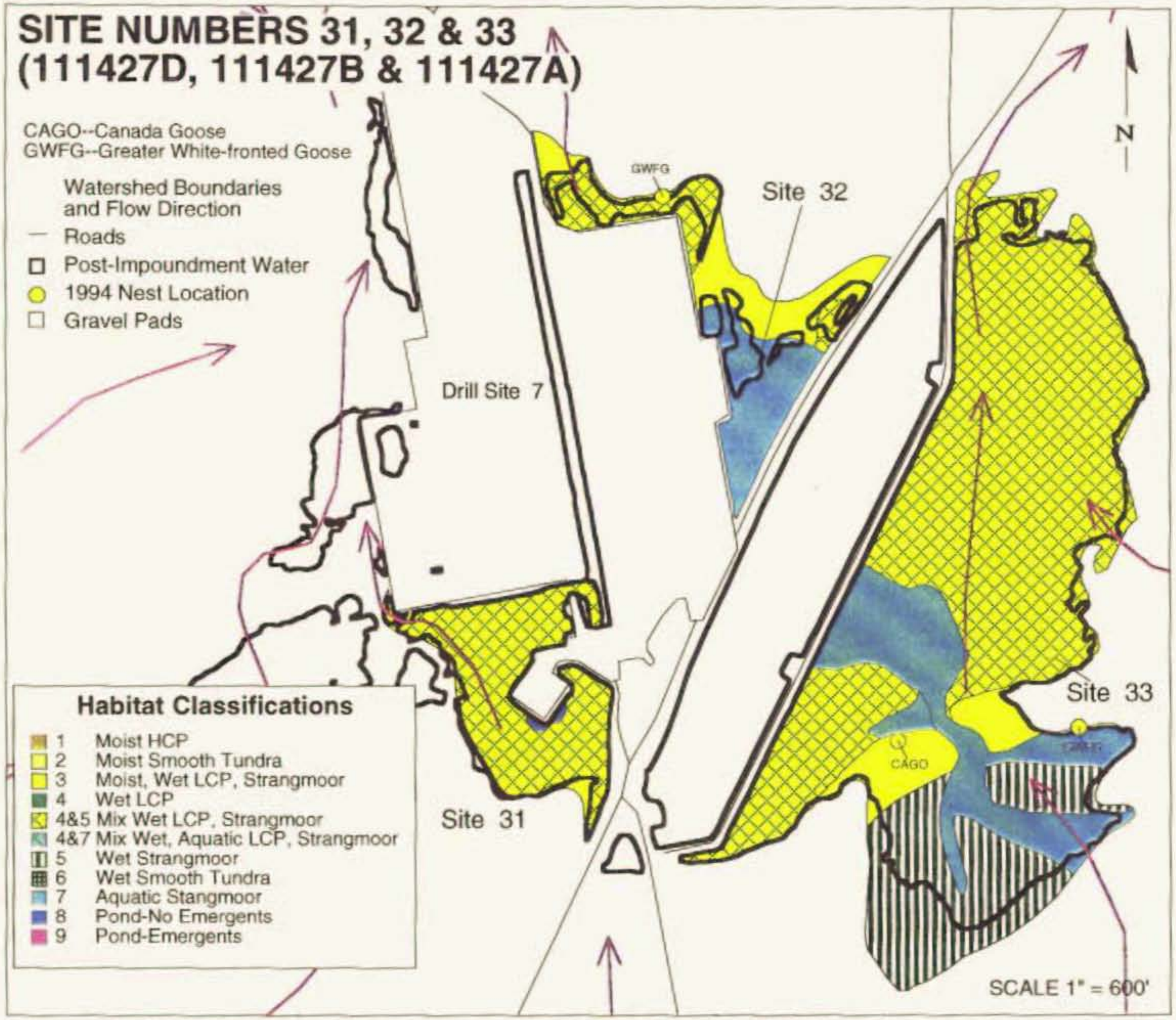


Figure 10. Study Sites 31, 32 and 33 (Impoundments 111427D, 111427B and 111427A) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 193 birds of 15 species were recorded at Sites 31, 32 and 33 during periods 2, 3 and 4, summer 1994.

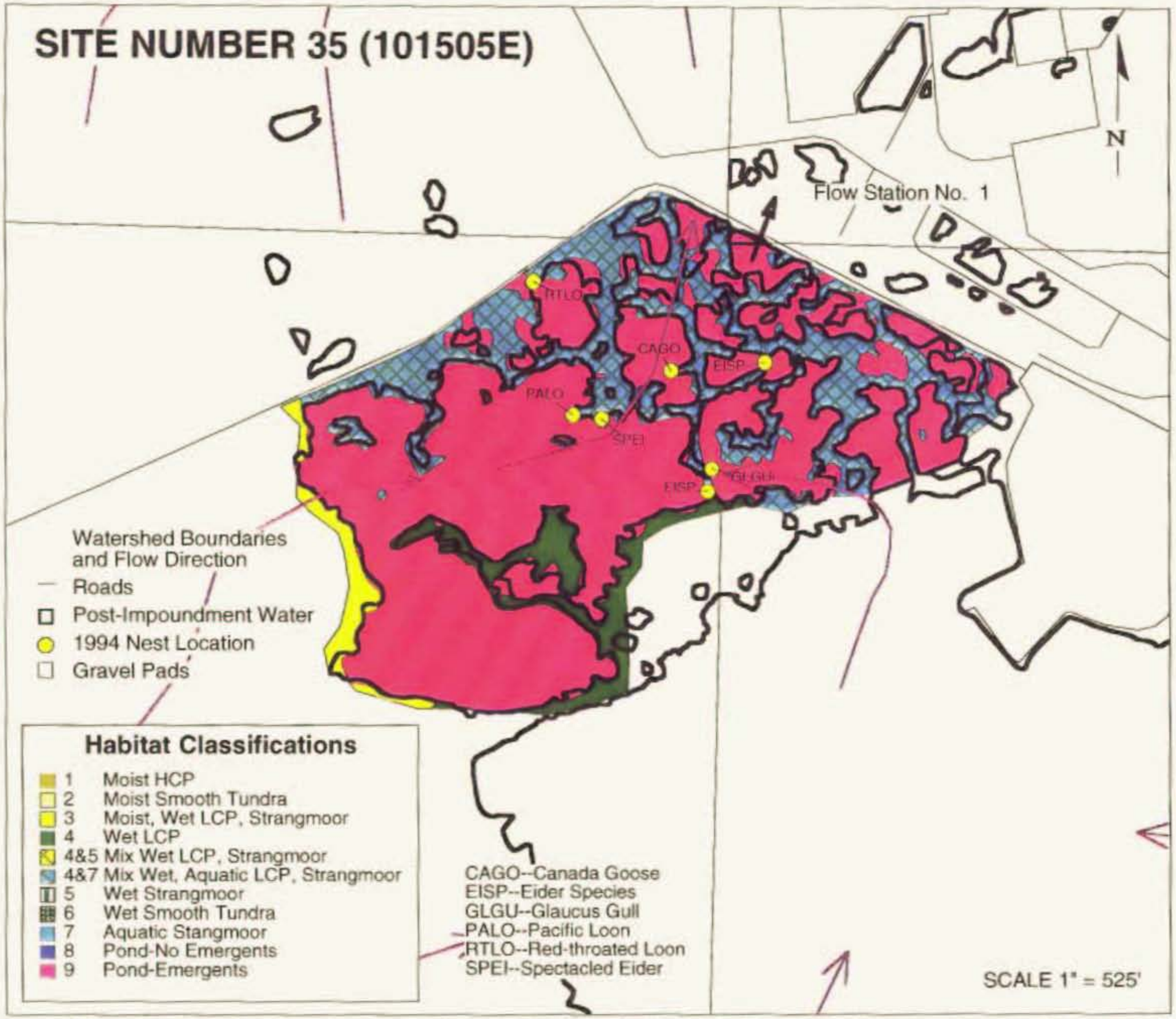


Figure 11. Study Site 35 (Impoundment 101505E) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 167 birds of 14 species were recorded at Site 35 during periods 2, 3 and 4, summer 1994.

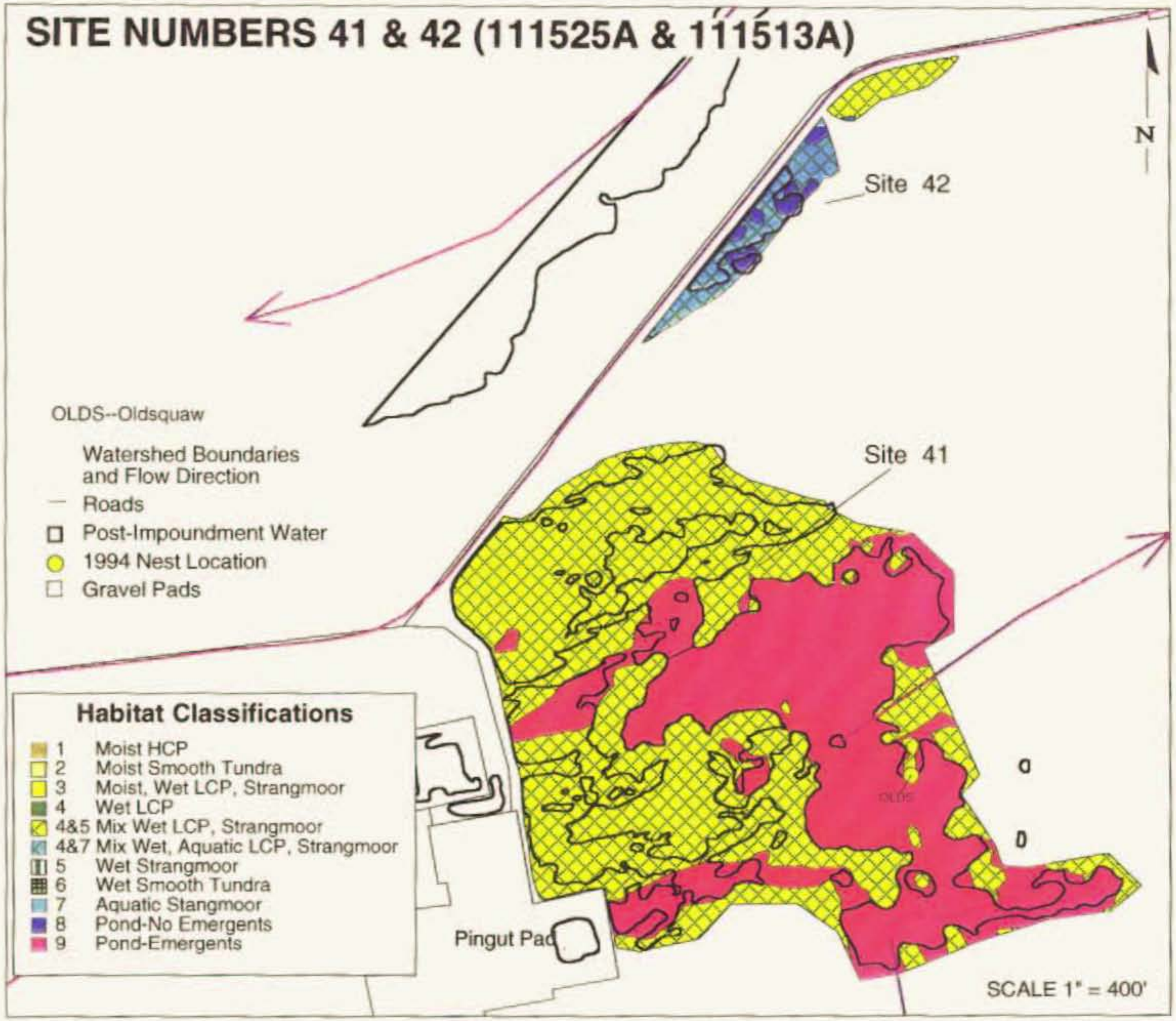


Figure 12. Study Sites 41 and 42 (Impoundments 111525A and 111513A) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 112 birds of 12 species were recorded at Sites 41 and 42 during periods 2, 3 and 4, summer 1994.

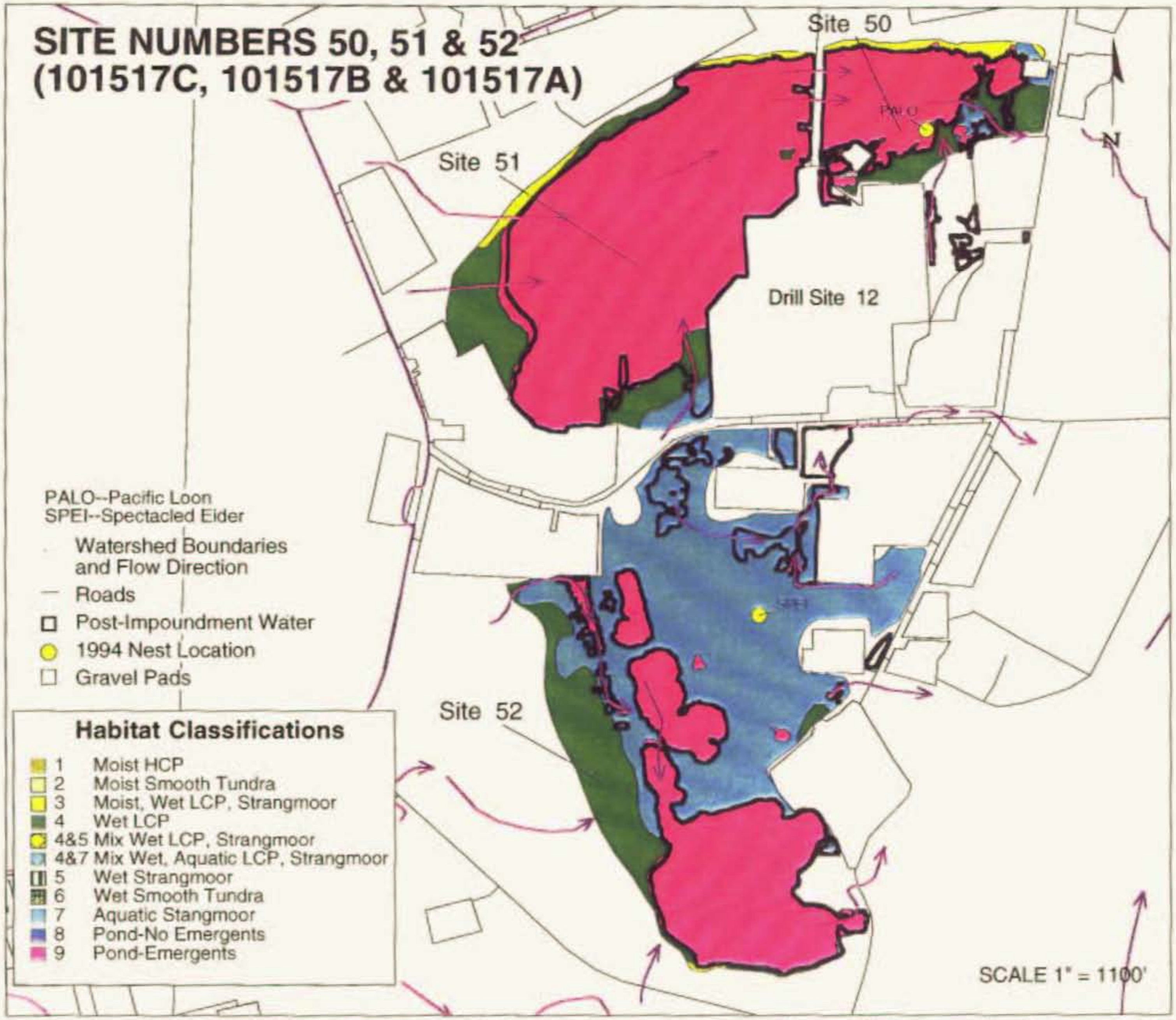


Figure 13. Study Sites 50, 51 and 52 (Impoundments 101517C, 101517B and 101517A) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 939 birds of 21 species were recorded at Sites 50, 51 and 52 during periods 2, 3 and 4, summer 1994.

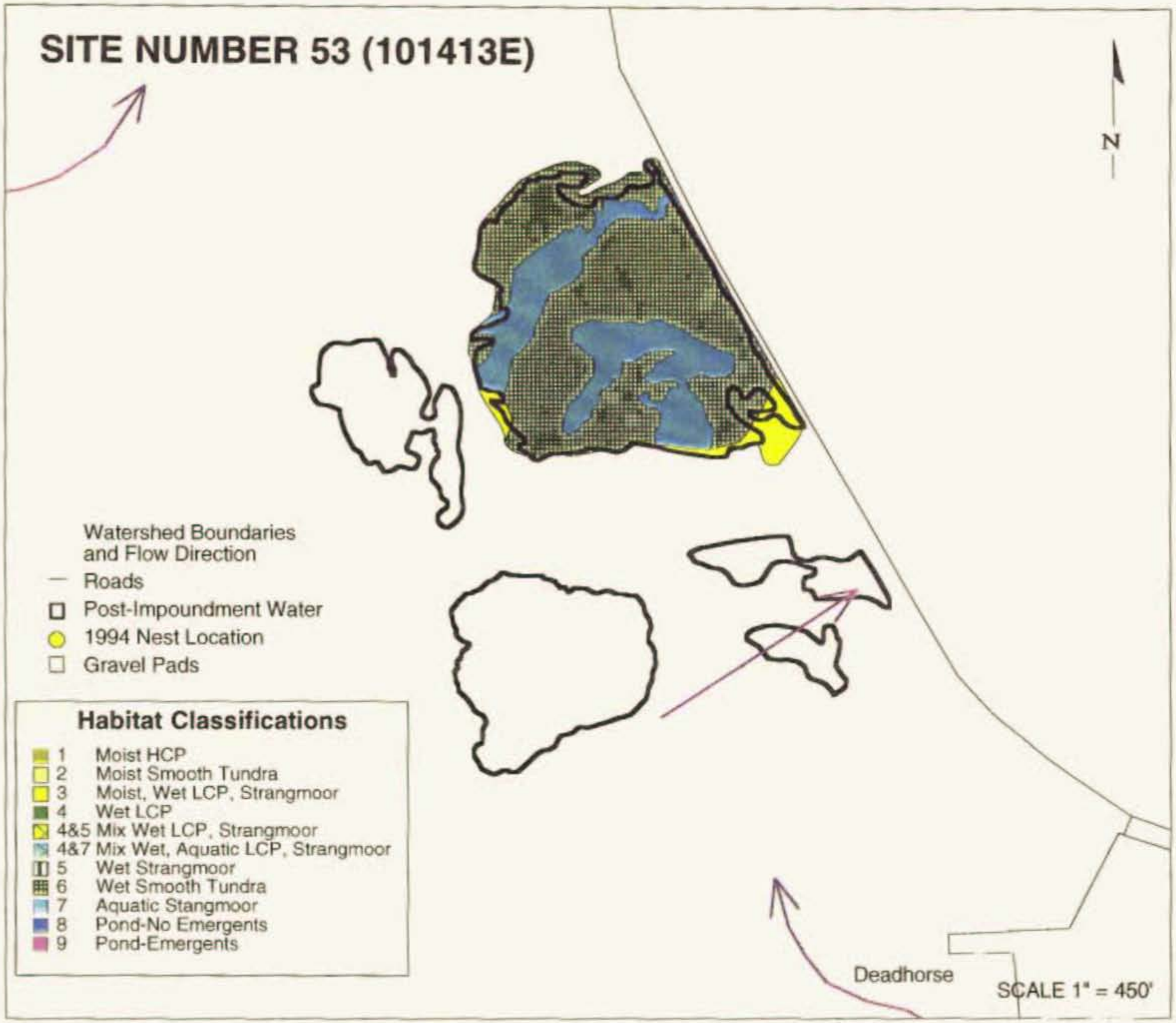


Figure 14. Study Site 53 (Impoundment 101413E) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 102 birds of 10 species were recorded at Site 53 during periods 2, 3 and 4, summer 1994.

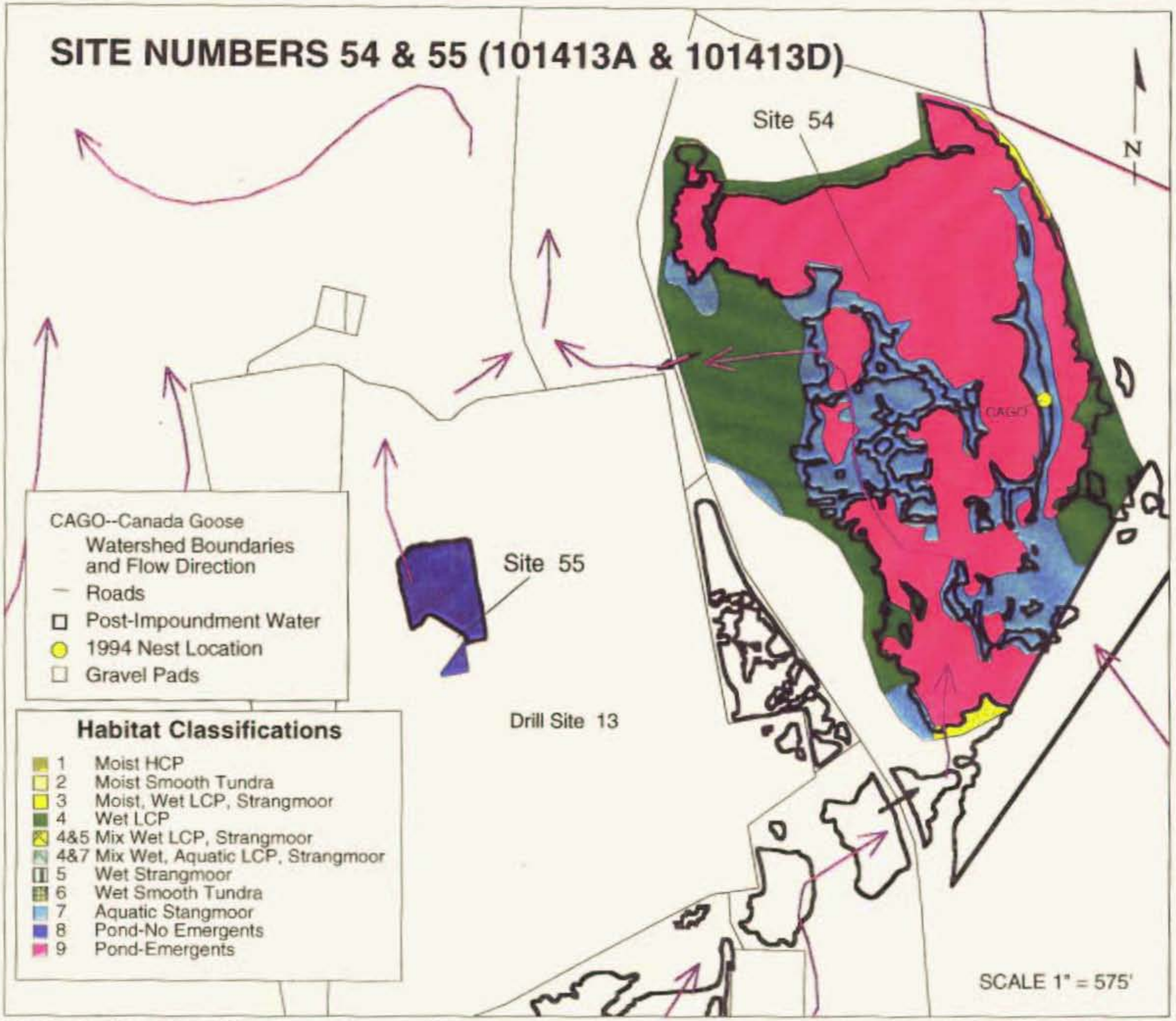


Figure 15. Study Sites 54 and 55 (Impoundments 101413A and 101413D) map showing pre-development habitat mapping based on 1955 aerial photography, post-impoundment open water boundaries based on July 1993 aerial photography, and waterfowl nest locations from summer 1994 field studies in the Prudhoe Bay oil field, Alaska.
A total of 209 birds of 12 species were recorded at Sites 54 and 55 during periods 2, 3 and 4, summer 1994.

Table 9. Comparisons of the weighted mean densities of 14 common bird species and bird nests prior to and after impoundment of tundra habitats in the Prudhoe Bay oil field, Alaska, 1994.

	Mean Number of Birds per sq km						Mean Number of nests per sq km					
Major Species	Pre-Impound.	% of Total	Rank	Post-Impound.	% of Total	Rank	Pre-Impound.	% of Total	Rank	Post-Impound.	% of Total	Rank
Pacific Loon	3.20	1.53	10	10.15	5.88	6	2.19	34.89	1	4.39	60.80	1
Red-throated Loon	1.31	0.62	14	0.28	0.16	13	1.43	22.78	2	0.28	3.88	4
King Eider	6.40	3.06	8	4.01	2.32	8	0.97	15.42	4	0.57	7.89	3
Greater White-fronted Goose	2.45	1.17	12	8.22	4.76	7	0.56	8.97	5	1.84	25.48	2
Oldsquaw	9.54	4.56	7	10.58	6.13	5	1.12	17.94	3	0.14	1.94	5
Red-necked Phalarope	10.00	4.78	6	81.26	47.09	1						
Red Phalarope	28.64	13.68	4	3.64	2.11	9						
Pectoral Sandpiper	36.25	17.32	2	15.49	8.98	3						
Semipalmated Sandpiper	35.96	17.18	3	21.34	12.37	2						
Dunlin	19.43	9.28	5	0.42	0.24	12						
Stilt Sandpiper	1.67	0.80	13	1.04	0.60	10						
Lapland Longspur	47.49	22.68	1	15.30	8.87	4						
Lesser Golden Plover	4.46	2.13	9	0.85	0.49	11						
Buff-breasted Sandpiper	2.54	1.21	11	0.00	0.00	14						

Table 10. Results of regression analyses and paired-sample statistics for weighted mean densities of birds (birds/sq km) in areas affected by impoundments. Pre-impoundment densities were computed from historical bird density data for 11 tundra habitats (Troy 1988, Troy unpublished data), and impoundment densities were based on systematic sampling during three periods at 51 randomly selected impoundments, Prudhoe Bay oil field, Alaska, summer 1994. Densities were also corrected for 1994 variation by a correction factor provided by D. Troy (pers. comm.).

Test	n				Probability (α=0.05)
Simple Regression					
		Equation			
Data uncorrected for 1994 variation. Figure 4.	14	$y = 0.18x + 9.6$		$r^2 = 0.019$	$p = 0.64$
Data corrected for 1994 variation. Figure 5.	14	$y = 0.13x + 6.7$		$r^2 = 0.020$	$p = 0.64$
Mann-Whitney U test		Mean Rank			
		Pre-Impoundment	Post-Impoundment		
Data uncorrected for 1994 variation.	14	16	13	$Z = -0.965$	$p = 0.33$
Data corrected for 1994 variation.	14	16.6	12.4	$Z = -1.332$	$p = 0.18$
Wilcoxon signed rank (paired-sample) test		Mean Rank			
		Positive Rank	Negative Rank		
Data uncorrected for 1994 variation.	14	7.3 (n=10)	8(n=4)	$Z=-1.287$	$p = 0.20$
Data corrected for 1994 variation.	14	7.1(n=11)	9(n=3)	$Z=-1.601$	$p = 0.11$

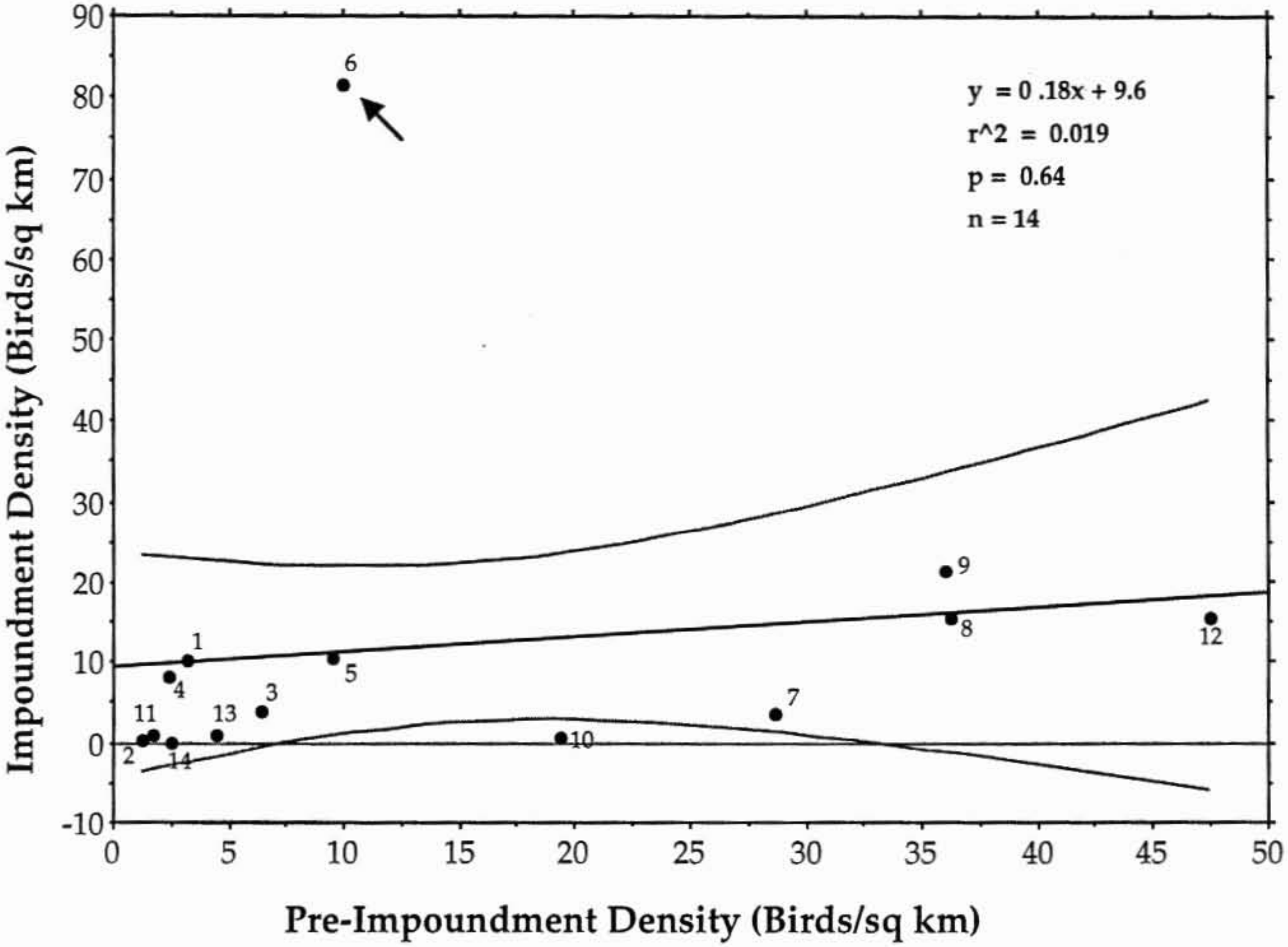


Figure 16. Comparisons of weighted mean densities of birds (birds/sq km) in areas affected by impoundments. Pre-impoundment densities were computed from historical bird density data for 10 typical tundra habitats (Troy 1988, Troy unpub. data), and impoundment densities were based on systematic sampling during three periods at 51 randomly selected impoundments. Numbers next to data points indicate the 14 species of tundra nesting birds used in the comparison: 1=Pacific Loon, 2= Red-throated Loon, 3=King Eider, 4=Greater White-fronted Goose, 5=Oldsquaw, 6=Red-necked Phalarope, 7=Red Phalarope, 8=Pectoral Sandpiper, 9=Semipalmated Sandpiper, 10=Dunlin, 11=Stilt Sandpiper, 12=Lapland Longspur, 13=Lesser Golden Plover, 14=Buff-breasted Sandpiper.

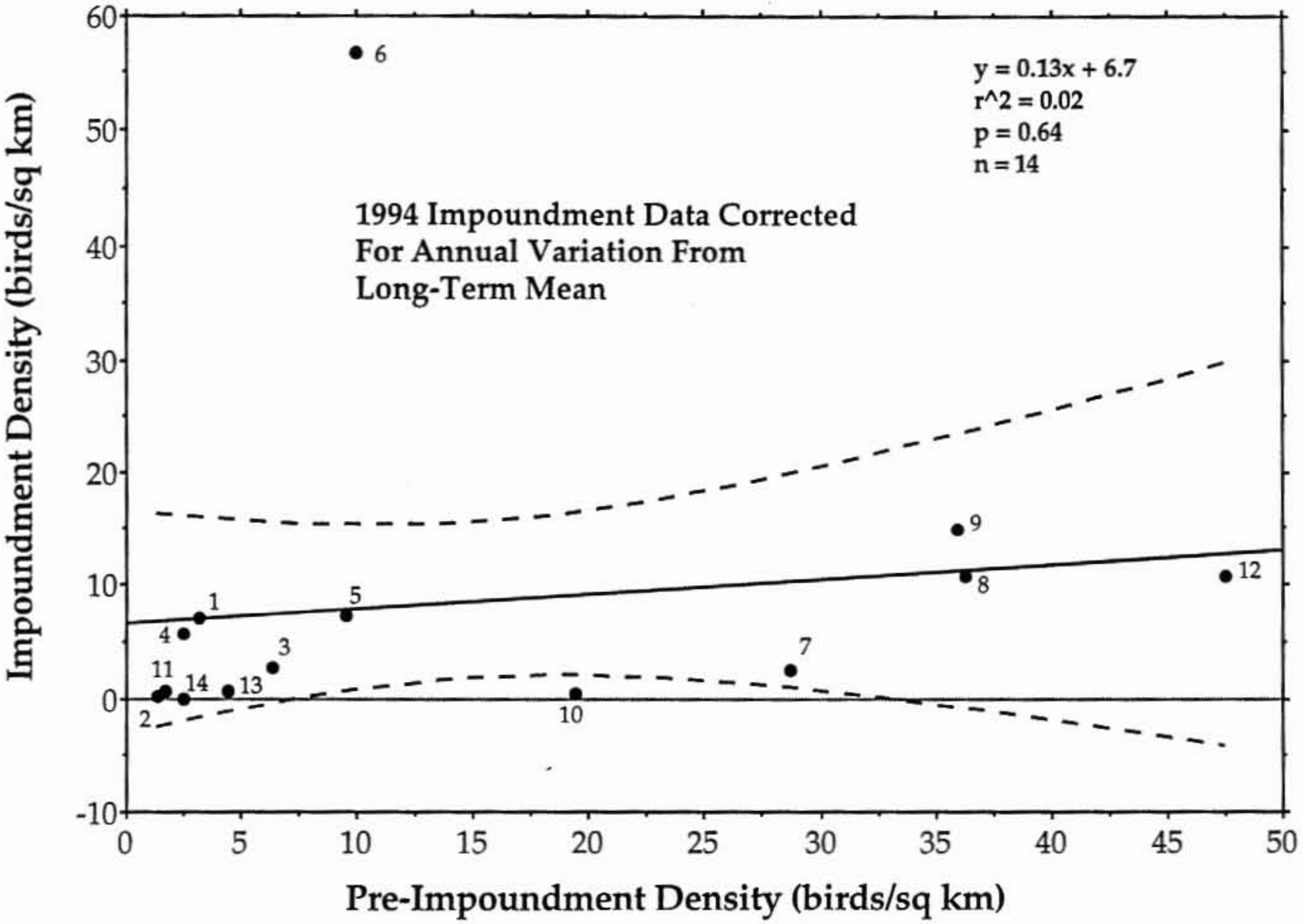


Figure 17. Comparison of corrected weighted mean densities of birds (birds/sq km) in areas affected by impoundments. Pre-impoundment densities were computed from historical bird density data for 10 typical tundra habitats (Troy 1988, Declan Troy unpub. data), and impoundment densities were based on systematic sampling during three periods at 51 randomly selected impoundments. Impoundment densities shown in Figure 4 were corrected for annual variation from the long-term means in Troy (1988) with 1994 densities provided by D. Troy (pers. comm.). Data points represent the same 14 species indicated in Figure 16.

were no significant differences and non-significant regression in bird densities for the pre-impoundment bird densities versus the post impoundment bird densities (Table 10).

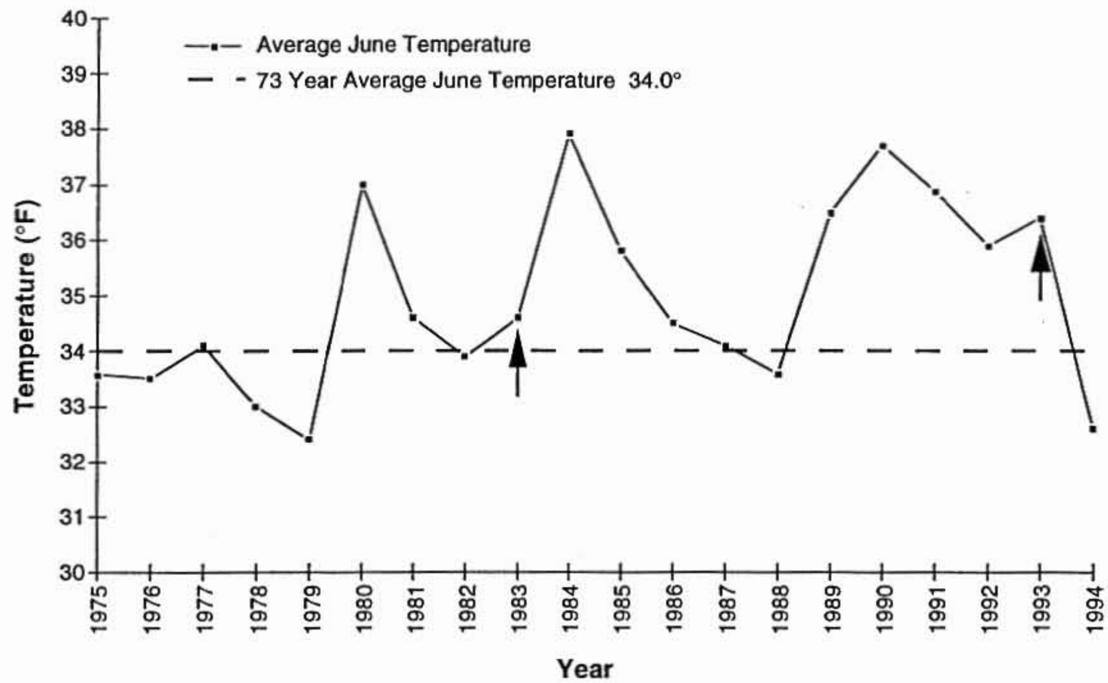
DISCUSSION

Habitat Alteration

The total 11.3 km^2 temporarily and permanently flooded by impoundments in 1993 is less than the comparable 1983 estimate of 14 km^2 reported by Walker et al. (1987). This difference may be due to several factors. Drainage and culvert maintenance throughout the oil field have been improved since Walker et al. (1987) conducted their study. The effects of secondary impacts from impounded water have been reduced in the last decade, and are not as extensive as previously reported. In addition, the 14 km^2 Walker et al. (1987) found was based on 1:24000 scale mapping and was measured using planimetry. Our study was based on 1:6000 scale mapping and GIS calculated areas. The area of pre-development open water within the impoundment flood areas was not determined on the 1:24000 mapping used to calculate the 14 km^2 impact area (Walker et al. 1987) . In this study, we mapped all impoundments larger than 0.0002 km^2 in size at a 1:6000 scale throughout the entire PBOF. Because these values include areas of pre-development open water, they do not accurately represent the tundra area impacted by flooding. In this case, our calculation of 8.0 km^2 temporarily and permanently flooded tundra most accurately describes the area affected by impoundments in the PBOF.

Annual variation in snowfall, precipitation and temperatures during spring thaw, can also influence the progression and extent of flooding during June. To determine if weather conditions were similar in 1983 and 1993, and to determine if these years represent average conditions for the North Slope weather data from Barrow, Alaska, were summarized (NOAA 1995, Fig. 18). Barrow was the closest continuously recording weather station covering 1982 to 1993, which included temperature and precipitation records. Conditions during 1983 were generally drier and cooler than in 1993, suggesting that the extent of flooding during 1993 should have been at least as large as in 1983. These data indicate that conditions during 1993 were higher than average for snowfall, slightly below average for July precipitation and slightly warmer than average in June. These conditions may have led to an increased impoundment flood area over dryer annual conditions. Snowfall and precipitation were similar in 1993 and 1994, when impoundment mapping and bird use were recorded, but June temperature averaged cooler in 1994 (Fig. 18).

On a landscape scale, considering the entire PBOF unit area of 968 km^2, the total area flooded by impoundments represents 1.1% of the PBOF (11.3 km^2 of 968 km^2). The total tundra



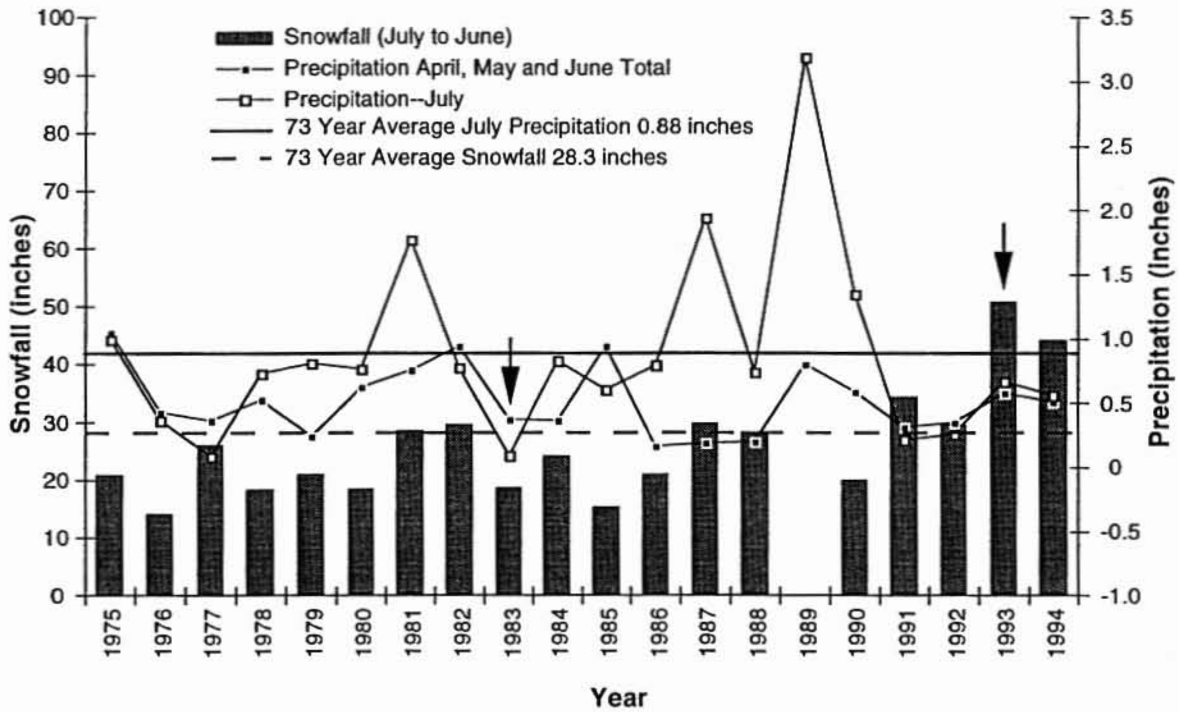


Figure 18. Barrow, Alaska weather station summary for 1975 through 1994 for mean temperature in June, annual (June to July) snowfall, and precipitation (NOAA 1995). Years for impoundment mapping aerial photography were 1983 for Walker et al. (1986) and 1993 for this study.

area affected by impoundments represents 0.8% of the PBOF unit area (8.0 km^2 of 968 km^2). These numbers are representative of the entire unit area, because the entire area was assessed to locate impoundments. Pre-development habitat mapping shows that many impoundments in the PBOF were originally either water bodies or various types of aquatic tundra. Habitat alterations caused by impoundments have predominately altered aquatic and wet habitats by retaining additional melt water. Similarly, Walker et al. (1987) found most impoundment flooding occurred in drained lake basins. Of the 11.3 km^2 altered by impoundments, 3.3 km^2 was open water prior to development and 4.2 km^2 was probably aquatic strangmoor; both of these habitats retain natural standing water throughout the summer, and are augmented by flooding (Appendix A, Table A-1). In fact, lakes, ponds, and aquatic tundra represented 74% of the historical habitats currently affected by impoundments (Table 3). In addition, most of the tundra area which is currently affected by impounded water is flooded only temporarily, and most has drained by mid-July (6.0 km^2 temporary versus 2.0 km^2 permanently flooded tundra, Appendix A, Table A-1)).

It seems likely that the impounding currently present in the PBOF may have only moderately altered pre-development habitats. Based on pre-development habitat mapping at the 51 bird use sites, 59% of the tundra area affected by impoundments was aquatic strangmoor which may normally contain standing water into July (Table 3). Comparison of pre-development habitats covered by the maximum flood area (11.3 km^2) with Walker et al. (1987) findings also indicates that a substantial portion (49%) of the area covered by impoundments was historically aquatic tundra (Fig. 19). Walker's analysis indicates that larger portions of wet (42%) and moist tundra (8%) were affected by impoundments, however it is unclear if the area of pre-development water was removed from consideration (Walker et al. 1987). If we consider only the area of tundra affected by impoundments in 1993 (Fig. 19), the proportion of wet and moist tundra are more similar to Walker's evaluation (Walker et al. 1987).

Wet tundra (2.96 km^2, 37%) and moist tundra (0.34 km^2, 4%) categories may represent the largest change in habitat within the PBOF (Table 3, Fig. 19). For the temporarily flooded tundra areas, increased water retention tends to make moist and wet vegetation categories, wet and aquatic categories. This generally leads to a reduction in vegetation diversity favoring *Arctophila fulva* and *Carex aquatilis* in the wettest areas. However, these areas represent a very small portion, 0.3%, of the entire PBOF unit. For the areas where permanent open water has been added, previous comparative impoundment studies of productivity and waterbird use indicated that although there is a great deal of diversity between individual impoundments and individual natural ponds, they may be functionally equivalent (Kertell 1993, Kertell 1994). The primary difference

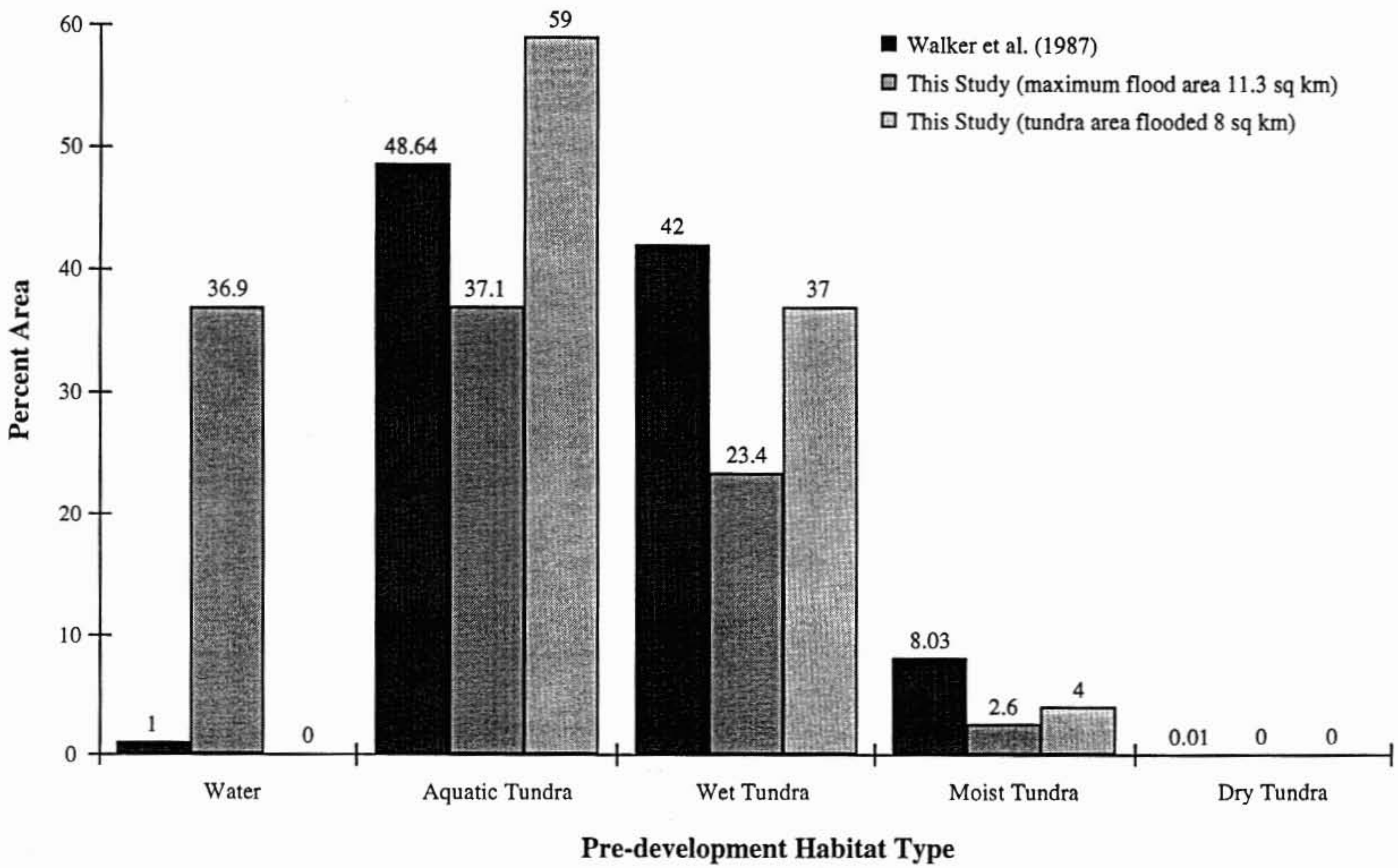


Figure 19. Comparison of pre-development habitat types covered by flooding from Walker et al. (1987) and this study. Walker et al. (1987) estimates are based on 63 sq km of 1:6000 scale mapping within the Prudhoe Bay oil field, vegetation types are from July 1949 black and white 1:24000 scale aerial photography, and flood areas are from July 1983 natural color 1:18000 aerial photography.

between impoundments and natural ponds was in the amount and timing of water level fluctuations (Kertell 1994).

Bird Use of Impounded Sites

In contrast to the perception that impoundments may restrict nesting and effectively displace birds in the PBOF (Walker et al. 1987; NRDC 1991), we found 17 species to nest in impounded areas. These results are not unexpected; many impounded areas are also natural water bodies, pond complexes, or drained lake basins which now retain some additional melt water which either drains by mid-summer or remains throughout the summer. Many of the nests recorded in impoundments, primarily those of geese and ducks, were located on small islands and peninsulas within pond complexes, and others, primarily those of loons and phalaropes, were in emergent vegetation. In addition, we recorded 37 species using impounded sites for foraging. The Spectacled Eider, currently listed federally as a Threatened Species, was recorded feeding and nesting in impounded sites (Appendix B, Table B-1). Studies of Spectacled Eiders in the PBOF (TERA 1995) and elsewhere (Bergman et al. 1977, Derksen et al. 1981) document use of shallow *Carex*-lined ponds and deep lakes by Spectacled Eiders. These habitat characteristics were typical of the impoundments used by Spectacled Eiders in this study (Table 5 and 6).

To evaluate habitat changes within impoundments, we compared bird densities obtained in summer 1994 with expected densities based on the historical habitat composition (as of 1955) in the impounded sites we sampled. For the Wilcoxon and Mann-Whitney U tests, no significant differences were found between pre-development calculated bird densities and post-development measured bird densities. These analyses are designed to detect unidirectional changes; either consistent increases or consistent decreases. Pre-impoundment and impoundment bird densities, while generally showing a decrease in density, exhibit bi-directional changes with large increases for a few species, and decreases for others. The changes for individual species show that Pacific Loons, Greater White-fronted Geese, Red-necked Phalaropes, (and, in the uncorrected data set, Oldsquaw) increased in abundance in impounded areas. These species are attracted to habitat types with permanent water (Troy 1988). The remaining 10 species decreased in abundance in impounded areas. Of the species which decreased in abundance, several prefer drier habitats: Lapland Longspurs, Lesser Golden-Plovers, and Buff-breasted Sandpipers (Troy 1988). Although these differences must be interpreted with caution considering the high variability in bird densities typically found in the PBOF (TERA 1993), they suggest that the increased flooding from impoundments has attracted species which prefer permanent water and emergent vegetation, and has displaced species which may have used the drier habitats in impoundments which are now flooded.

The regression analyses do not show a significant relationship between the bird densities currently found in PBOF impoundments and those expected in the pre-development habitats. In agreement with the results discussed above, the lack of a positive correlation between the two data sets suggests some habitat alteration. The point for Red-necked Phalaropes is a statistical outlier (Figs. 16 and 17) and, when this point is removed, the correlations are significant and positive. This suggests that perhaps the most substantial change is the large increase in sightings of Red-necked Phalaropes in impounded areas. Because Red-necked Phalaropes are naturally more common in the PBOF than in more coastal sites (TERA 1993), and because the bird densities used to produce pre-development expected values are biased towards data from more coastal sites, we would expect *a priori to* find more Red-necked Phalaropes in the oil field area. This coastal bias in the pre-development density estimates cannot completely explain the large increase in sightings of Red-necked Phalaropes, however, because three other species, Semipalmated Sandpiper, Stilt Sandpiper, and Lapland Longspur (TERA 1993), are also naturally more abundant in the oil field than they are at coastal sites, and these species are all within the 95% confidence bounds for the regression lines (Figs. 16 and 17). Thus, one of the most significant effects of impounding in the PBOF may be the attraction of Red-necked Phalaropes to impoundments.

CONCLUSIONS

This study evaluated the extent and affect of impoundments on bird habitat and bird use in the PBOF.

- Most impoundments generally occur in areas with natural lakes and ponds, specifically drained lake basins, and their effect is to cause a retention of melt water.

- Open water and aquatic tundra were 74% of the pre-development habitats affected by impoundments. These habitats normally may retain water into July.

- Although impoundments have altered bird habitat in the PBOF, the area of permanently and temporarily flooded tundra, 8.0 km^2, represents only 0.8% of the PBOF unit area.

- Thirty-seven species of birds were recorded at impoundments, and 17 species, including Spectacled Eiders (which are federally listed as a Threatened Species), nested on impoundments. Shorebird density was 59%, waterfowl density was 23%, and duck density was 15% of the density of all bird combined

- Impoundments generally support higher waterfowl and lower shorebird and passerine densities than pre-development habitats, but bird habitat density relationships are highly variable and these trends were not statistically significant.

- The most substantial change from pre-development conditions was an eight-fold increase in Red-necked Phalaropes in impounded areas.

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LIST OF APPENDIXES

APPENDIX A

DATABASE OF IMPOUNDMENTS IN THE PRUDHOE BAY OIL FIELD, ALASKA, 1994

Table A-1 Geographic Information System impoundment database, file name "Imp flood," for all impoundments mapped in Figure 2. Each record is associated with a mapped flood area polygon, data fields are; ID--bird use study site numbers, ImpNo--individual impoundment identifiers, Prewater--area of open water within flood polygon based on 1955 aerial photography, Postwater--area of open water within flood polygon based on 1993 aerial photography, Source--data used to define flood polygons (p=aerial photography, f=field study, w=post-development water boundary, s=area sampled for bird use), Impact--tundra area covered by permanent or temporary flooding (Area-Prewater=Impact).

ID	ImpNo	Prewater	Postwater	Area	Source	Impact
0	101401A	0.000	0.013	0.031	p	0.031
56	101401B	0.001	0.002	0.007	f	0.006
0	101403A	0.000	0.005	0.010	p	0.010
0	101403D	0.013	0.017	0.063	p	0.050
30	101405A	0.000	0.071	0.104	f	0.104
54	101413A	0.132	0.191	0.271	f	0.139
0	101413B	0.000	0.013	0.020	p	0.020
55	101413D	0.010	0.009	0.010	p	0.000
53	101413E	0.000	0.054	0.061	p	0.061
0	101413F	0.000	0.008	0.066	p	0.066
0	101425A	0.001	0.018	0.056	p	0.055
0	101425B	0.001	0.029	0.041	p	0.040
44	101501A	0.000	0.048	0.059	p	0.059
49	101501B	0.000	0.006	0.008	f	0.008
36	101503A	0.007	0.009	0.030	p	0.023
0	101503A	0.002	0.016	0.018	p	0.016
0	101503B	0.000	0.000	0.005	p	0.005
0	101503B	0.004	0.006	0.018	p	0.014
43	101503C	0.001	0.006	0.014	f	0.013
0	101503E	0.003	0.002	0.073	p	0.070
0	101503E	0.001	0.009	0.015	p	0.014
0	101503F	0.000	0.010	0.022	p	0.022
37	101503G	0.024	0.023	0.059	p	0.035
0	101505C	0.012	0.006	0.035	p	0.023
0	101505D	0.003	0.003	0.016	p	0.013
35	101505E	0.155	0.161	0.235	s	0.080
0	101505F	0.013	0.010	0.032	p	0.019
0	101505F	0.003	0.000	0.005	p	0.002
57	101505G	0.000	0.000	0.018	p	0.018
0	101513A	0.000	0.007	0.012	p	0.012
0	101513B	0.002	0.003	0.013	p	0.011
0	101513B	0.002	0.002	0.006	p	0.004
0	101515A	0.002	0.010	0.026	p	0.024

Table A-1. Continued.

ID	ImpNo	Prewater	Postwater	Area	Source	Impact
0	101515B	0.000	0.005	0.007	p	0.007
46	101515C	0.000	0.011	0.017	p	0.017
47	101515D	0.013	0.030	0.031	p	0.018
48	101515E	0.009	0.029	0.045	p	0.036
48	101515E	0.000	0.000	0.007	p	0.007
0	101515F	0.002	0.006	0.016	p	0.014
45	101515G	0.019	0.037	0.048	p	0.029
0	101515G	0.005	0.007	0.009	p	0.004
52	101517A	0.182	0.175	0.586	f	0.404
51	101517B	0.345	0.352	0.426	f	0.081
50	101517C	0.086	0.085	0.134	f	0.048
0	101529A	0.002	0.002	0.004	p	0.002
0	101529A	0.014	0.014	0.022	p	0.008
0	101603B	0.002	0.003	0.006	p	0.004
0	101603C	0.002	0.000	0.005	p	0.003
0	101603C	0.000	0.001	0.003	p	0.002
0	101605A	0.010	0.010	0.022	p	0.012
0	101629A	0.000	0.004	0.009	p	0.009
0	101629A	0.035	0.114	0.132	p	0.097
0	111201A	0.007	0.021	0.042	p	0.035
0	111203C	0.002	0.003	0.005	p	0.003
0	111203D	0.002	0.003	0.010	p	0.008
6	111203E	0.000	0.002	0.005	p	0.005
6	111203E	0.000	0.000	0.005	p	0.005
0	111203G	0.000	0.002	0.008	p	0.008
0	111205A	0.000	0.000	0.003	p	0.003
2	111205A	0.005	0.005	0.009	p	0.004
0	111205A	0.003	0.002	0.011	p	0.008
0	111213B	0.006	0.016	0.051	p	0.045
0	111213C	0.000	0.002	0.003	p	0.003
0	111215A	0.002	0.003	0.007	p	0.005
0	111215A	0.005	0.005	0.011	p	0.006
0	111215B	0.003	0.004	0.015	p	0.012
0	111215C	0.004	0.004	0.010	p	0.006
0	111215D	0.001	0.002	0.009	p	0.008
0	111215E	0.001	0.004	0.013	p	0.012
0	111215F	0.001	0.002	0.017	p	0.016
3	111215G	0.160	0.411	0.615	f	0.455
0	111215H	0.003	0.003	0.032	p	0.029
0	111217A	0.000	0.008	0.014	p	0.014
14	111301A	0.149	0.179	0.370	f	0.221
0	111301B	0.005	0.014	0.026	p	0.021
13	111301C	0.049	0.096	0.199	f	0.150
19	111301F	0.009	0.015	0.025	f	0.016
0	111303A	0.000	0.005	0.015	p	0.015

Table A-1. Continued.

ID	ImpNo	Prewater	Postwater	Area	Source	Impact
0	111303A	0.000	0.002	0.009	p	0.009
0	111303B	0.001	0.009	0.038	p	0.037
12	111303C	0.266	0.256	0.462	f	0.196
0	111305A	0.005	0.012	0.012	p	0.007
0	111305A	0.001	0.012	0.037	p	0.036
18	111313A	0.081	0.072	0.468	f	0.387
0	111313B	0.000	0.001	0.011	p	0.011
0	111313B	0.000	0.000	0.025	p	0.025
0	111313C	0.000	0.003	0.007	p	0.007
0	111313C	0.003	0.003	0.019	p	0.016
18	111313C	0.000	0.000	0.415	f	0.415
0	111313C	0.000	0.002	0.002	p	0.002
0	111313D	0.068	0.080	0.780	f	0.712
0	111313G	0.063	0.061	0.104	p	0.041
0	111313H	0.002	0.003	0.021	p	0.019
17	111313I	0.006	0.027	0.041	p	0.035
0	111313J	0.000	0.000	0.002	p	0.002
0	111313J	0.004	0.009	0.016	p	0.012
11	111315A	0.012	0.016	0.037	f	0.025
0	111315B	0.011	0.016	0.025	p	0.014
10	111315C	0.083	0.100	0.117	s	0.034
0	111315D	0.014	0.000	0.032	p	0.018
0	111315E	0.002	0.007	0.014	p	0.012
9	111315F	0.000	0.000	0.008	p	0.008
9	111315F	0.026	0.033	0.053	p	0.027
0	111315G	0.005	0.010	0.024	p	0.019
0	111325A	0.023	0.037	0.053	p	0.030
0	111325B	0.002	0.006	0.035	p	0.033
0	111325B	0.006	0.006	0.042	p	0.036
0	111327A	0.001	0.008	0.017	p	0.016
0	111327B	0.026	0.028	0.055	p	0.029
0	111329A	0.004	0.018	0.040	p	0.036
0	111329B	0.002	0.003	0.033	p	0.031
24	111401A	0.000	0.003	0.014	f	0.014
59	111401B	0.000	0.005	0.032	f	0.032
0	111401C	0.031	0.045	0.071	w	0.040
25	111401D	0.000	0.039	0.044	p	0.044
0	111401E	0.000	0.003	0.009	p	0.009
0	111401E	0.003	0.002	0.037	p	0.034
0	111401F	0.001	0.004	0.013	p	0.012
0	111403A	0.018	0.043	0.222	p	0.204
0	111405A	0.010	0.011	0.053	p	0.043
20	111405B	0.001	0.006	0.039	f	0.038
0	111405C	0.003	0.007	0.027	p	0.024
0	111413A	0.000	0.008	0.038	p	0.038

Table A-1. Continued.

ID	ImpNo	Prewater	Postwater	Area	Source	Impact
0	111413B	0.000	0.008	0.009	p	0.009
0	111413C	0.000	0.005	0.007	p	0.007
0	111415A	0.002	0.024	0.055	p	0.053
28	111417B	0.200	0.195	0.472	p	0.272
27	111417C	0.415	0.416	0.478	f	0.063
0	111417D	0.002	0.009	0.013	p	0.011
29	111417F	0.000	0.000	0.007	p	0.007
29	111417F	0.000	0.000	0.022	p	0.022
29	111417F	0.000	0.000	0.029	p	0.029
29	111417F	0.000	0.056	0.031	p	0.031
0	111425A	0.007	0.053	0.091	p	0.084
0	111425A	0.001	0.005	0.013	p	0.012
0	111425B	0.012	0.003	0.022	p	0.010
0	111425C	0.003	0.003	0.007	p	0.004
34	111425D	0.002	0.005	0.008	f	0.006
0	111425E	0.000	0.003	0.003	p	0.003
33	111427A	0.000	0.212	0.243	f	0.243
32	111427B	0.000	0.013	0.042	f	0.042
31	111427D	0.001	0.035	0.038	f	0.037
0	111427F	0.014	0.011	0.030	p	0.016
0	111427G	0.016	0.082	0.091	p	0.075
0	111429C	0.000	0.011	0.107	p	0.106
0	111429D	0.004	0.007	0.021	p	0.017
42	111513A	0.000	0.000	0.002	f	0.002
42	111513A	0.001	0.002	0.006	f	0.005
0	111515A	0.011	0.014	0.023	p	0.012
0	111517A	0.000	0.005	0.011	p	0.011
0	111517B	0.001	0.002	0.014	p	0.013
41	111525A	0.057	0.085	0.134	f	0.077
0	111525B	0.000	0.017	0.021	p	0.021
0	111525C	0.002	0.010	0.013	p	0.012
40	111525D	0.012	0.092	0.100	p	0.088
0	111527A	0.000	0.017	0.024	p	0.024
0	111527B	0.016	0.017	0.042	p	0.026
0	111527C	0.000	0.021	0.041	p	0.041
38	111527D	0.038	0.047	0.149	f	0.111
0	111529A	0.014	0.033	0.069	p	0.055
0	121225A	0.002	0.008	0.027	p	0.025
7	121225B	0.000	0.004	0.006	f	0.006
8	121225C	0.024	0.030	0.050	p	0.026
0	121327A	0.006	0.003	0.035	p	0.029
0	121329A	0.005	0.010	0.044	p	0.039
23	121425A	0.019	0.052	0.098	f	0.079
0	121425D	0.013	0.053	0.083	p	0.070
0	121425E	0.001	0.002	0.003	p	0.002

Table A-1. Continued.

ID	ImpNo	Prewater	Postwater	Area	Source	Impact
22	121427A	0.001	0.009	0.010	p	0.009
0	121427B	0.077	0.086	0.215	p	0.138
0	121427C	0.000	0.006	0.009	p	0.009
21	121427D	0.001	0.004	0.018	f	0.017
Area Totals (sq km)		3.298	5.262	11.258		7.960

APPENDIX B

NUMBERS AND DENSITIES OF BIRD SPECIES USING IMPOUNDMENTS AT STUDY SITES IN THE PRUDHOE BAY OIL FIELD, ALASKA, 1994

Table B-1. Impoundment characteristics and numbers and densities of species of birds recorded on impoundments in the Prudhoe Bay area during 1994.

Site Number	Impound. Number	Impound. Area (sq km)	Area of Open Water (sq km)	Area of Tundra (sq km)	Pacific Loon n	Total	#/ sq km	Total Nests	Nests/ sq km	Red-throated Loon n	Total	#/ sq km	Total Nests	Nests/ sq km	King Eider n	Total	#/ sq km	Total Nests	Nests/ sq km	Greater White-fronted Goose n	Total	#/ sq km	Total Nests	Nests/ sq km	Oldsquaw n	Total	#/ sq km	Total Nests	Nests/ sq km
2	111205A	0.009	0.005	0.003	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	38.99	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
3	111215G	0.615	0.411	0.204	21	27	14.63	6	9.75	0	0	0.00	0	0.00	9	15	8.13	0	0.00	26	37	20.05	6	9.75	7	9	4.88	0	0.00
6	111203E	0.010	0.002	0.008	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
7	121225B	0.006	0.004	0.002	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	59.74	0	0.00	0	0	0.00	0	0.00
8	121225C	0.050	0.030	0.020	0	0	0.00	0	0.00	0	0	0.00	0	0.00	11	11	73.97	0	0.00	0	0	0.00	0	0.00	5	5	33.62	0	0.00
9	111315F	0.061	0.033	0.028	5	7	38.37	1	16.44	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
10	111315C	0.116	0.100	0.017	5	5	14.32	1	8.59	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	2	2	5.73	0	0.00
11	111315A	0.037	0.016	0.021	4	5	44.66	1	26.80	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
12	111303C	0.462	0.256	0.206	13	17	12.26	2	4.33	0	0	0.00	0	0.00	6	7	5.05	1	2.16	8	21	15.15	2	4.33	3	5	3.61	0	0.00
13	111301C	0.199	0.096	0.103	4	6	10.05	1	5.02	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
14	111301A	0.370	0.179	0.191	12	14	12.61	2	5.40	0	0	0.00	0	0.00	0	0	0.00	0	0.00	6	13	11.71	0	0.00	0	0	0.00	0	0.00
17	111313I	0.041	0.027	0.014	3	4	32.65	1	24.49	0	0	0.00	0	0.00	2	2	16.32	0	0.00	1	1	8.16	0	0.00	0	0	0.00	0	0.00
18	111313A	0.884	0.072	0.814	7	8	3.02	1	1.13	0	0	0.00	0	0.00	0	0	0.00	1	1.13	1	1	0.38	0	0.00	0	0	0.00	0	0.00
19	111301F	0.025	0.015	0.010	4	3	40.68	1	40.68	0	0	0.00	0	0.00	3	2	27.12	0	0.00	3	3	40.68	0	0.00	0	0	0.00	0	0.00
20	111405B	0.039	0.006	0.033	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
21	121427D	0.018	0.004	0.014	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
22	121427A	0.010	0.009	0.001	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
23	121425A	0.098	0.052	0.045	8	10	34.14	2	20.49	0	0	0.00	0	0.00	1	1	3.41	0	0.00	3	10	34.14	0	0.00	0	0	0.00	0	0.00
24	111401A	0.014	0.003	0.011	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
25	111401D	0.044	0.039	0.005	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	2	5	37.85	0	0.00	3	3	22.71	0	0.00
27	111417C	0.478	0.416	0.062	9	20	13.95	1	2.09	0	0	0.00	0	0.00	3	2	1.40	1	2.09	1	2	1.40	0	0.00	10	42	29.30	0	0.00
28	111417B	0.472	0.195	0.277	16	21	14.82	3	6.35	0	0	0.00	0	0.00	2	2	1.41	0	0.00	1	1	0.71	0	0.00	0	0	0.00	0	0.00
29	111417F	0.089	0.056	0.031	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
30	101405A	0.104	0.071	0.033	5	4	12.86	1	9.64	0	0	0.00	0	0.00	0	0	0.00	0	0.00	5	5	16.07	2	19.29	3	3	9.64	0	0.00
31	111427D	0.038	0.035	0.002	1	1	8.87	0	0.00	0	0	0.00	0	0.00	12	14	124.18	0	0.00	0	0	0.00	0	0.00	4	4	35.48	0	0.00
32	111427B	0.042	0.013	0.029	0	0	0.00	0	0.00	0	0	0.00	0	0.00	4	6	47.17	0	0.00	4	4	31.45	1	23.58	0	0	0.00	0	0.00
33	111427A	0.243	0.212	0.031	7	8	10.97	1	4.11	0	0	0.00	0	0.00	0	0	0.00	0	0.00	4	3	4.11	1	4.11	0	0	0.00	0	0.00
34	111425D	0.008	0.005	0.003	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
35	101505E	0.235	0.161	0.074	8	9	12.78	1	4.26	2	2	2.84	1	4.26	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
36	101505A	0.030	0.009	0.020	2	2	22.58	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
37	101503G	0.059	0.023	0.035	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	4	8	45.31	0	0.00
38	111527D	0.149	0.047	0.102	6	7	15.70	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
40	111525D	0.100	0.092	0.008	4	5	16.65	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	3.33	0	0.00
41	111525A	0.134	0.085	0.049	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	14	13	32.41	1	7.48
42	111513A	0.008	0.002	0.005	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
43	101503C	0.014	0.006	0.007	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	3	3	72.89	0	0.00
44	101501A	0.059	0.048	0.011	1	1	5.61	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	5.61	0	0.00
45	101515G	0.048	0.037	0.011	2	2	13.87	1	20.81	0	0	0.00	0	0.00	6	12	83.25	0	0.00	0	0	0.00	0	0.00	3	4	27.75	0	0.00
46	101515C	0.017	0.011	0.006	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	2	2	39.19	0	0.00
47	101515D	0.031	0.030	0.002	2	1	10.68	1	32.03	0	0	0.00	0	0.00	5	5	53.38	1	32.03	0	0	0.00	0	0.00	0	0	0.00	0	0.00
48	101515E	0.045	0.029	0.016	2	2	14.96	0	0.00	0	0	0.00	0	0.00	2	2	14.96	0	0.00	0	0	0.00	0	0.00	1	1	7.48	0	0.00
49	101501B	0.008	0.006	0.002	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	2	1	40.95	1	122.85	0	0	0.00	0	0.00
50	101517C	0.134	0.085	0.049	4	7	17.41	1	7.46	0	0	0.00	0	0.00	0	0	0.00	0	0.00	4	14	34.83	0	0.00	4	4	9.95	0	0.00
51	101517B	0.426	0.352	0.074	3	7	5.47	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	8	28	21.89	0	0.00	22	90	70.36	0	0.00
52	101517A	0.586	0.175	0.411	6	6	3.41	1	1.71	0	0	0.00	1	1.71	1	3	1.71	0	0.00	0	0	0.00	0	0.00	18	19	10.81	0	0.00
53	101413E	0.061	0.054	0.007	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	2	2	10.88	0	0.00	2	4	21.77	0	0.00
54	101413A	0.271	0.191	0.080	5	6	7.39	1	3.70	0	0	0.00	0	0.00	0	0	0.00	0	0.00	3	21	25.88	0	0.00	0	0	0.00	0	0.00
55	101413D	0.010	0.009	0.001	0	0	0.00	0	0.00	4	4	135.23	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	33.81	0	0.00
56	101401B	0.007	0.002	0.005	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
57	101505G	0.018	0.000	0.018	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00
59	111401B	0.032	0.005	0.027	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	10.35	0	0.00	0	0	0.00	0	0.00
All	All	7.060	3.822	3.239	169[a]	215[c]	10.15[d]	31[g]	4.39[h]	6	6	0.28	2	0.28	68	85	4.01	4	0.57	86	174	8.22	13	1.84	113	224	10.58	1	0.14
Site no's	Impno's				51[b]		9.13[e]		5.01[i]	51		2.71		0.12	51		9.81		0.73	51		8.36		3.61	51		10.31		0.15
							1.64[f]		1.30[j]			2.65		0.09			3.48		0.63			2.04		2.46			2.51		0.15

[a]total number of observations, [b]total number of sites, [c]total number of birds, [d]mean weighted density of all birds (# birds/3x7.06 sq km), [e]average density, [f]SE, [g]total number of nests, [h]density of nests (#nests/7.06 sq km), [i] average density, [j]SE

Table B-1. Continued.																															
	Red-necked Phalarope					Red Phalarope					Pectoral Sandpiper					Semipalmated Sandpiper					Dunlin			Stilt Sandpiper			Lapland Longspur				
Site Number	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	Total Nests	Nests/ sq km
2	2	9	350.88	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	38.99	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
3	40	96	52.02	3	1.63	20	30	16.25	0	0.00	38	91	49.31	0	0.00	14	21	11.38	0	0.00	5	5	2.71	9	11	5.96	29	45	24.38	3	1.63
6	0	0	0.00	0	0.00	5	7	224.79	0	0.00	2	2	64.23	0	0.00	1	1	32.11	0	0.00	0	0	0.00	1	1	32.11	0	0	0.00	0	0.00
7	1	2	119.47	0	0.00	0	0	0.00	0	0.00	2	3	179.21	0	0.00	3	7	418.16	0	0.00	0	0	0.00	0	0	0.00	6	9	537.63	0	0.00
8	17	32	215.18	1	6.72	0	0	0.00	0	0.00	3	3	20.17	0	0.00	5	9	60.52	0	0.00	0	0	0.00	0	0	0.00	6	8	53.80	0	0.00
9	2	2	10.96	0	0.00	0	0	0.00	0	0.00	3	6	32.89	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	3	3	16.44	0	0.00
10	6	13	37.23	0	0.00	0	0	0.00	0	0.00	2	2	5.73	0	0.00	2	3	8.59	0	0.00	0	0	0.00	0	0	0.00	1	1	2.86	0	0.00
11	8	16	142.91	0	0.00	0	0	0.00	0	0.00	2	2	17.86	0	0.00	2	4	35.73	0	0.00	0	0	0.00	0	0	0.00	5	7	62.52	0	0.00
12	20	58	41.84	0	0.00	6	7	5.05	0	0.00	18	31	22.36	0	0.00	7	8	5.77	0	0.00	0	0	0.00	1	2	1.44	4	4	2.89	0	0.00
13	12	22	36.83	1	1.67	2	2	3.35	0	0.00	5	6	10.05	0	0.00	1	1	1.67	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
14	28	90	81.06	0	0.00	5	6	5.40	0	0.00	9	10	9.01	1	0.90	5	6	5.40	0	0.00	0	0	0.00	0	0	0.00	5	5	4.50	0	0.00
17	7	14	114.27	1	8.16	0	0	0.00	0	0.00	4	4	32.65	0	0.00	3	3	24.49	0	0.00	0	0	0.00	0	0	0.00	5	5	40.81	0	0.00
18	26	184	69.42	0	0.00	1	1	0.38	0	0.00	13	14	5.28	0	0.00	2	2	0.75	0	0.00	0	0	0.00	0	0	0.00	2	2	0.75	0	0.00
19	27	73	989.96	0	0.00	4	8	108.49	0	0.00	4	5	67.81	0	0.00	0	0	0.00	0	0.00	0	0	0.00	1	1	13.56	3	4	54.24	0	0.00
20	5	9	77.02	0	0.00	1	4	34.23	0	0.00	2	2	17.12	0	0.00	2	2	17.12	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
21	10	15	284.74	0	0.00	0	0	0.00	0	0.00	3	4	75.93	0	0.00	2	2	37.97	0	0.00	0	0	0.00	0	0	0.00	1	1	18.98	0	0.00
22	1	1	35.05	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
23	11	25	85.36	0	0.00	2	3	10.24	0	0.00	4	4	13.66	0	0.00	4	4	13.66	0	0.00	0	0	0.00	0	0	0.00	2	2	6.83	0	0.00
24	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	2	6	142.45	0	0.00	1	1	23.74	0	0	0.00	0	0	0.00	0	0.00
25	8	13	98.42	0	0.00	0	0	0.00	0	0.00	4	4	30.28	0	0.00	6	10	75.71	0	0.00	0	0	0.00	0	0	0.00	2	3	22.71	0	0.00
27	10	16	11.16	0	0.00	0	0	0.00	0	0.00	6	16	11.16	0	0.00	17	115	80.23	0	0.00	0	0	0.00	0	0	0.00	7	8	5.58	0	0.00
28	8	14	9.88	0	0.00	0	0	0.00	0	0.00	1	1	0.71	0	0.00	14	31	21.88	0	0.00	0	0	0.00	0	0	0.00	2	2	1.41	0	0.00
29	13	35	131.47	1	3.76	0	0	0.00	0	0.00	1	1	3.76	0	0.00	1	1	3.76	0	0.00	0	0	0.00	0	0	0.00	2	3	11.27	0	0.00
30	13	27	86.79	0	0.00	0	0	0.00	0	0.00	9	11	35.36	0	0.00	4	5	16.07	0	0.00	0	0	0.00	1	1	3.21	5	5	16.07	0	0.00
31	12	52	461.24	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	3	9	79.83	0	0.00	0	0	0.00	0	0	0.00	2	2	17.74	0	0.00
32	4	7	55.03	0	0.00	0	0	0.00	0	0.00	2	2	15.72	0	0.00	1	1	7.86	0	0.00	0	0	0.00	0	0	0.00	5	7	55.03	0	0.00
33	16	26	35.65	0	0.00	0	0	0.00	0	0.00	5	7	9.60	0	0.00	3	3	4.11	0	0.00	0	0	0.00	0	0	0.00	10	12	16.45	0	0.00
34	3	3	118.91	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
35	21	42	59.63	0	0.00	1	1	1.42	0	0.00	20	25	35.49	0	0.00	17	28	39.75	1	1.42	3	3	4.26	1	1	1.42	13	17	24.13	0	0.00
36	12	40	451.67	0	0.00	0	0	0.00	0	0.00	3	3	33.88	0	0.00	3	4	45.17	0	0.00	0	0	0.00	0	0	0.00	3	3	33.88	0	0.00
37	13	55	311.53	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	1	1	5.66	0	0.00
38	18	31	69.54	0	0.00	0	0	0.00	0	0.00	7	7	15.70	0	0.00	2	2	4.49	0	0.00	0	0	0.00	0	0	0.00	26	32	71.78	0	0.00
40	7	15	49.95	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	3	14	46.62	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
41	19	33	82.27	1	2.49	4	4	9.97	1	2.49	5	5	12.47	0	0.00	8	10	24.93	0	0.00	0	0	0.00	0	0	0.00	11	13	32.41	0	0.00
42	2	6	264.55	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
43	5	6	145.77	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	2	48.59	0	0.00	0	0	0.00	0	0	0.00	1	2	48.59	0	0.00
44	3	5	28.04	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	9	21	117.77	0	0.00	0	0	0.00	0	0	0.00	6	9	50.47	0	0.00
45	12	32	221.99	0	0.00	1	1	6.94	0	0.00	4	4	27.75	0	0.00	5	9	62.43	0	0.00	0	0	0.00	1	1	6.94	8	12	83.25	1	6.94
46	10	33	646.68	0	0.00	0	0	0.00	0	0.00	1	1	19.60	0	0.00	1	1	19.60	0	0.00	0	0	0.00	0	0	0.00	1	1	19.60	0	0.00
47	4	9	96.09	0	0.00	0	0	0.00	0	0.00	2	2	21.35	0	0.00	1	1	10.68	0	0.00	0	0	0.00	0	0	0.00	8	8	85.42	0	0.00
48	11	38	284.20	0	0.00	0	0	0.00	0	0.00	3	3	22.44	0	0.00	5	6	44.87	0	0.00	0	0	0.00	0	0	0.00	7	8	59.83	0	0.00
49	7	14	573.30	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	40.95	0	0.00	0	0	0.00	0	0	0.00	2	2	81.90	0	0.00
50	25	69	171.64	0	0.00	0	0	0.00	0	0.00	3	4	9.95	0	0.00	8	10	24.88	0	0.00	0	0	0.00	0	0	0.00	7	7	17.41	0	0.00
51	13	93	72.70	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	8	17	13.29	1	0.78	0	0	0.00	0	0	0.00	2	2	1.56	0	0.00
52	32	166	94.44	0	0.00	0	0	0.00	0	0.00	10	12	6.83	0	0.00	33	54	30.72	1	0.57	0	0	0.00	0	0	0.00	34	45	25.60	0	0.00
53	14	59	321.09	1	5.44	1	1	5.44	0	0.00	4	7	38.10	0	0.00	5	5	27.21	0	0.00	0	0	0.00	2	4	21.77	0	0	0.00	0	0.00
54	29	101	124.46	2	2.46	2	2	2.46	0	0.00	21	24	29.57	0	0.00	6	6	7.39	0	0.00	0	0	0.00	0	0	0.00	15	21	25.88	0	0.00
55	5	6	202.84	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	3	5	169.03	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
56	2	4	189.13	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	2	2	94.56	0	0.00
57	2	10	190.37	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	1	1	19.04	0	0.00
59	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	1	1	10.35	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00
Siteno's	576	1721	81.26	11	0.52	55	77	3.64	1	0.05	225	328	15.49	1	0.05	225	452	21.34	3	0.14	9	9	0.42	17	22	1.04	255	324	15.30	4	0.19
	51		164.80		0.63	51		8.52		0.05	51		19.67		0.02	51		37.90		0.05	51		0.60	51		1.69	51		34.39		0.17
			26.31		0.24			4.87		0.05			4.13		0.02			9.15		0.03			0.47			0.80			10.75		0.14

Table B-1. Continued.

Site	Lesser Golden Plover			Bairds Sandpiper			Black-bellied Plover			Long-billed Dowitcher			Common Snipe		
Number	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km
2	0	0	0.00	0	0	0.00	0	0	0.00	1	1	38.99	0	0	0.00
3	2	7	3.79	1	1	0.54	6	9	4.88	20	47	25.47	0	0	0.00
6	0	0	0.00	0	0	0.00	0	0	0.00	1	5	160.57	0	0	0.00
7	0	0	0.00	0	0	0.00	1	1	59.74	0	0	0.00	0	0	0.00
8	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
9	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
10	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
11	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
12	1	1	0.72	0	0	0.00	1	1	0.72	3	6	4.33	0	0	0.00
13	0	0	0.00	0	0	0.00	0	0	0.00	1	11	18.42	0	0	0.00
14	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	2	1.80
17	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
18	0	0	0.00	0	0	0.00	0	0	0.00	4	18	6.79	2	2	0.75
19	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
20	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
21	0	0	0.00	0	0	0.00	0	0	0.00	1	15	284.74	0	0	0.00
22	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
23	0	0	0.00	0	0	0.00	1	4	13.66	0	0	0.00	0	0	0.00
24	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
25	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
27	1	3	2.09	1	1	0.70	1	26	18.14	0	0	0.00	0	0	0.00
28	1	2	1.41	1	2	1.41	0	0	0.00	1	1	0.71	0	0	0.00
29	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
30	0	0	0.00	0	0	0.00	1	1	3.21	2	2	6.43	0	0	0.00
31	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
32	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
33	0	0	0.00	0	0	0.00	0	0	0.00	2	2	2.74	0	0	0.00
34	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
35	2	2	2.84	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
36	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
37	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
38	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
40	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
41	0	0	0.00	0	0	0.00	0	0	0.00	1	4	9.97	0	0	0.00
42	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
43	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
44	0	0	0.00	1	1	5.61	0	0	0.00	0	0	0.00	0	0	0.00
45	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
46	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
47	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
48	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
49	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
50	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
51	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
52	1	3	1.71	0	0	0.00	0	0	0.00	0	0	0.00	5	8	4.55
53	0	0	0.00	0	0	0.00	1	1	5.44	0	0	0.00	0	0	0.00
54	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
55	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
56	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
57	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
59	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
Siteno's	8	18	0.85	4	5	0.24	12	43	2.03	37	112	5.29	8	12	0.57
	51		0.25	51		0.16	51		2.07	51		10.96	51		0.14
			0.11			0.11			1.24			6.37			0.10

Site	Ruddy Turnstone			Semipalmated Plover					Tundra Swan					Black Brant		
Number	n	Total	#/ sq km	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km
2	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
3	0	0	0.00	0	0	0.00	0	0.00	4	3	1.63	1	1.63	0	0	0.00
6	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
7	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
8	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
9	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
10	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
11	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
12	0	0	0.00	0	0	0.00	0	0.00	2	4	2.89	0	0.00	0	0	0.00
13	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
14	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
17	0	0	0.00	2	2	16.32	0	0.00	0	0	0.00	0	0.00	0	0	0.00
18	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
19	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
20	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
21	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
22	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
23	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
24	0	0	0.00	3	3	71.23	0	0.00	0	0	0.00	0	0.00	0	0	0.00
25	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
27	1	1	0.70	18	29	20.23	3	2.09	0	0	0.00	0	0.00	0	0	0.00
28	0	0	0.00	12	18	12.70	0	0.00	0	0	0.00	0	0.00	0	0	0.00
29	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
30	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
31	0	0	0.00	0	0	0.00	0	0.00	2	2	17.74	0	0.00	0	0	0.00
32	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
33	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
34	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
35	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
36	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
37	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
38	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
40	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
41	0	0	0.00	0	0	0.00	0	0.00	5	14	34.90	0	0.00	2	2	4.99
42	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
43	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
44	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
45	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
46	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
47	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
48	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
49	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
50	0	0	0.00	2	2	4.98	0	0.00	0	0	0.00	0	0.00	0	0	0.00
51	0	0	0.00	1	1	0.78	0	0.00	0	0	0.00	0	0.00	0	0	0.00
52	0	0	0.00	1	1	0.57	0	0.00	0	0	0.00	0	0.00	0	0	0.00
53	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
54	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
55	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
56	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
57	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
59	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0.00	0	0	0.00
Siteno's	1	1	0.05	39	56	2.64	3	0.14	13	23	1.09	1	0.14	2	2	0.09
	51		0.01	51		2.49		0.04	51		1.12		0.03			0.10
			0.01			1.48		0.04			0.16		0.00			0.01

Table B-1. Continued.

Site Number	Canada Goose n	Canada Goose Total	Canada Goose #/ sq km	Canada Goose Total Nests	Canada Goose Nests/ sq km	Mallard n	Mallard Total	Mallard #/ sq km	Northern Pintail n	Northern Pintail Total	Northern Pintail #/ sq km	Northern Shoveler n	Northern Shoveler Total	Northern Shoveler #/ sq km	American Wigeon n	American Wigeon Total	American Wigeon #/ sq km	Greater Scaup n	Greater Scaup Total	Greater Scaup #/ sq km	Greater Scaup Total Nests	Greater Scaup Nests/ sq km	Green-winged Teal n	Green-winged Teal Total	Green-winged Teal #/ sq km	Spectacled Eider n	Spectacled Eider Total	Spectacled Eider #/ sq km	Spectacled Eider Total Nests	Spectacled Eider Nests/ sq km
2	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
3	22	24	13.00	5	8.13	0	0	0.00	2	3	1.63	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	3	3	1.63	1	1.63
6	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
7	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
8	0	0	0.00	0	0.00	0	0	0.00	4	8	53.80	0	0	0.00	0	0	0.00	3	2	13.45	1	20.17	0	0	0.00	0	0	0.00	0	0.00
9	2	2	10.96	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
10	0	0	0.00	0	0.00	0	0	0.00	1	4	11.46	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
11	0	0	0.00	0	0.00	0	0	0.00	2	2	17.86	0	0	0.00	0	0	0.00	2	2	17.86	0	0.00	0	0	0.00	0	0	0.00	0	0.00
12	12	9	6.49	3	6.49	0	0	0.00	6	14	10.10	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	4	10	7.21	0	0.00
13	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
14	2	4	3.60	0	0.00	0	0	0.00	11	42	37.83	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
17	2	6	48.97	0	0.00	0	0	0.00	1	8	65.30	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	2	2	16.32	0	0.00
18	0	0	0.00	0	0.00	0	0	0.00	4	97	36.59	3	4	1.51	2	4	1.51	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	1	1.13
19	2	2	27.12	0	0.00	0	0	0.00	2	3	40.68	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	4	4	54.24	0	0.00
20	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
21	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
22	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
23	8	10	34.14	2	20.49	0	0	0.00	1	1	3.41	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
24	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
25	0	0	0.00	0	0.00	0	0	0.00	1	2	15.14	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
27	2	4	2.79	0	0.00	0	0	0.00	1	2	1.40	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
28	9	15	10.59	1	2.12	0	0	0.00	1	1	0.71	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
29	0	0	0.00	0	0.00	0	0	0.00	1	1	3.76	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
30	1	2	6.43	0	0.00	0	0	0.00	6	6	19.29	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	1	1	3.21	0	0	0.00	0	0.00
31	0	0	0.00	0	0.00	0	0	0.00	2	5	44.35	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
32	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
33	6	8	10.97	1	4.11	0	0	0.00	1	2	2.74	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
34	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
35	6	5	7.10	1	4.26	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	5	8	11.36	1	4.26
36	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
37	0	0	0.00	0	0.00	1	1	5.66	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
38	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
40	0	0	0.00	0	0.00	0	0	0.00	4	5	16.65	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
41	0	0	0.00	0	0.00	0	0	0.00	2	3	7.48	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
42	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
43	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
44	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	2	2	11.22	0	0	0.00	0	0.00
45	0	0	0.00	0	0.00	0	0	0.00	3	3	20.81	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
46	0	0	0.00	0	0.00	0	0	0.00	1	1	19.60	0	0	0.00	0	0	0.00	2	2	39.19	0	0.00	0	0	0.00	0	0	0.00	0	0.00
47	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
48	0	0	0.00	0	0.00	0	0	0.00	3	6	44.87	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	1	2	14.96	1	1	7.48	0	0.00
49	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
50	7	17	42.29	0	0.00	0	0	0.00	15	34	84.58	0	0	0.00	0	0	0.00	2	2	4.98	0	0.00	4	5	12.44	0	0	0.00	0	0.00
51	7	42	32.83	0	0.00	1	9	7.04	8	52	40.65	0	0	0.00	2	2	1.56	2	3	2.35	0	0.00	1	3	2.35	4	7	5.47	0	0.00
52	12	15	8.53	2	3.41	0	0	0.00	6	7	3.98	0	0	0.00	0	0	0.00	1	1	0.57	0	0.00	6	9	5.12	6	12	6.83	1	1.71
53	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
54	5	5	6.16	1	3.70	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	5	5	6.16	0	0.00
55	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	2	2	67.61	0	0.00
56	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
57	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
59	1	2	20.69	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0.00
Siteno's	106	172	8.12	16	2.27	2	10	0.47	89	312	14.73	3	4	0.19	4	6	0.28	12	12	0.57	1	0.14	15	22	1.04	36	54	2.55	4	0.57
			5.74		1.03			0.25			11.86	51		0.03	51		0.06	51		1.54		0.40	51		0.97	51		3.61		0.17
			0.80		0.14			0.03			1.66			0.00			0.01			0.22		0.06			0.14			0.51		0.02

Table B-1. Continued.

Site	Glaucous Gull					Sabine's Gull			Arctic Tern			Parasitic Jaeger			Pomarine Jaeger			Long-tailed Jaeger			Snow Bunting					Redpoll		
Number	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	n	Total	#/ sq km	Total Nests	Nests/ sq km	n	Total	#/ sq km
2	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	1	3	116.96
3	5	9	4.88	0	0.00	1	1	0.54	0	0	0.00	5	8	4.33	0	0	0.00	1	2	1.08	1	1	0.54	0	0.00	0	0	0.00
6	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
7	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	2	3	179.21	0	0.00	0	0	0.00
8	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
9	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
10	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	2	2	5.73	0	0.00	0	0	0.00
11	2	2	17.86	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
12	1	1	0.72	0	0.00	0	0	0.00	0	0	0.00	3	3	2.16	0	0	0.00	1	2	1.44	0	0	0.00	0	0.00	0	0	0.00
13	2	6	10.05	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
14	4	8	7.21	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	0.90	0	0.00	0	0	0.00
17	1	1	8.16	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	2	2	16.32	0	0.00	1	2	16.32
18	0	0	0.00	0	0.00	0	0	0.00	1	1	0.38	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
19	1	1	13.56	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	13.56	0	0.00	0	0	0.00
20	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
21	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
22	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
23	5	7	23.90	2	20.49	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
24	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
25	1	1	7.57	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
27	2	2	1.40	0	0.00	3	7	4.88	0	0	0.00	1	2	1.40	0	0	0.00	0	0	0.00	14	19	13.26	0	0.00	0	0	0.00
28	4	8	5.65	1	2.12	2	2	1.41	0	0	0.00	0	0	0.00	1	1	0.71	0	0	0.00	5	59	41.64	0	0.00	0	0	0.00
29	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	3	4	15.03	0	0.00	0	0	0.00
30	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	7	8	25.72	0	0.00	0	0	0.00
31	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	8.87	0	0.00	1	2	17.74
32	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
33	2	3	4.11	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
34	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	2	2	79.27	0	0.00	0	0	0.00
35	6	20	28.39	1	4.26	0	0	0.00	0	0	0.00	1	2	2.84	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
36	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	11.29	0	0.00	0	0	0.00
37	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
38	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
40	1	1	3.33	0	0.00	1	25	83.25	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	4	5	16.65	0	0.00	0	0	0.00
41	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	1	2	4.99	0	0	0.00	0	0	0.00	2	2	4.99	0	0.00	0	0	0.00
42	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
43	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	3	3	72.89	0	0.00	0	0	0.00
44	1	2	11.22	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	3	5	28.04	0	0.00	0	0	0.00
45	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	6.94	7	7	48.56	1	6.94	0	0	0.00
46	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
47	2	2	21.35	0	0.00	0	0	0.00	0	0	0.00	1	2	21.35	0	0	0.00	0	0	0.00	1	1	10.68	0	0.00	1	5	53.38
48	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	7.48	0	0.00	0	0	0.00
49	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	40.95	0	0.00	0	0	0.00
50	1	1	2.49	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	4	4	9.95	0	0.00	0	0	0.00
51	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	3	9	7.04	0	0.00	0	0	0.00
52	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	2	2	1.14	0	0	0.00	0	0	0.00	6	8	4.55	0	0.00	0	0	0.00
53	4	6	32.65	0	0.00	1	13	70.75	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
54	0	0	0.00	0	0.00	0	0	0.00	1	2	2.46	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
55	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
56	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
57	1	1	19.04	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
59	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	1	2	20.69	0	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0	0.00
Siteno's	46	82	3.87	4	0.57	8	48	2.27	2	3	0.14	15	23	1.09	1	1	0.05	3	5	0.24	77	150	7.08	1	0.05	4	12	0.57
	51		4.38		0.53	51		3.15	51		0.06	51		1.15	51		0.01	51		0.19	51		13.00		0.14	51		4.01
			0.61		0.07			0.44			0.01			0.16			0.00			0.03			1.82		0.02			0.56