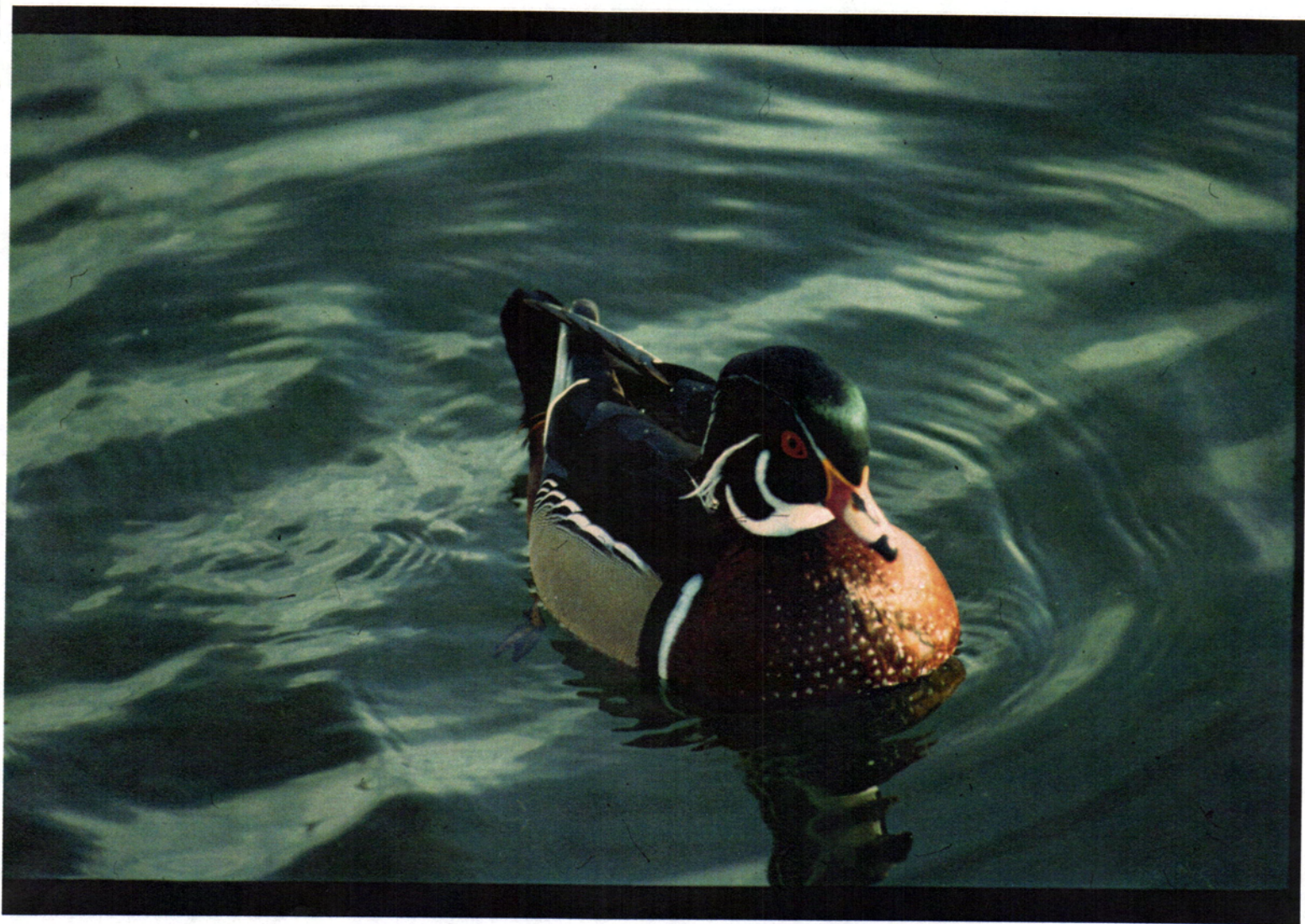


1994-1997 LAKE POWELL WINTER AQUATIC BIRD SURVEYS,
GLEN CANYON NATIONAL RECREATION AREA,
UTAH AND ARIZONA



*RESOURCE MANAGEMENT DIVISION
GLEN CANYON NATIONAL RECREATION AREA
SEPTEMBER 1998*

**1994-1997 LAKE POWELL WINTER AQUATIC BIRD SURVEYS,
GLEN CANYON NATIONAL RECREATION AREA, UTAH AND ARIZONA**

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September 1998

ABSTRACT

This report presents the results of a three-year survey of aquatic birds on Lake Powell, Glen Canyon National Recreation Area. Aquatic birds were defined as members of all families from Gaviidae through Anatidae and all families from Rallidae through Laridae (1998 AOU sequence). Surveys were conducted monthly between September and April from 1994 through 1997. Each survey was three days long, and covered standardized routes in seven designated survey areas on the 150-mile long reservoir. Over the course of the study 72,893 individuals of 54 species were detected. This represents 70% of all aquatic species documented on Lake Powell. The most common species were, in order of abundance, American Coot, Western Grebe, Gadwall, Green-winged Teal, Ring-billed Gull, Common Goldeneye, and Redhead. The first two accounted for 80% of all detections, and the seven most common species accounted for 89% of all detections. Diving species were most abundant, accounting for 90% of all detections. Several rare or new species were documented for Glen Canyon NRA and Lake Powell, including Yellow-billed Loon, Red-necked Grebe, Greater Scaup, Surf Scoter, White-winged Scoter, Barrow's Goldeneye, Oldsquaw, and Herring Gull. Numbers of birds generally peaked in November, although significant numbers were also found on December and January surveys. Species richness and diversity were greatest in spring. The most commonly utilized habitats on Lake Powell were shallow-water bays (<100 foot depth) and shorelines with drowned tamarisk scrub. Principal components analysis indicated that species assemblages were fairly consistent over fall migration and winter, but were much more unpredictable during spring migration. Changes in assemblages also reflected differences in reservoir water levels and the abundance of small fish. At higher water levels birds were generally more common, and a significant positive relationship was found in some survey areas between Western Grebe abundance and Threadfin Shad abundance. Survey data from January 1988 indicate that few if any significant changes appear to have taken place in over-wintering assemblages in the last 9 years. Comparisons with other reservoirs along the Colorado River are made, as are recommendations for future surveys.

INTRODUCTION

The construction of Glen Canyon Dam and filling of Lake Powell created a large, deep water reservoir on the central Colorado Plateau (Figure 1). The dam was completed in 1963 and the reservoir began filling in 1964, reaching full pool in 1980. Lake habitat has thus been in existence for ca. 30-35 years. During that time a variety of aquatic bird species previously rare or unknown in the region have been recorded on the newly formed reservoir. In fact, through 1997 some 80 species of aquatic birds (see definition below) have been recorded on Lake Powell (LaRue *et al.* 1998), some in large numbers.

The Colorado River was originally a dynamic sediment-laden river with peak flows during spring flooding and minimum flows during the winter months (Carothers and Brown 1991). The spring floods scoured out the river channel, preventing the establishment of aquatic vegetation. Primary productivity was low because of poor light penetration in the muddy waters. Early accounts indicate that few aquatic species occurred along the Colorado River prior to the construction of the many dams now regulating its flow (Behle and Higgins 1958; Carothers and Brown 1991; Rosenberg *et al.* 1991). Grinnell (1914) conducted wildlife surveys along the lower Colorado River downstream of Needles in 1910 and noted that only a few American Coots and dabbling ducks occurred. The situation today is very different. The construction of large dams on the Colorado River created habitat for waterfowl and other aquatic species both above and below the dams. Hoover Dam was the first to be completed, in 1936, creating Lake Mead. Other dams were soon constructed downstream (Parker, Imperial, and Davis). The general effects of these dams have been to greatly increase both wintering and breeding habitat for aquatic avifauna. The clear cold tail waters below the dams create conditions conducive for the growth of aquatic vegetation, supporting large wintering populations of waterfowl. The deep reservoirs above the dams provide wintering habitat for a variety of aquatic birds, especially diving species like grebes.

Prior to 1994, no systematic long-term winter surveys of Lake Powell had been initiated. In January of 1988 a lake-wide survey was conducted, documenting 3715 individuals of 21 species. In November of 1992 a lake-wide survey for Western Grebe was conducted, with 3,619 individuals recorded. In February of 1994 a survey in Warm Creek Bay documented the presence of three species of loons; Common, Pacific, and Yellow-billed (*Utah Birds* 10(1): 9). The Yellow-billed Loon was the second record for Utah.

In May of 1994 the Resource Management Division of Glen Canyon NRA acquired a 32 foot Munson with a cruising radius of 10-12 hours. This boat offered ample speed, a stable platform for spotting scopes, and an enclosed cabin for winter survey work. Because of a lack of baseline data on wintering aquatic bird populations on Lake Powell, a systematic survey program was initiated in October of 1994. This program was conducted through April of 1997.

The results of the first year of surveys was reported in Grahame et al. (1995). This report documents the results of all three years of surveys. The primary goal of the three-year program was to inventory selected areas of Lake Powell to determine the numbers and kinds of migrant and over-wintering aquatic bird species.

METHODS

Preliminary observations by boat and fixed-wing plane located areas of Lake Powell where significant concentrations of birds occurred. Based on these observations, earlier reports, and the logistics of operating on a 150-mile long lake, six areas were designated for monthly surveys; Good Hope Bay, Bullfrog Bay, Hall's Creek Bay, Warm Creek Bay, Wahweap Bay, and Antelope Island. Because high concentrations of Western Grebe were occasionally reported at the mouth of Trachyte Creek and in the Hite area (e.g., 550 birds at Hite on October 25, 1994; Audubon Field Notes 49: 75, 1995), Trachyte Canyon was added in October of 1995. Antelope Island is in Arizona, while the other six survey areas are in Utah (Appendix 1). No main channel reaches or narrow side canyons were included in the designated survey routes because few birds were seen in these areas. Once a month between October and April, a three day survey was conducted, starting at Good Hope Bay and Trachyte Canyon on day one, moving to Bullfrog and Hall's Creek Bays on day two, and ending at Warm Creek and Wahweap Bays and Antelope Island on day three. Fixed routes were followed along the shorelines of these seven survey areas (see Appendix 1). Most birds seen were directly identified and counted. Large rafts of Western Grebes and American Coots were occasionally encountered, however, and in some cases numbers had to be estimated. In these cases, two observers independently estimated numbers, with an average taken where estimates were close (within ca. 10%). If the estimates were well off, then new counts were made until the estimates reasonably matched. Attempts were made to avoid double counting individuals due to their movements. The counts reported in this paper are thus conservative. One assumption that had to be made was that birds counted on different days did not move between survey areas over night. In general no attempt was made to distinguish between Clark's and Western Grebes in large rafts. However, occasional checks were made in order to determine the percentage of Clark's and to document their presence on Lake Powell.

For each bird observed, data recorded included location, time of day, species, habitat, behavior, and where possible sex and age (Appendix 2). Incidental observations were included while moving between designated survey areas, but were not included in total numbers. Aquatic birds are defined as all members of the following families; all families from Gaviidae through Anatidae, and all families from Rallidae through Laridae (AOU 1998 sequence). Sightings of raptors and Belted Kingfishers were also recorded during the survey. For each species, its principal means of foraging on Lake Powell was determined. Four foraging guilds were used: Aerialists (gulls, terns), dabblers (dabbling ducks), divers

(diving ducks, coots, grebes, loons, comorants, etc.), and waders (shorebirds, herons, etc.). Notes on weather and lake levels were taken. Most surveys were conducted by two experienced bird observers. Because of stormy weather, boat problems, and the government shutdowns, surveys were not conducted in November 1995, and October and December 1997. Partial surveys were conducted in March and April of 1996, with only down lake areas surveyed. Seasons were defined as fall (September-November), winter (December-February), and spring (March-April).

In order to compare different years and months, bird abundance was normalized by dividing the number of birds by the number of surveys conducted in that year or month. Principal components analysis was performed on a data set that included all species except those found only once during the study. Bird abundance was correlated with axis scores using Pearson's and Kendall correlations. Analysis of variance (ANOVA) was performed on subsets of the data with lake levels and Threadfin Shad population data (data from Utah Division of Wildlife Resources) as the factors. For both lake levels and fish numbers, two levels were used, high and low. These values were computed by determining the mean lake elevation and fish abundance over the course of the study. Those values falling below the mean were assigned to the low category, and those above the mean to the high category. Values of species richness (S), Shannon diversity index (H'), and evenness ($E=H'/\log S$) were computed for each survey-area. All computations were done using the PC-ORD 3.0 program.

RESULTS

Table 1 lists the results of each season's survey. In all 54 species were detected at least once during the surveys (Appendix 3). A total of 117 surveys were conducted in seven areas on 19 different months between October 1994 and April 1997. Survey dates can be found in Appendix 8. Mean survey time was 87 minutes, varying from 15 to 180 minutes. A significant difference occurred in survey time between years, with surveys in 1996-1997 taking significantly longer than surveys in previous years (ANOVA, $F=3.35$, $p=0.04$). Total detections amounted to 72,893 over the three years. The raw data can be found in Appendices 4-7. Diving species dominated the surveys in all years, accounting for 90% of all detections. Of the remainder, 7% were dabbling ducks, 2% were aerial species (gulls, terns), and less than 1% were shorebirds or other waders. American Coot was the most abundant species (48% of all detections), followed by Western Grebe (33%), Gadwall (2.4%), Green-winged Teal (1.7%), Ring-billed Gull (1.5%), Common Goldeneye (1.3%), and Redhead (1.1%). The remaining 37 species were under 1% of the total number of detections.

1994-1995

The 1994-95 season was characterized by an extremely mild and warm winter.

Table 1. Summary of the 1994-1997 Lake Powell aquatic bird surveys. Normalized numbers are abundance divided by the number of surveys conducted in that year and are shown as the mean per survey area per survey.

TAXON	GUILD	1994-1995	1995-1996	1996-1997	TOTALS	% OF TOTAL
Loons	Divers	38	55	32	125	0.17
Grebes	Divers	5540	9422	9880	24842	34.02
Pelicans/Comorants	Divers	264	191	103	558	0.77
Coots	Divers	19440	5599	9946	34985	48.25
Gulls/Terns	Aerialists	493	868	271	1632	2.23
Wading Birds	Waders	216	111	209	536	0.74
Ducks/Geese	Dabblers	1478	925	2678	5081	7.02
	Divers	2318	1264	1341	4923	6.8
TOTALS		29787	18435	24460	72682	100
NORMALIZED		709	466	699	624	
GUILD TOTALS	Aerialists	493	848	271	1612	2.22
	Waders	216	111	209	536	0.74
	Dabblers	1478	925	2678	5081	7.01
	Divers	27600	16288	21372	65260	90.03

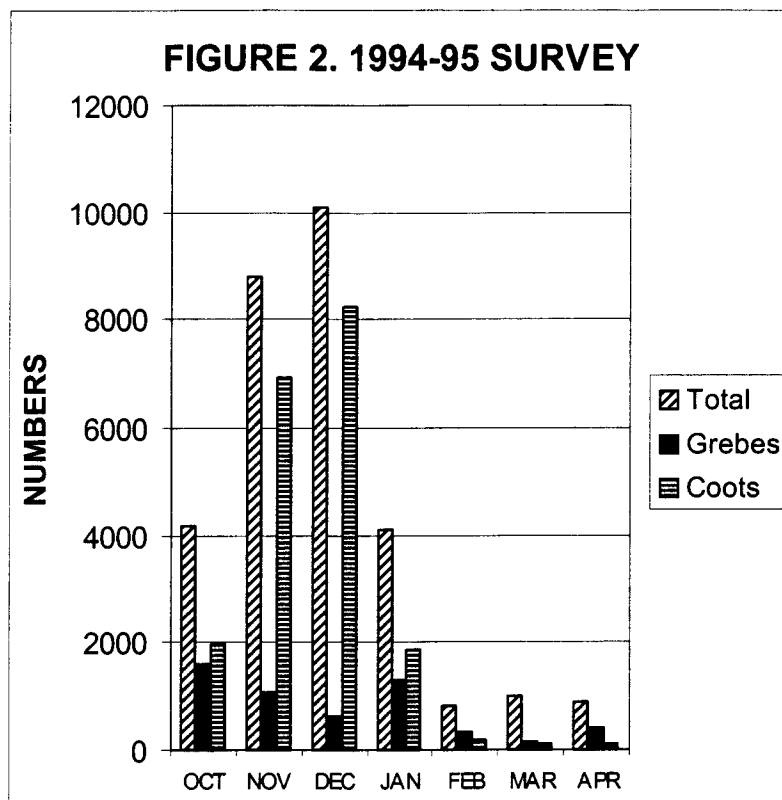
Threadfin Shad populations were low except for incidental catches during electrofishing in Warm Creek Bay in September/October of 1994. The surveys detected 29,907 individuals of 40 species (Table 2, Figure 2). Bird numbers peaked in December, with over 10,000 individuals counted in the six survey areas. After December, numbers dropped sharply through April. Mean number of birds seen per survey area per survey was 709. American Coot was the most common species in most areas, with a high count of 8,288 in December. Western Grebe was the second most common species, with most individuals found in Good Hope Bay. The high count for this species was a raft of 1,100 birds discovered in Good Hope Bay in October.

Throughout the year the most productive area was Wahweap Bay, with 32% of all detections. Hall's Creek Bay was second overall, with 24% of detections. Antelope Island had the fewest detections. Some areas were characterized by

Table 2. Summary of the 1994-1995 season by guild and month.

GROUP	OCT	NOV	DEC	JAN	FEB	MAR	APR
Total	4164	8812	10118	4081	814	1022	896
Divers	3948	8503	9770	3760	658	480	601
Dabblers	118	143	285	252	111	519	50
Waders	9	9	4	8	4	9	173
Aerialists	89	157	59	61	41	14	72
Grebes	1618	1087	628	1296	329	160	420
Coots	1970	6944	8243	1872	175	130	104

Figure 2. Summary of aquatic bird abundance by month in 1994-1995 on Lake Powell.



particular species. Most Western Grebe's were found in Good Hope Bay, while American Coot's were most numerous in Wahweap and Hall's Creek Bays. In general, dabbling ducks like Gadwall and Mallard were concentrated in down-lake areas. Species richness did not vary much from fall to spring (fall=12.4, winter=12.6, spring=11.8 species per survey area), but diversity was much higher in spring (spring, $H'=1.628$; fall, $H'=0.782$; winter, $H'=1.130$). Evenness was highest in spring, and lowest in the fall (spring, $E=0.672$; winter, $E=0.466$; fall, $E=0.311$).

In addition to the Yellow-billed Loon (see Appendix 3), other unusual sightings for Lake Powell during the 1994-95 survey included one-two Horned Grebes seen intermittently throughout the winter, one Surf Scoter, and one Pacific Loon. A pair of American White Pelicans was present until December in upper Wahweap Bay, and a single bird lingered at Bullfrog Marina until January.

1995-1996

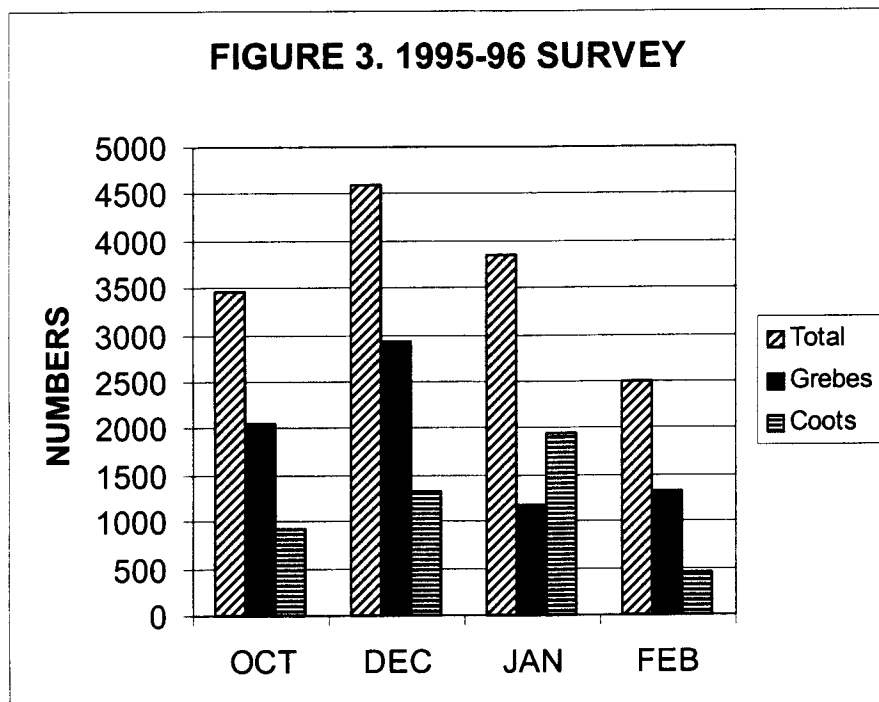
Again, 1995-96 was an extremely mild season, with few storms between September and April. Threadfin Shad populations were high in most areas, although trawl catch data were low in the Bullfrog Bay and Wahweap Bay in the previous summer. Surveys were not conducted in November because of the

government shutdown. Down-lake areas were also surveyed in September. March and April data are not shown as only down-lake areas were surveyed (see Appendices 4-5). The numbers of aquatic species were lower than the previous year, with 18,446 detections of 47 species (Table 3, Figure 3). Mean number of detections per survey area per survey were 466. Western Grebe was the most common species, with 9,191 birds counted. American Coot numbers were significantly lower than 1994-95, with 5,599 detections. Numbers of gulls, particularly Ring-billed, were much higher than 1994-95. Trachyte Creek was added to the survey areas because of reports of large numbers of Western Grebe. The largest flock of this species, 1,000, was seen at the mouth of Trachyte Creek in December of 1995.

Table 3. Summary of the 1995-1996 season by guild and month.

GROUP	OCT	DEC	JAN	FEB
Total	3472	4592	3837	2496
Divers	3227	4452	3482	2192
Dabblers	186	91	280	248
Waders	51	11	6	11
Aerialists	8	37	69	45
Grebes	2052	2937	1172	1326
Coots	915	1323	1944	447

Figure 3. Summary of aquatic bird abundance by month in 1995-1996 on Lake Powell.



Bullfrog Bay and Warm Creek Bay were the most productive survey areas for numbers of birds, but Wahweap Bay was the most species-rich, with 35 species seen. Again species richness, diversity and evenness were highest on spring surveys ($S=12.7$, $H'=1.33$, $E=0.52$) compared with winter ($S=10.8$, $H'=1.01$, $E=0.41$) and fall ($S=8.9$, $H'=0.86$, $E=0.40$) surveys.

Lake Powell's first record of Red-necked Grebe was a bird in Warm Creek Bay in January 1996. Other unusual species included Oldsquaw and Barrow's Goldeneye seen in Hall's Creek Bay and Warm Creek Bay, and a Yellow-billed Loon in Warm Creek Bay in March and April.

1996-1997

Conditions were generally mild through most of the winter of 1996-97, although December was stormy. Boat problems forced the cancellation of the October and December surveys. Threadfin Shad populations remained high in the summer of 1996, particularly in down-lake areas. Total detections increased to 24,537 birds of 43 species (Table 4, Figure 4). American Coot was the most common species, with 9,946 detections (40%), followed closely by Western Grebe with 9,397 detections (38%). A large flock of 1,700 birds of this species was seen at the mouth of Trachyte Creek in November. Other common species included Green-winged Teal, Gadwall, Northern Pintail, Northern Shoveler, and Redhead. Overall dabbling duck numbers were higher than the previous two years.

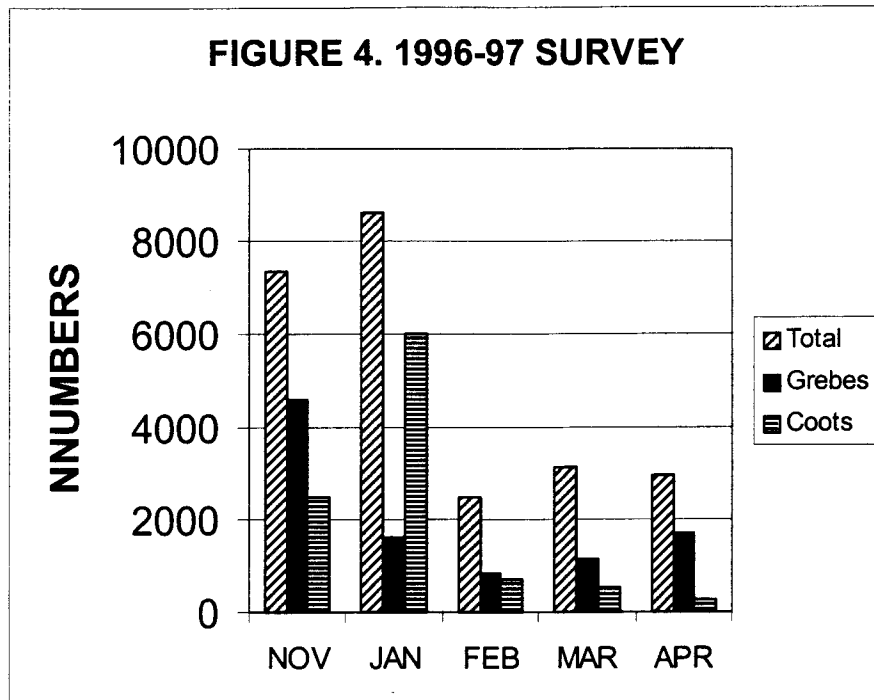
Table 4. Summary of the 1996-1997 season by guild and month.

GROUP	NOV	JAN	FEB	MAR	APR
Total	7349	8622	2481	3135	2950
Divers	7209	8278	1689	2072	2124
Dabblers	106	300	747	1056	469
Waders	9	11	12	1	176
Aerialists	25	28	33	4	181
Grebes	4583	1620	828	1142	1707
Coots	2475	6021	673	507	270

Bullfrog, Warm Creek and Wahweap Bays were the most productive survey areas. Wahweap Bay was the most species-rich, with 37 species detected. As in the previous years, richness, diversity and evenness were highest in spring surveys ($S=15.7$, $H'=1.69$, $E=0.64$) compared with winter ($S=12.9$, $H'=1.16$, $E=0.46$) and fall ($S=10.7$, $H'=0.58$, $E=0.24$) surveys. The fall of 1996 was particularly low in diversity and richness.

The region's second record of Red-necked Grebe was of a bird seen twice, once in Wahweap Bay in January, then again in March off Antelope Island. Unusual were the numbers of Horned Grebe that over-wintered, with 84 detections, mostly in Bullfrog and Hall's Creek Bays and around Antelope Island.

Figure 4. Summary of aquatic bird abundance by month in 1996-1997 on Lake Powell.



Northern Pintail was much more common than in previous years, with good-sized flocks detected, e.g., 255 in Warm Creek Bay and 185 in Wahweap Bay in February.

Survey area and seasonal patterns

A principal components analysis (PCA) of survey areas by year is shown in Figure 5. Five survey areas changed relatively little between years, Good Hope Bay, Bullfrog Bay, Antelope Island, Warm Creek Bay, and Trachyte Creek. Two areas, Hall's Creek Bay and Wahweap Bay showed considerable shifts in bird assemblages between 1994-1995 and 1995-1996. The five species with the largest correlations on the first two axes are listed in Table 5. On PCA axis one, Common Merganser, Bufflehead, Western Grebe, Double-crested Cormorant, and Oldsquaw have strong positive correlations, while Lesser Scaup, California Gull, Lesser Yellowlegs, Ring-billed Gull, and Great Egret have strong negative correlations. This axis reflects a shift in bird assemblages from areas with large winter concentrations of diving species to areas with few wintering species but large numbers of spring migrants. PCA axis two is dominated by Red-breasted Merganser, Gadwall, Double-crested Cormorant, Great Blue Heron, and Bufflehead on the positive end, and Western Grebe, Redhead, Ring-necked Duck, Surf Scoter, and Yellow-billed Loon on the negative end. This axis reflects the large decline in bird numbers in Hall's Creek Bay in 1995-96 and 1996-97,

with only Double-crested Comorant consistently found in winter and good concentrations of Red-breasted Merganser and Gadwall during fall and spring migration. The negative end of axis two is characterized by survey areas dominated by large concentrations Western Grebe and relatively high numbers of Ring-necked Duck and Redhead in fall and winter months.

Figure 6 shows the results of a PCA of aquatic species by month and year. PCA axis one reflects spring and fall months on the negative end and late fall and winter months on the positive end. Species strongly correlated with this axis

Table 5. The five species most highly correlated with the PCA axis scores of the survey-area by year ordination (Figure 5) using Pearson's correlation.

AXIS	Positive	Negative
PCA I	Double-crested Comorant Mallard Bufflehead Common Merganser American Coot	Great Egret Franklin's Gull California Gull White-faced Ibis American Avocet
PCA II	Green-winged Teal Cinnamon Teal Horned Grebe Canada Goose Gadwall	Great Blue Heron Double-crested Comorant Pied-billed Grebe Ring-billed Gull Hooded Merganser

Table 6. The five species most highly correlated with the PCA axis scores of the month by year ordination (Figure 6) using Pearson's correlation.

AXIS	Positive	Negative
PCA I	Double-crested Comorant Mallard Bufflehead Common Merganser American Coot	Great Egret Franklin's Gull California Gull White-faced Ibis American Avocet
PCA II	Green-winged Teal Cinnamon Teal Horned Grebe Canada Goose Gadwall	Great Blue Heron Double-crested Comorant Pied-billed Grebe Ring-billed Gull Hooded Merganser

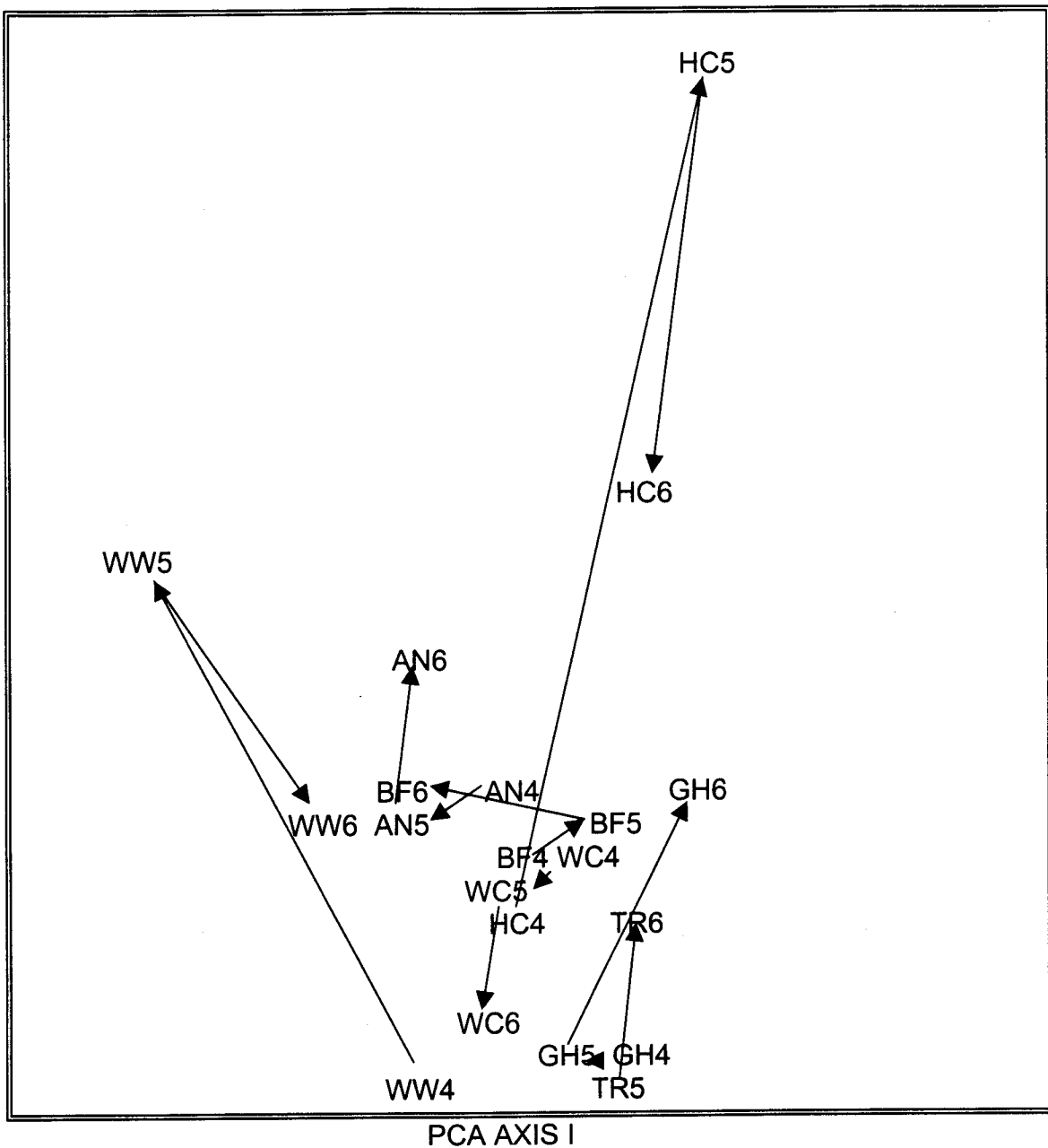


Figure 5. A principal components analysis (PCA) of aquatic bird species on Lake Powell by year and survey area. The first two axes are shown, accounting for 17% and 15% of the variation in the data respectively. Years are 4=1994-95, 5=1995-96, and 6=1996-97. AN=Antelope Island, BF=Bullfrog Bay, GH=Good Hope Bay, HC=Hall's Creek, TR=Trachyte Creek, WC=Warm Creek Bay, and WW=Wahweap Bay.

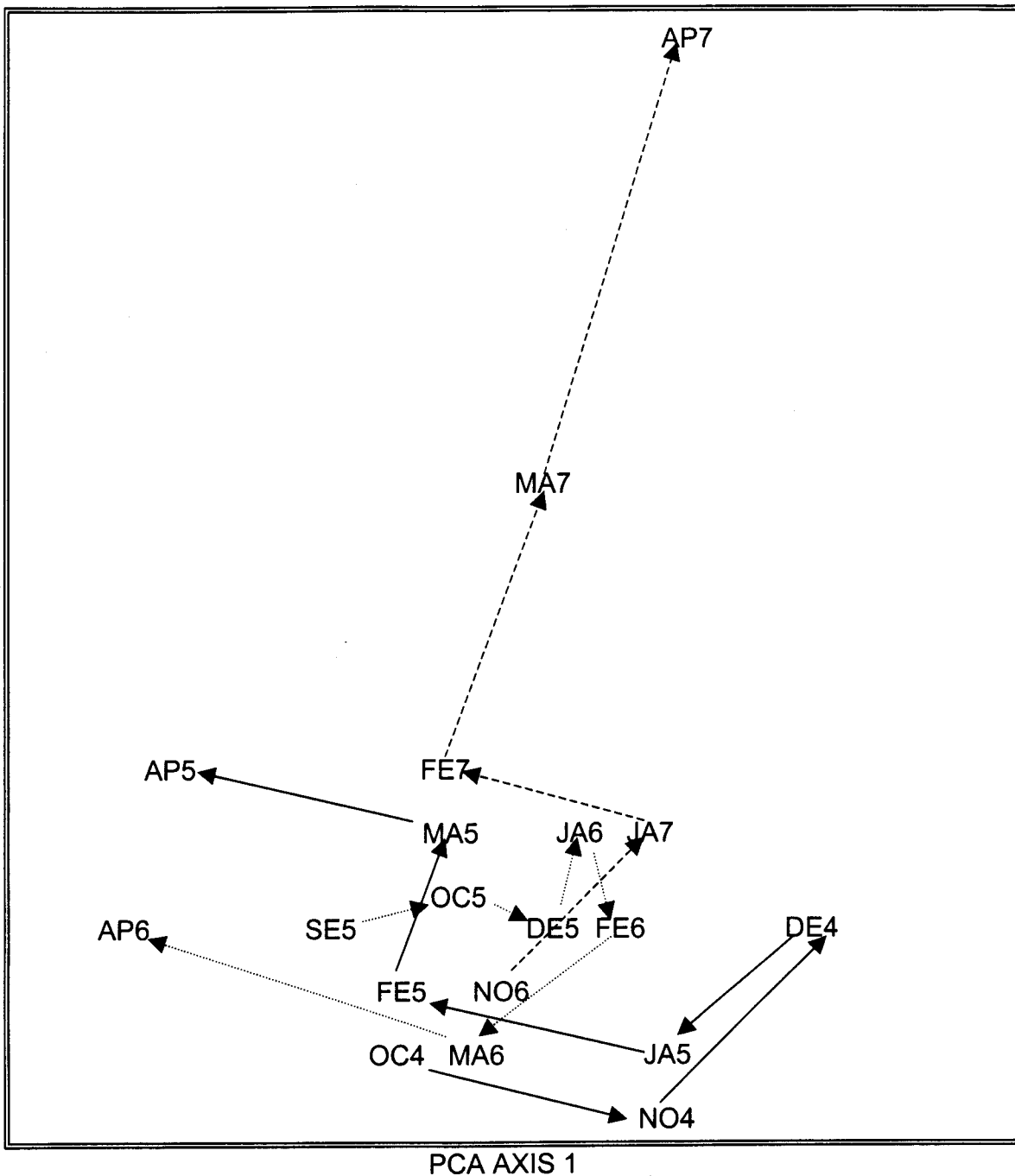


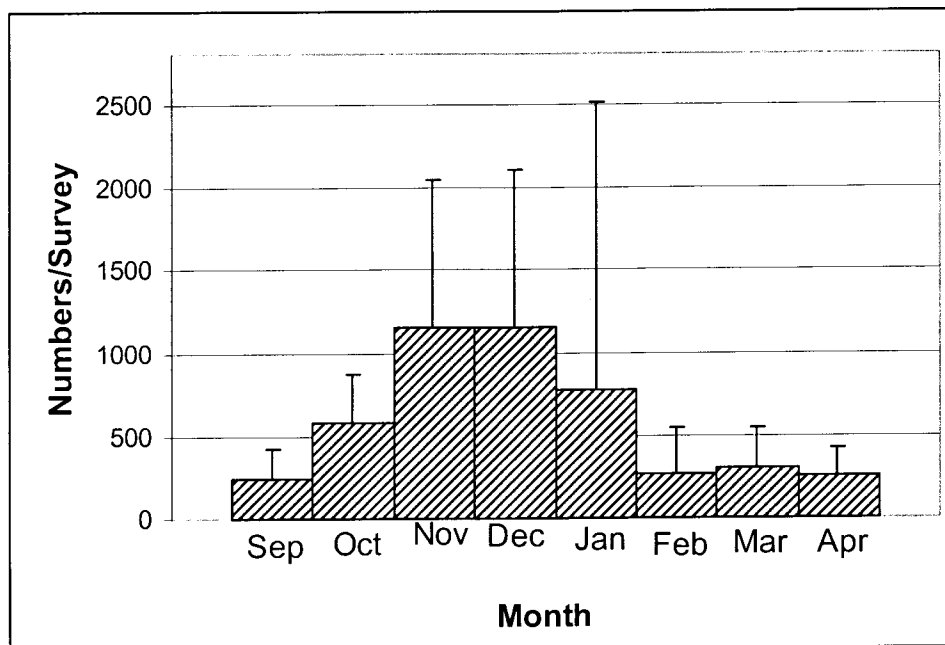
Figure 6. A principal components analysis (PCA) of aquatic bird data on Lake Powell by month and year. The first two axes are shown, accounting for 20% and 13% of the variation in the data respectively. Years are 4=1994, 5=1995, 6=1996, 7=1997. Months (September-April) are shown by their first two letters. Lines connect surveys in monthly order for each year.

include Great Egret, Franklin's Gull, California Gull, White-faced Ibis and American Avocet on the negative end, and Double-crested Comorant, Mallard, Bufflehead, Common Merganser, and American Coot on the positive end (Table 6). The second PCA axis reflects the relatively high numbers of waterfowl detected during February, March and April of 1997. Species strongly correlated with this axis include Green-winged Teal, Cinnamon Teal, Horned Grebe, Canada Goose, and Gadwall on the positive end, and Great Blue Heron, Double-crested Comorant, Pied-billed Grebe, Ring-billed Gull, and Hooded Merganser on the negative end.

Monthly Patterns

Between 1994 and 1997, numbers of birds were highest in the November-January period, generally peaking in November. After January numbers of aquatic birds dropped sharply through April, although slight increases generally occurred during spring migration. Throughout the three years of the program, spring surveys were consistently the most diverse ($S=13.6$, $H'=1.58$, $E=0.62$), followed by winter ($S=12.0$, $H'=1.09$, $E=0.44$) and fall ($S=10.8$, $H'=0.76$, $E=0.33$).

Figure 7. Numbers of aquatic birds detected on Lake Powell per survey each month between September and April summed over the years 1994-1997. The error bars indicate one standard deviation.



January comparisons from 1988-1997

In January 1988 a full lake survey was conducted. Data from five areas are directly comparable to the 1994-97 data, Bullfrog Bay, Hall's Creek Bay, Warm Creek Bay, Wahweap Bay, and Antelope Island. Appendix 9 summarizes results of January surveys from these five areas for four years 1988 and 1995-1997.

Overall numbers of birds and species were generally comparable between years, although numbers were much higher in 1997. Both 1988 and 1995 were years of low fish production (particularly Threadfin Shad), while 1996 and 1997 were generally good years. In 1988 both Northern Pintail and Canvasback were recorded from several areas. Both of these species were scarce in the 1994-97 surveys. Gadwall was absent in 1988, while it has become one of the more common wintering species in recent years.

Numbers vs. prey fish

In order to determine if any relationships existed between aquatic species abundance and prey base, several ANOVA's of bird abundance with Threadfin Shad were computed. No significant relationships between total birds and fish data from trawl, electroshock and larval plankton catch methods were found. However, a weakly significant relationship was discovered between numbers and larval Shad ($p=0.087$, $F=3.00$). When larval Shad numbers were high in plankton samples, bird abundance was low. Re-analyzing this data using only grebe (primarily Western Grebe) abundance and data from only those survey areas where fish were collected revealed a somewhat weaker relationship ($p=0.105$).

Concentrating only on divers, the results of ANOVA's were similar to those for total bird abundance. However, a significant relationship was found between grebe abundance and trawl data in Wahweap, Bullfrog and Good Hope Bays ($F=4.32$, $p=0.041$, Table 7). In survey seasons following high trawl catches of Shad, grebe abundance was significantly higher in the three bays compared with low Shad years.

Numbers vs. lake elevation

There was a tendency for more birds to be detected at higher lake levels. An ANOVA revealed a strongly significant interaction between lake level and year ($F=535.72$, $p<<0.00001$). Despite this, an ANOVA of bird abundance with lake level as the treatment was not significant ($F=0.43$, $p=0.52$). Also, an ANOVA of bird abundance with year as the treatment was not significant ($F=1.35$, $p=0.26$).

Habitats

The majority (>90%) of all detections were in one of two habitats, shallow open water, and shoreline with drowned vegetation. Western Grebe was most often found on open shallow water (<100 feet) in the principal bays. This was also where most spring migration sightings of California and Franklin's Gulls occurred. Dabbling and diving ducks and American Coots generally concentrated along the margins of the bays, in shallow depths (<20 feet) where drowned Tamarisk occurred. During fall and spring migration these patterns weakened, as flocks of birds were often found resting on deeper water as well.

Table 7. ANOVA of grebe abundance and Threadfin Shad abundance from trawl data in three surveys areas, Good Hope Bay, Bullfrog Bay, and Wahweap Bay, 1994-1997.

SUMMARY						
Groups	Count	Sum	Average	Variance		
HIGH	24	8096	337.3333	74475.79		
LOW	59	11763	199.3728	75419.23		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	324709	1	324709.0	4.320734	0.04081	3.9588599
Within Groups	6087259	81	75151.34			
Total	6411968	82				

Survey Area Accounts

1. Good Hope Bay

Good Hope Bay has primarily rocky shores with some fringing Tamarisk. No significant inflow areas occur. The only consistently encountered species in Good Hope Bay were Western Grebe and Common Merganser. This is one the most significant areas on Lake Powell for Western Grebe, particularly during fall migration, when flocks up to 1,000 birds have been seen.

2. Bullfrog Bay

Bullfrog Bay consists of a mixture of sandy and rocky shorelines. Fringing and drowned Tamarisk is common, particularly at the head of the bay in the vicinity of the inflow of Bullfrog Creek. Bullfrog Bay was consistently the most diverse in aquatic species of the mid- and up-lake portions of Lake Powell. Except for the fall and winter of 1994-1995, Bullfrog Bay supported large numbers of Western Grebe, peaking in November of 1996 at 1,055. Other commonly seen species included Double-crested Cormorant, Bufflehead, Common Goldeneye and Gadwall. Rare species seen in Bullfrog Bay include Greater Scaup, Pacific Loon, Forster's Tern, Lesser Yellowlegs, and Greater Yellowlegs. Throughout the winters of 1994-95 and 1995-96 one to two Wood Ducks were seen regularly at the Bullfrog gas dock.

3. Hall's Creek Bay

Hall's Creek Bay consists primarily of slickrock and sand shorelines, especially at high lake levels, with an extensive area of drowned Fremont Cottonwood and riparian scrub at the upper end where Hall's Creek empties into the bay. Hall's Creek is a permanent stream, flowing year-round. When Lake Powell levels

were low in the winter of 1994-95, Hall's Creek Bay was extremely productive, with large concentrations of American Coot. Since lake levels have increased, this bay has supported far fewer birds. Double-crested Cormorant is consistently present at the upper end of the bay. Highest numbers of this species is in fall, e.g., 41 in October 1994, and 39 in October of 1995. In the winter of 1995-96 most individuals stayed, with a count of 35 in February of 1996. This overwintering concentration of birds coincided with high Threadfin Shad numbers and a mild winter. Some rare species seen in Hall's Creek Bay include Herring Gull, Oldsquaw, Pacific Loon, and Surf Scoter.

4. Warm Creek Bay

Warm Creek Bay is a large shallow water bay characterized by extensive sandy beaches and fringing drowned Tamarisk. Where Warm Creek reaches the lake extensive mudflats and riparian scrub occurs. This bay has been consistently one of the most productive for aquatic birds. During the winters of 1995-96 and 1996-97 large numbers of American Coot and Western Grebe occurred, e.g., 3906 coot in January 1997. Other commonly seen species include Common Merganser, Gadwall, Green-winged Teal, Northern Pintail (1996-97), Red-breasted Merganser, Redhead, and Ring-necked Duck. Rare species seen in Warm Creek Bay include Herring Gull, Oldsquaw, Pacific Loon, Red-necked Grebe, and Yellow-billed Loon.

5. Wahweap Bay

Wahweap Bay is the most topographically complex of the survey areas. Numerous shallow bays occur, some fringed by slickrock or cliffs, others by sandy beaches and drowned Tamarisk. Wahweap Creek is an intermittent stream, although it flows most of the year. One of the most extensive stands of riparian scrub on the lake occurs at the head of the bay. Wahweap Bay has generally supported the most diverse assemblages of aquatic species on the lake. The central part of the bay north of the marina often supports flocks of pelican, gulls and waterfowl during migration. Remarkable was an incidental sighting of a flock of 15,500 Eared Grebe seen on the bay on January 16, 1997. During spring migration the bay supports the majority of the shorebird and gull sightings on the lake, with groups of American White Pelican, California Gull, Franklin's Gull, Marbled Godwit, and Ring-billed Gull often seen. Rare species seen on the bay include Barrow's Goldeneye, Bonaparte's Gull, Great Egret, Greater Scaup, Lesser Yellowlegs, Pacific Loon, Red-necked Grebe, Surf Scoter, Willet, and Yellow-billed Loon.

6. Antelope Island

Antelope Island was formed when Lake Powell flooded Wahweap and Warm Creek Bays. Most of the island is fringed with cliffs, although several small bays with sandy beaches and drowned Tamarisk occur, especially on the southwest

and west sides. The bay on the west side has often supported numbers of waterfowl, particularly during fall migration. Proximity to the much larger concentrations of waterfowl on the Colorado River below Glen Canyon Dam may also explain the diversity of waterfowl seen in this area. Antelope Island has generally been the most productive survey area for shorebirds, especially on the large bay on the southwest side opposite Antelope Point and on the northwest corner, where several small islands form at higher lake levels. Rare species seen around Antelope Island include Hooded Merganser, Red-necked Grebe and Snow Goose.

7. Trachyte Canyon

This area was added in fall 1996 because of reports of large concentrations of Western Grebe seen in the past. Trachyte Creek mouth and surrounding areas consists primarily of cliffs and rocky shorelines, with little drowned vegetation. Trachyte Creek supports a year-round flow. The largest flock of Western Grebe seen during the three-year program was one of 1,700 in November 1996. Other than these grebe concentrations, few other species were detected in the survey area.

DISCUSSION

The Lake Powell aquatic bird surveys of 1994-1997 have provided valuable baseline data. We now have a reasonably good understanding of the aquatic species that over-winter and migrate through the region in spring and fall. Numerous species have been added to the Glen Canyon NRA species list, and several rarities have been documented for the region, including Yellow-billed Loon, Pacific Loon, Red-necked Grebe, Greater Scaup, Barrow's Goldeneye, Oldsquaw, Surf Scoter, and Herring Gull.

Lake Powell is poor habitat for dabbling ducks. Because of the fluctuations in reservoir levels of 20-30 feet each year, aquatic vegetation (e.g., pondweeds) cannot establish. Drowned Tamarisk provides some habitat, and the majority of the waterfowl and American Coots detected were associated with this habitat. During migration numerous waterfowl species migrate through the region, and probably use the reservoir as a resting area. It is unlikely, however, that these birds linger for long. Most winter surveys revealed only a few hundred dabbling ducks at a time on the reservoir.

Lake Powell appears to provide suitable habitat for American Coot and diving species, especially Western Grebe. December 1994 surveys found over 8,000 coot in six survey areas. The November 1996 surveys found 4,500 Western Grebe in seven survey areas. The January 1997 surveys counted over 6,000 coot. At least in mild winters when resources (fish) are abundant, good numbers of these two species over-winter. Numbers generally peaked in November, remained high through January, then declined as northbound migration

commenced.

Another species that has benefited from the creation of Lake Powell is Ring-billed Gull. This species arrives in mid- to late September, and generally leaves in April, although a few birds linger into May. Ring-billed Gulls over-winter in good numbers, particularly at Wahweap and Bullfrog Bays. The presence of boat docks, marinas and camping areas in part explains their presence on the reservoir. Another resource they exploit is the introduced fresh-water clam *Corbicula*. The gulls have been seen on many occasions hovering with a clam over an area of slickrock, then dropping it onto the rock, which cracks it open.

Over the three years of surveys, some patterns were fairly constant. For example, the monthly ordination (Figure 6) showed that fall migratory and over-wintering bird assemblages were relatively predictable and stable. The principal difference between years was in the number of birds, rather than which species were present. Apparently the over-wintering stability in the bird community may have existed for some time, since the data from the January 1988 survey are very similar to the 1994-1997 data. This pattern breaks down with spring migration, which during the three years was consistently more unpredictable in species presence and abundance. In order to reveal any underlying patterns in spring migration, it is likely that several more years of survey data will be needed.

The operations of Glen Canyon Dam may have important indirect effects on migratory and wintering birds on Lake Powell. There was a consistent pattern of higher abundance in years with higher reservoir levels, although the differences were not significant. Much stronger was the connection between Threadfin Shad abundance and Western Grebe abundance. If dam operations affect shad spawning, then changes in prey base abundance brought about by dam operations can also affect bird abundance.

Glen Canyon Dam has been in place for 35 years, and since its completion and the filling of Lake Powell many species of aquatic birds have utilized the newly created resources of the reservoir. The single pre-dam survey in the summer of 1959 and other pre-dam literature for the Colorado River through Glen Canyon indicates that 26 species were known from the river (Behle 1960; Behle and Higgins 1959). Currently, 80 species have been reported on the reservoir (Spence 1998). Other large reservoirs on the Colorado River downstream of Glen Canyon Dam, especially Lake Mead and Lake Havasu, have much larger aquatic species lists (Rosenberg *et al.* 1991; NPS 1991). These reservoirs have had a much longer period of time to attract birds, and it is likely that Lake Powell will continue to attract additional species over time. There are many interesting similarities in the bird communities of these three reservoirs. All support good numbers of American Coot and Western Grebe in winter, and all have had similar vagrants over time, such as Yellow-billed Loon, Red-necked Grebe, Brown Pelican, and Sabine's Gull. Given time, species that have been seen on the older reservoirs should eventually discover Lake Powell. Especially likely to

occur are several species of gulls, including Glaucous, Glaucous-winged, Thayer's, Little, and Laughing.

RECOMMENDATIONS

Three principal recommendations are made for future work on the aquatic birds of Lake Powell. First, the logistics costs of conducting three-day surveys on the reservoir are very high. A less time-consuming and costly approach is to restrict surveys to down-lake areas (Wahweap Bay, Antelope Island, and Warm Creek Bay) which are adjacent to the government docks and boats. Because monthly surveys give a relatively poor understanding of turn-over in aquatic species composition over time, these down-lake surveys should also be done more often. A bi-weekly survey of the three down-lake areas would only require 20% of the logistics effort and surveyor time as the monthly full-lake surveys.

A second recommendation is that these biweekly surveys be extended into August and May in order to provide a better understanding of early fall and later spring migration.

Third, research on the prey base for fish-eating and other diving species that over-winter on Lake Powell (principally American Coot and Western Grebe) should be undertaken to determine what if any effects dam operations and reservoir conditions (salinity, water chemistry, volume, levels, etc.) have on the resource base.

ACKNOWLEDGMENTS

Mark Sogge and Dr. Charles van Riper III reviewed an earlier draft, for which I am grateful. Boat pilots included Tony Napolitan and Tom Haberle. Surveyors included Nikolle Brown, Aaron Flesch, John Grahame, Chris Florian, Chuck LaRue, Laurie Ness, Clive Pinnoch, Brenda Russell, Elliott Swarthout, and Mark Wotawa. The support and enthusiasm of Brenda Russell has been invaluable for this project. John Ritenour, Chief of the Resource Management Division, provided support and encouragement. The data on fish numbers was kindly supplied by George Blommer of Utah Division of Wildlife Resources.

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APPENDIX 1

Lake Powell aquatic bird surveys, 1994-1997. Maps of designated survey areas.

APPENDIX 2

Lake Powell aquatic bird survey data forms.

GLCA LAKE POWELL WATERBIRD SURVEY FORM I

PAGE ____ OF ____

DESIGNATED SURVEY AREA _____
 OBSERVERS _____
 WETLAND TYPE riparian lacustrine palustrine
 WEATHER _____

DATE _____
 TIME START _____
 TIME END _____
 LAKE LEVEL _____

SPECIES	NUMBER	HABITAT	BEHAVIOR
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

HABITAT: DW=deep water/main channel; SW=shallow water/bay; NV=nearshore-vegetation (on shore); NVD=nearshore vegetation (drowned); NS=nearshore sand; NR=nearshore rock/cobble; NC=nearshore cliff/slickrock; NM=nearshore mud; OV=onshore vegetation; OS=Onshore sand; OR=onshore rock/cobble; OC=onshore cliff/slickrock; OM=onshore mud; DT=drowned tree. **BEHAVIOR:** FLO=flyover; FOR=foraging; RES=resting; COR=courtship; DIV=Ddiving PRN=preening/bathing; REC=reacting to observer; SWI=swimming; PER=perching. **NOTATION:** use a slash (/) to indicate relationship between number, habitat and behavior. Use a comma to indicate different observations, but do not use in habitat and behavior. Example: (WEGR 3,15/10/5 DW/SW/NC FOR/DIV/SWI) means that the groups of 3 and 15 had similar habitat and behavior codes.

NOTES ON BACK (weather, habitat, other observations)

PAGE _____ OF _____

DATE _____ OBSERVERS _____

[illegible]

NUMBER: A=adult; J=juvenile; Y=young-of-year; m=male; f=female. **LOCATION:** RM=river mile along lake. **HABITAT:** L=lacustrine, P=palustrine, R=riparian; DW=deep water/main channel; SW=shallow water/bay; NV=nearshore-vegetation (on shore); NVD=nearshore vegetation (drowned); NS=nearshore sand; NR=nearshore rock/cobble; NC=nearshore cliff/slickrock; NM=nearshore mud; OV=onshore vegetation; OS=Onshore sand; OR=onshore rock/cobble; OC=onshore cliff/slickrock; OM=onshore mud; DT=drowned tree. **BEHAVIOR:** FLO=flyover; FOR=foraging; RES=resting; COR=courtship; DIV=Ddiving PRN=preening/bathing; REC=reacting to observer; SWI=swimming; PER=perching. **WEATHER:** CL=cloudy; PC=partly cloudy; SU=sunny; CA=calm; BR=breezy; WI=windy; RA=raining; SN=snowing; TBF=temperature below freezing; if a number is listed=degrees F (estimated).

NOTES ON BACK (weather, habitat, other observations)

APPENDIX 3

ANNOTATED SPECIES LIST (alphabetical by common name; total detections in () following account)

1. American Avocet (*Recurvirostra americana*)

A rare species, with four sightings. Single birds were seen on 4/96 in Wahweap Bay and 4/97 on Antelope Island, while a flock of seven were seen in Wahweap Bay on 4/97 and a group of four in Bullfrog Bay in 4/97. American Avocet breeds at the Wahweap Sewage Treatment Plant, and is otherwise a sparse migrant in spring and fall in the region (13).

2. American Coot (*Fulica americana*)

The most abundant species over the three years of the study. American Coots accounted for over 48% of all bird sightings. They were abundant in 1994-95 and common again in 1996-97. However, in 1995-96 numbers were very low except for December of 1996. Coots forage in a variety of ways, but on Lake Powell they generally dive in very shallow water, foraging on algae and associated crustaceans growing on rocks or drowned vegetation. Coots are strongly concentrated around the margins of shallow bays with abundant drowned tamarisk, habitat that is especially common in Bullfrog, Warm Creek, and Wahweap Bays (34,985).

3. American White Pelican (*Pelecanus erythrorhynchos*)

Pelicans generally migrate through the area in August, and were missed on the surveys. However, two birds lingered at Wahweap Bay from October through December of 1994. A single bird was observed at Bullfrog from November 1994 to January 1995 (9).

4. American Wigeon (*Anas americana*)

A relatively uncommon species, generally seen only in fall and spring migration. Large flocks of this species regularly over-winter on Page golf courses, so apparently the lake does not provide proper foraging habitat for wigeons (183).

5. Barrow's Goldeneye (*Bucephala islandica*)

Small flocks of this species regularly over-winter on the Colorado River below Glen Canyon Dam. However, Barrow's Goldeneye are rare on Lake Powell, with only two sightings. A small flock of eight was seen on Hall's Creek Bay in February 1996, and two birds were seen in Wahweap Bay in December 1995 (10).

6. Black-crowned Night Heron

A sparse migrant along the Colorado River, two birds were seen in April 1996 in Tamarisk at the head of Warm Creek Bay (2).

7. Blue-winged Teal (*Anas discors*)

A rare species in the Lake Powell area, with only a few sightings of small flocks in September and October of 1995. The largest flock was 30 on Wahweap Bay in October 1995. Because of difficulties in identifying birds in eclipse plumage, some sightings of teal during the program could not be identified and could have been either this species or Cinnamon Teal (58).

8. Bonaparte's Gull (*Larus philadelphia*)

A rare migrant in the area, with two birds in Wahweap Bay in October 1995 (2).

9. Bufflehead (*Bucephala albeola*)

A fairly common over-wintering species, with peak numbers between December and February. Buffleheads frequent the upper ends of shallow bays, especially Bullfrog and Hall's Creek Bays. The largest counts were of 54 birds in December 1995 and 52 birds in January 1996 in Bullfrog Bay. Relatively rare in down lake areas. There are no records between April and September on Lake Powell (515).

10. California Gull (*Larus californicus*)

A common migrant in spring, especially in down lake areas, but rare in fall surveys. There are records for every month over the three years of surveys except January. The largest count was of 205 birds in Wahweap Bay in April 1996 (418).

11. Canada Goose (*Branta canadensis*)

A sparse fall migrant on Lake Powell, generally not lingering beyond November. A few birds are seen in spring. The largest flock was of 46 birds in Warm Creek Bay in March 1997. This species commonly over-winters at the Page sewage treatment plant and adjacent golf course (166).

12. Cattle Egret (*Bubulcus ibis*)

A rare migrant in the area. Two birds were seen in Wahweap Bay in April 1997 (2).

13. Cinnamon Teal (*Anas cyanoptera*)

A rare spring migrant, with few birds detected prior to 1997. That year small flocks were seen in scattered locations, with the largest being 10 in Warm Creek Bay in March and 14 in Wahweap Bay in April (67).

14. Clark's Grebe (*Aechmophorus clarkii*)

A rare migrant in spring and fall. Inspection of Western Grebe rafts indicate that <1% are Clark's. No winter records are known. Generally this species occurs as single birds or more often pairs at the upper ends of bays, associated with drowned Tamarisk (17).

15. Common Goldeneye (*Bucephala clangula*)

A fairly common winter resident, with small flocks occurring in most survey areas between December and February. Numbers were much lower in 1996-1997 compared with the previous two years. Common Goldeneye's are one of the most common over-wintering species on the Colorado River below Glen Canyon Dam (970).

16. Common Loon (*Gavia immer*)

A sparse but regular migrant and winter resident, with records from every survey month except September 1995. The largest single count was five birds in Warm Creek bay in February 1996. Common Loons are generally solitary on Lake Powell (109).

17. Common Merganser (*Mergus merganser*)

A fairly common winter resident and migrant, with records from most survey months. The species was much more common in 1995-96 than subsequent years (733).

18. Double-crested Cormorant (*Phalacrocorax auritus*)

A common fall migrant and over-wintering species in some bays, especially Hall's Creek Bay. Numbers peak in fall or winter, and generally most birds are gone by March or April. The largest flock was of 41 in upper Hall's Creek Bay in October 1994 (547).

19. Eared Grebe (*Podiceps nigricollis*)

A common fall migrant, often lingering in small numbers through the winter. The largest group seen during surveys was 168 in Wahweap Bay in January 1997.

Extraordinary was a sighting of 17,000 birds in Wahweap Bay and adjacent areas on January 16, 1997. They were gone the morning of January 17 (636).

20. Forster's Tern (*Sterna forsteri*)

A fairly common migrant through the region in May and August, sometimes in large flocks (e.g., 150 on a small island off northeast point of Antelope Island on May 11, 1995). Only one record during survey months of four seen in Bullfrog Bay in April 1997 (4).

21. Franklin's Gull (*Larus pipixcan*)

Small numbers of Franklin's Gulls migrate through the Lake Powell area in April and May. Most sightings are from down lake or Bullfrog Bay. April 1997 was a particularly good year, with 59 birds counted in four survey areas. The largest flocks were of 14 individuals in Bullfrog Bay and 43 individuals in Wahweap Bay. On May 2 of 1997, 65 birds were counted at the Wahweap sewage treatment plant, which is located about one mile from shoreline (80).

22. Gadwall (*Anas strepera*)

A common species, seen in all survey months. Numbers peak in winter and early spring during migration (1,764).

23. Great Blue Heron (*Ardea herodias*)

An uncommon winter resident, and very rare summer resident. Small numbers generally occur in the survey areas, particularly during years with high Threadfin Shad populations (138).

24. Great Egret (*Casmerodius albus*)

A very rare spring migrant, with two records. Single adults were seen in Wahweap Bay in April 1995 and April 1996 (2).

25. Greater Scaup (*Aythya marila*)

A very rare migrant on the lake with two records. A single bird was seen flying over Bullfrog Bay in January 1995, and a small flock of five individuals was seen flying over Wahweap Bay in March of 1996. Greater Scaup is a rare but regular over-wintering species on the Colorado River below Glen Canyon Dam, with most records between December and February. (6).

26. Greater Yellowlegs (*Tringa melanoleuca*)

A single record of three birds in Bullfrog Bay in April 1997 (3).

27. Green-winged Teal (*Anas crecca*)

An uncommon fall and spring migrant, with peak numbers in October, February, and March. A few birds linger through the winter. Larger numbers were seen in early spring of 1997, e.g., 165 around Antelope Island and 152 in Wahweap Bay in March 1997 (1,270).

28. Herring Gull (*Larus argentatus*)

A rare migrant with four records, Hall's Creek Bay in October 1994 and March 1996, Warm Creek Bay in November 1995, and Wahweap Bay in January 1997. All four were of first winter birds (4).

29. Hooded Merganser (*Lophodytes cucullatus*)

Very small numbers move through the region in late fall and early winter (November-January). There is a record of a single male from March 1995 in Hall's Creek Bay (31).

30. Horned Grebe (*Podiceps auritis*)

Prior to 1996-97 a rare fall and spring migrant, with only two winter records; single birds in Good Hope Bay in January 1995 and in Bullfrog Bay in February 1996. For unknown reasons the species was relatively common on Lake Powell during the 1996-97 surveys, with 84 detections compared with seven in 1994-95 and one in 1995-96. During the five months surveyed counts included 16 in November, 10 in January, 11 in February, 29 in March, and 18 in April (92).

31. Killdeer (*Charadrius vociferus*)

Killdeer's are common migrants in the Page area, but apparently very rare on the lake. Only two records, a single bird in Bullfrog Bay in November 1994, and three birds on Antelope Island in April 1997. This species, like other smaller shorebirds, may be more common than the numbers indicate, but is probably easily overlooked from a boat on the water (4).

32. Lesser Scaup (*Aythya affinis*)

A relatively common migrant and winter resident, with small flocks most often seen in Wahweap Bay and around Antelope Island. This is one of the more common over-wintering species on the Colorado River below Glen Canyon Dam (654).

33. Lesser Yellowlegs (*Tringa flavipes*)

A very rare spring migrant, with three records. Two birds were seen on the early date of February 14, 1996 in Bullfrog Bay. Four birds were in Wahweap Bay in March 1996, and three in Wahweap Bay in April 1997 (9).

34. Long-billed Curlew (*Numenius americanus*)

A very rare spring migrant, with a single record of six birds off Antelope Island in April 1996 (6).

35. Mallard (*Anas platyrhynchos*)

A common over-wintering duck, encountered in small flocks in most survey areas. Particularly common on Bullfrog and Hall's Creek Bays. Mallards were scarce in the 1995-96 winter (534).

36. Marbled Godwit (*Limosa fedoa*)

A sparse but regular April migrant, most likely to be seen in Wahweap Bay or around Antelope Island. The largest flight was of 168 birds in April 1995 in down lake areas, e.g., 100 in Wahweap Bay, 60 on Antelope Island, and eight in Warm Creek Bay (218).

37. Northern Pintail (*Anas acuta*)

Uncommon but fairly regular migrant or winter resident, scarce in 1995-96. Relatively large numbers were seen in late winter of 1997, with 255 birds in Wahweap Bay and 185 in Warm Creek Bay in February 1997 (624).

38. Northern Shoveler (*Anas clypeata*)

Uncommon but fairly regular migrant or winter resident, scarce in 1995-96. Relatively large numbers were seen in spring of 1997, with 91 in March and 189 in April. The largest flock was of 90 birds at Trachyte Creek in April 1997 (624).

39. Oldsquaw (*Clangula hyemalis*)

A very rare winter resident and migrant, with four records. A male was seen in Hall's Creek Bay in January 1996, then again on the February survey. A bird of unknown sex in Hall's Creek Bay in March of 1996 may have been same individual. A bird of unknown sex was seen in Warm Creek Bay in November 1996 (4).

40. Pacific Loon (*Gavia pacifica*)

A rare but regular migrant and possible winter resident. In all there are seven records, one from October 1994, two from October 1995, one from January 1996, two from November 1996, and one from April 1997. The species has been seen in all survey areas except Antelope Island and Good Hope Bay. There is a possibility for the 1994-96 records to have been of Arctic Loon, although the last three records were specifically identified as Pacific Loon (7).

41. Pied-billed Grebe (*Podilymbus podiceps*)

An uncommon but regularly seen species, with records from all survey months. Numbers tend to peak in late fall and winter (November-January). A majority of the records are from 1994-95 (63%), when the species was particularly common on Lake Powell. The largest count was of 39 on Wahweap Bay in January 1995 (377).

42. Red-breasted Merganser (*Mergus serrator*)

A regular migrant in small numbers, with highest counts in late fall and spring. The winter of 1996-97 numerous birds over-wintered, e.g., 18 in January and 12 in February (168).

43. Red-necked Grebe (*Podiceps grisegena*)

Very rare with three records of single birds, January 1996, January 1997, and March 1997. Two were in Warm Creek Bay and one was seen in an adjacent part of the Antelope Island survey area. These are the first records for Glen Canyon NRA and Lake Powell (3).

44. Redhead (*Aythya americana*)

An uncommon migrant and winter resident. Redhead numbers peaked in December and January of 1994-95, when flocks of 191 and 175 respectively were seen in Wahweap Bay. Numbers of Redhead's were very low in 1995-96, while more were seen in 1996-97, including a flock of 164 in Warm Creek Bay in January 1997 (822).

45. Ring-billed Gull (*Larus delawarensis*)

A common winter resident, Ring-billed Gulls start appearing at Lake Powell in late September, departing by late April or early May. The largest count was of 359 in March 1996 (1124).

46. Ring-necked Duck (*Aythya collaris*)

An uncommon migrant and winter resident, with numbers peaking in December and January. As is the case for other waterfowl, this species was scarce on Lake Powell the winter of 1995-96. The largest flock seen was of 141 in Warm Creek Bay in January 1997 (719).

47. Ruddy Duck (*Oxyura jamaicensis*)

An uncommon and somewhat erratic fall and spring migrant, most commonly seen in October. A few birds lingered over the winter of 1996-97. The largest count was of 80 birds off Antelope Island in October 1995 (303).

48. Snow Goose (*Chen caerulescens*)

A single bird was seen with a flock of American Coot off Antelope Island in December 1995 (1).

49. Snowy Egret (*Egretta thula*)

A very rare spring migrant to the shores of Lake Powell, with only two records of single birds; Bullfrog Bay in March 1995, and Warm Creek Bay in April 1997 (2).

50. Surf Scoter (*Melanitta perspicillata*)

A very rare migrant with only two records. A female/immature was seen in Wahweap Bay in October of 1994, and a second female/immature was seen in Hall's Creek Bay in April 1995. This species has also been recorded from the Colorado River below Glen Canyon Dam several times (2).

51. Western Grebe (*Aechmophorus occidentalis*)

The second most common species on Lake Powell over the duration of the program. Western Grebes generally occur in rafts ranging from a dozen up to 1,700 at the mouth of Trachyte Creek in November 1996. Traditionally, large numbers have been seen at this location, Good Hope Bay, and Bullfrog Bay. There is a strong gradient of increasing numbers from down-lake areas towards Hite at the far northern end of the lake (NPS unpublished data). Peak numbers tend to occur in fall or early winter (October-December) coinciding with southbound migration. A smaller peak occurs in March and April as well. Large numbers were counted the fall and winter of 1995-96 and 1996-97, coinciding with relatively high Threadfin Shad populations (23,712).

52. White-faced Ibis (*Plegadis chihi*)

Small flocks occur regularly in April during northbound migration. These flocks

often linger into May and early June in the Wahweap area (107).

53. Willet (*Catoptrophorus semipalmatus*)

A rare spring migrant, with three records. Two birds were seen with Marbled Godwits in April 1995, and four birds were sighted in April 1997. A small flock of 16 birds was seen in Hall's Creek Bay in April 1997. Otherwise this species is a sparse migrant in spring and fall at sewage treatment ponds in the Page area (22).

54. Yellow-billed Loon (*Gavia adamsii*)

A Yellow-billed Loon was first seen on February 10, 1994 in Warm Creek Bay. The bird associated with both Common and Pacific Loons. The second record was on December 21, 1994, again in Warm Creek Bay. The bird then moved to Wahweap Bay, where it was seen twice opposite the Coves, on February 15 and March 15 of 1995. The same individual was probably involved in all these sightings. This same bird or another returned the next year, with sightings in Warm Creek Bay on February 15, 1996 and March 15, 1996. These sightings represent the second through seventh records for Utah, although they may all have been of the same individual (5).

APPENDIX 4

Aquatic bird surveys on Lake Powell, 1994-1997. Summary data by year and survey area. GHB=Good Hope Bay, BFB=Bullfrog Bay, HCB=Hall's Creek Bay, WCB=Warm Creek Bay, WWB=Wahweap Bay, ANI=Antelope Island, and TRC=Trachyte Creek.

1994-1995 AQUATIC BIRD SURVEYS								
SPECIES	ACRONYM	GHB	BFB	HCB	WCB	WWB	ANI	SURVEY TOTAL
American Avocet	AMAV	0	0	0	0	0	0	0
American Coot	AMCO	103	2397	5716	2528	7250	1446	19440
American White Pelican	AWPE	0	3	0	0	6	0	9
American Widgeon	AMWI	2	5	5	48	26	33	119
Barrow's Goldeneye	BAGO	0	0	0	0	0	0	0
Black-crowned Night Heron	BCNH	0	0	0	0	0	0	0
Blue-winged Teal	BWTE	0	0	0	0	0	0	0
Bonaparte's Gull	BOGU	0	0	0	0	0	0	0
Bufflehead	BUFF	10	117	59	0	0	2	188
California Gull	CAGU	3	2	3	14	35	0	57
Canada Goose	CAGO	0	0	55	1	3	13	72
Cattle Egret	CAEG	0	0	0	0	0	0	0
Cinammon Teal	CITE	0	2	0	2	3	2	9
Clark's Grebe	CLGR	1	4	0	1	0	0	6
Common Goldeneye	COGO	13	81	50	18	35	250	447
Common Loon	COLO	0	4	7	8	9	5	33
Common Merganser	COME	61	73	76	83	48	36	377
Double-crested Comorant	DCCO	1	27	164	9	54	0	255
Eared Grebe	EAGR	7	67	13	6	54	17	164
Forster's Tern	FOTE	0	0	0	0	0	0	0
Franklin's Gull	FRGU	0	0	0	1	4	0	5
Gadwall	GADW	29	162	92	103	52	148	586
Great Blue Heron	GBHE	2	14	6	10	11	0	43
Great Egret	GREG	0	0	0	0	1	0	1
Greater Scaup	GRSC	0	1	0	0	0	0	1
Greater Yellowlegs	GRYE	0	0	0	0	0	0	0
Green-winged Teal	GWTE	0	17	12	37	135	27	228
Herring Gull	HEGU	0	0	1	0	0	0	1
Hooded Merganser	HOME	0	0	1	18	0	2	21
Horned Grebe	HOGR	1	1	4	1	0	0	7
Killdeer	KILL	0	1	0	0	0	0	1
Lesser Scaup	LESC	6	6	47	0	128	51	238
Lesser Yellowlegs	LEYE	0	0	0	0	0	0	0
Long-billed Curlew	LBCU	0	0	0	0	0	0	0
Mallard	MALL	0	24	89	66	95	43	317
Marbled Godwit	MAGO	0	0	0	8	120	40	168
Nothern Pintail	NOPI	0	9	22	6	55	20	112
Northern Shoveler	NOSH	0	9	10	1	4	11	35
Oldsquaw	OLSQ	0	0	0	0	0	0	0
Pacific Loon	PALO	0	0	0	0	1	0	1
Pied-billed Grebe	PBGR	4	11	46	64	104	9	238
Red-breasted Merganser	RBME	0	0	1	7	1	12	21
Red-necked Grebe	RNGR	0	0	0	0	0	0	0
Redhead	REDH	5	21	21	2	405	11	465
Ring-billed Gull	RBGU	35	71	51	32	186	55	430
Ring-necked Duck	RNDU	3	6	85	10	297	15	416
Ruddy Duck	RUDU	0	25	40	0	30	47	142
Snow Goose	SNGO	0	0	0	0	0	0	0
Snowy Egret	SNEG	0	1	0	0	0	0	1
Surf Scoter	SUSC	0	0	1	0	1	0	2
Western Grebe	WEGR	3869	460	288	100	361	46	5124
White-faced Ibis	WFIB	0	0	0	0	0	0	0
Willet	WILL	0	0	0	0	2	0	2
Yellow-billed Loon	YBLO	0	0	0	1	2	0	3
Unknown Duck	undu	0	3	6	4	3	5	21
Unknown Grebe	ungr	0	1	0	0	0	0	1

SPECIES	ACRONYM	GHB	BFB	HCB	WCB	WWB	ANI	SURVEY TOTAL
Unknown Gull	ungu	0	0	0	0	0	0	0
Unknown Loon	unlo	1	0	0	0	0	0	1
Unknown other	unk	0	0	73	0	26	0	99
TOTALS		4156	3625	7044	3189	9547	2346	29907
SPECIES		17	29	28	28	32	24	40

Survey Areas: GHB=Good Hope Bay, BFB=Bullfrog Bay, HCB=Hall's Creek Bay, WCB=Warm Creek Bay
 WWB=Wahweap Bay, ANI=Antelope Island

1995-1996 AQUATIC BIRD SURVEYS									
SPECIES	ACRONYM	GHB	BFB	HC B	WCB	WWB	ANI	TRC	SURVEY TOTAL
American Avocet	AMAV	0	0	0	0	1	0	0	1
American Coot	AMCO	5	383	529	2035	976	1652	19	5599
American White Pelican	AWPE	0	0	0	0	0	0	0	0
American Widgeon	AMWI	1	0	1	9	4	19	0	34
Barrow's Goldeneye	BAGO	0	0	8	0	2	0	0	10
Black-crowned Night Heron	BCNH	0	0	0	2	0	0	0	2
Blue-winged Teal	BWTE	0	0	0	6	40	12	0	58
Bonaparte's Gull	BOGU	0	0	0	0	2	0	0	2
Bufflehead	BUFF	0	80	107	0	7	11	0	205
California Gull	CAGU	0	15	5	19	211	48	0	298
Canada Goose	CAGO	0	0	7	0	5	0	0	12
Cattle Egret	CAEG	0	0	0	0	0	0	0	0
Cinammon Teal	CITE	0	0	0	10	0	0	0	10
Clark's Grebe	CLGR	0	0	0	0	0	0	2	2
Common Goldeneye	COGO	5	106	205	38	10	48	0	412
Common Loon	COLO	0	6	7	15	10	12	0	50
Common Merganser	COME	10	14	58	64	10	6	3	165
Double-crested Comorant	DCCO	0	33	118	13	25	0	0	189
Eared Grebe	EAGR	10	20	19	12	38	36	8	143
Forster's Tern	FOTE	0	0	0	0	0	0	0	0
Franklin's Gull	FRGU	0	0	0	0	13	3	0	16
Gadwall	GADW	7	110	204	10	54	35	0	420
Great Blue Heron	GBHE	0	12	11	13	14	0	0	50
Great Egret	GREG	0	0	0	0	1	0	0	1
Greater Scaup	GRSC	0	0	0	0	5	0	0	5
Greater Yellowlegs	GRYE	0	0	0	0	0	0	0	0
Green-winged Teal	GWTE	0	26	26	45	49	72	0	218
Herring Gull	HEGU	0	0	1	0	0	0	0	1
Hooded Merganser	HOME	0	0	2	0	0	0	0	2
Horned Grebe	HOGH	0	1	0	0	0	0	0	1
Killdeer	KILL	0	0	0	0	0	0	0	0
Lesser Scaup	LESC	15	5	0	38	75	70	0	203
Lesser Yellowlegs	LEYE	0	2	0	0	4	0	0	6
Long-billed Curlew	LBCU	0	0	0	0	0	6	0	6
Mallard	MALL	0	19	14	21	18	3	0	75
Marbled Godwit	MAGO	0	0	0	0	7	9	0	16
Nothorn Pintail	NOPI	0	3	0	1	1	17	0	22
Northern Shoveler	NOSH	0	23	27	0	4	20	0	74
Oldsquaw	OLSQ	0	0	2	1	0	0	0	3
Pacific Loon	PALO	0	1	1	0	1	0	0	3
Pied-billed Grebe	PBGR	7	19	23	20	8	4	3	84
Red-breasted Merganser	RBME	0	4	41	2	9	18	0	74
Red-necked Grebe	RNGR	0	0	0	1	0	0	0	1
Redhead	REDH	4	1	1	3	17	36	0	62
Ring-billed Gull	RBGU	4	45	35	42	296	129	0	551
Ring-necked Duck	RNDU	0	7	0	0	16	0	0	23
Ruddy Duck	RUDU	0	1	0	2	15	91	5	114
Snow Goose	SNGO	0	0	0	0	0	1	0	1
Snowy Egret	SNEG	0	0	0	0	0	0	0	0
Surf Scoter	SUSC	0	0	0	0	0	0	0	0
Western Grebe	WEGR	1381	3210	523	1367	488	132	2090	9191
White-faced Ibis	WFIB	0	0	0	0	21	0	0	21
Willet	WILL	0	0	0	0	0	0	0	0
Yellow-billed Loon	YBLO	0	0	0	2	0	0	0	2
Unknown Duck	undu	1	0	0	0	4	2	0	7
Unknown Grebe	ungr	0	0	0	0	0	0	0	0

SPECIES	ACRONYM	GHB	BFB	HCB	WCB	WWB	ANI	TRC	SURVEY TOTAL
Unknown Gull	ungu	0	0	0	0	0	0	0	0
Unknown Loon	unlo	0	0	0	0	0	0	0	0
Unknown other	unk	1	0	0	0	1	0	1	3
TOTALS		1451	4146	1975	3789	2462	2492	2131	18448
SPECIES		10	25	25	26	35	25	7	48

Survey Areas: GHB=Good Hope Bay, BFB=Bullfrog Bay, HCB=Hall's Creek Bay, WCB=Warm Creek Bay, WWB=Wahweap Bay, ANI=Antelope Island, TRC=Trachyte Creek.

1996-1997 AQUATIC BIRD SURVEYS

SPECIES	ACRONYM	GHB	BFB	HC	WCB	WWB	ANI	TRC	SURVEY TOTAL
American Avocet	AMAV	0	4	0	0	7	1	0	8
American Coot	AMCO	14	213	50	5832	2357	1362	118	9669
American White Pelican	AWPE	0	0	0	0	0	0	0	0
American Wigeon	AMWI	7	11	0	7	4	1	0	12
Barrow's Goldeneye	BAGO	0	0	0	0	0	0	0	0
Black-crowned Night Heron	BCNH	0	0	0	0	0	0	0	0
Blue-winged Teal	BWTE	0	0	0	0	0	0	0	0
Bonaparte's Gull	BOGU	0	0	0	0	0	0	0	0
Bufflehead	BUFF	0	41	59	4	11	5	2	22
California Gull	CAGU	1	4	0	10	48	0	0	58
Canada Goose	CAGO	0	2	6	46	15	12	1	74
Cattle Egret	CAEG	0	0	0	0	2	0	0	2
Cinammon Teal	CITE	7	5	0	10	18	8	0	36
Clark's Grebe	CLGR	0	1	0	3	5	0	0	8
Common Goldeneye	COGO	5	6	58	12	12	17	1	42
Common Loon	COLO	2	5	5	4	7	3	0	14
Common Merganser	COME	80	9	15	33	15	30	9	87
Double-crested Comorant	DCCO	3	5	67	13	9	4	2	28
Eared Grebe	EAGR	1	66	9	4	198	51	0	253
Forster's Tern	FOTE	0	4	0	0	0	0	0	0
Franklin's Gull	FRGU	0	14	0	1	43	0	1	45
Gadwall	GADW	94	178	96	81	121	107	81	390
Great Blue Heron	GBHE	2	3	12	7	10	10	1	28
Great Egret	GREG	0	0	0	0	0	0	0	0
Greater Scaup	GRSC	0	0	0	0	0	0	0	0
Greater Yellowlegs	GRYE	0	3	0	0	0	0	0	0
Green-winged Teal	GWTE	89	160	64	96	209	176	30	511
Herring Gull	HEGU	0	0	0	1	1	0	0	2
Hooded Merganser	HOME	0	0	0	0	8	0	0	8
Horned Grebe	HOGH	16	16	13	6	6	25	2	39
Killdeer	KILL	0	0	0	0	0	3	0	3
Lesser Scaup	LESC	5	25	0	13	100	68	2	183
Lesser Yellowlegs	LEYE	0	0	0	0	3	0	0	3
Long-billed Curlew	LBCU	0	0	0	0	0	0	0	0
Mallard	MALL	5	79	5	47	0	6	0	53
Marbled Godwit	MAGO	0	15	0	3	13	3	0	19
Nothorn Pintail	NOPI	1	33	2	262	188	4	0	454
Northern Shoveler	NOSH	26	44	20	21	87	16	90	214
Oldsquaw	OLSQ	0	0	0	1	0	0	0	1
Pacific Loon	PALO	0	0	0	1	1	0	1	3
Pied-billed Grebe	PBGR	13	6	9	6	4	10	7	27
Red-breasted Merganser	RBME	9	11	15	5	11	16	6	38
Red-necked Grebe	RNGR	0	0	0	0	1	1	0	2
Redhead	REDH	0	12	2	189	80	12	0	281
Ring-billed Gull	RBGU	0	41	22	44	24	10	2	80
Ring-necked Duck	RNDU	3	8	1	149	94	18	7	268
Ruddy Duck	RUDU	0	16	8	2	5	10	6	23
Snow Goose	SNGO	0	0	0	0	0	0	0	0
Snowy Egret	SNEG	0	0	0	1	0	0	0	1
Surf Scoter	SUSC	0	0	0	0	0	0	0	0
Western Grebe	WEGR	1060	1999	1002	1346	1937	118	1935	9397
White-faced Ibis	WFIB	0	46	0	0	26	14	0	40
Willet	WILL	0	0	16	0	4	0	0	4
Yellow-billed Loon	YBLO	0	0	0	0	0	0	0	0
Unknown Duck	undu	2	5	0	0	0	0	0	0
Unknown Grebe	ungr	0	0	0	4	0	0	0	4

[illegible]

APPENDIX 5

Aquatic bird surveys on Lake Powell, 1994-1997. Data by survey month and area.

Trachyte Creek

SPECIES	Oct-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	Nov-96	Jan-97	Feb-97	Mar-97	Apr-97
American Avocet	0	0	0	0	0	0	0	0	0	0	0
American Coot	19	0	0	0	0	0	65	15	37	0	1
American White Pelican	0	0	0	0	0	0	0	0	0	0	0
American Wigeon	0	0	0	0	0	0	0	0	0	0	0
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0	2	0	0	0
California Gull	0	0	0	0	0	0	0	0	0	0	0
Canada Goose	0	0	0	0	0	0	0	0	0	0	1
Cinnamon Teal	0	0	0	0	0	0	0	0	0	0	0
Clark's Grebe	2	0	0	0	0	0	0	0	0	0	0
Common Goldeneye	0	0	0	0	0	0	0	1	0	0	0
Common Loon	0	0	0	0	0	0	0	0	0	0	0
Common Merganser	0	1	2	0	0	0	0	0	0	9	0
Double-crested Cormorant	0	0	0	0	0	0	0	0	1	0	1
Eared Grebe	8	0	0	0	0	0	0	0	0	0	0
Forester's Tern	0	0	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	1
Gadwall	0	0	0	0	0	0	0	33	0	8	40
Great Blue Heron	0	0	0	0	0	0	0	0	1	0	0
Great Egret	0	0	0	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Green-winged Teal	0	0	0	0	0	0	0	11	10	9	0
Herring Gull	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0	0	0	0	0
Horned Grebe	0	0	0	0	0	0	1	0	0	0	1
Killdeer	0	0	0	0	0	0	0	0	0	0	0
Lesser Scaup	0	0	0	0	0	0	0	2	0	0	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0
Marbled Godwit	0	0	0	0	0	0	0	0	0	0	0
Northern Pintail	0	0	0	0	0	0	0	0	0	0	0
Northern Shoveler	0	0	0	0	0	0	0	0	0	0	90
Old Squaw	0	0	0	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	1	0	0	0	0
Pied-billed Grebe	0	0	3	0	0	0	0	4	2	1	0
Red-breasted merganser	0	0	0	0	0	0	0	4	2	0	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	0
Redhead	0	0	0	0	0	0	0	0	0	0	0
Ring-billed Gull	0	0	0	0	0	0	0	1	1	0	0
Ring-necked Duck	0	0	0	0	0	0	0	7	0	0	0
Ruddy Duck	0	5	0	0	0	0	0	0	0	0	6
Snow Goose	0	0	0	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0
Western Grebe	545	1000	310	235	0	0	1700	105	50	43	37
White-faced Ibis	0	0	0	0	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown Duck	0	0	0	0	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown other	1	0	0	0	0	0	0	0	0	0	0

Good Hope Bay

SPECIES	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	Sep-95	Oct-95	Dec-95	Jan-96
American Avocet	0	0	0	0	0	0	0	0	0	0	0
American Coot	0	20	24	56	1	0	2	0	1	4	0
American White Pelican	0	0	0	0	0	0	0	0	0	0	0
American Wigeon	0	0	0	2	0	0	0	0	1	0	0
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	10	0	0	0	0	0	0	0	0	0
California Gull	0	3	0	0	0	0	0	0	0	0	0
Canada Goose	0	0	0	0	0	0	0	0	0	0	0
Cinnamon Teal	0	0	0	0	0	0	0	0	0	0	0
Clark's Grebe	0	0	0	1	0	0	0	0	0	0	0
Common Goldeneye	0	0	3	8	2	0	0	0	0	0	4
Common Loon	0	0	0	0	0	0	0	0	0	0	0
Common Merganser	0	14	14	3	2	23	5	0	0	2	2
Double-crested Cormorant	0	1	0	0	0	0	0	0	0	0	0
Eared Grebe	0	0	1	2	1	0	3	0	6	0	3
Forester's Tern	0	0	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0
Gadwall	0	2	17	10	0	0	0	0	5	0	2
Great Blue Heron	1	1	0	0	0	0	0	0	0	0	0
Great Egret	0	0	0	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Green-winged Teal	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0	0	0	0	0
Horned Grebe	0	0	0	1	0	0	0	0	0	0	0
Killdeer	0	0	0	0	0	0	0	0	0	0	0
Lesser Scaup	0	1	0	0	0	5	0	0	0	15	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0
Marbled Godwit	0	0	0	0	0	0	0	0	0	0	0
Northern Pintail	0	0	0	0	0	0	0	0	0	0	0
Northern Shoveler	0	0	0	0	0	0	0	0	0	0	0
Old Squaw	0	0	0	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	0	0	0	0
Pied-billed Grebe	0	0	2	2	0	0	0	0	0	7	0
Red-breasted merganser	0	0	0	0	0	0	0	0	0	0	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	0
Redhead	0	0	0	0	0	5	0	0	4	0	0
Ring-billed Gull	0	35	0	0	0	0	0	0	0	1	2
Ring-necked Duck	0	0	3	0	0	0	0	0	0	0	0
Ruddy Duck	0	0	0	0	0	0	0	0	0	0	0
Snow Goose	0	0	0	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0
Western Grebe	1100	852	470	1055	238	50	104	0	853	490	16
White-faced Ibis	0	0	0	0	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown Duck	0	0	0	0	0	0	0	0	0	1	0
Unknown Grebe	0	0	0	0	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0	0	0	0
Unknown Loon	1	0	0	0	0	0	0	0	0	0	0
Unknown other	0	0	0	0	0	0	0	0	0	1	0

Good Hope Bay

SPECIES	Feb-96	Mar-96	Apr-96	Nov-96	Jan-97	Feb-97	Mar-97	Apr-97
American Avocet	0	0	0	0	0	0	0	0
American Coot	0	0	0	0	0	8	5	1
American White Pelican	0	0	0	0	0	0	0	0
American Wigeon	0	0	0	0	0	0	0	7
Barrow's Goldeneye	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0	0
California Gull	0	0	0	0	0	1	0	0
Canada Goose	0	0	0	0	0	0	0	0
Cinnamon Teal	0	0	0	0	0	0	0	7
Clark's Grebe	0	0	0	0	0	0	0	0
Common Goldeneye	1	0	0	0	1	3	1	0
Common Loon	0	0	0	1	0	0	0	1
Common Merganser	6	0	0	0	3	23	17	37
Double-crested Cormorant	0	0	0	0	0	0	3	0
Eared Grebe	1	0	0	1	0	0	0	0
Forester's Tern	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0	0
Gadwall	0	0	0	0	0	13	31	50
Great Blue Heron	0	0	0	0	0	1	0	1
Great Egret	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0
Green-winged Teal	0	0	0	0	0	25	43	21
Herring Gull	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0	0
Horned Grebe	0	0	0	0	0	2	8	6
Killdeer	0	0	0	0	0	0	0	0
Lesser Scaup	0	0	0	0	0	0	5	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	3	2
Marbled Godwit	0	0	0	0	0	0	0	0
Northern Pintail	0	0	0	0	0	0	0	1
Northern Shoveler	0	0	0	0	0	0	10	16
Old Squaw	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	0
Pied-billed Grebe	0	0	0	3	2	4	2	2
Red-breasted merganser	0	0	0	0	3	3	1	2
Red-necked Grebe	0	0	0	0	0	0	0	0
Redhead	0	0	0	0	0	0	0	0
Ring-billed Gull	1	0	0	0	0	0	0	0
Ring-necked Duck	0	0	0	0	0	0	0	3
Ruddy Duck	0	0	0	0	0	0	0	0
Snow Goose	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0
Western Grebe	22	0	0	609	192	116	46	97
White-faced Ibis	0	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	0	0
Unknown Duck	0	0	0	0	0	0	2	0
Unknown Grebe	0	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0
Unknown other	0	0	0	0	0	0	2	2

Bullfrog Bay

SPECIES	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	Sep-95	Oct-95	Dec-95	Jan-96
American Avocet	0	0	0	0	0	0	0	0	0	0	0
American Coot	335	661	665	587	76	55	18	0	78	42	147
American White Pelican	0	1	1	1	0	0	0	0	0	0	0
American Wigeon	0	0	1	4	0	0	0	0	0	0	0
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0
Bufflehead	2	38	54	20	3	0	0	0	0	7	52
California Gull	0	0	0	0	0	0	2	0	0	1	0
Canada Goose	0	0	0	0	0	0	0	0	0	0	0
Cinnamon Teal	0	0	0	0	0	0	2	0	0	0	0
Clark's Grebe	1	0	0	0	0	2	1	0	0	0	0
Common Goldeneye	0	4	23	22	32	0	0	0	0	0	73
Common Loon	0	0	1	1	0	1	1	0	1	3	2
Common Merganser	33	1	21	12	2	1	3	0	0	4	4
Double-crested Cormorant	0	5	9	7	2	4	0	0	1	10	22
Eared Grebe	27	1	10	2	2	17	8	0	1	5	6
Forester's Tern	0	0	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0
Gadwall	2	15	22	31	10	82	0	0	0	10	43
Great Blue Heron	2	2	1	2	0	7	0	0	3	3	2
Great Egret	0	0	0	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	1	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Green-winged Teal	0	4	2	5	1	5	0	0	0	0	5
Herring Gull	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0	0	0	0	0
Horned Grebe	0	1	0	0	0	0	0	0	0	0	0
Killdeer	0	1	0	0	0	0	0	0	0	0	0
Lesser Scaup	0	0	4	2	0	0	0	0	0	0	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	3	0	10	0	10	1	0	5	5	4
Marbled Godwit	0	0	0	0	0	0	0	0	0	0	0
Northern Pintail	0	0	0	0	0	7	2	0	0	0	0
Northern Shoveler	0	0	4	3	0	0	2	0	0	7	7
Old Squaw	0	0	0	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	0	1	0	0
Pied-billed Grebe	0	3	3	2	1	2	0	0	5	8	3
Red-breasted merganser	0	0	0	0	0	0	0	0	0	4	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	0
Redhead	0	4	15	2	0	0	0	0	0	1	0
Ring-billed Gull	31	6	1	20	9	4	0	0	6	19	8
Ring-necked Duck	4	0	0	0	0	2	0	0	0	0	7
Ruddy Duck	15	9	0	0	0	0	1	0	0	0	0
Snow Goose	0	0	0	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	1	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0
Western Grebe	141	40	24	103	58	42	52	0	261	895	529
White-faced Ibis	0	0	0	0	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown Duck	1	0	1	0	1	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	1	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown other	0	0	0	0	0	0	0	0	0	0	0

Bullfrog Bay

SPECIES	Feb-96	Mar-96	Nov-96	Jan-97	Feb-97	Mar-97	Apr-97
American Avocet	0	0	0	0	0	0	4
American Coot	91	25	137	16	13	19	28
American White Pelican	0	0	0	0	0	0	0
American Wigeon	0	0	0	0	0	6	5
Barrow's Goldeneye	0	0	0	0	0	0	0
Black-crowned Night Heron		0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0
Bufflehead	20	1	1	12	18	10	0
California Gull	0	14	0	0	0	0	4
Canada Goose	0	0	0	0	0	2	0
Cinnamon Teal	0	0	0	0	0	1	4
Clark's Grebe	0	0	1	0	0	0	0
Common Goldeneye	33	0	0	0	1	5	0
Common Loon	0	0	1	2	0	0	2
Common Merganser	6	0	0	1	2	2	4
Double-crested Cormorant	0	0	3	2	0	0	0
Eared Grebe	6	2	41	0	1		24
Forester's Tern	0	0	0	0	0	0	4
Franklin's Gull	0	0	0	0	0	0	14
Gadwall	55	2	35	93	19	18	13
Great Blue Heron	0	4	1	1	1	0	0
Great Egret	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	3
Green-winged Teal	21	0	0	27	58	44	31
Herring Gull	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0
Horned Grebe	1	0	3	7	1	4	1
Killdeer	0	0	0	0	0	0	0
Lesser Scaup	5	0	10	0	0	14	1
Lesser Yellowlegs	2	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0
Mallard	2	3	42	5	2	27	3
Marbled Godwit	0	0	0	0	0	0	15
Northern Pintail	3	0	0	0	0	33	0
Northern Shoveler	9	0	0	0	0	0	44
Old Squaw	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0
Pied-billed Grebe	0	3	4	1	0	0	1
Red-breasted merganser	0	0	4	3	0	4	0
Red-necked Grebe	0	0	0	0	0	0	0
Redhead	0	0	9	0	0	3	0
Ring-billed Gull	7	5	5	4	8	4	20
Ring-necked Duck	0	0	0	0	5	0	3
Ruddy Duck	0	1	0	0	0	16	0
Snow Goose	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0
Western Grebe	765	760	1055	324	182	168	270
White-faced Ibis	0	0	0	0	0	0	46
Willet	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	0
Unknown Duck	0	0	0	5	0	0	0
Unknown Gull	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0
Unknown other	0	0	13	0	1	0	0

Hall's Creek Bay

SPECIES	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	Sep-95	Oct-95	Dec-95	Jan-96
American Avocet	0	0	0	0	0	0	0	0	0	0	0
American Coot	199	2384	2996	49	0	28	60	0	8	31	253
American White Pelican	0	0	0	0	0	0	0	0	0	0	0
American Wigeon	0	2	0	0	0	3	0	0	0	0	1
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	4	6	32	13	4	0	0	0	32	22
California Gull	3	0	0	0	0	0	0	0	1	4	0
Canada Goose	7	24	21	0	3	0	0	0	6	0	1
Cinnamon Teal	0	0	0	0	0	0	0	0	0	0	0
Clark's Grebe	0	0	0	0	0	0	0	0	0	0	0
Common Goldeneye	0	15	3	12	13	6	1	0	0	11	58
Common Loon	0	3	2	2	0	0	0	0	1	1	1
Common Merganser	20	23	17	3	5	4	4	0	0	4	6
Double-crested Cormorant	41	33	31	18	28	8	5	0	39	6	16
Eared Grebe	2	1	6	4	0	0	0	0	2	4	2
Forester's Tern	0	0	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0
Gadwall	1	8	3	48	2	30	0	0	0	33	103
Great Blue Heron	2	1	1	2	0	0	0	0	3	3	2
Great Egret	0	0	0	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Green-winged Teal	4	0	0	8	0	0	0	0	0	0	8
Herring Gull	1	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	1	0	0	0	2	0
Horned Grebe	2	1	0	0	0	1	0	0	0	0	0
Killdeer	0	0	0	0	0	0	0	0	0	0	0
Lesser Scaup	0	8	30	9	0	0	0	0	0	0	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	56	21	12	0	0	0	0	0	2	11
Marbled Godwit	0	0	0	0	0	0	0	0	0	0	0
Northern Pintail	0	7	15	0	0	0	0	0	0	0	0
Northern Shoveler	0	0	10	0	0	0	0	0	0	0	18
Old Squaw	0	0	0	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	0	0	0	1
Pied-billed Grebe	3	35	4	3	0	1	0	0	6	5	5
Red-breasted merganser	0	0	0	0	0	1	0	0	0	15	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	0
Redhead	0	0	21	0	0	0	0	0	0	0	1
Ring-billed Gull	39	5	2	0	5	0	0	0	18	1	11
Ring-necked Duck	16	36	33	0	0	0	0	0	0	0	0
Ruddy Duck	35	0	0	0	0	0	5	0	0	0	0
Snow Goose	0	0	0	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	1	0	0	0	0
Western Grebe	207	12	20	33	3	9	4	0	196	124	5
White-faced Ibis	0	0	0	0	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown Duck	0	0	0	0	4	2	0	0	0	0	0
Unknown Grebe								0	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown other	69	2	0	0	0	0	2	0	0	0	0

Hall's Creek Bay

SPECIES	Feb-96	Mar-96	Nov-96	Jan-97	Feb-97	Mar-97	Apr-97
American Avocet	0	0	0	0	0	0	0
American Coot	192	45	18	11	9	8	4
American White Pelican	0	0	0	0	0	0	0
American Wigeon	0	0	0	0	0	0	0
Barrow's Goldeneye	8	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0
Bufflehead	42	11	0	13	40	6	0
California Gull	0	0	0	0	0	0	0
Canada Goose	0	0	6	0	0	0	0
Cinnamon Teal	0	0	0	0	0	0	0
Clark's Grebe	0	0	0	0	0	0	0
Common Goldeneye	136	0	0	53	5	0	0
Common Loon	2	2	0	0	0	5	0
Common Merganser	37	11	1	6	1	1	6
Double-crested Cormorant	35	22	20	26	11	10	0
Eared Grebe	10	1	8	0	1	0	0
Forester's Tern	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0
Gadwall	62	6	4	35	42	15	0
Great Blue Heron	3	0	3	1	4	1	3
Great Egret	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0
Green-winged Teal	13	5	3	3	36	22	0
Herring Gull	0	1	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0
Horned Grebe	0	0	7	0	0	4	2
Killdeer	0	0	0	0	0	0	0
Lesser Scaup	0	0	0	0	0	0	0
Lesser Yellowlegs	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0
Mallard	0	1	0	2	1	2	0
Marbled Godwit	0	0	0	0	0	0	0
Northern Pintail	0	0	0	0	0	2	0
Northern Shoveler	9	0	2	16	0	2	0
Old Squaw	1	1	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0
Pied-billed Grebe	7	0	8	0	0	1	0
Red-breasted merganser	0	26	1	4	0	10	0
Red-necked Grebe	0	0	0	0	0	0	0
Redhead	0	0	0	1	0	1	0
Ring-billed Gull	4	1	9	10	3	0	0
Ring-necked Duck	0	0	0	0	0	0	1
Ruddy Duck	0	0	0	7	1	0	0
Snow Goose	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0
Western Grebe	28	170	459	437	1	68	37
White-faced Ibis	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	16
Yellow-billed Loon	0	0	0	0	0	0	0
Unknown Duck	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0
Unknown Loon	0	0	0	2	0	0	0
Unknown other	0	0	0	0	0	0	0

Warm Creek Bay

SPECIES	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-96	Sep-95	Oct-95	Dec-95	Jan-96	Feb-96
American Avocet	0	0	0	0	0	0	0	0	0	0	0	0
American Coot	246	655	1006	572	32	7	10	366	143	574	814	40
American White Pelican	0	0	0	0	0	0	0	0	0	0	0	0
American Wigeon	0	3	3	0	0	42	0	0	0	0	9	0
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	6	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0	0	0	0	0	0
California Gull	7	0	0	0	0	0	7	1	5	1	0	0
Canada Goose	0	0	0	1	0	0	0	0	0	0	0	0
Cinnamon Teal	0	0	0	0	0	0	2	0	0	0	0	0
Clark's Grebe	0	0	0	0	0	0	1	0	0	0	0	0
Common Goldeneye	0	0	14	4	0	0	0	0	0	0	16	21
Common Loon	0	1	3	1	1	1	1	0	1	2	4	5
Common Merganser	20	18	34	6	2	3	0	0	0	0	48	5
Double-crested Cormorant	0	3	0	0	2	4	0	0	1	6	1	5
Eared Grebe	1	1	0	1	1	0	2	0	1	1	4	0
Forester's Tern	0	0	0	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	1	0	0	0	0	0
Gadwall	0	0	6	5	0	92	0	0	0	0	6	4
Great Blue Heron	3	2	2	1	1	0	1	0	1	2	1	4
Great Egret	0	0	0	0	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0	0
Green-winged Teal	0	0	0	4	2	31	0	0	0	0	7	38
Herring Gull	0	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	13	5	0	0	0	0	0	0	0	0	0
Horned Grebe	0	0	0	0	0	0	1	0	0	0	0	0
Killdeer	0	0	0	0	0	0	0	0	0	0	0	0
Lesser Scaup	0	0	0	0	0	0	0	0	0	12	1	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	19	35	2	10	0	0	0	15	6	0
Marbled Godwit	0	0	0	0	0	0	8	0	0	0	0	0
Northern Pintail	0	0	0	0	0	6	0	0	0	0	0	0
Northern Shoveler	0	0	0	1	0	0	0	0	0	0	0	0
Old Squaw	0	0	0	0	0	0	0	0	0	0	1	0
Pacific Loon	0	0	0	0	0	0	0	0	0	0	0	0
Pied-billed Grebe	6	23	18	15	2	0	0	0	3	2	5	7
Red-breasted merganser	0	5	2	0	0	0	0	0	0	2	0	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	1	0
Redhead	0	0	0	1	1	0	0	0	0	3	0	0
Ring-billed Gull	7	18	4	3	0	0	0	0	2	4	2	7
Ring-necked Duck	0	0	5	5	0	0	0	0	0	0	0	0
Ruddy Duck	0	0	0	0	0	0	0	0	0	0	0	0
Snow Goose	0	0	0	0	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0	0
Western Grebe	49	8	7	6	9	11	10	1	50	246	211	211
White-faced Ibis	0	0	0	0	0	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	1	0	0	0	0	0	0	0	0	1
Unknown Duck	0	0	0	0	4	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0	0	0	0	0
Unknown other	0	0	0	0	0	0	0	0	0	0	0	0

Warm Creek Bay

SPECIES	Mar-96	Apr-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97
American Avocet	0	0	0	0	0	0	0
American Coot	45	53	1417	3906	272	175	62
American White Pelican	0	0	0	0	0	0	0
American Wigeon	0	0	0	0	0	0	7
Barrow's Goldeneye	0	0	0	0	0	0	0
Black-crowned Night Heron	0	2	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0
Bufflehead	0	0	0	1	2	1	0
California Gull	0	12	4	0	0	0	6
Canada Goose	0	0	0	0	0	46	0
Cinnamon Teal	8	2	0	0	0	10	0
Clark's Grebe		0	0	0	0	1	2
Common Goldeneye	1	0	0	8	0	4	0
Common Loon	3	0	3	0	0	0	1
Common Merganser	1	10	8	14	6	2	3
Double-crested Cormorant	0	0	1	8	4	0	0
Eared Grebe	5	1	0	0	0	4	0
Forester's Tern	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	1
Gadwall	0	0	0	4	16	54	7
Great Blue Heron	2	3	2	3	1	0	1
Great Egret	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0
Green-winged Teal	0	0	0	11	11	66	8
Herring Gull	0	0	1	0	0	0	0
Hooded Merganser	0	0		0	0	0	0
Horned Grebe	0	0	2	2	2	0	0
Killdeer	0	0	0	0	0	0	0
Lesser Scaup	25	0	1	1	0	11	0
Lesser Yellowlegs	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0
Mallard	0	0	10	26	11	0	0
Marbled Godwit	0	0	0	0	0	0	3
Northern Pintail	1	0	0	6	255	1	0
Northern Shoveler	0	0	0	0	4	17	0
Old Squaw	0	0	1	0	0	0	0
Pacific Loon	0	0	1	0	0	0	0
Pied-billed Grebe	3	0	0	2	0	2	2
Red-breasted merganser	0	0	2	1	1	0	1
Red-necked Grebe	0	0	0	0	0	0	0
Redhead	0	0	25	164	0	0	0
Ring-billed Gull	27	0	4	2	1	0	37
Ring-necked Duck	0	0	6	141	0	2	0
Ruddy Duck	0	0	0	2	0	0	0
Snow Goose	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	1
Surf Scoter	0	0	0	0	0	0	0
Western Grebe	201	447	260	22	234	414	416
White-faced Ibis	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	0
Yellow-billed Loon	1	0	0	0	0	0	0
Unknown Duck	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0
Unknown Loon	0	0	0	1	0	0	0
Unknown other	0	0	0	8	4	40	0

Wahweap Bay

Species	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	Sep-95	Oct-95	Dec-95	1-Jan
American Avocet	0	0	0	0	0	0	0	0	0	0	0
American Coot	690	2690	3251	528	62	27	2	256	100	426	106
American White Pelican	2	2	2	0	0	0	0	0	0	0	0
American Wigeon	20	0	2	0	0	4	0	4	0	0	0
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	2	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	10	30	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	2	0	0
Bufflehead	0	0	0	0	0	0	0	0	0	0	2
California Gull	0	0	0	0	0	0	35	0	6	0	0
Canada Goose	0	0	0	0	0	0	3	0	0	4	0
Cinnamon Teal	0	0	0	0	0	0	3	0	0	0	0
Clark's Grebe	0	0	0	0	0	0	0	0	0	0	0
Common Goldeneye	0	2	6	12	0	15	0	0	0	0	7
Common Loon	0	1	1	3	1	1	2	0	2	0	3
Common Merganser	0	6	10	26	4	1	1	0	0	2	0
Double-crested Cormorant	0	13	5	16	14	0	6	0	12	1	4
Eared Grebe	16	3	16	8	4	3	4	8	0	5	2
Forester's Tern	0	0	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	4	0	0	0	0
Gadwall	2	3	5	6	1	15	20	4	4	1	32
Great Blue Heron	1	2	0	3	3	2	0	0	1	3	1
Great Egret	0	0	0	0	0	0	1	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Green-winged Teal	16	0	0	8	70	41	0	22	1	0	8
Herring Gull	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0	0	0	0	0
Horned Grebe	0	0	0	0	0	0	0	0	0	0	0
Killdeer	0	0	0	0	0	0	0	0	0	0	0
Lesser Scaup	0	21	88	9	0	9	1	2	13	35	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	15	52	8	20	0	3	0	13	2
Marbled Godwit	0	0	0	0	0	0	120	0	0	0	0
Northern Pintail	2	5	6	5	10	27	0	0	0	0	1
Northern Shoveler	0	0	0	2	0	2	0	0	0	0	3
Old Squaw	0	0	0	0	0	0	0	0	0	0	0
Pacific Loon	1	0	0	0	0	0	0	0	1	0	0
Pied-billed Grebe	1	26	29	39	5	1	3	1	0	1	2
Red-breasted merganser	0	1	0	0	0	0	0	0	0	0	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	0
Redhead	5	18	191	175	0	12	4	0	0	0	0
Ring-billed Gull	1	90	36	14	13	9	23	1	9	6	45
Ring-necked Duck	7	63	128	74	0	25	0	0	12	0	4
Ruddy Duck	14	0	0	0	0	1	15	1	14	0	0
Snow Goose	0	0	0	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	1	0	0	0	0	0	0	0	0	0	0
Western Grebe	49	80	16	15	4	12	185	5	57	134	61
White-faced Ibis	0	0	0	0	0	0	0	0	0	0	0
Willet	0	0	0	0	0	0	2	0	0	0	0
Yellow-billed Loon	0	0	0	0	1	1	0	0	0	0	0
Unknown Duck	0	0	0	0	1	2	0	4	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0	0	0	0
Unknown	5	0	0	20	1	0	0	0	0	0	0

Wahweap Bay

Species	Feb-96	Mar-96	Apr-96	Nov-96	Jan-97	Feb-97	Mar-97	Apr-97
American Avocet	0	0	1	0	0	0	0	7
American Coot	38	40	10	491	1295	250	210	111
American White Pelican	0	0	0	0	0	0	0	0
American Wigeon	0	0	0	0	0	3	1	0
Barrow's Goldeneye	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0
Bufflehead	1	4	0	0	1	2	8	0
California Gull	0	0	205	0	0	0	0	48
Canada Goose	1	0	0	4	0	11	0	0
Cinnamon Teal	0	0	0	0	0	0	4	14
Clark's Grebe	0	0	0	0	0	0	2	3
Common Goldeneye	3	0	0	0	0	0	12	0
Common Loon	2	1	2	1	1	0	2	3
Common Merganser	0	8	0	0	5	6	2	2
Double-crested Cormorant	3	5	0	2	4	1	2	0
Eared Grebe	0	2	21	0	168	0	17	13
Forester's Tern	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	13	0	0	0	0	43
Gadwall	12	1	0	0	18	14	72	17
Great Blue Heron	2	7	0	2	3	3	0	2
Great Egret	0	0	1	0	0	0	0	0
Greater Scaup	0	5	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0
Green-winged Teal	4	14	0	0	2	26	152	29
Herring Gull	0	0	0	0	1	0	0	0
Hooded Merganser	0	0	0	8	0	0	0	0
Horned Grebe	0	0	0	3	0	2	1	0
Killdeer	0	0	0	0	0	0	0	0
Lesser Scaup	0	25	0	11	0	0	89	0
Lesser Yellowlegs	0	4	0	0	0	0	0	3
Long-billed Curlew	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0
Marbled Godwit	0	0	7	0	0	0	0	13
Northern Pintail	0	0	0	0	0	185	3	0
Northern Shoveler	1	0	0	0	2	0	51	34
Old Squaw	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	1
Pied-billed Grebe	3	1	0	1	2	0	0	1
Red-breasted merganser	5	0	4	1	0	0	0	10
Red-necked Grebe	0	0	0	0	1	0	0	0
Redhead	0	17	0	0	0	32	25	23
Ring-billed Gull	22	205	8	2	2	17	0	3
Ring-necked Duck	0	0	0	5	72	5	3	9
Ruddy Duck	0	0	0	0	1	0	0	4
Snow Goose	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0
Western Grebe	28	40	163	372	320	219	340	686
White-faced Ibis	0	0	21	0	0	0	0	26
Willet	0	0	0	0	0	0	0	4
Yellow-billed Loon	0	0	0	0	0	0	0	0
Unknown Duck	0	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0
Unknown	0	1	0	0	0	0	0	0

Antelope Island

Species	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	Sep-95	Oct-95	Dec-95	Jan-96
American Avocet	0	0	0	0	0	0	0	0	0	0	0
American Coot	500	534	301	82	4	13	12	20	566	246	624
American White Pelican	0	0	0	0	0	0	0	0	0	0	0
American Wigeon	26	0	0	0	0	7	0	0	17	0	2
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	12	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	2	0	0	0	0	0	0	4	0	0
California Gull	0	0	0	0	0	0	0	0	0	0	0
Canada Goose	0	11	0	0	0	2	0	0	0	0	0
Cinnamon Teal	0	0	0	0	0	2	0	0	0	0	0
Clark's Grebe	0	0	0	0	0	0	0	0	0	0	0
Common Goldeneye	0	85	82	71	1	11	0	0	0	0	1
Common Loon	3	0	0	0	0	1	1	0	4	0	1
Common Merganser	1	0	5	6	13	9	2	0	1	0	0
Double-crested Cormorant	0	0	0	0	0	0	0	0	0	0	0
Eared Grebe	4	0	2	1	0	7	3	0	0	10	4
Forester's Tern	0	0	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0
Gadwall	1	0	77	0	2	64	4	0	30	0	1
Great Blue Heron	0	0	0	0	0	0	0	0	0	0	0
Great Egret	0	0	0	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Green-winged Teal	22	0	0	0	0	5	0	0	56	0	0
Herring Gull	0	0	0	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	2	0	0	0	0	0	0	0
Horned Grebe	0	0	0	0	0	0	0	0	0	0	0
Killdeer	0	0	0	0	0	0	0	0	0	0	0
Lesser Scaup	10	0	20	0	0	19	2	0	60	0	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	0	0	0	0
Mallard	7	0	36	0	0	0	0	0	0	0	0
Marbled Godwit	0	0	0	0	0	0	40	0	0	0	0
Northern Pintail	8	0	0	0	0	12	0	0	14	0	0
Northern Shoveler	0	0	0	0	0	0	11	0	17	0	0
Old Squaw	0	0	0	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	0	0	0	0
Pied-billed Grebe	0	2	0	3	1	2	1	0	1	0	0
Red-breasted merganser	0	0	0	0	0	0	12	0	0	1	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	0
Redhead	10	1	0	0	0	0	0	0	5	2	0
Ring-billed Gull	0	0	16	24	14	1	0	0	2	0	1
Ring-necked Duck	0	0	5	4	0	6	0	0	0	0	0
Ruddy Duck	44	1	0	0	0	0	2	0	80	0	0
Snow Goose	0	0	0	0	0	0	0	0	0	1	0
Snowy Egret	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0
Western Grebe	9	0	0	0	0	0	37	4	55	0	

Antelope Island

Species	Feb-96	Mar-96	Apr-96	Nov-96	Jan-97	Feb-97	Mar-97	Apr-97
American Avocet	0	0	0	0	0	0	0	1
American Coot	86	44	66	347	778	84	90	63
American White Pelican	0	0	0	0	0	0	0	0
American Wigeon	0	0	0	0	1	0	0	0
Barrow's Goldeneye	0	0	0	0	0	0	0	0
Black-crowned Night Heron	0	0	0	0	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0
Bufflehead	0	7	0	0	1	0	2	2
California Gull	0	0	48	0	0	0	0	0
Canada Goose	0	0	0	0	0	0	12	0
Cinnamon Teal	0	0	0	0	0	0	8	0
Clark's Grebe	0	0	0	0	0	0	0	0
Common Goldeneye	32	15	0	0	17	0	0	0
Common Loon	0	4	3	0	0	1	2	0
Common Merganser	3	2	0	0	3	1	13	13
Double-crested Cormorant	0	0	0	1	1	0	2	0
Eared Grebe	2	10	10	0	28	0	0	23
Forester's Tern	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	3	0	0	0	0	0
Gadwall	2	0	2	0	3	0	102	2
Great Blue Heron	0	0	0	1	3	1	0	5
Great Egret	0	0	0	0	0	0	0	0
Greater Scaup	0	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0
Green-winged Teal	12	4	0	0	0	0	165	11
Herring Gull	0	0	0	0	0	0	0	0
Hooded Merganser	0	0	0	0	0	0	0	0
Horned Grebe	0	0	0	0	1	4	12	8
Killdeer	0	0	0	0	0	0	0	3
Lesser Scaup	0	10	0	4	0	0	64	0
Lesser Yellowlegs	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	6	0	0	0	0	0
Mallard	0	3	0	0	2	2	2	0
Marbled Godwit	0	0	9	0	0	0	0	3
Northern Pintail	0	3	0	0	0	3	1	0
Northern Shoveler	0	1	2	0	0	0	11	5
Old Squaw	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	0
Pied-billed Grebe	0	0	3	0	2	3	3	2
Red-breasted merganser	0	3	14	1	3	6	0	6
Red-necked Grebe	0	0	0	0	0	0	1	0
Redhead	1	28	0	0	6	0	6	0
Ring-billed Gull	4	121	1	0	8	2	0	0
Ring-necked Duck	0	0	0	0	18	0	0	0
Ruddy Duck	0	0	11	4	0	0	6	0
Snow Goose	0	0	0	0	0	0	0	0
Snowy Egret	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0
Western Grebe	0	0	73	45	0	0	0	73
White-faced Ibis	0	0	0	0	0	0	0	14
Willet	0	0	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	0	0
Unknown Duck	0	0	0	0	0	0	0	0
Unknown Grebe	0	0	0	0	0	0	0	0
Unknown Gull	0	0	0	0	0	0	0	0
Unknown Loon	0	0	0	0	0	0	0	0
Unknown other	0	0	0	0	0	0	0	0

APPENDIX 6

Aquatic bird surveys on Lake Powell, 1994-1997. Summary data by month.

SPECIES	OC4	NO4	DE4	JA5	FE5	MA5	AP5	SE5	OC5	DE5	JA6	FE6	MA6	AP6	NO6	JA7	FE7	MA7	AP7
AMAV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	12
AMCO	1970	6944	8243	1874	175	130	104	642	915	1323	1944	447	199	129	2475	6021	673	507	270
AWPE	2	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMWI	46	5	6	6	0	56	0	4	18	0	12	0	0	0	0	1	3	7	19
BAGO	0	0	0	0	0	0	0	0	0	2	0	8	0	0	0	0	0	0	0
BCNH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
BWTE	0	0	0	0	0	0	0	28	30	0	0	0	0	0	0	0	0	0	0
BOGU	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
BUFF	2	54	60	52	16	4	0	0	4	39	76	63	23	0	1	30	62	27	2
CAGU	10	3	0	0	0	0	44	1	12	6	0	0	14	265	4	0	1	0	58
CAGO	7	35	21	1	3	2	3	0	6	4	1	1	0	0	10	0	11	60	1
CAEG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
CITE	0	0	0	0	0	2	7	0	0	0	0	0	8	2	0	0	0	23	25
CLGR	1	0	0	1	0	2	2	0	2	0	0	0	0	0	0	1	0	0	3
COGO	0	106	131	129	48	32	1	0	0	11	159	226	16	0	0	80	9	22	0
COLO	3	5	7	7	2	4	5	0	9	6	11	9	10	5	6	3	1	9	7
COME	74	62	101	56	28	41	15	0	1	13	62	57	22	10	9	32	39	46	65
DCCO	41	55	45	41	46	16	11	0	53	23	43	43	27	0	27	41	17	17	1
EAGR	50	6	35	18	8	27	20	8	18	25	21	19	20	32	50	196	2	21	60
FOTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
FRGU	0	0	0	0	0	0	5	0	0	0	0	0	0	16	0	0	0	0	59
GADW	6	28	130	100	15	283	24	4	39	44	187	135	9	2	39	186	104	300	129
GBHE	9	8	4	8	4	9	1	0	8	11	6	9	13	3	9	11	12	1	12
GREG	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
GRSC	0	0	0	1	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
GRYE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
GWTE	42	4	2	25	73	82	0	22	57	0	28	88	23	0	3	54	166	501	100
HEGU	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
HOME	0	13	5	2	0	1	0	0	0	2	0	0	0	0	8	0	0	0	0
HOGH	2	2	0	1	0	1	1	0	0	0	0	1	0	0	16	10	11	29	18
KILL	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
LESC	10	30	142	20	0	33	3	2	73	62	1	5	60	0	26	3	0	183	1
LEYE	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	0	3
LBCU	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
MALL	7	59	91	109	10	40	1	3	5	35	23	2	7	0	52	35	16	34	5
MAGO	0	0	0	0	0	0	168	0	0	0	0	0	0	16	0	0	0	0	34

SPECIES	OC4	NO4	DE4	JA5	FE5	MA5	AP5	SE5	OC5	DE5	JA6	FE6	MA6	AP6	NO6	JA7	FE7	MA7	AP7
NOPI	10	12	21	5	10	52	2	0	14	0	1	3	4	0	0	6	443	40	1
NOSH	0	0	14	6	0	2	13	0	17	7	28	19	1	2	2	18	4	91	189
OLSQ	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0
PALO	1	0	0	0	0	0	0	0	2	0	1	0	0	0	2	0	0	0	1
PBGR	10	89	56	64	9	6	4	1	15	23	18	17	7	3	16	13	9	9	8
RBME	0	6	2	0	0	1	12	0	0	22	0	5	29	18	9	18	12	15	19
RNGR	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0
REDH	15	23	227	178	1	17	4	0	9	6	1	1	45	0	34	171	32	35	23
RBGU	78	154	59	61	41	14	23	1	37	31	69	45	359	9	20	27	32	4	60
RNDU	27	99	174	83	0	33	0	0	12	0	11	0	0	0	11	238	10	5	16
RUDU	108	10	0	0	0	1	23	1	96	5	0	0	1	11	4	10	1	22	10
SNGO	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SNEG	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
SUSC	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
WEGR	1555	992	537	1212	312	124	392	10	2017	2889	1132	1289	1171	683	4500	1400	802	1079	1616
WFIB	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	86
WILL	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	20
YBLO	0	0	1	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
TOTALS	4088	8808	10,117	4061	802	1016	893	727	3471	4590	3837	2496	2080	1237	7336	8606	2472	3091	2948

APPENDIX 7

Aquatic bird surveys on Lake Powell, 1994-1997. Summary of species diversity, lake elevations, fish data, and survey times by survey. GHB=Good Hope Bay, BFB=Bullfrog Bay, HCB=Hall's Creek Bay, WCB=Warm Creek Bay, WWB=Wahweap Bay, ANI=Antelope Island, and TRC=Trachyte Creek. S=species richness, H' =Shannon diversity, E=Pielou's evenness. Lake elevation in feet above 3,000 feet. Number is the total number of individuals detected per survey. Trawl, electro and larval are indices to Threadfin Shad numbers by three different census techniques, and M=missing data. Divers and grebes are number of individuals detected of diving species and grebes respectively. Time is number of minutes.

SURVEY	AREA	YEAR	MONTH	SEASON	S	E	H	LAKE ELEVATION	LAKE	NUMBER
GHB1094	GHB	94-95	10	F	2	0.01	0.007	54	LOW	1101
GHB1194	GHB	94-95	11	F	10	0.199	0.457	52	LOW	939
GHB1294	GHB	94-95	12	W	8	0.263	0.548	51	LOW	534
GHB195	GHB	94-95	1	W	10	0.155	0.357	48	LOW	1140
GHB295	GHB	94-95	2	W	5	0.092	0.148	46	LOW	244
GHB395	GHB	94-95	3	S	4	0.721	0.999	45	LOW	83
GHB495	GHB	94-95	4	S	4	0.28	0.388	46	LOW	114
GHB1095	GHB	95-96	10	F	6	0.069	0.124	85	HIGH	870
GHB1295	GHB	95-96	12	W	6	0.159	0.286	82	HIGH	519
GHB196	GHB	95-96	1	W	6	0.775	1.389	79	HIGH	29
GHB296	GHB	95-96	2	W	5	0.555	0.894	78	HIGH	31
GHB1196	GHB	96-97	11	F	4	0.04	0.055	77	HIGH	614
GHB197	GHB	96-97	1	W	5	0.15	0.242	72	HIGH	201
GHB297	GHB	96-97	2	W	11	0.599	1.436	58	LOW	199
GHB397	GHB	96-97	3	S	13	0.774	1.986	63	LOW	175
GHB497	GHB	96-97	4	S	16	0.681	1.889	63	LOW	254
BUL1094	BUL	94-95	10	F	11	0.548	1.315	54	LOW	593
BUL1194	BUL	94-95	11	F	18	0.285	0.824	52	LOW	799
BUL1294	BUL	94-95	12	W	18	0.362	1.047	51	LOW	861
BUL195	BUL	94-95	1	W	20	0.41	1.229	48	LOW	837
BUL295	BUL	94-95	2	W	11	0.657	1.575	46	LOW	196
BUL395	BUL	94-95	3	S	15	0.707	1.914	45	LOW	241
BUL495	BUL	94-95	4	S	13	0.598	1.533	46	LOW	94
BUL1095	BUL	95-96	10	F	10	0.372	0.858	85	HIGH	362
BUL1295	BUL	95-96	12	W	16	0.239	0.662	82	HIGH	1024
BUL196	BUL	95-96	1	W	16	0.534	1.48	79	HIGH	914
BUL296	BUL	95-96	2	W	15	0.394	1.067	78	HIGH	1026
BUL396	BUL	95-96	3	S	11	0.163	0.39	76	HIGH	820
BUL1196	BUL	96-97	11	F	16	0.327	0.907	77	HIGH	1352
BUL197	BUL	96-97	1	W	14	0.458	1.209	72	HIGH	498
BUL297	BUL	96-97	2	W	13	0.544	1.394	58	LOW	311
BUL397	BUL	96-97	3	S	18	0.703	2.031	63	LOW	380
BUL497	BUL	96-97	4	S	23	0.632	1.983	63	LOW	544
HAC1094	HAC	94-95	10	F	16	0.616	1.708	54	LOW	582
HAC1194	HAC	94-95	11	F	19	0.197	0.58	52	LOW	2658
HAC1294	HAC	94-95	12	W	19	0.157	0.463	51	LOW	3242
HAC195	HAC	94-95	1	W	14	0.834	2.201	48	LOW	235
HAC295	HAC	94-95	2	W	8	0.827	1.72	46	LOW	72
HAC395	HAC	94-95	3	S	12	0.76	1.888	45	LOW	96
HAC495	HAC	94-95	4	S	7	0.499	0.971	46	LOW	80
HAC1095	HAC	95-96	10	F	10	0.474	1.091	85	HIGH	280
HAC1295	HAC	95-96	12	W	16	0.682	1.89	82	HIGH	278
HAC196	HAC	95-96	1	W	19	0.59	1.737	79	HIGH	525
HAC296	HAC	95-96	2	W	16	0.734	2.035	78	HIGH	589
HAC396	HAC	95-96	3	S	14	0.577	1.522	76	HIGH	303
HAC1196	HAC	96-97	11	F	14	0.309	0.814	77	HIGH	549
HAC197	HAC	96-97	1	W	15	0.464	1.257	72	HIGH	625
HAC297	HAC	96-97	2	W	13	0.717	1.84	58	LOW	155
HAC397	HAC	96-97	3	S	16	0.715	1.982	63	LOW	158
HAC497	HAC	96-97	4	S	7	0.694	1.351	63	LOW	69

TRAWL	ELECTRO	LARVAL	DIVERS	GREBES	TIME	SURVEYOR'S
LOW	LOW	M	1101	1100	90	2
LOW	LOW	M	898	852	89	2
LOW	LOW	M	517	473	72	2
LOW	LOW	M	1128	1061	105	2
LOW	LOW	M	244	239	85	2
LOW	LOW	M	83	50	70	2
LOW	LOW	M	114	107	80	2
HIGH	HIGH	M	864	859	60	1
HIGH	HIGH	M	519	497	60	2
HIGH	HIGH	M	25	19	60	2
HIGH	HIGH	M	30	23	50	2
HIGH	LOW	M	614	613	57	2
HIGH	LOW	M	201	194	98	2
HIGH	LOW	M	159	122	167	2
HIGH	LOW	M	90	56	180	2
HIGH	LOW	M	151	105	130	2
LOW	LOW	LOW	558	169	90	2
LOW	LOW	LOW	768	45	137	2
LOW	LOW	LOW	830	37	145	2
LOW	LOW	LOW	762	107	100	2
LOW	LOW	LOW	176	61	80	2
LOW	LOW	LOW	126	63	88	2
LOW	LOW	LOW	85	62	75	2
LOW	HIGH	HIGH	348	267	90	2
LOW	HIGH	HIGH	979	908	180	2
LOW	HIGH	HIGH	845	538	90	2
LOW	HIGH	HIGH	927	772	100	2
LOW	HIGH	HIGH	792	765	80	2
HIGH	LOW	LOW	1282	1104	118	2
HIGH	LOW	LOW	368	332	131	2
HIGH	LOW	LOW	224	184	140	2
HIGH	LOW	LOW	245	172	112	2
HIGH	LOW	LOW	334	296	132	2
LOW	LOW	LOW	594	M	160	2
LOW	LOW	LOW	2557	M	91	2
LOW	LOW	LOW	3169	M	127	2
LOW	LOW	LOW	165	M	87	2
LOW	LOW	LOW	62	M	50	2
LOW	LOW	LOW	63	M	83	2
LOW	LOW	LOW	82	M	80	2
LOW	HIGH	HIGH	252	M	105	2
LOW	HIGH	HIGH	235	M	122	2
LOW	HIGH	HIGH	370	M	95	2
LOW	HIGH	HIGH	498	M	110	2
LOW	HIGH	HIGH	289	M	90	2
HIGH	LOW	LOW	522	M	90	2
HIGH	LOW	LOW	560	M	93	2
HIGH	LOW	LOW	69	M	111	2
HIGH	LOW	LOW	114	M	106	2
HIGH	LOW	LOW	50	M	88	2

SURVEY	AREA	YEAR	MONTH	SEASON	S	E	H	LAKE ELEVATION	LAKE	NUMBER
WAR1094	WAR	94-95	10	F	8	0.466	0.97	54	LOW	339
WAR1194	WAR	94-95	11	F	12	0.255	0.634	52	LOW	750
WAR1294	WAR	94-95	12	W	15	0.216	0.585	51	LOW	1129
WAR195	WAR	94-95	1	W	16	0.242	0.671	48	LOW	651
WAR295	WAR	94-95	2	W	11	0.628	1.505	46	LOW	55
WAR395	WAR	94-95	3	S	10	0.717	1.651	45	LOW	207
WAR495	WAR	94-95	4	S	11	0.829	1.987	46	LOW	44
WAR995	WAR	95-96	9	F	4	0.086	0.119	88	HIGH	374
WAR1095	WAR	95-96	10	F	10	0.41	0.943	85	HIGH	209
WAR1295	WAR	95-96	12	W	13	0.355	0.911	82	HIGH	870
WAR196	WAR	95-96	1	W	17	0.345	0.976	79	HIGH	1137
WAR296	WAR	95-96	2	W	12	0.573	1.423	78	HIGH	348
WAR396	WAR	95-96	3	S	13	0.515	1.321	76	HIGH	323
WAR496	WAR	95-96	4	S	8	0.306	0.595	76	HIGH	530
WAR1196	WAR	96-97	11	F	17	0.237	0.671	77	HIGH	1748
WAR197	WAR	96-97	1	W	19	0.164	0.483	72	HIGH	4324
WAR297	WAR	96-97	2	W	14	0.539	1.421	58	LOW	820
WAR397	WAR	96-97	3	S	16	0.554	1.537	63	LOW	810
WAR497	WAR	96-97	4	S	16	0.366	1.016	63	LOW	558
WAH1094	WAH	94-95	10	F	16	0.284	0.786	54	LOW	828
WAH1194	WAH	94-95	11	F	17	0.202	0.572	52	LOW	3026
WAH1294	WAH	94-95	12	W	17	0.247	0.699	51	LOW	3807
WAH195	WAH	94-95	1	W	18	0.581	1.68	48	LOW	995
WAH295	WAH	94-95	2	W	14	0.698	1.842	46	LOW	200
WAH395	WAH	94-95	3	S	20	0.842	2.523	45	LOW	228
WAH495	WAH	94-95	4	S	19	0.592	1.744	46	LOW	434
WAH995	WAH	95-96	9	F	12	0.349	0.866	88	HIGH	317
WAH1095	WAH	95-96	10	F	15	0.714	1.933	85	HIGH	264
WAH1295	WAH	95-96	12	W	13	0.406	1.042	82	HIGH	633
WAH196	WAH	95-96	1	W	16	0.659	1.826	79	HIGH	283
WAH296	WAH	95-96	2	W	14	0.752	1.983	78	HIGH	125
WAH396	WAH	95-96	3	S	16	0.609	1.688	76	HIGH	379
WAH496	WAH	95-96	4	S	12	0.573	1.423	76	HIGH	456
WAH1196	WAH	96-97	11	F	13	0.361	0.927	77	HIGH	903
WAH197	WAH	96-97	1	W	17	0.364	1.031	72	HIGH	1898
WAH297	WAH	96-97	2	W	15	0.62	1.678	58	LOW	776
WAH397	WAH	96-97	3	S	19	0.65	1.915	63	LOW	996
WAH497	WAH	96-97	4	S	26	0.506	1.647	63	LOW	1111
ANI1094	ANI	94-95	10	F	13	0.388	0.994	54	LOW	645
ANI1194	ANI	94-95	11	F	7	0.279	0.542	52	LOW	636
ANI1294	ANI	94-95	12	W	9	0.638	1.401	51	LOW	544
ANI195	ANI	94-95	1	W	8	0.634	1.318	48	LOW	193
ANI295	ANI	94-95	2	W	6	0.753	1.349	46	LOW	35
ANI395	ANI	94-95	3	S	15	0.772	2.09	45	LOW	161
ANI495	ANI	94-95	4	S	12	0.745	1.851	46	LOW	127
ANI995	ANI	95-96	9	F	3	0.853	0.937	88	HIGH	36
ANI1095	ANI	95-96	10	F	15	0.539	1.459	85	HIGH	912
ANI1295	ANI	95-96	12	W	5	0.16	0.258	82	HIGH	260
ANI196	ANI	95-96	1	W	7	0.055	0.106	79	HIGH	634
ANI296	ANI	95-96	2	W	8	0.57	1.185	78	HIGH	142

TRAWL	ELECTRO	LARVAL	DIVERS	GREBES	TIME	SURVEYOR'S
LOW	HIGH	LOW	322	56	90	2
LOW	HIGH	LOW	727	32	132	2
LOW	HIGH	LOW	1095	25	99	2
LOW	HIGH	LOW	611	22	75	2
LOW	HIGH	LOW	50	12	60	2
LOW	HIGH	LOW	26	11	56	2
LOW	HIGH	LOW	25	14	75	2
LOW	HIGH	HIGH	367	1	50	2
LOW	HIGH	HIGH	201	54	70	2
LOW	HIGH	HIGH	848	249	85	2
LOW	HIGH	HIGH	1106	221	130	2
LOW	HIGH	HIGH	295	218	99	1
LOW	HIGH	HIGH	285	209	104	2
LOW	HIGH	HIGH	511	448	70	2
HIGH	HIGH	LOW	1727	262	151	2
HIGH	HIGH	LOW	4281	26	90	2
HIGH	HIGH	LOW	529	240	74	2
HIGH	HIGH	LOW	656	421	103	2
HIGH	HIGH	LOW	487	420	132	2
LOW	HIGH	LOW	791	66	140	2
LOW	HIGH	LOW	2926	109	110	2
LOW	HIGH	LOW	3743	61	137	2
LOW	HIGH	LOW	925	62	127	2
LOW	HIGH	LOW	96	13	46	2
LOW	HIGH	LOW	108	16	73	2
LOW	HIGH	LOW	223	192	91	2
LOW	HIGH	HIGH	273	14	90	2
LOW	HIGH	HIGH	211	57	75	2
LOW	HIGH	HIGH	606	140	68	2
LOW	HIGH	HIGH	191	65	70	2
LOW	HIGH	HIGH	83	31	60	1
LOW	HIGH	HIGH	149	43	89	2
LOW	HIGH	HIGH	200	184	116	2
HIGH	HIGH	LOW	895	376	75	2
HIGH	HIGH	LOW	1870	491	90	2
HIGH	HIGH	LOW	517	221	105	2
HIGH	HIGH	LOW	713	703	122	2
HIGH	HIGH	LOW	866	360	150	2
LOW	HIGH	LOW	581	M	60	2
LOW	HIGH	LOW	625	M	50	2
LOW	HIGH	LOW	415	M	57	2
LOW	HIGH	LOW	169	M	47	2
LOW	HIGH	LOW	19	M	35	2
LOW	HIGH	LOW	68	M	60	2
LOW	HIGH	LOW	72	M	80	2
LOW	HIGH	HIGH	24	M	35	2
LOW	HIGH	HIGH	776	M	83	2
LOW	HIGH	HIGH	259	M	50	2
LOW	HIGH	HIGH	630	M	53	2
LOW	HIGH	HIGH	124	M	55	1

SURVEY	AREA	YEAR	MONTH	SEASON	S	E	H	LAKE ELEVATION	LAKE	NUMBER
ANI396	ANI	95-96	3	S	14	0.669	1.766	76	HIGH	255
ANI496	ANI	95-96	4	S	14	0.727	1.92	76	HIGH	251
ANI1196	ANI	96-97	11	F	7	0.262	0.51	77	HIGH	403
ANI197	ANI	96-97	1	W	16	0.211	0.585	72	HIGH	875
ANI297	ANI	96-97	2	W	10	0.415	0.955	58	LOW	107
ANI397	ANI	96-97	3	S	18	0.669	1.932	63	LOW	502
ANI497	ANI	96-97	4	S	16	0.739	2.048	63	LOW	234
TRA1095	TRA	95-96	10	F	4	0.174	0.241	85	HIGH	574
TRA1295	TRA	95-96	12	W	3	0.036	0.039	82	HIGH	1006
TRA196	TRA	95-96	1	W	3	0.084	0.092	79	HIGH	315
TRA296	TRA	95-96	2	W	1	0	0	78	HIGH	235
TRA1196	TRA	96-97	11	F	4	0.121	0.167	77	HIGH	1767
TRA197	TRA	96-97	1	W	11	0.602	1.445	72	HIGH	185
TRA297	TRA	96-97	2	W	8	0.592	1.231	58	LOW	104
TRA397	TRA	96-97	3	S	5	0.705	1.135	63	LOW	70
TRA497	TRA	96-97	4	S	9	0.576	1.267	63	LOW	178

TRAWL	ELECTRO	LARVAL	DIVERS	GREBES	TIME	SURVEYOR'S
LOW	HIGH	HIGH	123	M	80	2
LOW	HIGH	HIGH	180	M	100	2
HIGH	HIGH	LOW	402	M	47	2
HIGH	HIGH	LOW	858	M	26	2
HIGH	HIGH	LOW	99	M	64	2
HIGH	HIGH	LOW	201	M	143	2
HIGH	HIGH	LOW	190	M	140	2
HIGH	HIGH	M	575	M	30	1
HIGH	HIGH	M	1006	M	25	2
HIGH	HIGH	M	315	M	20	2
HIGH	HIGH	M	235	M	15	2
HIGH	LOW	M	1767	M	25	2
HIGH	LOW	M	140	M	62	2
HIGH	LOW	M	92	M	32	2
HIGH	LOW	M	53	M	20	2
HIGH	LOW	M	46	M	40	2

APPENDIX 8

1994-1995 Surveys

Weather

October 18-20	Clear, warm, occasional breezes
November 28-30	Clear, cold, occasional light breezes
December 19-21	Clear, cool becoming warm, calm
January 18-20	Clear, warm, calm
February 13-15	Clear. Cool to warm, slightly breezy, some light rain
March 13-15	Clear to p. cloudy, cool to mild, calm to breezy
April 18-20	Cloudy, cool, some light rain, calm

1995-1996 Surveys

Weather

September 21	Clear, warm, calm
October 25-27	Clear, warm, calm to slightly breezy
December 4-6	Clear to p. cloudy, mild, calm
January 18-20	Clear to p. cloudy, cool to mild, calm to slightly breezy
February 13-15	Clear, mild, calm
March 13-14	Clear to p. cloudy, warm, calm
April 12	Clear, warm, calm

1996-1997 Surveys

Weather

November 20-22	P. cloudy, warm, occasional light rain, calm
January 17, 22-23	P. cloudy to clear, cool, light breezes
February 19-21	Clear to p. cloudy, cool, breezy with some wind gusts
March 19-21	Clear, warm, calm
April 16-18	Clear, warm, calm

APPENDIX 9

Aquatic bird surveys on Lake Powell. Summary data by survey area for January of 1988, 1995, 1996, and 1997. GHB=Good Hope Bay, BFB=Bullfrog Bay, HCB=Hall's Creek Bay, WCB=Warm Creek Bay, WWB=Wahweap Bay, ANI=Antelope Island, and TRC=Trachyte Creek.

SPECIES	BFB88	HC888	WCB88	WNB88	ANI88	BFB95	HC895	WCB95	WNB95	ANI95	BFB96	HC896	WCB96	WNB96	ANI96	BFB97	HC897	WCB97	WNB97	ANI97
AMCO	16	4	1304	1490	100	587	49	572	528	82	147	253	814	106	624	16	11	3906	1295	778
AMWI	0	0	0	2	0	4	0	0	0	0	0	1	9	0	2	0	0	0	0	1
AWPE	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOGU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUFF	0	9	0	0	0	20	32	0	0	0	52	22	0	2	0	12	13	1	1	1
CAGO	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
CANV	0	2	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COGO	0	6	4	8	0	22	12	4	12	71	73	58	16	7	1	0	53	8	0	17
COLO	0	0	0	0	0	1	2	1	3	0	2	1	4	3	1	2	0	0	1	0
COME	4	1	3	18	0	12	3	6	26	6	4	6	48	0	0	1	6	14	5	3
DCCO	2	19	3	1	0	7	18	0	16	0	22	16	1	4	0	2	26	8	4	1
EAGR	0	0	2	0	0	2	4	1	8	1	6	2	4	2	4	0	0	0	168	28
GADW	0	0	0	0	0	31	48	5	6	0	43	103	6	32	1	93	35	4	18	3
GBHE	1	0	0	0	0	2	2	1	3	0	2	2	1	1	0	1	1	3	3	3
GWTE	2	0	0	7	0	5	8	4	8	0	5	8	7	8	0	27	3	11	2	0
HEGU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
HOGH	1	0	0	7	0	0	0	0	0	0	0	0	0	0	0	7	0	2	0	1
HOME	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
LESC	11	13	0	0	0	2	9	0	9	0	0	0	1	0	0	0	0	1	0	0
MALL	0	0	43	15	0	10	12	35	52	0	4	11	6	2	0	5	2	26	0	2
NOPI	0	0	10	47	35	0	0	0	5	0	0	0	0	1	0	0	0	6	0	0
NOSH	0	0	0	0	0	3	0	1	2	0	7	18	0	3	0	0	16	0	2	0
OLSQ	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PALO	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PBGR	0	0	0	1	0	2	3	15	39	3	3	5	5	2	0	1	0	2	2	2
RBGU	0	2	0	27	7	20	0	3	14	24	8	11	2	45	1	4	10	2	2	8
RBME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	1	0	3
REDH	0	0	98	162	0	2	0	1	175	0	0	1	0	0	0	0	1	164	0	6
RNDU	0	0	50	25	0	0	0	5	74	4	7	0	0	4	0	0	0	141	72	18
RNGR	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
RUDU	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	7	2	1	0
WEGR	68	48	10	11	0	103	33	6	15	0	529	5	211	61	0	324	437	22	320	0
TOTALS	105	104	1527	1829	142	836	235	661	995	193	914	525	1137	283	634	498	625	4324	1898	875

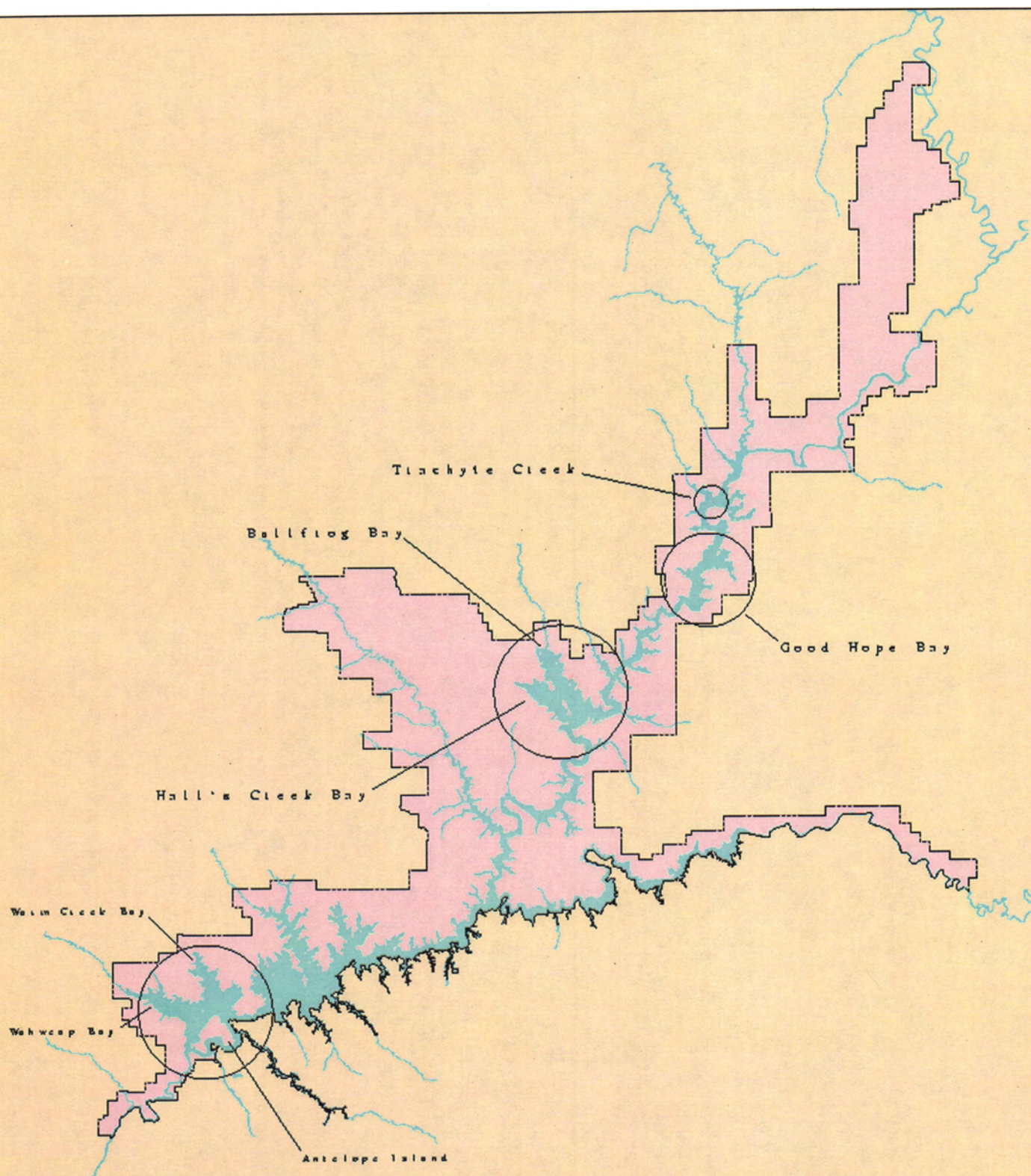
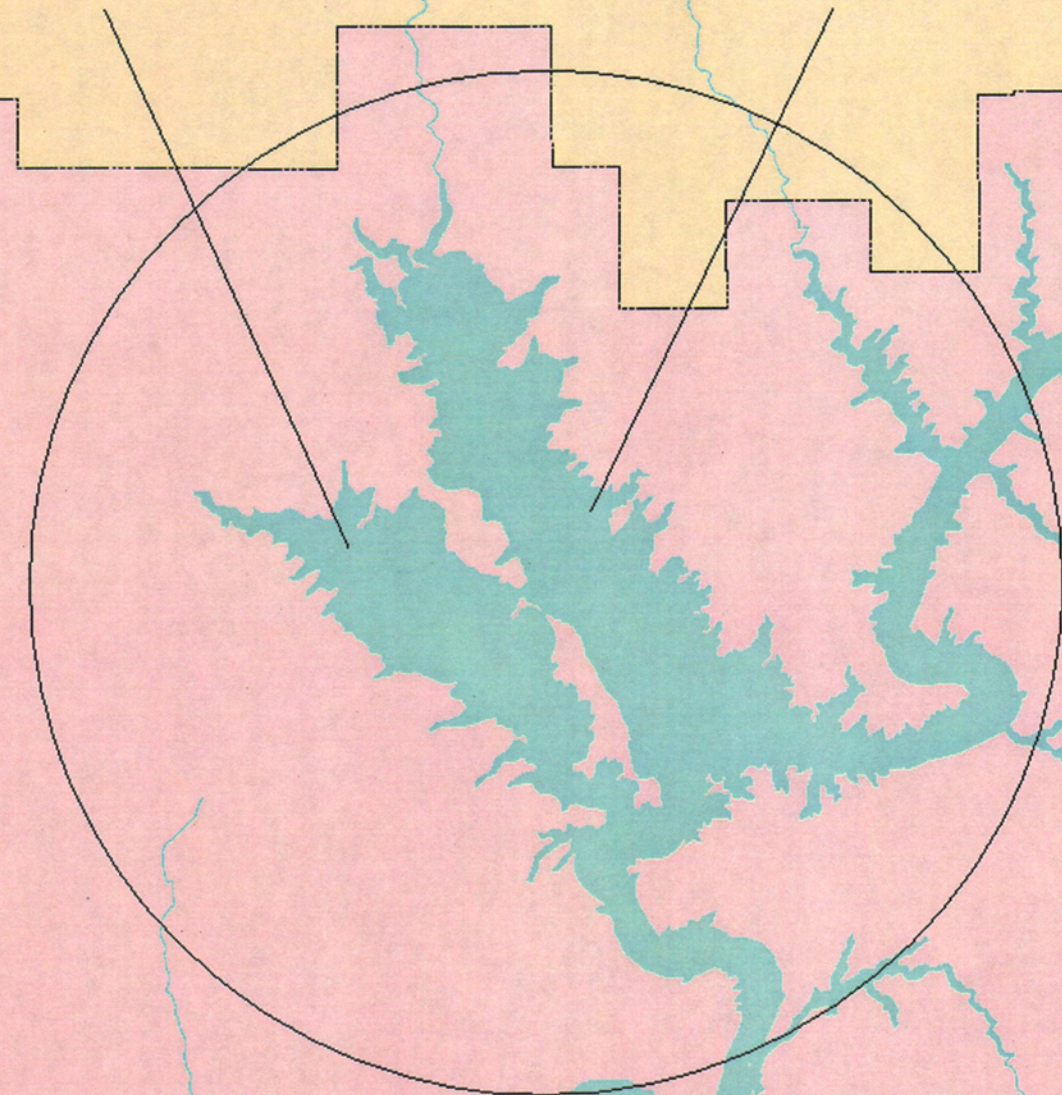


Figure 1.

Lake Powell, Glen Canyon National Recreation Area
Designated walleye areas are circled

Hall's Creek Bay

Bullfrog Bay



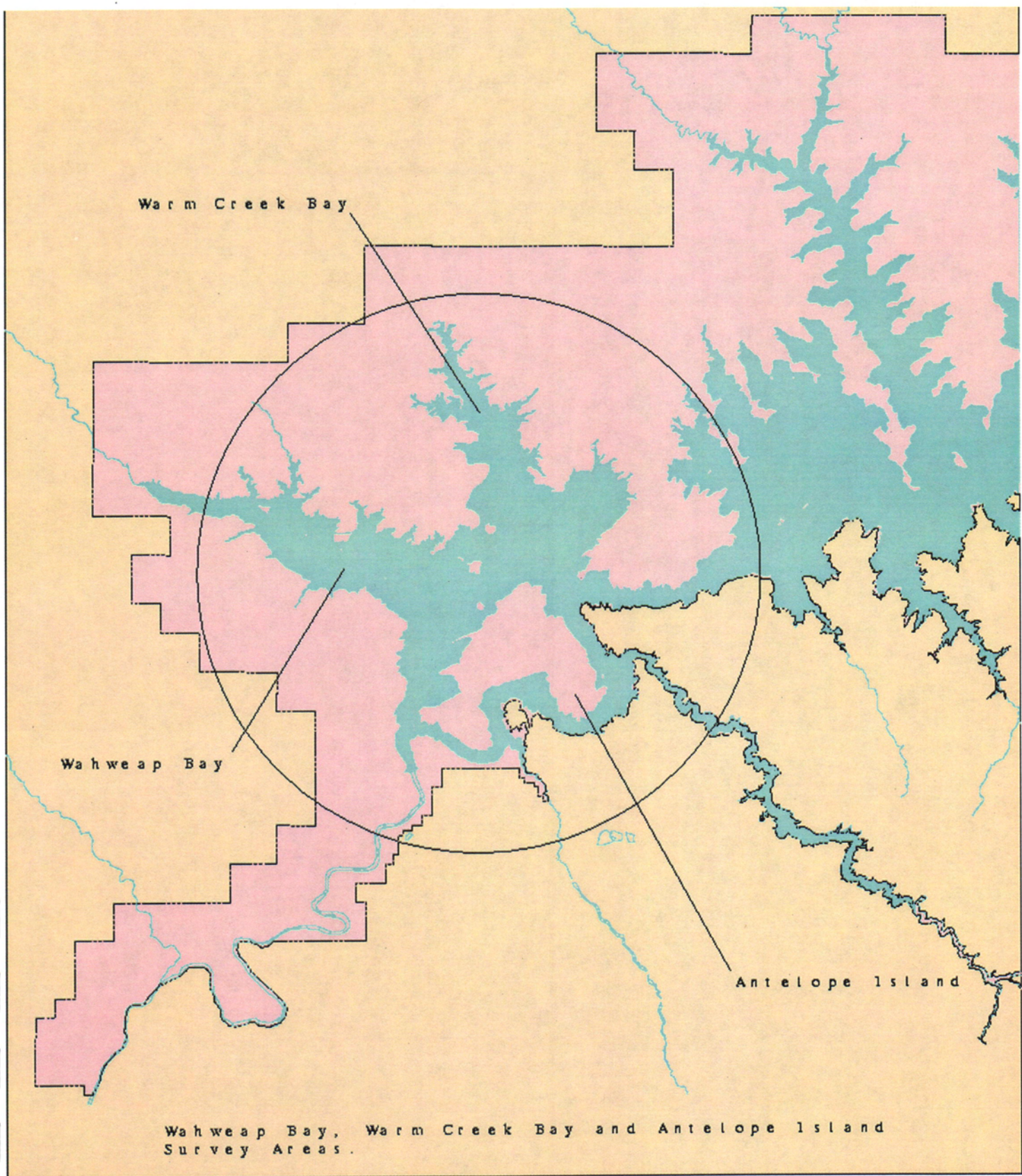
Hall's Creek Bay and Bullfrog Bay Survey Areas

Warm Creek Bay

Wahweap Bay

Antelope Island

Wahweap Bay, Warm Creek Bay and Antelope Island
Survey Areas.



Trachyte Creek

Good Hope Bay

Good Hope Bay and Trachyte Creek Survey Areas

