1986

Bird Use of Lakes in the Claremont-Upland Area

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BIRD USE OF LAKES IN THE CLAREMONT-UPLAND AREA

By

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A Thesis

Submitted to the Biology Department of Pomona College

In Partial Satisfaction of the Requirements

For the Degree of Bachelor of Arts

2 May 1986

ABSTRACT

I studied water bird use of two lakes in the Claremont-Upland area to determine what physical, chemical, and biological aspects of these lakes provide suitable water bird habitat and food resources. I censused the Bernard Field Station Lake in Claremont and a gravel pit freshwater area in Upland from 10/85 to 3/86 for water bird use. I also mapped these sites, noted their water surface area and water depth changes, monitored their water chemistry, and censused their vegetation. The results of this work showed more total water birds per hour of observation time, and more birds per hour of observation time of each food preference type, at the Upland Lakes than at the BFS Lake, except for diving ducks, which I found at both sites in similar abundance, and coots, which I found at the BFS Lake in greater abundance than at the Upland Lakes. The Shannon-Weiner Index of Diversity, H', used to determine bird species diversity, was higher for most individual census dates and on average, at the Upland Lakes than at the BFS Lake. The Upland Lakes had fewer species and less abundance of true aquatic plants than the BFS Lake; however, the BFS Lake had fewer different types of habitat (i.e. open shoreline, thick emergent shoreline vegetation, mudflats, grassy areas, etc.) than did the Upland Lakes. The Upland Lakes, although originally very similar to the BFS Lake in total water surface area, came to have four times the water surface area of the BFS Lake as time progressed, due to winter rainfall and run-off. The results of bird censuses also showed many more migrant than resident birds using the Upland Lakes area, while few mi-

grant birds used the BFS Lake.

Water bird use differences between these sites are the result of the interaction of the unique ecological factors of each site. The Upland Lakes provide more diverse habitats, greater water surface area, a more accessible, open, isolated location for stopovers for migratory birds than the BFS Lake provides. The BFS Lake provides only two major habitat types for water bird use: thick shoreline emergent vegetation (mostly cattails), and open water. Diving ducks and coots utilize these habitats well and thus, with the exception of migratory flocks of diving ducks, used the BFS Lake as frequently, or more frequently than they used the Upland Lakes. Other birds that forage in muddy, open shore or grassy, open shore areas preferred the Upland Lakes area (dabbling ducks and shorebirds). Additional observation of similar water area in Claremont, Upland, and Montclair, California could produce a larger data base to demonstrate conclusively such tentative findings of this study as size of water surface area being directly proportional to amount of migratory bird use.

INTRODUCTION

In this study, I compare bird use of the Bernard Field Station Lake with bird use of a gravel pit lake at the southeastern corner of Campus and 19th Streets in Upland, in an effort to determine what physical, chemical, and biological aspects of each of these aquatic ecosystems provide suitable bird habitat or resources. I chose these two lakes for comparison because I believed the artificial BFS Lake to be a significantly more heterogeneous environment, with more diverse shoreline and submergent

vegetation and microhabitats, than the Upland Lakes, which are the result of runoff and groundwater filling a shrubby, sparsely vegetated rocky basin. The two areas did prove to be very different in terms of bird habitat; however, they differed in ways contrary to my original expectations.

If one of the study areas provides less habitat diversity than the other, the diversity of birds using this less diverse site should be less than that of the more diverse site because the more diverse site provides more ecological niches to be filled by a greater number of species and of individuals (Hurst et al. 1980). Hurst et al. (1980) found this to be the case in their investigation of the effects of the destruction of riparian vegetation in the Sacramento River Valley, California on birds. The results of their year-long census of bird populations in unaltered riparian habitat and habitat cleared of vegetation for riverbank stabilization projects (rip-rap habitat) showed that a significant loss in carrying capacity and diversity of avifauna had occurred in the rip-rap habitat and agricultural land adjacent to it as compared to unaltered riparian habitat and its adjacent agricultural land. Their vegetation censuses of the study areas showed much less plant species diversity in the rip-rap areas than in the unaltered riparian habitat. Also, there was no structural vegetation diversity in the rip-rap habitat while there were three vegetation layers in the unaltered riparian forests. They concluded that a greater number of species could be supported by the unaltered riparian habitat because of its greater number of available niches abd thus its greater heterogeneity.

The work of Hurst et al. (1980) demonstrated why the clearing of riparian forest along the Sacramento River Valley severely reduced the bird populations in cleared areas: birds need the diverse resources provided by the layered vegetation, such as protection from predators, perching areas, insect attraction, seeds, etc. To apply these results to my study, the theory behind these findings must be examined. MacArthur and MacArthur (1961) studied the application of the Shannon-Weiner Diversity Index, $H' = -p_i \log_e p_i$, (where $p_i = n_i/N$ and n is the number of individuals of species i, while N is the total number of individuals of all species) to describe the true diversity of woodland bird populations. They found that in deciduous forests, bird species diversity was positively correlated with foliage height diversity but not correlated with plant species diversity. A diversity of foliage heights provides a diversity of bird foraging and nesting areas. But plant species diversity, if all the plants are of the same general height, all grasses and annuals for example, does not provide diverse ecological niches. Therefore, in my study of water birds, I predicted that a lake having a variety of resource areas (i.e. some open shoreline, some thick emergent vegetation, some submergent vegetation, and nearby terrestrial vegetation) should promote more bird species diversity than a lake of one or two types of resources (i.e. thick submergent vegetation and entire shore lined with homogeneous emergent vegetation). This comparison of types of habitat should, as MacArthur and MacArthur (1961) found for foliage heights in forest habitat, be more important in attracting more different types and numbers of birds than actual plant species diversity.

The application of this theory to my study is limited by another factor: many birds using these lakes are migrants, staying at a site for only a few days or less in some cases. The results of the Shannon-Weiner Diversity Index (H') as MacArthur and MacArthur (1961), describe it are intended to describe the "information content" of a community of resident animals. Diversity is positively correlated with the number of ecological niches available to these resident animals. But in studying resource utilization patterns in grassland and shrubsteppe bird communities in Wisconsin, Wiens (1977) found that the differences his study revealed in habitat occupancy were not uniform. Instead they varied depending on which individuals were compared within a single habitat type and when the comparisons were made. He concluded that unless the bird populations were in resource-defined equilibrium, short-term studies would not produce clear results. If some of the animals in my study are migrants, such resource-defined equilibrium will not be present at the areas where they stop for short visits. Thus, the number of ecological niches at these sites may not be positively correlated with the number of birds and number of bird species using these sites for very short times. But, assuming all bird species using both sites fed at them, at least for a short time, bird species diversity will be compared to site habitat diversity.

Keith (1961) conducted a study to discover what habitat parameters are important to waterfowl on small impoundments of southeastern Alberta. He censused waterfowl populations for over five years on a group of diverse ponds in the parklands and mixed prairie grassland habitat of southeastern Alberta. He also did

stomach content analyses to determine food preferences of different species. He described four categories of waterfowl based on food preference: dabblers; divers; baldpates (American Widgeon) and gadwalls; and geese. Of these, the dabbler, diver, and baldpate/gadwall categories were seen in this study. Keith (1961) defined dabblers as those ducks (pintails, mallards, cinnamon teal, blue-winged teal, shovelers, and green-winged teal) that take mainly seeds and fruits of submergent and shore plants (spike-rush, milfoil, pondweeds, sedges, bulrushes, and *Juncus* spp.) and that consume only a very small percentage of animal matter (snails, insects, Hemiptera, Diptera larvae, and *Daphnia* spp. egg cases). He defined divers as those ducks (redheads, buffleheads, scaups, ruddy ducks, and canvasbacks) that prefer submergent plants (milfoil and widgeon grass) over emergent plants (spike-rush, sedge, and *Juncus* spp.) and consume more animal matter (especially that of the benthos: snails, *Daphnia* spp. egg cases, Trichoptera larvae, and Diptera larvae) than dabblers do. Keith separated baldpates and gadwalls from dabblers because he found they did not utilize seeds and fruits of plants in their diets (except for those of spike-rush). Instead, he found these birds took mainly the leaves and stems of grasses and submergent aquatics, and very little animal matter. For my purposes, I will include the baldpates (American Widgeon) (no gadwalls were observed) in the dabbler category because the one seed type that Keith (1961) did find them eating, spike-rush, occurs at one of my study sites,the BFS Lake.

Once he established these diet preference categories, Keith (1961) could interpret waterfowl distribution patterns in terms

of available food resources. For example, he explained a major increase of dabblers on a reflooded pond (from fewer than 50 dabblers before flooding to more than 1000 dabblers after flooding) as being due to the response of submergent plants to temporary drying: intensive seed production. Reflooding produced a body of water filled with floating seeds, mostly of spike-rush, and hence many dabblers. Keith (1961) found few seasonal food preference differences among waterfowl, but noted that regional food preference differences are important since past studies done in other parts of North America found other preferred foods for similar categories of birds. Thus, his specific food plant findings may only generally apply to these categories of ducks in my study.

A finding of Keith (1961) that does seem relevant to water bird study in the Claremont-Upland area is his investigation of the effects of shoreline domination by cattails on waterfowl. According to Keith (1961), cattails commonly monopolize edges of ponds from the edge of dry ground to water depths of three feet, eliminating spike-rush and severely reducing submergent vegetation. He hypothesized that dabblers would be reduced more than divers as a result of cattail invasion since cattails nearly eliminate all shallow water feeding areas. In the breeding season, his censuses supported this hypothesis: small ponds with cattail-filled edges had the fewest dabblers per unit shoreline while ruddy ducks (divers) preferred such ponds. As a further test of the effects of cattails on waterfowl populations, Keith (1961) experimentally eliminated cattails from some ponds. He found bird usage by all species of these ponds to increase fourfold over

what it had previously been. Besides the cattail absence allowing waterfowl shoreline food plants and submergent food plants to increase, Keith (1961) also hypothesized that cattail removal increased waterfowl usage of the ponds by providing more "shoreline loafing spots" for waterfowl and by allowing the birds a clear view of the adjacent shore and terrain so they could detect land-based predators.

Johnsgard (1956) studied another habitat parameter that affects bird use of freshwater habitats: water level. His study area was in the Columbia Basin of eastern Washington where a high water table created many small water areas, "potholes", between shifting sand dunes. The construction of a new dam and reservoir greatly raised the water level of all of these groundwater ponds. His breeding season censuses showed various bird populations to be affected by the water rise in one or more of four ways: loss of nesting cover; loss of breeding habitat; reduction of food availability; or direct nest flooding. Most importantly, Johnsgard (1956) found almost all bird species using the area (waterfowl, shorebirds, and terrestrial birds) to have a distinct preference for a certain type of pothole or a distinct successional vegetation stage surrounding a pothole, and thus the alteration of this habitat by rising water often greatly reduced bird usage of the pothole.

Hobaugh and Teer (1981) also investigated the relationship between water surface area and lake bird use, but not by studying flooded lakes. Instead, they compared waterfowl use of fifty-five flood prevention lakes in North-Central Texas, by doing 16 biweekly aerial censuses from August of 1976 to April of 1977. They compared the results of their bird censuses to physical,

limnological, and vegetative characteristics of each lake, attempting to find correlations. They discovered that the two most important characteristics influencing waterfowl use of these lakes were 1) amount of aquatic vegetation and 2) lake water surface area. Common aquatic vegetation in many of their lakes was similar to that of the BFS Lake (muskgrass, water primrose, spike-rush, flat sedge, and cattails). They found water surface area of the lakes to be positively correlated ($P<0.01$) with both number of all ducks, and number of dabblers only. However, they noted that this correlation was strongly influenced by the extremely high number of ducks on each of the two lakes with the largest water surface area. Omitting those two points, the correlation was only $P<0.25$. The strongest positive correlation they found was between amount of aquatic vegetation and total number of ducks, number of dabblers, and number of divers. In general, they stated that lakes with the largest amounts of aquatic vegetation received the most duck use regardless of their other characteristics. Related to this correlation between amount of aquatic plant life and number of waterfowl, Hobaugh and Teer (1981) found that increasing amounts of submergent vegetation were positively correlated with clearer water, in these permanent lakes. Thus, they suggested management practices aimed at improving water clarity in flood-prevention lakes to increase their value to waterfowl.

My study has described what specific habitat parameters in the Claremont-Upland area affect different water bird species by 1) comparing two areas with different habitat types and by 2) monitoring seasonal bird use changes and trying to correlate

these changes with habitat changes or patterns of bird migration through our area. The results provide necessary information for understanding water bird communities in the Claremont-Upland area and their possible management.

STUDY AREAS

The Bernard Field Station Lake

The BFS Lake is an artificial freshwater body of 2.4 hectares in area with a maximum depth of 21 feet. It was created by lining an excavated basin with plastic, covering the plastic with imported soil to a depth of one foot, and filling it with Claremont tap water. It has no groundwater or runoff source; its only input is tapwater and rainwater. While this lake was created with the intention of providing a diversity of habitats (deep water, marshes, muddy shores, sandy shores, and an island), it has become a much more homogeneous habitat: deep water, cattail and bulrush marsh, a cattail-lined shoreline, and an island surrounded by cattails. The great majority of the periphery of the lake is lined with cattails extending from one to three meters laterally into the water (see Figure 1).

The lake is rich in phytoplankton and zooplankton. Some fish also inhabit the lake. Mosquitofish (Gambusia affinis) and largemouth bass (Micropterus salmoides) are currently most common while green sunfish (Lepomis cyanellus) are present but rare (personal observation from spring 1985 plankton study at lake).

Submergent vegetation that I found upon sampling the near shore lake bottom consisted of muskgrass (Chara sp.) and water

primrose (Ludwigia palustris). Emergent vegetation is dominated by cattails (Typha latifolia) but a large stand of bulrush (Scirpus acutus) persists in the marsh, and wire-grass (Juncus textilis), umbrella sedge (Cyperus virens), and spike-rush (Eleocharis palustris) are also occasionally found (Fig.1). Marginal vegetation consists mostly of the arroyo willow (Salix lasiolepsis), but laurel sumac (Rhus laurina), white alder (Alnus rhombifolia), and Baccharis emoryi are also present. Various grasses and small perennials or annuals such as cudweed (Gnaphalium beneolens) and bird's foot trefoil (Lotus scoparius) are found a few meters from the water's edge near open shoreline (Fig. 1). All of these species are further described in Table 1.

The Upland Lakes

This gravel pit freshwater area at 19th and Campus Streets in Upland, was, during the preliminary work of this study (10/05/85), a series of very small (1,000 m^2= average size), shallow (three feet maximum depth, western-most lake), unconnected ponds, countersunk in a pit 30 to 45 meters deep. There were originally six ponds, five of which were groundwater ponds, and one of which had a mountain runoff creek feeding it. On 10/20/85, these ponds were still separate but some were much larger (up to 11,000 m^2) and the creek now fed the two western-most ponds (Figures 2 and 3). On 11/02/85 only three completely separated water areas remained. The creek now fed the two west ponds and the nearest northern pond also (Figure 2). On 11/23/85, all of the water was connected and fed by the creek. Additional water surface area changes and depth fluctuations occurred during the study. Figure 2 details

all changes. The maximum total water surface area obtained was reached on 2/22: 96,500 ± 100 m^2. Maximum depth achieved at point A (Figure 2), one of the deepest main water points, was also reached on 2/22: 10.0 ft. The west lake did not vary in terms of water surface area (Figure 3). Its depth varied similarly to the depth changes at point A.

Initially, the ponds were surrounded by three shore types: sandy, with sparse, scrubby, short vegetation (Brassica nigra, Enceliopsis covillei, Lotus scoparius, Frasera parryi, and Mimulus guttatus); muddy with sparse, reedy, marsh type vegetation (Typha latifolia, Baccharis emoryi and other submerged terrestrial shrubs); and grassy, with lush grass around the water's edge (various grasses, Gnaphalium palustre, Lobularia maritima, Cyperus esculentus, and Erodium cicutarium) (Table 2). All area between the ponds was sparsely covered by scrubby, short vegetation, less than one meter tall, with some woody shrubs, such as B.emoryi, amongst boulders in very dry, rocky soil. The immediate north edge of the west pond was the only area in the gravel pit to have taller, true emergent aquatic vegetation, besides having larger terrestrial shrubs (B.emoryi). With the rising of the water level, the shrubs of the west pond margin were submerged, as were all of the grassy shores and many of mudflat areas of the main water area. The remaining shore habitat types were 1) the west lake with its emergent cattails and now emergent B.emoryi forming a thick, tall, (up to 2 m above water level) shoreline curtain (Figure 3) and 2) the main water body with either steep-sided (1-8 m) dirt and rock cliffs at the margins or sparsely vegetated, dry, sandy soil with terrestrial vegetation: Brassica nigra, a

few sparsely placed grasses, red-stem filaree (Erodium cicutarium), and cudweed (Gnaphalium palustre), plus much bare, sandy, well-drained ground with fine gravel and boulders. The results of a vegetation transect located as shown in Figure 2 quantified the overwhelming abundance of bare ground in this area.

Since the entire main body of this lake is ephemeral, few, if any, true aquatic submergent or emergent vascular plants are present (Table 2).

Brush rabbits (Sylvilagus bachmani), coyotes (Canis latrans), and mule deer (Odocoileus hemionus hemionus) were observed near the lakes, in the dry, scrubby vegetation areas. Two four- to six-inch bright orange fish, probably discarded goldfish, were observed in the west lake on October 5. Other fish may also inhabit the lakes: a large (8- to 10- inch) fish carcass was found on the cliff two meters above the east-most water on 11/23/85. And, two people fishing stated that they had caught carp and crappie, and that they had heard of trout being caught, in the west lake.

METHODS

I initially did quantitative censusing of water birds at one or the other site each week (10/20 - 12/13). Starting on 1/13, an attempt to census both sites every week was made. Initial time spent learning to identify bird species, mapping the Upland Lakes area, and time lost due to interrupted censusing at the Upland site (human interference) led to fewer censuses obtained than expected during the first half of the project. Periods of heavy and prolonged rainfall during the second half of the project also decreased the number of censuses obtained.

At the Upland Lakes, I censused the entire water area (with the exception on 2/22 of the water area east of the eastern-most north-south running road which also was not included in the calculation of total water surface area for that date) by walking from east to west along the northern cliff, then on to the road due east of the west lake (Figures 2 and 3). The time this procedure required each day was recorded since it varied with the amount of water present that had to be scanned with binoculars. On each census date, a good count of all water birds over the entire water area was obtained. This count became more difficult as water surface area increased, especially with the development of the "island" in the southern portion of the east water because I had to check for birds behind it.

At the BFS Lake, I spent most of my census time at the opening on the east side of the lake (cattail-free area), scanning the lake with binoculars. From this point, nearly the entire lake can be seen at once. Since the lake is small, birds temporarily out of view soon swim back into view, making determination of total number of individuals much faster than at the much larger Upland Lakes area. I also walked around the entire lake, after sitting (watching waterfowl) to check for shorebirds and possible bird nests in the emergent shoreline vegetation.

During each census, I recorded time of day; weather conditions; species, number, sex, and age of birds seen; locations of groups of birds, estimated from compass angle and distance of birds to known distance reference points; habitat birds were seen in; general activity of birds; and duration of time of the census. This information was collected only for waterfowl, shorebirds, and

other fish-eating or aquatic birds. The location of nests, when seen, was also recorded.

At each census time at the Upland Lakes, physical boundaries of water areas were mapped and depth at point A (Figure 2) was checked. The BFS Lake water surface area did not vary significantly, but depth may have increased roughly half a meter with extensive rainfall in February (small marshes appeared on the east, lower side of the lake and a couple of puddles formed to the south of the lake). Representative samples of emergent and marginal vegetation were taken at both sites and identified. No true aquatic submergent vegetation was obtained at the Upland Lakes, although it is no doubt present in the west lake. A vegetation transect (Figure 2 shows its location) was done at the Upland Lakes to quantify "typical" scrubby, vegetation.

Initially, I censused the following chemical parameters at both sites: color, pH, alkalinity, PO_4^{-3}, NO_3^{-1}, CO_2, SiO_3^{-2}, SO_4^{-2}, Ca^{+2}, Mg^{+2}, and total hardness. This was done only once: an additional check was done using a Hach Total Dissolved Solids (Portable Conductivity) meter. I also noted the presence of fish, mammals, and humans at both sites during censuses.

I converted bird census data to comparable relative indices of abundance for each date by dividing number of birds seen by amount of time spent observing. I did this to correct for the different size of the Upland Lakes water surface area vs. that of the BFS Lake. But I also plotted raw numbers of birds vs. water surface area, at the Upland Lakes, to examine the effects of that parameter on the bird populations. I used the Spearman Rank nonparametric correlation test to determine significance of

correlations between various factors. I used the Shannon-Weiner Diversity Index (H') on bird census data for each date at both sites. I calculated percent abundances of major shoreline vegetation species and bare ground for the BFS Lake from my estimated vegetation map (Figure 1). I calculated relative dominance (same as percent abundance: total interval length of species n divided by total interval length of all species x 100), for bare ground and for plant species, for the vegetation transect done at the Upland Lakes in order to quantify the typical vegetation of the gravel pit. Finally, I used the scattered additional bird census data from earlier years at the BFS Lake to check for bird species (richness) changes that perhaps correspond to natural vegetational succession or introduced vegetational changes since the construction of that lake.

RESULTS

Table 3 lists the common names of the water bird species in this study, species names of these birds, and standard abbreviations of common names that will be used to identify the species in tables and figures, when necessary. In this table, birds are grouped according to their major food preferences. Detailed information about the ecology of each species can be found in the Appendix.

The total number of birds seen per hour of observation time compared with date at both sites (Figure 4) shows a marked contrast between the sites: the Upland Lakes had more birds per hour of observation on every census date but one (10/20) than the BFS Lake had on any census date. Overall, the Upland Lakes had

75.9 birds per hour of observation time (all dates lumped), while the BFS Lake had 23.9 birds per hour of observation time (all dates lumped). Fluctuations of these total bird values from one date to the next show no significant correlation with date, and probably best coincide with weather fluctuations.

To determine separate trends among ecologically diverse groups within the bird populations, I grouped species of birds together according to major food preferences (see Appendix for full details on general food habits of each species). Species falling into each food preference category are listed in Table 3.

Figure 5 shows number of dabblers per hour of observation time on each census date at both sites. Again, I found no significant correlation of bird number with date and the Upland Lakes had many more dabblers than the BFS Lake for all but two dates. Overall, the Upland Lakes had 26.6 dabblers per hour of observation time while the BFS Lake had 1.44 dabblers per hour of observation time.

Number of divers per hour of observation time vs. census date at both sites shows a significant correlation ($P < 0.05$) of more divers at the Upland Lakes as the season progressed (i.e. going from October to March), with an interruption on 1/26 and 2/01 possibly due to the heavy rains of that week (Figure 6). No such correlation was found at the BFS Lake. Except for the very high and very low starting (10/20) and ending (3/02 and 2/22) values at the Upland Lakes, the number of divers per hour of observation was very similar to that at the BFS Lake. Total number of divers per hour of observation time at the Upland Lakes was 18.3 while total number of divers per hour of observation time at the BFS Lake was 13.0.

Figure 7 shows number of coots per hour of observation time plotted vs. census date for both sites. I found no significant correlation of coot number with date. Coots are unusual in that only they were found more abundantly at the BFS Lake, for all dates but one, than at the Upland Lakes. Total number of coots per hour of observation at the BFS Lake was 10.1 while at the Upland Lakes it was 4.0.

Figure 8 contains the graph of number of fish-eaters per hour of observation vs. each census date for both sites. Again, no significant correlation with date exists, and the Upland Lakes have higher values than the BFS Lake for all but one date. Overall, the Upland Lakes had 6.2 fish-eaters per hour of observation while the BFS Lake had very few: 0.29 fish-eaters per hour of observation time (only one pied-billed grebe).

Number of shorebirds per hour of observation time is plotted vs. census date for both sites in Figure 9. I never observed any shorebirds at the BFS Lake. The Upland Lakes shorebird numbers showed no significant correlation with date. Overall, the Upland Lakes had 20.79 shorebirds per hour of observation time.

A comparison of total numbers of each species of bird per hour of observation time for each date at both sites (Table 4) indicates that the most abundant species at the Upland Lakes, during my study, were pintail ducks (13.89 total PINT per total hours of observation time) followed by mallard ducks (8.78 total MALL per total hours of observation time), killdeer (8.66 total KILL per total hours of observation time), and least sandpipers (8.19 total LESA per total hours of observation time). While these species were very abundant on some census dates, they were

completely absent on others; the bird community species composition fluctuated greatly with census date. At the BFS Lake, coots (10.09 total coots per total hours of observation time), and ruddy ducks (9.22 total RUDU per total hours of observation time) were most abundant. These species were present at every sampling of the BFS Lake (and at all but two censuses at the Upland Lakes) indicating a more stable, resident bird community at the BFS Lake.

To eliminate the effects of water surface area differences on total bird abundance variation with date, I plotted raw total numbers of birds observed divided by water surface area at the sites vs. the census date (Figure 10). This shows trends in bird abundance due to date alone. Since the water surface area of the BFS Lake remained practically unchanged, this graph is no different in shape for the BFS Lake than the graph for total number of birds per hour of observation time vs. census date (FIgure 4). However, the Upland Lakes graph is very different from its total number birds per hour of observation time vs. census date graph (Figure 4). Figure 10 shows a significant negative correlation ($P < 0.05$) of birds per hectare of water surface area with increasing time, from October (10/20) to March (3/02).

I found the Shannon-Weiner Diversity Index (H') to be greater at the Upland Lakes than at the BFS Lake for all but two of the Upland Lakes' census dates (Figure 11). Mean H' per census date for the Upland Lakes was 0.65 ± 0.14 while for the BFS Lake it was 0.42 ± 0.09. Diversity at neither site shows significant correlation with date.

Percent abundance of plant species of the BFS Lake shoreline, as calculated from my vegetation map (Figure 1) shows cattails

to be the dominant emergent plant (34.3%) and the arroyo willow (37.1%) to be the dominant marginal plant, with only six other prominent shoreline species and little bare ground shoreline (7.0%) (Table 5). At the Upland Lakes, however, relative dominance (percent abundance) calculated from a 50 meter vegetation transect (shown in Figure 2) shows bare ground to be the overwhelming dominant (80.0%) seconded, very distantly, by the tall (up to 1 meter) annual Brassica nigra, and with only three other species of annuals and several small grasses present (Table 6). Since this transect was done from the shore of the main water body, northeastward, it is representative only of the main water area. Figure 3 presents an approximate mapping of the west lake's unique vegetation. The differences are major; however, since only a slight proportion of the total Upland Lakes' birds were seen on the west lake, data from this main water area transect will be compared to overall Upland Lakes' bird data.

The extreme differences in estimated percent abundance of bare ground shoreline at the two sites may affect bird use of the sites. Total numbers of each type of bird per hour of observation time at each site compared to the estimated percent abundance of bare ground shoreline at each site show that all types except coots were more numerous at the site with higher percent bare ground, the Upland Lakes. Shorebirds and dabblers showed the most marked differences in abundance between the two sites. Shorebirds found were 20.79 birds per total hours of observation time at the Upland Lakes and 0 birds per total hours of observation time at the BFS Lake. Dabblers were 26.6 birds per total hours of observation time at the Upland Lakes and 1.44 birds per total hours

of observation time at the BFS Lake. Bird species diversity also increased with percent abundance of bare ground, that is it was greater, overall, at the Upland Lakes than at the BFS Lake.

Table 7 details the results of complete chemical analyses at both sites in November and TDS measurements at both sites in March. These findings indicate greater nitrate concentration at the Upland Lakes (0.36 mg/l) than at the BFS Lake (0.04 mg/l) but few other nutrients, less total hardness, alkalinity, and total dissolved solids at the Upland Lakes than at the BFS Lake.

Because the Upland Lakes underwent a sequence of water surface area changes and water depth changes during this study, I examined Upland Lakes bird data vs. these changes, and included a mean data point for the BFS Lake on water surface area graphs. Since the BFS Lake is bowl-shaped (with a variety of depths), rather than pan-shaped (with one mean depth) like the Upland Lakes, a data point for it for bird data vs. water depth would not be meaningful.

The number of birds of each type showed some trends of change with water surface area changes: the number of shorebirds observed decreased greatly with increasing water surface area (significant negative correlation, $P < 0.05$)(Figure 12); the number of dabblers increased slightly, with great fluctuation, (no significant correlation) with increasing water surface area (Figure 13); and the number of divers increased dramatically (significant correlation, P 0.01) with increasing water surface area (Figure 14). Numbers of coots and fish-eaters were not significantly correlated with increasing water surface area (Figures 15 and 16). Bird species diversity did not show significant correlation with

water surface area change at the Upland Lakes (Figure 17).

Since water depth changes at the Upland Lakes did not correspond precisely to water surface area changes (see Figure 2), I also examined the Upland Lakes bird data vs. water depth changes. No discernable associations between water depth and numbers of birds of each type observed were found, (Figures 18-21), except a trend toward a decrease in shorebird numbers with increasing depth, but with no significant correlation and a major fluctuation on 2/01: 9.0 ft (Figure 22). Comparing bird species diversity with water depth changes at the Upland Lakes shows no significant correlation (Figure 23).

Because the BFS Lake is a recently constructed artificial lake, it has experienced steady change in vegetation, both in terms of natural succession and artificial species introductions from one year to the next. Bird species composition has also changed. Table 8 shows bird species seen at the lake from October 1979 to April 1981 in censuses by Coppell and Corey (1981). Table 9 shows bird species data collected in more infrequent surveys by Oglesby from fall 1978 to December 1983. These data indicate a general decline (after the initial two years of the lake's existence) in bird species number seen at the lake (Figure 24). The data for Figure 24 were drawn from Coppell and Corey's data (1981), Oglesby's data (1978-1983), and my study and thus come from very different sample sizes, so only very tentative conclusions may be drawn from Figure 24. I found no statistically significant correlations between time and number of species present.

DISCUSSION

The major result of this study was that I observed more total birds per hour of observation time at the Upland Lakes than at the BFS Lake. A number of factors, collectively, were responsible for this. First, the physical surroundings of the two study sites may affect their accessibility and convenience for use by migratory birds. The Upland Lakes are located in a large, open area with sparsely populated surrounding terrain. They are sunken in a large gravel pit affording further distance from human populations (although not from human interference). The BFS Lake is much closer to a large, busy road and a town. It is located in the midst of scrubby, coastal sage vegetation somewhat denser than the vegetation surrounding the Upland Lakes. There is more bare ground at the Upland Lakes. These factors could influence resting site choice of migratory water birds, which represent a large proportion of the total birds seen at the Upland Lakes.

The fact that many brief visiting migrants were important at the Upland Lakes site accounts for the significant negative correlation of birds observed per hectare of water surface area at that site with time (Figure 10). Wintering birds became less and less numerous, with some fluctuations, as winter ended. Also, the influence of other suitable water bird habitat appearing locally, such as the filling of the Montclair spreading ponds, could have drawn migratory birds away from the Upland Lakes. Thus, despite the increasing surface water area of the Upland Lakes with date, total number of birds did not increase with this increasing water surface area because fewer migratory birds remained.

It is difficult to see this trend in Figure 4 since increasing water area is not corrected for by this figure. The BFS Lake, on the contrary, experienced little fluctuation of total birds per hectare of water surface area (Figure 10). This may be explained by the fact that migratory visitors to the BFS Lake were few compared to its two most important species, both residents, ruddy ducks and coots.

Chemical factors are not likely to have been an important factor influencing bird use of either site. Although Hobaugh and Teer (1981) noted that water clarity was important in promoting aquatic vegetation abundance which in turn attracted more water birds, they were discussing permanent lakes of age three years or more. The Upland Lakes are ephemeral, with only the west lake lasting year round, so although the water is clearer at the Upland Lakes (much lower TDS than at the BFS Lake, Table 7) the water level rises and falls quickly, giving aquatic plants only brief times to become established, and killing any that do entirely each summer. Thus, when comparing the Upland Lakes to the BFS Lake, water clarity shows little relationship to abundance of aquatic vegetation.

The true aquatic plant community at the Upland Lakes necessarily is less abundant and less diverse than that at the BFS Lake, having much less time to get established and grow before being killed each year (with the exception of the west lake). Greater habitat diversity was found at the Upland Lakes: bare shore, sandy, muddy, and gravelly areas; grassy areas, fields of lush grass prior to 2/22; submerged terrestrial scrubby plant areas, with decaying plant debris; open deep water areas with fish; and the

small, west lake cattail and other emergent aquatic plant area. But, at the BFS Lake, the emergent, marshy, mainly cattail lined shoreline and open water areas are the only available habitats. Thus, according to the findings of Keith (1961), bird usage of the BFS Lake should be less than usage of a similar lake with more open shoreline, especially with respect to dabblers. He was not studying shorebirds but it is apparent that they would be less able to use a cattail-lined lake than one with more open shore. Hurst et al. (1980) would also predict less bird usage at the BFS Lake than at a similar lake providing more available habitats for birds to use, as they found in their study of the effects of removal of vegetation layering in the Sacramento River Valley, California. However, while my findings of fewer birds per hour of observation time and fewer total birds per hectare of water surface area agree with the principles demonstrated by these earlier studies, it is uncertain whether the BFS Lake is similar enough in physical locale and water area to the Upland Lakes to make these comparisons significant.

While water surface area started out being very similar at both sites (10/20: 21,800 ± 100 m^2 at Upland Lakes and 24,000 m^2 at the BFS Lake at all census dates), the Upland Lakes rapidly came to have up to four times the water surface area of the BFS Lake (up to 96,500 ± m^2 on 2/22). Although, I graphed my data in terms of birds per hour of observation time in order to have directly comparable indices of bird usage by correcting for these water size differences, the actual larger water surface area may well have been the drawing factor attracting more birds to the Upland Lakes. Hobaugh and Teer (1981) stated that the two most

important factors affecting bird use of the lakes they studied in North-Central Texas were 1) amount of aquatic vegetation, and 2) lake water surface area. Amount of true aquatic vegetation was probably no greater, or even significantly less at the Upland Lakes than at the BFS Lake, but lake water surface area was definitely greater at the Upland Lakes. Since many more migratory bird species were seen at the Upland Lakes than at the BFS Lake, these species may have been using the Upland Lakes area as a resting place most importantly, and a feeding place secondarily, if at all. Thus, total amount of aquatic vegetation would not be as important to these species as physical setting of the site and water surface area and, possibly, habitats found at the lake would be. Keith (1961) suggested that waterfowl may prefer lakes with a shoreline with at least some open areas for out of water resting and clear view of land-based predators, which the Upland Lakes definitely have.

Looking more carefully at the results of this study by breaking total number of birds per hour of observation down into groups of birds with like food preferences shows some of the above factors to be stronger than others in influencing between site differences. First, the only type of bird found more abundantly (more total birds per hour of observation time) at the BFS Lake than at the Upland Lakes was coots. According to Bent (1926), coots are omnivorous feeders, relying heavily on plant foods but diving to acquire them, and taking a very wide variety of foods ranging from seeds and roots of pondweeds, to algae and slime collecting on rotting vegetation floating in marshes, to small fish, tadpoles, and insect larvae. They are resident in Southern

California. I observed a possible coot nest, in the midst of the stand of <u>Scirpus acutus</u> in the east marsh, on 3/22. (See Appendix for information on coots). Bent (1926) also noted that coots prefer to conceal their nests amongst thick cattails. The BFS Lake provides an ideal nesting area for the coots and a variety of foods that they can obtain since they can dive and are not very picky about what shoreline vegetation they eat. Also, since fewer other birds use the BFS Lake, it may be a more inviting site for coots than the Upland Lakes, where they would have to coexist and compete for less total aquatic vegetation with more other birds. Alternatively, this may work the other way. Sooter (1945), after doing a study of the effects of resident coots upon ducks on small lakes and marshes, hypothesized that coots may make lakes less desirable for ducks by possessively protecting their brooding areas and therefore reducing total available feeding habitat. He further described coots as "definitely more pugnacious than most waterfowl in breeding marshes". Since coots do breed at the BFS Lake, they may discourage long-term use of that water body by some other, less aggressive water birds.

Of all the other types of birds in this study, divers showed the most similar numbers per hour of observation at the Upland Lakes and at the BFS Lake. In fact, except for very high census totals on 2/22 and 3/02 at the Upland Lakes, the two lakes are relatively even in numbers of divers per hour of observation time. At the BFS Lake, the main divers seen have been ruddy ducks. They have been at the lake during every census of this study, have been seen by other observers in most months every year at the BFS Lake since 1978, and may well breed at the BFS Lake. Ruddy ducks were similarly present at all census dates at the Upland Lakes but two.

Additional divers were seen at both sites, but slightly less frequently at the BFS Lake than at the Upland Lakes (Table 4). The similarity of the sites, especially in terms of resident divers, may mean that both sites are suitable feeding areas for divers since they both provide open water and aquatic animal matter and some aquatic plant matter. Keith (1961) noted that divers in his study consumed more animal matter, especially benthic, than dabblers and were not as discouraged by ponds with thick emergent shoreline cattails as dabblers were. Also, he stated that ruddy ducks actually preferred cattail-lined ponds. The high total number of ruddy ducks observed at the BFS Lake supports this observation. The lack of striking difference in total number of divers per hour of observation between the sites indicates that for resident divers, neither site is a more appealing feeding site.

The last two census dates at the Upland Lakes (2/22 and 3/02) had a drastic increase in total number of divers per hour of observation. The main species accounting for these high numbers were lesser scaups and ring-necked ducks, respectively. These are both migratory in Southern California and therefore may have been using the Upland Lakes as a resting site; both were seen in large flocks and only in significant abundance on one census date each (Table 4). Therefore, size of the water surface area and its location may have been criteria by which those divers chose to use the Upland Lakes.

Another result of this study involving divers was that number of divers observed at the Upland Lakes increased fairly steadily with increasing water surface area (significant correlation, $P<0.01$) (Figure 14) but not with increasing water depth (Figure

19) and they are the only type of bird in this study to show this trend of increase with water surface area. This could simply be related to the influx of large flocks of migratory divers towards the later months of this study (the last two censuses, 3/02 and 2/22, are coincident with the greatest water surface areas). Or, increased water surface area may promote increases in available animal foods, floating plant seeds, or visibility of the site to birds flying over. This visibility may be most important since increasing water depth, which might also increase aquatic plant and animal food availability, did not cause number of divers per hour of observation time to increase.

In contrast to the similarity of the amount of use of divers of both sites (except for migratory divers), dabblers were clearly using the Upland Lakes more than the BFS Lake. Total number of dabblers per hour of observation at the Upland Lakes was 18 times that at the BFS Lake. Daily numbers of dabblers per hour of observation were higher at the Upland Lakes than at the BFS Lake for all Upland Lake censuses but the first (10/20) and an unusual census (very low total number of birds) occurring on the first clear morning after a long period of heavy rain (2/01). Keith (1961) stated that dabblers were most reduced by allowing a shoreline's vegetation to be overgrown with cattails since dabblers prefer shoreline foods (spike-rush, milfoil, sedges, bulrushes, and wiregrass) which are eventually eliminated by unchecked cattail growth. This seems to be the case at the BFS Lake, which has a shoreline dominated by cattails with overhanging willows, and a much smaller remaining stand of bulrush and only occasional patches of wiregrass and spike-rush. Keith (1961) also noted

that in flooded ponds with submergent plants, temporary drying then reflooding, as occurred at the Upland Lakes between 12/13 and 1/19, caused great production of seeds by these plants. This seed production was not observed at Upland, since few true aquatic submergent plants were seen in the main water area, but increased floating seeds of formerly terrestrial plants or floating dead matter of terrestrial plants could have been an attraction to dabblers, especially during great jumps in water surface area (10/20 - 11/02; 11/02 - 11/23; and 2/01 - 2/22).

The two species of birds most abundant at the Upland Lakes were mallards and pintails, both migratory dabblers. They were often seen in large flocks and may have been using the site mainly for resting, but I also saw mallards feeding in the lush grass near the main water before its flooding on 2/22. Whereas, the BFS Lake provides some of the plant species cited by Keith (1961) as dabbler food, Scirpus acutus (bulrush), Eleocharis palustris (spike-rush), Juncus textilis (wiregrass), and Cyperus virens (sedge), it provides these in little abundance compared to the availability of grasses, another possible dabbler food, in the main basin of the Upland Lakes area prior to its total flooding on 2/22, (and even after that, perhaps floating seeds provided dabbler food).

The total absence of shorebirds observed at the BFS Lake during this study demonstrates one of the most distinct differences between the BFS Lake and the Upland Lakes: virtual absence of bare ground shoreline at the BFS Lake (rough estimate: 7.0%) vs. high percentage at the Upland Lakes (estimate 80.0%, but some of this is cliff, well above the water level) (Tables 5 and 6).

Shorebirds were seen in high numbers at the Upland Lakes on most dates, both residents and migrants (Figure 9, Table 4). Their numbers also decreased, significantly, as water surface area and water depth increased at the Upland Lakes (Figures 12 and 22). Therefore, they seem to prefer shallower water with more areas of muddy, shallow shore (greatly reduced by rising water surface area at the Upland Lakes since more and more water boundaries were pushed to cliff edges). These findings agree with the foraging habits of shorebirds: probing in mud or shallow water for invertebrates of all sorts. (See Appendix for specific shorebird food preferences).

Previous years' census data for the BFS Lake (Coppell and Corey 1981 and Oglesby 1978 - 1983) show species of shorebirds present at the BFS Lake becoming progressively fewer as time progressed, from 5 species seen in 1980 to 1 species seen in 1983. This trend of decrease can be explained by the reduction of available bare ground shoreline at the BFS Lake as cattails, and other emergents, became more and more abundant with each year following the lake's establishment. The earlier, more open shoreline of the BFS Lake in 1980 had similar shorebird species composition and number to that of the Upland Lakes this year (Tables 8, 9, and 4).

With the exception of two census dates at the Upland Lakes, 12/13 and 3/02, few fish-eaters were observed at either site during this study. They were occasional at the Upland Lakes, and very rare at the BFS Lake (Figure 8). Again, suitable shoreline, water clarity, and the attraction of large water surface area might have drawn these birds to the Upland Lakes rather than the BFS Lake, since most of these birds, at both sites, were migratory,

seasonal visitors.

Greater Shannon-Weiner Diversity Indices for all but two census dates at the Upland Lakes than at the BFS Lake agree with the theory of bird species diversity as explained by MacArthur and MacArthur (1961): diversity of habitats provided by different types of plants, and bare ground, rather than diverse species of plants, provide the greater number of ecological niches required for greater bird species diversity. As previously discussed, the Upland Lakes does provide this diversity of habitats. The BFS Lake provides diverse aquatic plant species but lacks habitat diversity. Therefore, it seems that bird species diversity is appropriately greater at the Upland Lakes (Figure 11). However, the fact that many water birds using the Upland Lakes were migrants rather than residents may invalidate this reasoning. A diversity of areas and resources for feeding and breeding might not have been nearly as important to these birds as was having a large, safe, accessible water area to rest on, as a flock, for a short time. Also, since bird species diversity did not decrease regularly with increasing water surface area at the Upland Lakes, as might be predicted since shorebird favored habitats were increasingly reduced, perhaps the theory of bird species diversity being directly proportional to habitat diversity does not apply to the transient bird community at the Upland Lakes.

The general decrease in total numbers of water bird species observed at the BFS Lake from 1978 to present (Figure 24 and Tables 8 and 9), even if only based on a limited and varied censusing, supports the ideas of Keith (1961) about the effects of cattail-filled shoreline on waterfowl populations. Cattails have

become increasingly dominant with the aging of the lake and thus the other available resource areas for bird use have become increasingly limited. Birds best suited to using the lake surrounded by the thick cattail border, the omnivorous coots and ruddy ducks, have come to be its most abundant inhabitants.

CONCLUSIONS

The Upland Lakes provide more diverse habitats, greater water surface area, and a more isolated, larger, accessible location to migratory birds than the BFS Lake provides. These factors cause greater water bird use of the Upland Lakes than of the BFS Lake, with the exception of coot and ruddy duck use. The BFS Lake, in early years after its construction, provided similar habitats to those at the Upland Lakes, and accordingly had a much higher number of water bird species using it regularly (similar to that number of species using the Upland Lakes during this study) than it presently does.

Further work to more conclusively demonstrate these findings or to expand upon them could be additional observational field study or field experimental manipulation. If more ponds or lakes similar to the BFS Lake in size and vegetation, and additional lakes similar to the Upland Lakes site could be studied simultaneously with those two sites, more support for conclusions about why differences in bird use of these lake types exist would be acquired.

A very extensive observational study, similar to that done by Hobaugh and Teer (1981) in North-Central Texas, could involve censusing all lakes in the Claremont, Upland, and Montclair areas for water birds regularly. Each lake would be rated according

to vegetational, limnological, and physical characteristics. Then, as Hobaugh and Teer (1981) did, correlations between factors from this large data base could be determined using linear and multiple regression techniques.

An interesting experimental study to test the ideas of Keith (1961) regarding the beneficial effects of cattail removal on increasing waterfowl use of lakes could be done at the BFS Lake but its natural vegetational succession would have to be severely disrupted. Cattails could be physically removed from the entire lake and the water bird community carefully censused to determine if water bird use of the lake did increase, which species or types of birds increased the most, and whether more migratory water bird species of all types began using this lake regularly again.

Figure 1: BFS Lake

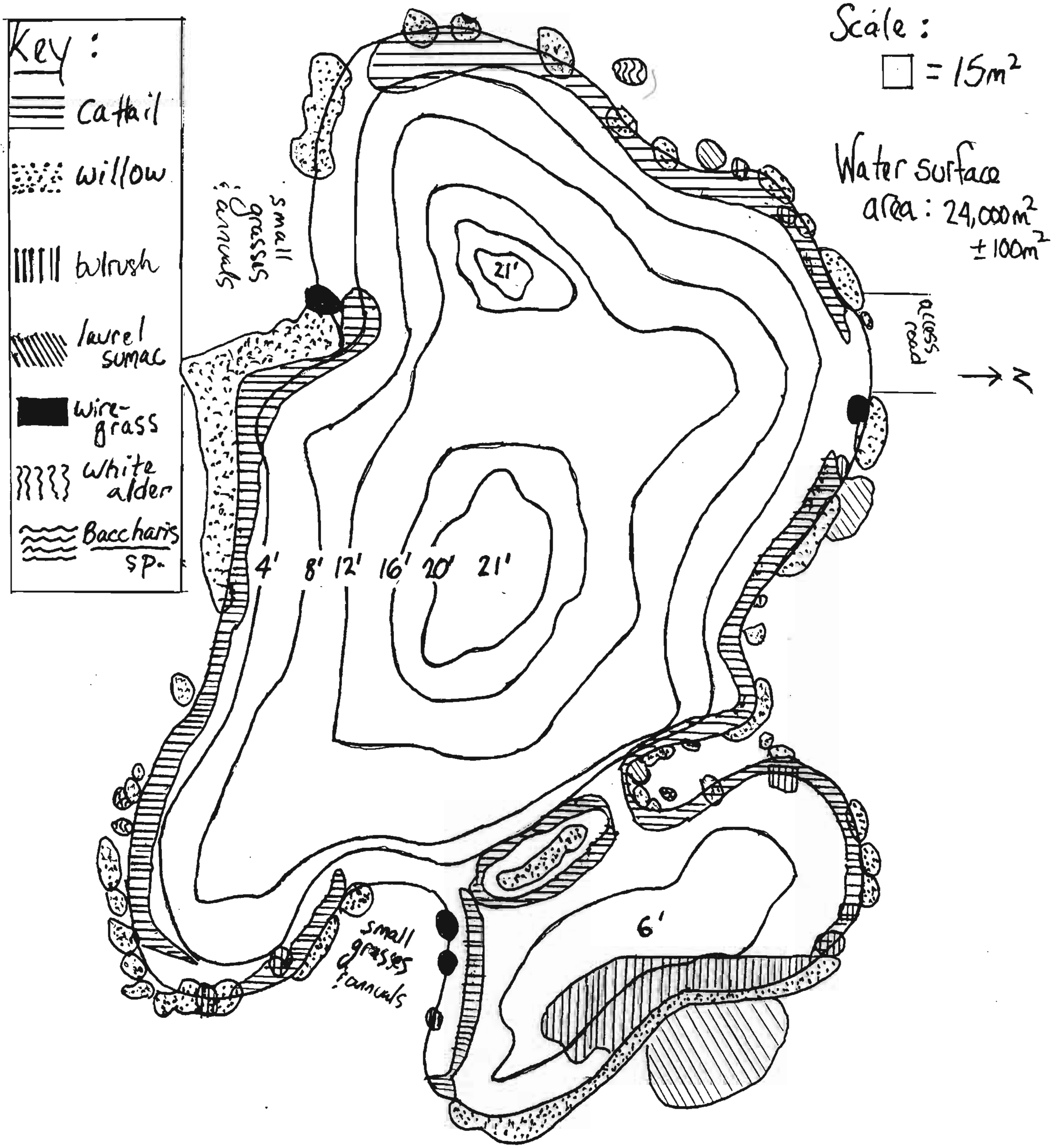
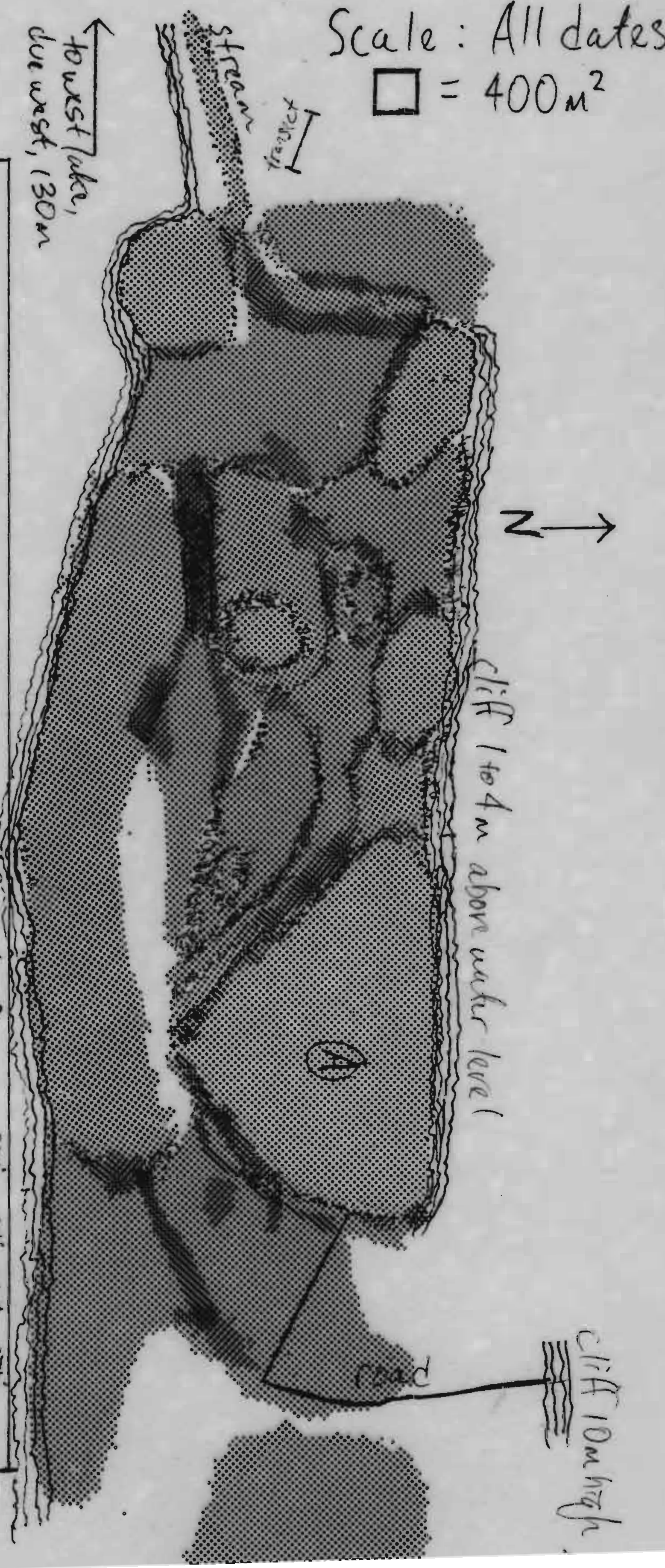


Figure 2:

Upland Lakes Main Water Body

2/22



Key: All dates

water

cliff

Water Surface Areas:

10/20 : 21,800 ± 100m²
11/02 : 38,500 ± 100m²
11/23 : 61,600 ± 100m²
12/13 : 64,700 ± 100m²
1/13 : 60,500 ± 100m²
1/19 : 60,500 ± 100m²
1/26 : 55,900 ± 100m²
2/01 : 64,700 ± 100m²
2/22 : 96,500 ± 100m²
3/02 : 95,200 ± 100m²

Depths at A:

10/20 : 3.0ft.
11/02 : 4.0ft.
11/23 : 6.5ft.
12/13 : 7.0ft.
1/13 : 5.0ft.
1/19 : 4.0ft.
1/26 : 3.0ft.
2/01 : 9.0ft.
2/22 : 10.0ft.
3/02 : 8.0ft.

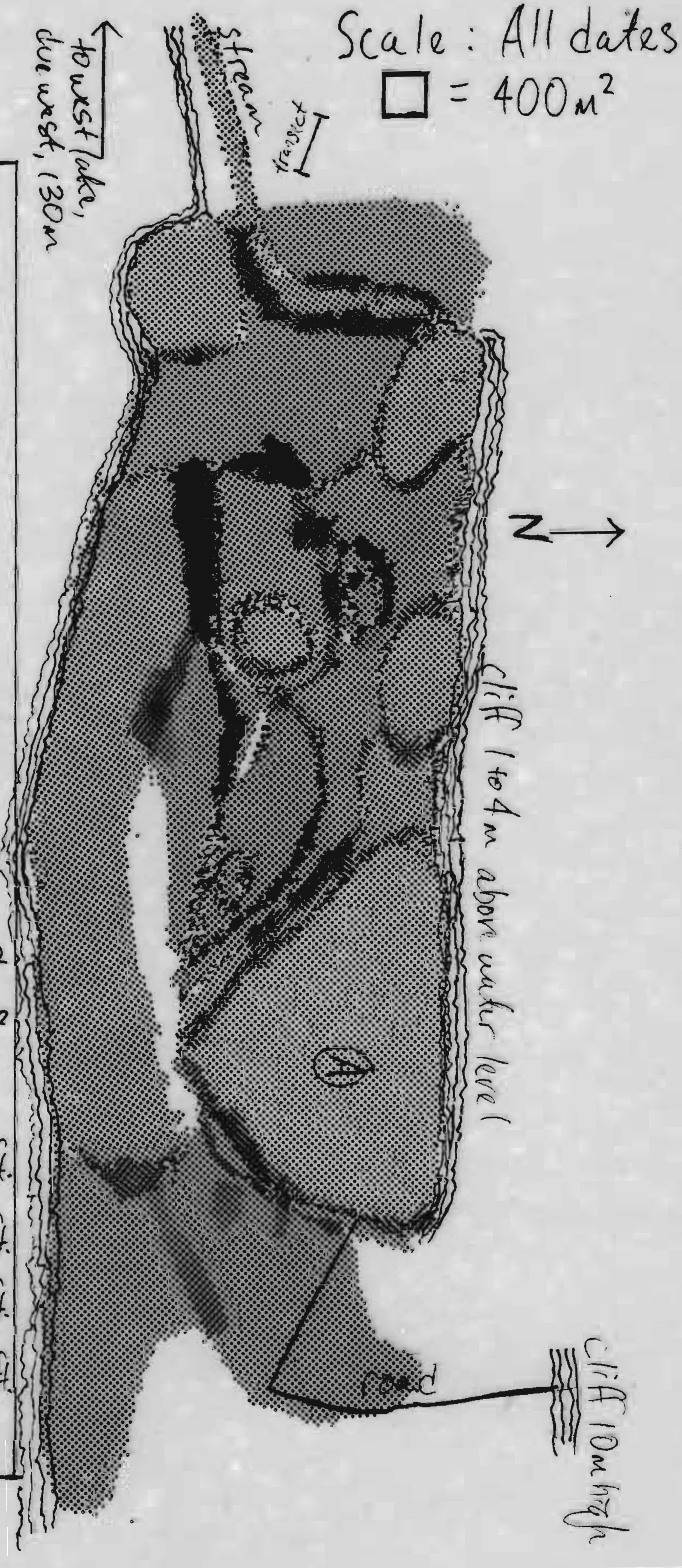
Figure 2:

Upland Lakes Main Water Body

3/02

Scale: All dates

□ = 400m²



Key: All dates

water

cliff

Water Surface Areas:

10/20 : 21,800 ± 100m²
11/02 : 38,500 ± 100m²
11/23 : 61,600 ± 100m²
12/13 : 64,700 ± 100m²
1/13 : 60,500 ± 100m²
1/19 : 60,500 ± 100m²
1/26 : 55,900 ± 100m²
2/01 : 64,700 ± 100m²
2/22 : 96,500 ± 100m²
3/02 : 95,200 ± 100m²

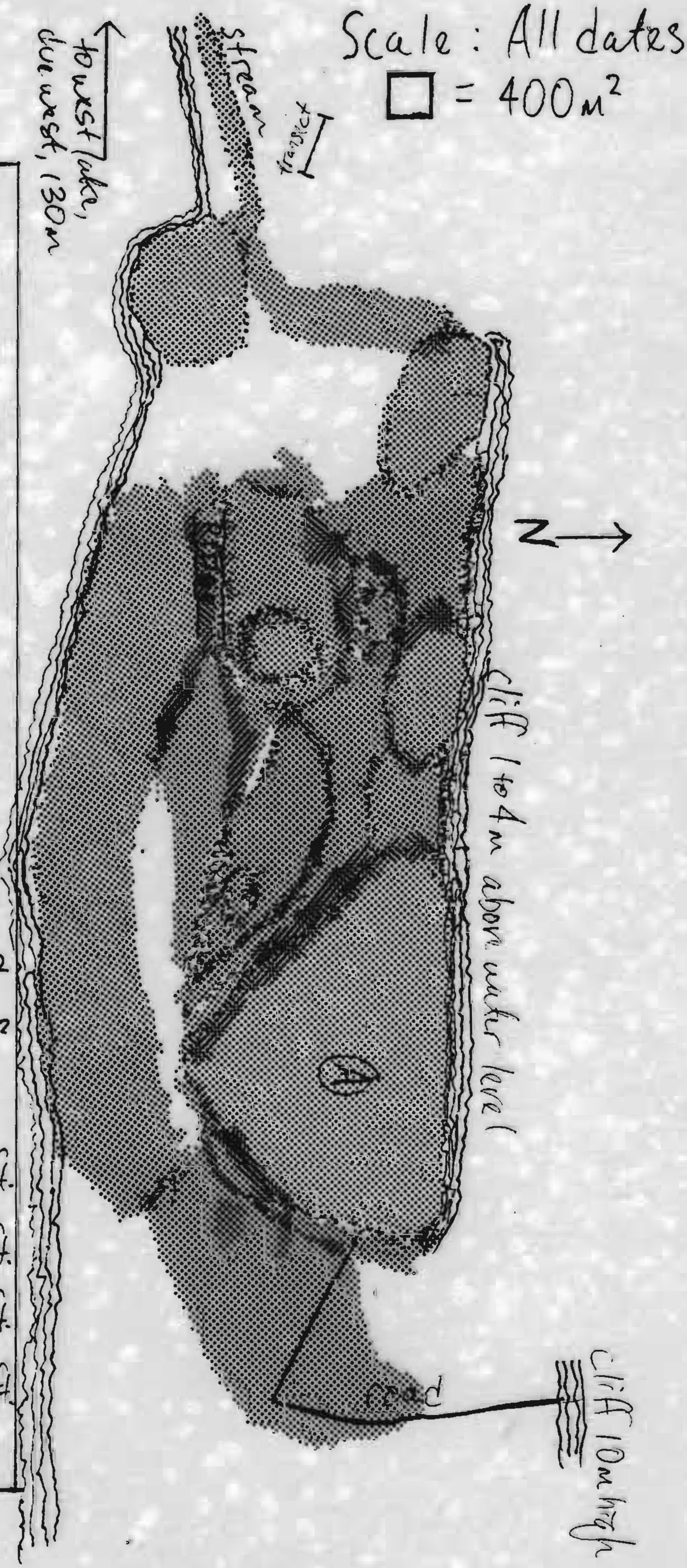
Depths at A:

10/20 : 3.0ft.
11/02 : 4.0ft.
11/23 : 6.5ft.
12/13 : 7.0ft.
1/13 : 5.0ft.
1/19 : 4.0ft.
1/26 : 3.0ft.
2/01 : 9.0ft.
2/22 : 10.0ft.
3/02 : 8.0ft.

12/13, 1/13 & 2/1

Figure 2:

Upland Lakes Main Water Body



Key: All dates

water

cliff

Water Surface Areas:

10/20 : 21,800 ± 100m²
11/02 : 38,500 ± 100m²
11/23 : 61,600 ± 100m²
12/13 : 64,700 ± 100m²
1/13 : 60,500 ± 100m²
1/19 : 60,500 ± 100m²
1/26 : 55,900 ± 100m²
2/01 : 64,700 ± 100m²
2/22 : 96,500 ± 100m²
3/02 : 95,200 ± 100m²

Depths at A:

10/20 : 3.0ft.	1/26 : 3.0ft.
11/02 : 4.0ft.	2/01 : 9.0ft.
11/23 : 6.5ft.	2/22 : 10.0ft.
12/13 : 7.0ft.	3/02 : 8.0ft.
1/13 : 5.0ft.	
1/19 : 4.0ft.	

12/13, 1/13, 2/1

Figure 2:

Upland Lakes Main Water Body

11/23

Key: All dates

- water
- cliff

Water Surface Areas:

10/20	21,800 ± 100 m^2
11/02	38,500 ± 100 m^2
11/23	61,600 ± 100 m^2
12/13	64,700 ± 100 m^2
1/13	60,500 ± 100 m^2
1/19	60,500 ± 100 m^2
1/26	55,900 ± 100 m^2
2/01	64,700 ± 100 m^2
2/22	96,500 ± 100 m^2
3/02	95,200 ± 100 m^2

Depths at A:

10/20	3.0 ft.	1/26	3.0 ft.
11/02	4.0 ft.	2/01	9.0 ft.
11/23	6.5 ft.	2/22	10.0 ft.
12/13	7.0 ft.	3/02	8.0 ft.
1/13	5.0 ft.		
1/19	4.0 ft.		

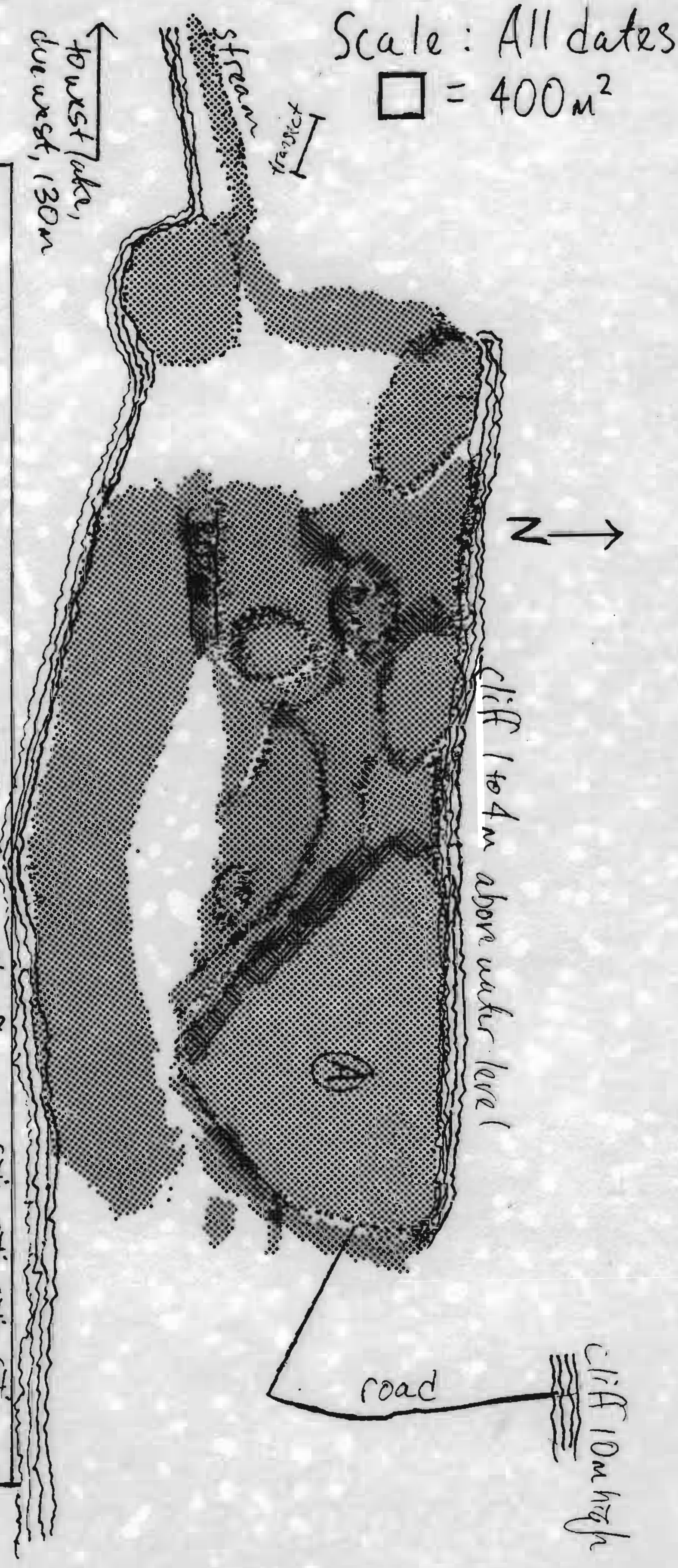


Figure 2:

Upland Lakes Main Water Body

1/19

Scale: All dates
□ = 400 m^2

Key: All dates

- water
- cliff

Water Surface Areas:

10/20 : 21,800 ± 100 m^2
11/02 : 38,500 ± 100 m^2
11/23 : 61,600 ± 100 m^2
12/13 : 64,700 ± 100 m^2
1/13 : 60,500 ± 100 m^2
1/19 : 60,500 ± 100 m^2
1/26 : 55,900 ± 100 m^2
2/01 : 64,700 ± 100 m^2
2/22 : 96,500 ± 100 m^2
3/02 : 95,200 ± 100 m^2

Depths at A:

10/20 : 3.0 ft.
11/02 : 4.0 ft.
11/23 : 6.5 ft.
12/13 : 7.0 ft.
1/13 : 5.0 ft.
1/19 : 4.0 ft.
1/26 : 3.0 ft.
2/01 : 9.0 ft.
2/22 : 10.0 ft.
3/02 : 8.0 ft.

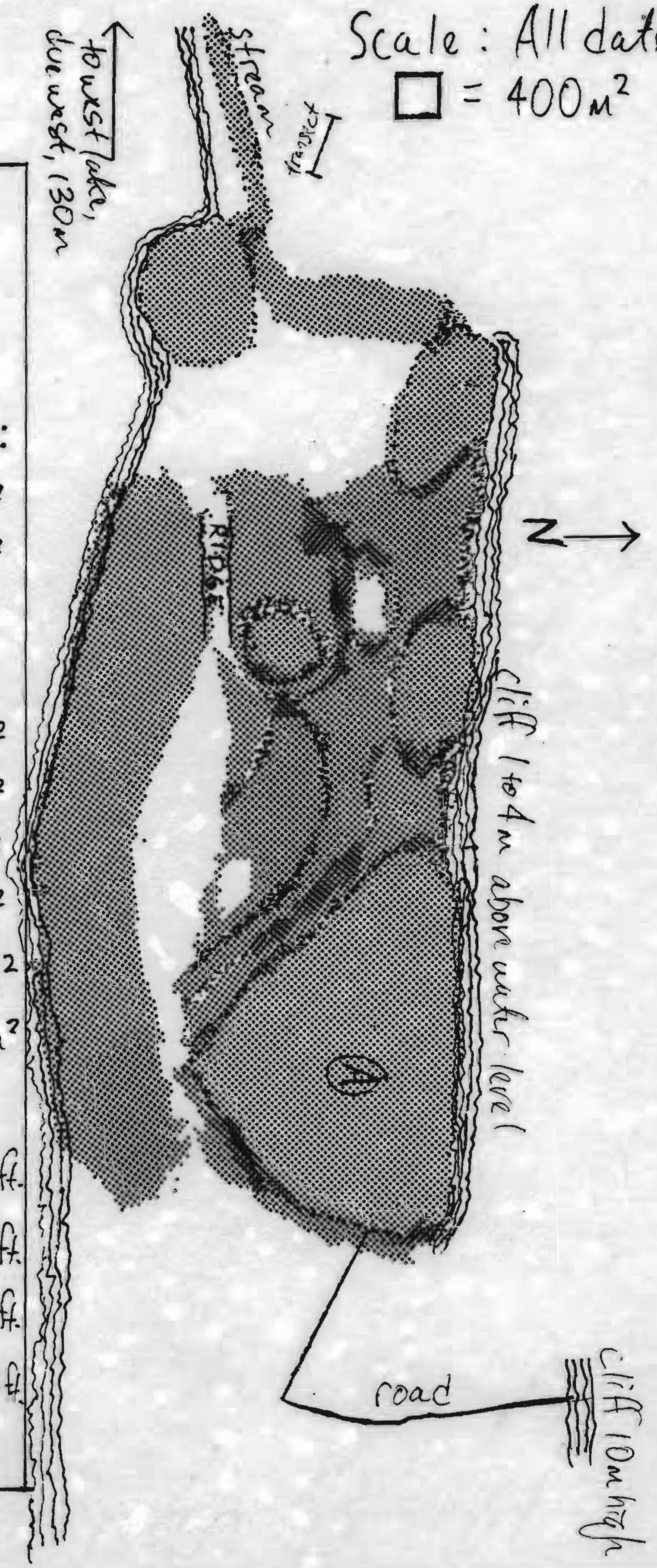
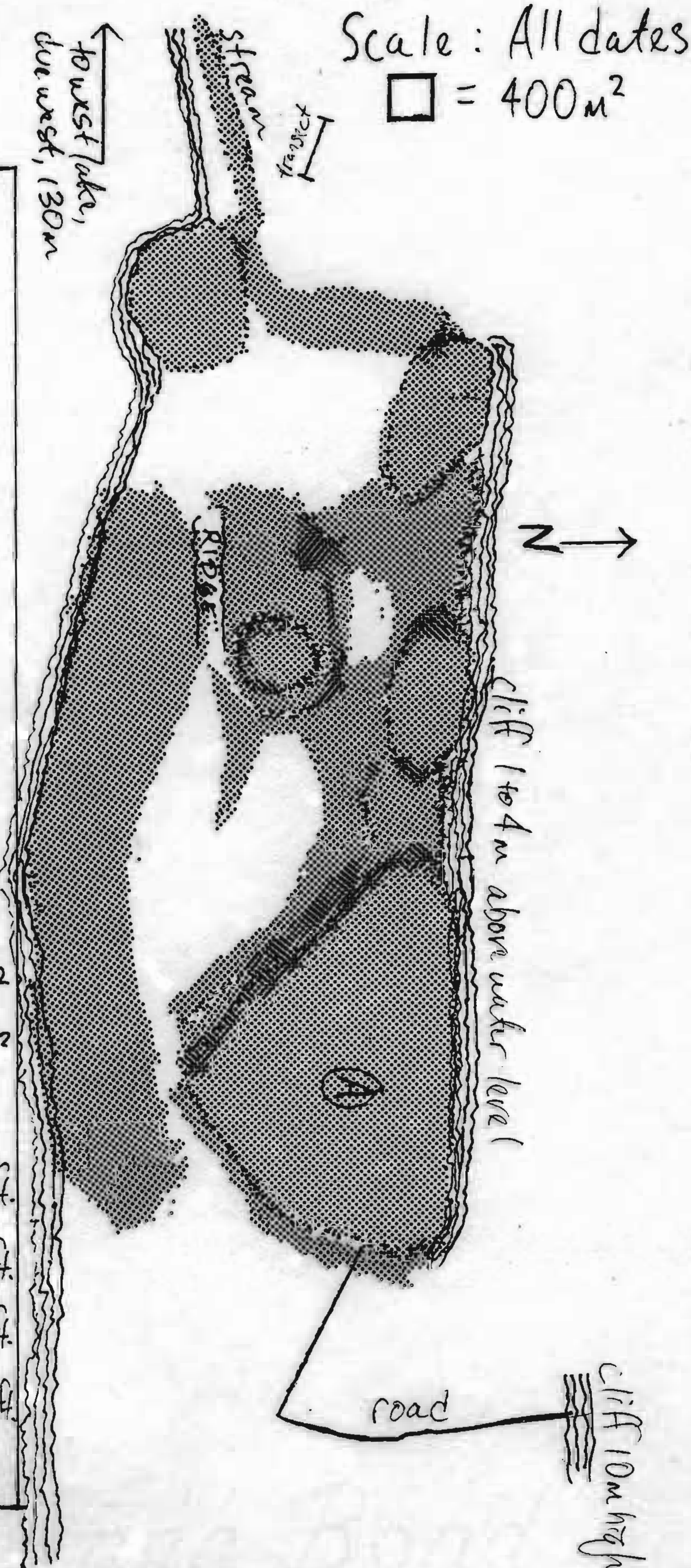


Figure 2:

Upland Lakes Main Water Body

1/26

Scale: All dates
□ = 400m^2



Key: All dates

water

cliff

Water Surface Areas:

10/20 : 21,800 ± 100m^2
11/02 : 38,500 ± 100m^2
11/23 : 61,600 ± 100m^2
12/13 : 64,700 ± 100m^2
1/13 : 60,500 ± 100m^2
1/19 : 60,500 ± 100m^2
1/26 : 55,900 ± 100m^2
2/01 : 64,700 ± 100m^2
2/22 : 96,500 ± 100m^2
3/02 : 95,200 ± 100m^2

Depths at A:

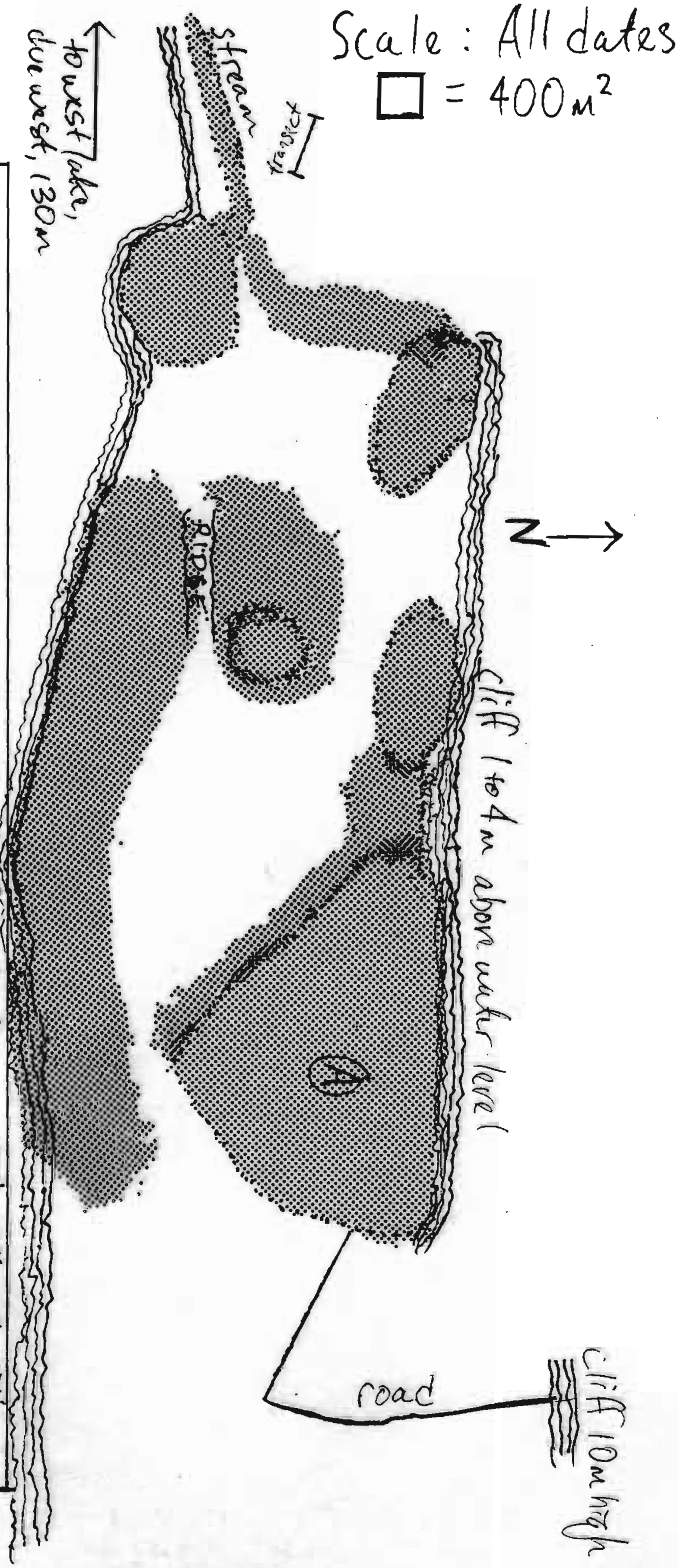
10/20 : 3.0ft.
11/02 : 4.0ft.
11/23 : 6.5ft.
12/13 : 7.0ft.
1/13 : 5.0ft.
1/19 : 4.0ft.
1/26 : 3.0ft.
2/01 : 9.0ft.
2/22 : 10.0ft.
3/02 : 8.0ft.

Figure 2:

Upland Lakes Main Water Body

10/11/02

Scale: All dates
□ = 400 m^2



Key: All dates

water

cliff

Water Surface Areas:

10/20 : 21,800 ± 100 m^2
11/02 : 38,500 ± 100 m^2
11/23 : 61,600 ± 100 m^2
12/13 : 64,700 ± 100 m^2
1/13 : 60,500 ± 100 m^2
1/19 : 60,500 ± 100 m^2
1/26 : 55,900 ± 100 m^2
2/01 : 64,700 ± 100 m^2
2/22 : 96,500 ± 100 m^2
3/02 : 95,200 ± 100 m^2

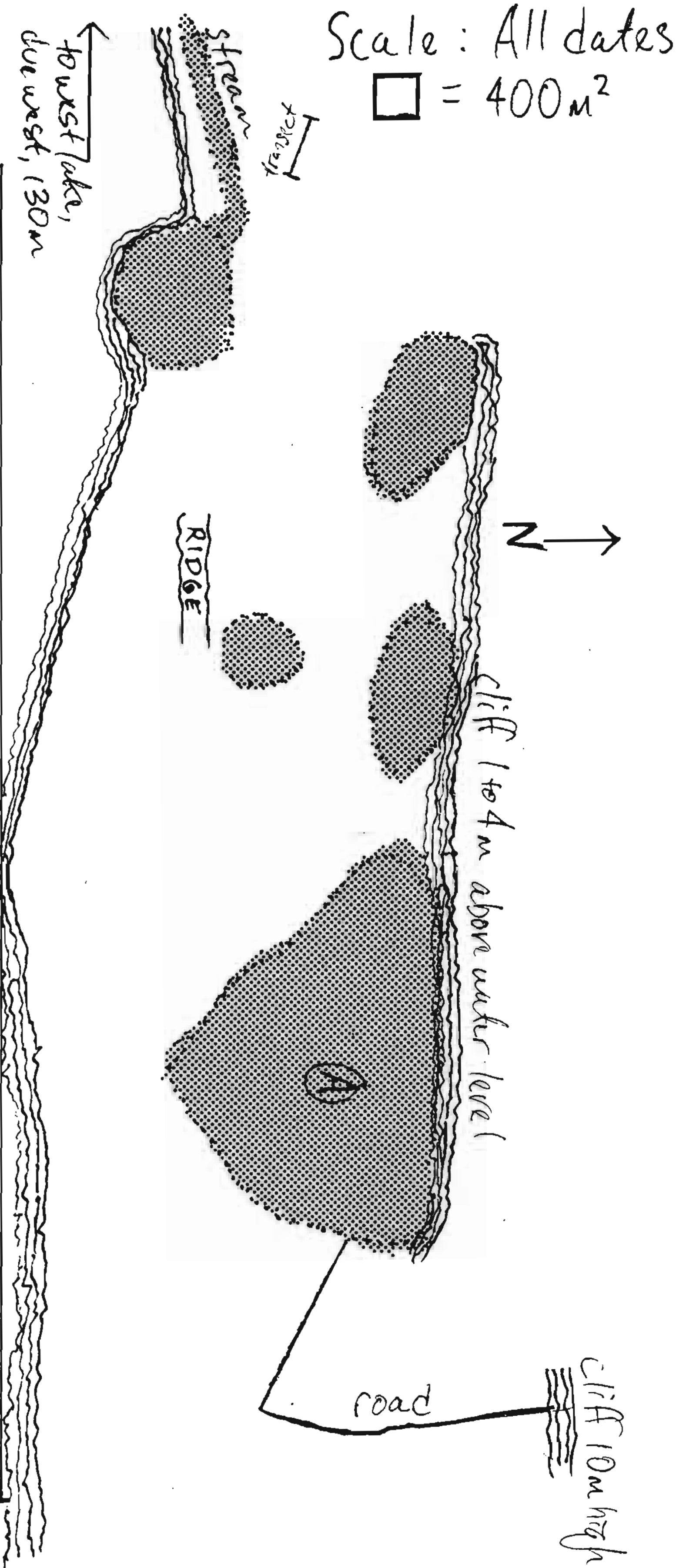
Depths at A:

10/20 : 3.0 ft. 1/26 : 3.0 ft.
11/02 : 4.0 ft. 2/01 : 9.0 ft.
11/23 : 6.5 ft. 2/22 : 10.0 ft.
12/13 : 7.0 ft. 3/02 : 8.0 ft.
1/13 : 5.0 ft.
1/19 : 4.0 ft.

Figure 2:

Upland Lakes Main Water Body

10/20



Key: All dates

water

cliff

Water Surface Areas:

10/20 : 21,800 ± 100m²
11/02 : 38,500 ± 100m²
11/23 : 61,600 ± 100m²
12/13 : 64,700 ± 100m²
1/13 : 60,500 ± 100m²
1/19 : 60,500 ± 100m²
1/26 : 55,900 ± 100m²
2/01 : 64,700 ± 100m²
2/22 : 96,500 ± 100m²
3/02 : 95,200 ± 100m²

Depths at A:

10/20 : 3.0ft.
11/02 : 4.0ft.
11/23 : 6.5ft.
12/13 : 7.0ft.
1/13 : 5.0ft.
1/19 : 4.0ft.
1/26 : 3.0ft.
2/01 : 9.0ft.
2/22 : 10.0ft.
3/02 : 8.0ft.

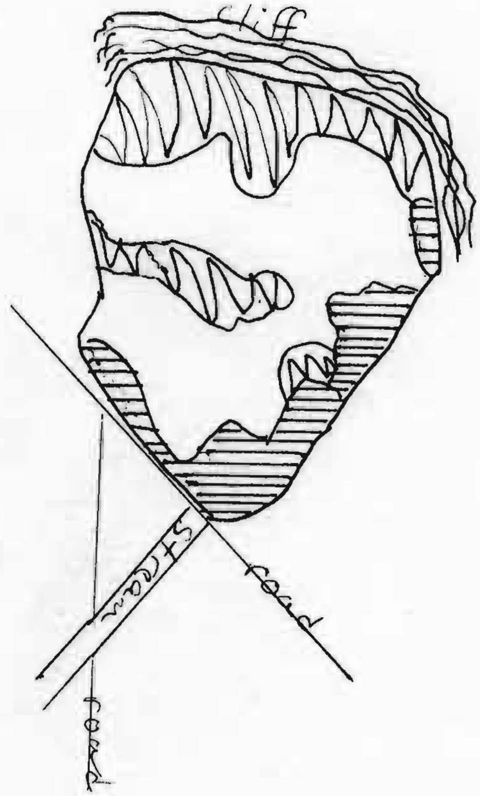
Figure 3: Upland West Lake

Key:

(horizontal lines) cattail

(zigzag) mixed scrubby terrestrial/emergent vegetation: including *Baccharis* sp., *Enceliopsis covillei*, *Lobularia maritima*, & *Brassica nigra*

(wavy lines) cliff, 4-8 m above water level



N →

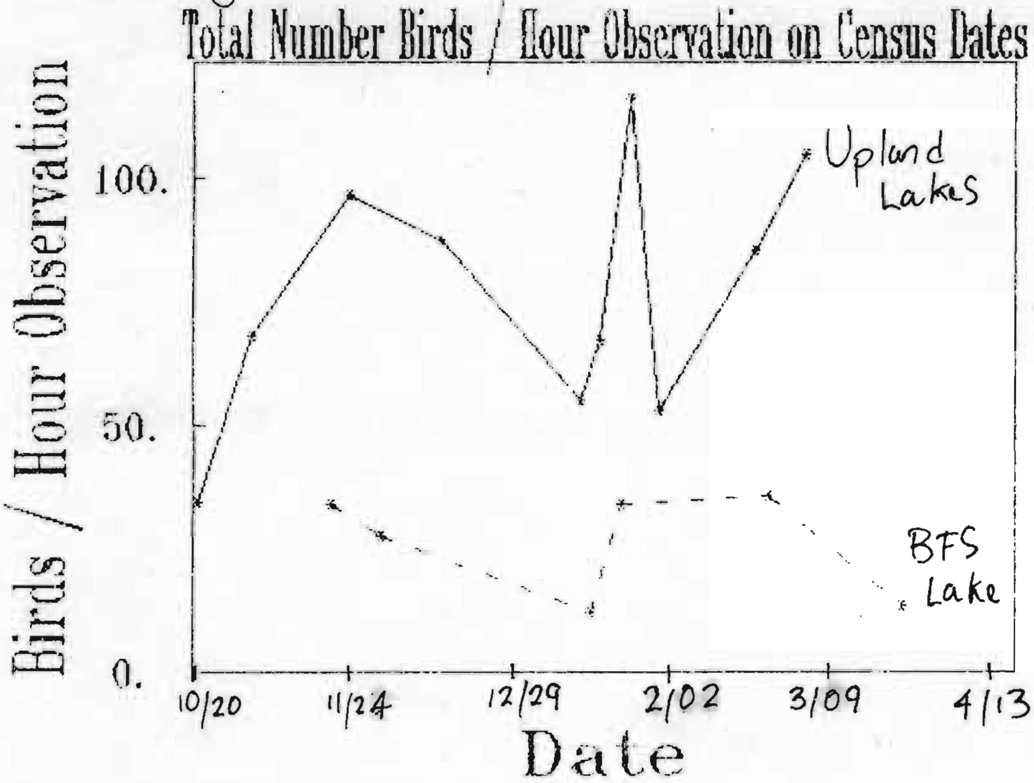
↓ to main water body, due east, 250 m

Scale:

□ = $100 m^2$

Water surface area: $3800 m^2 \pm 100 m^2$

Figure 4:



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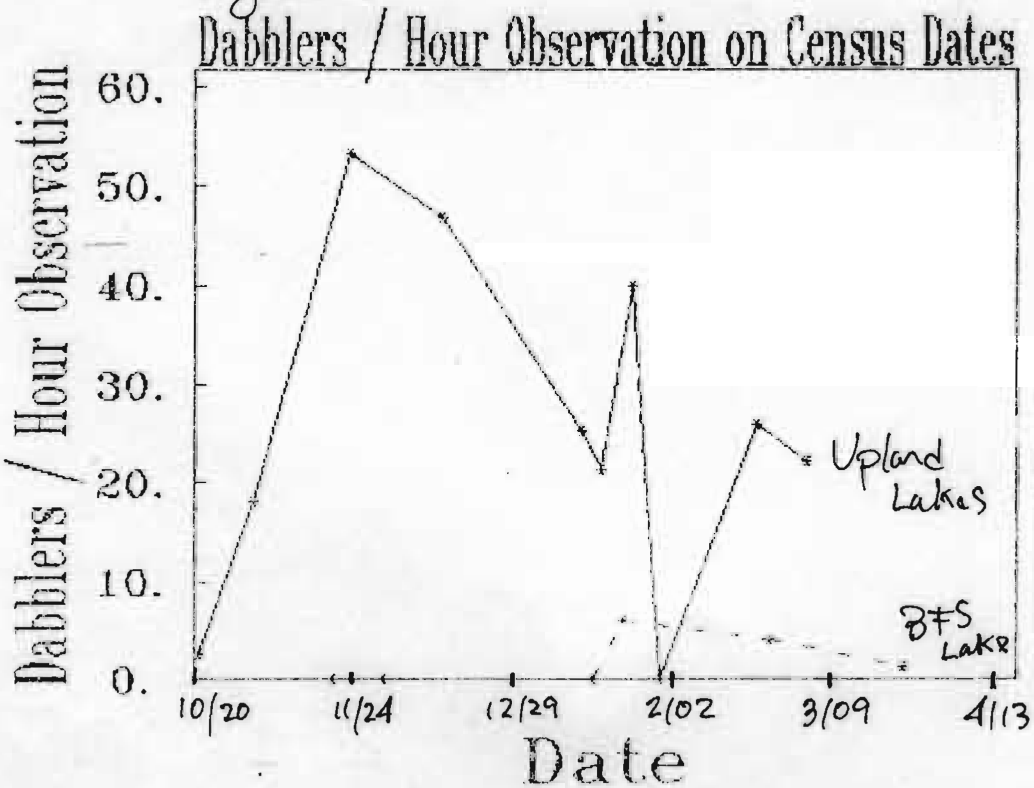

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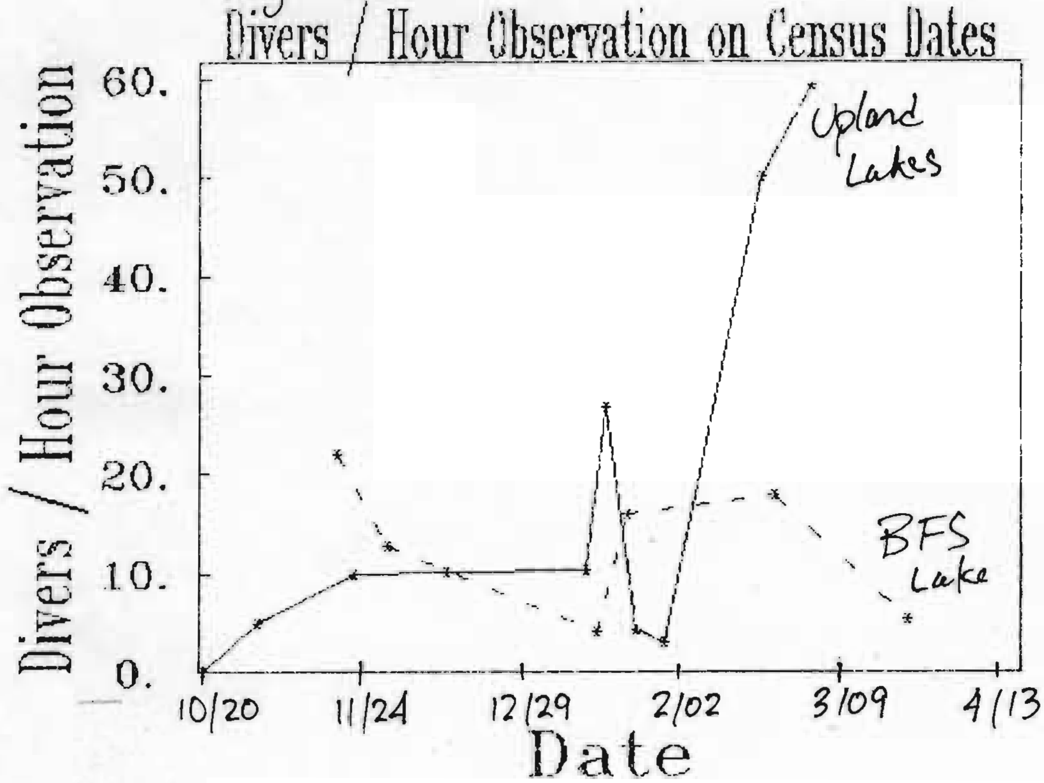

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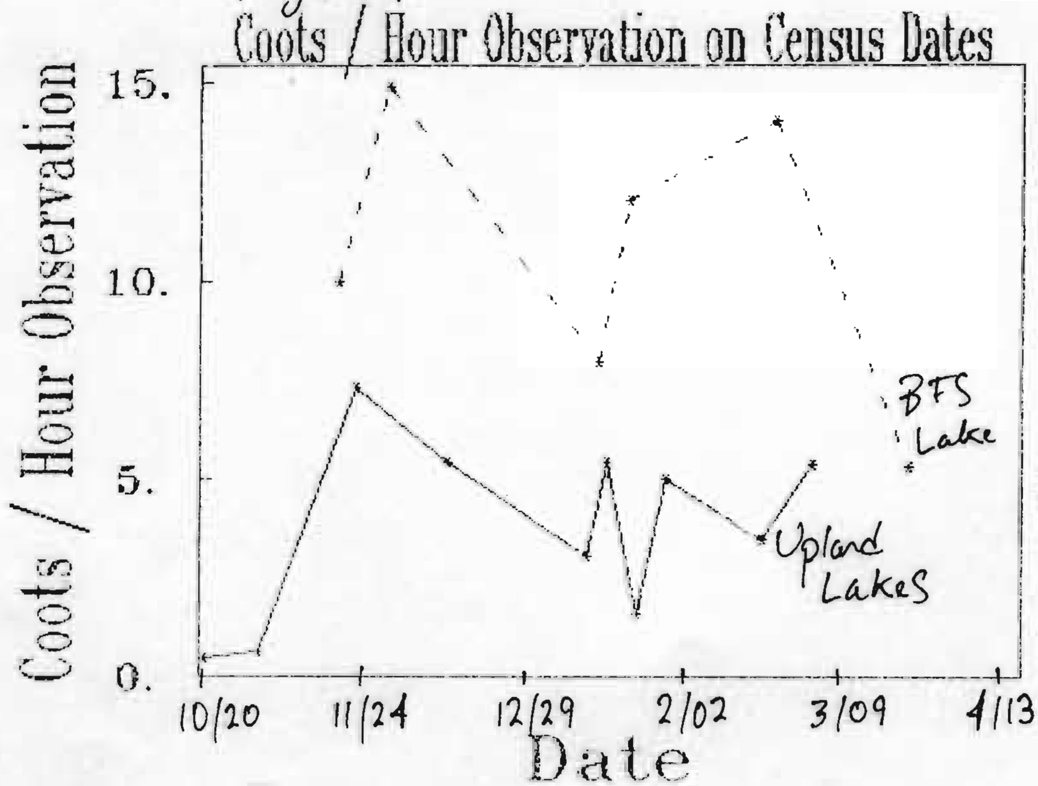

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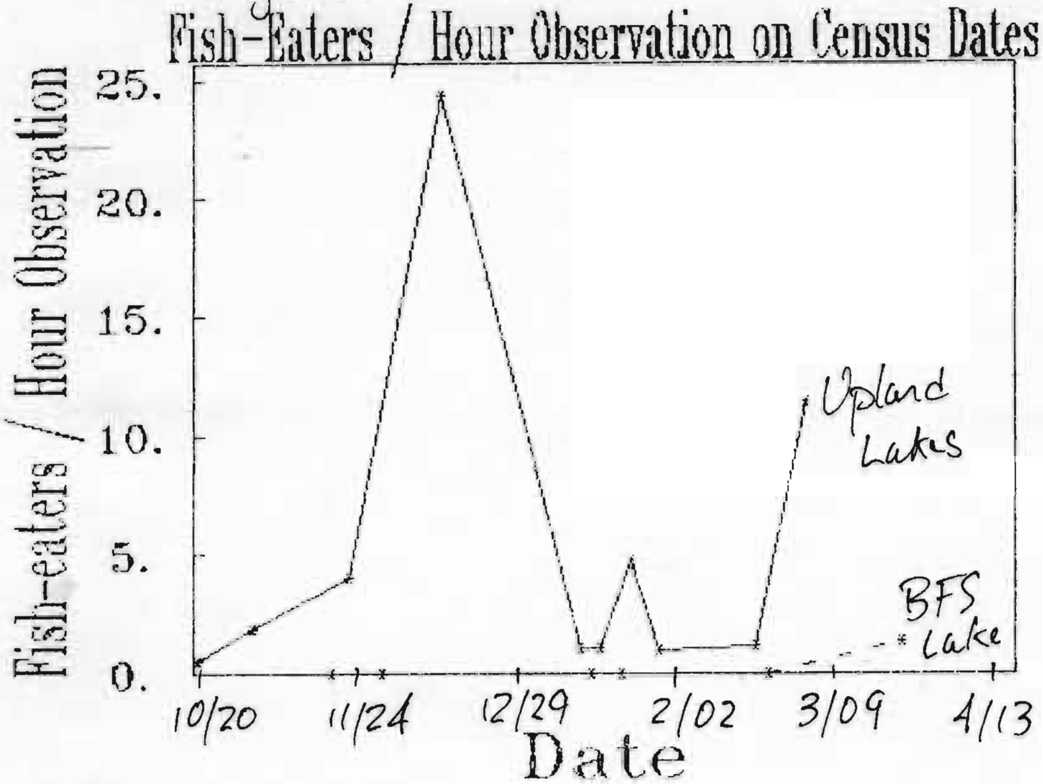

Figure 9:

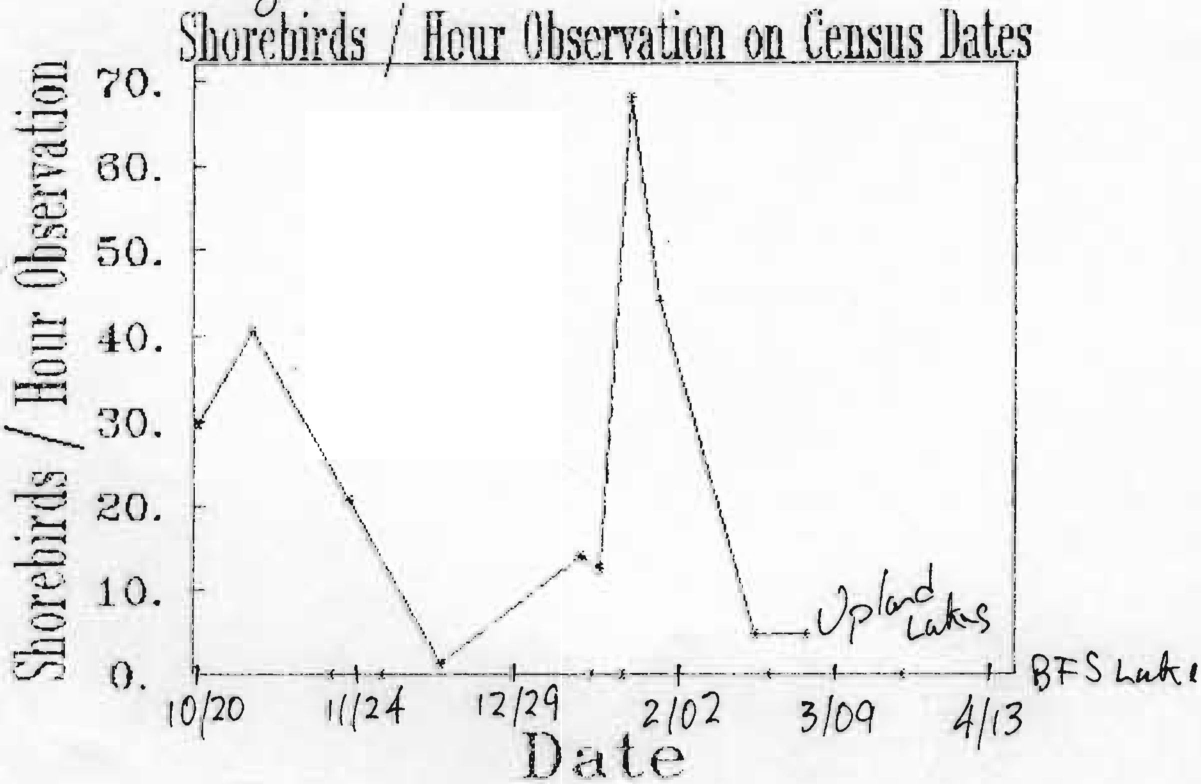

Figure 10:

Total Birds / ha of Surface Water Area on Census Dates

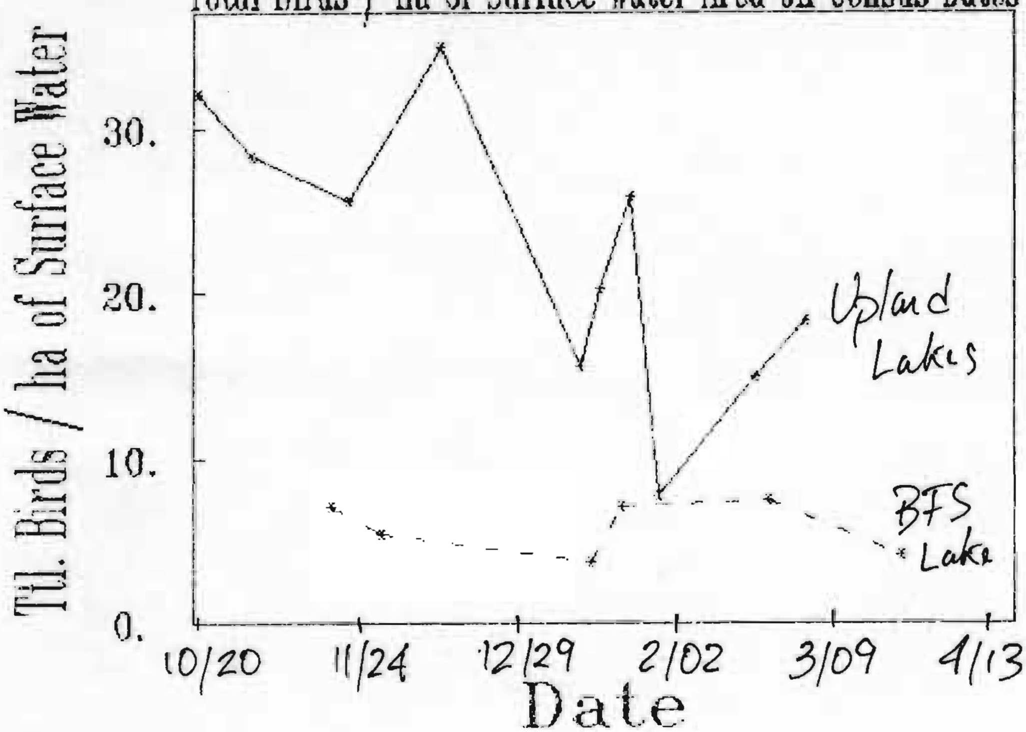

Figure 11:

Bird Species Diversity at both Sites on Census Dates

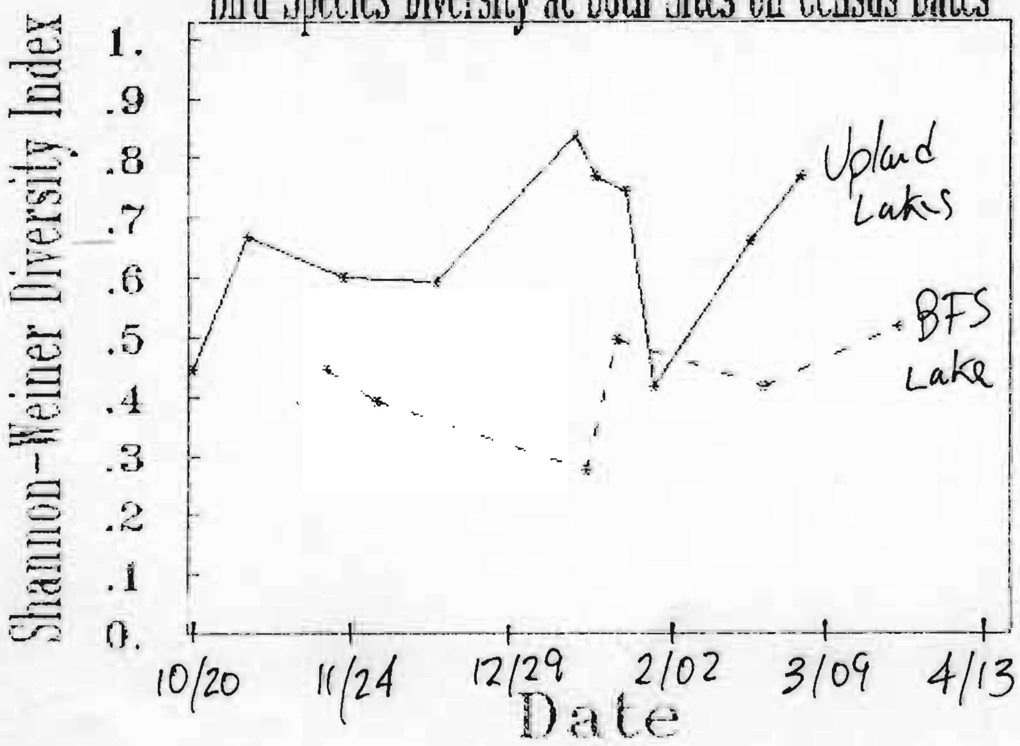

Figure 12:

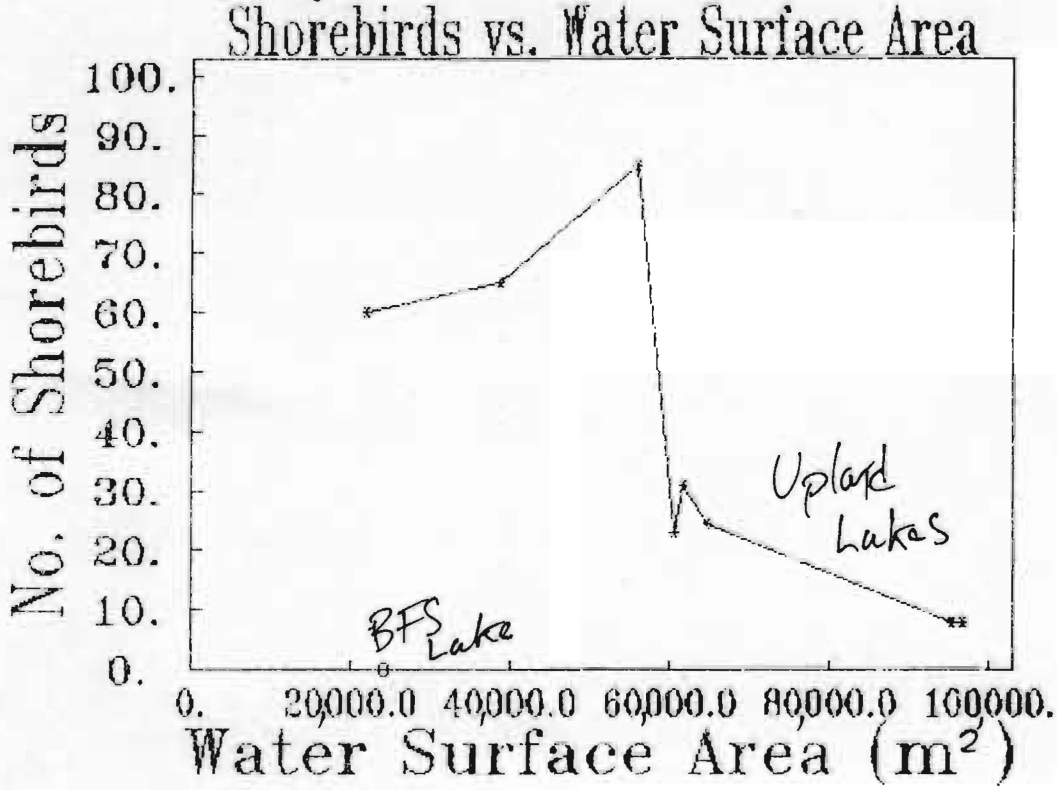

Figure 13:

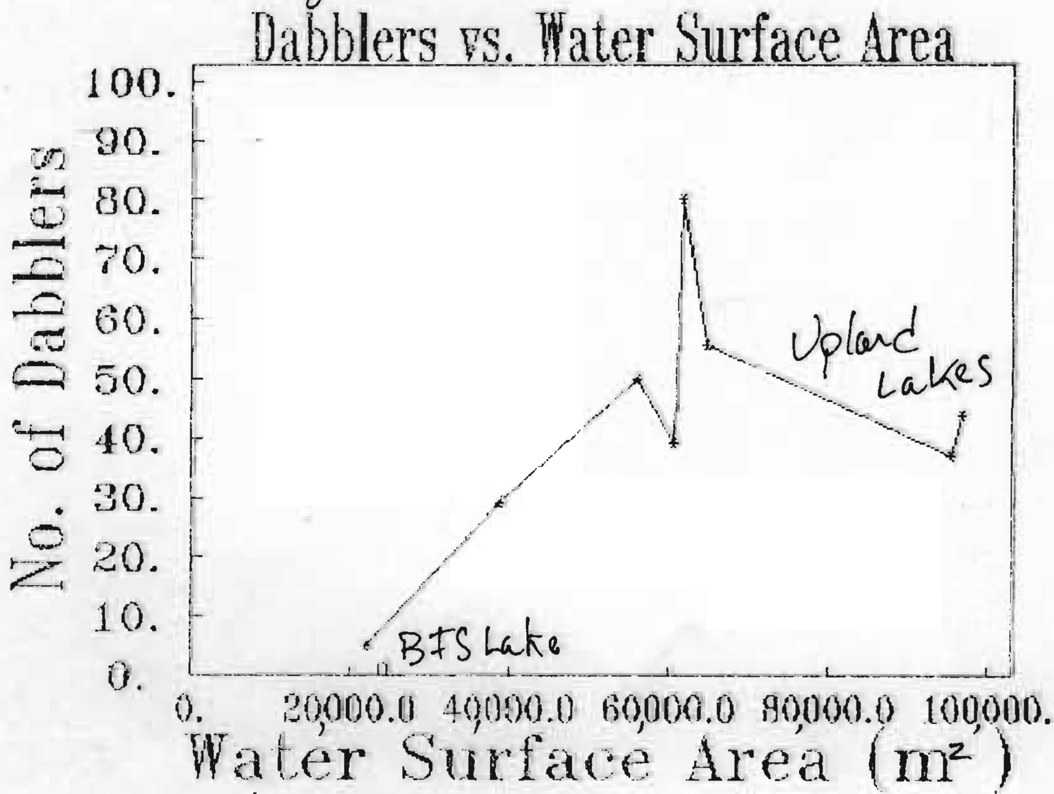

Figure 14:

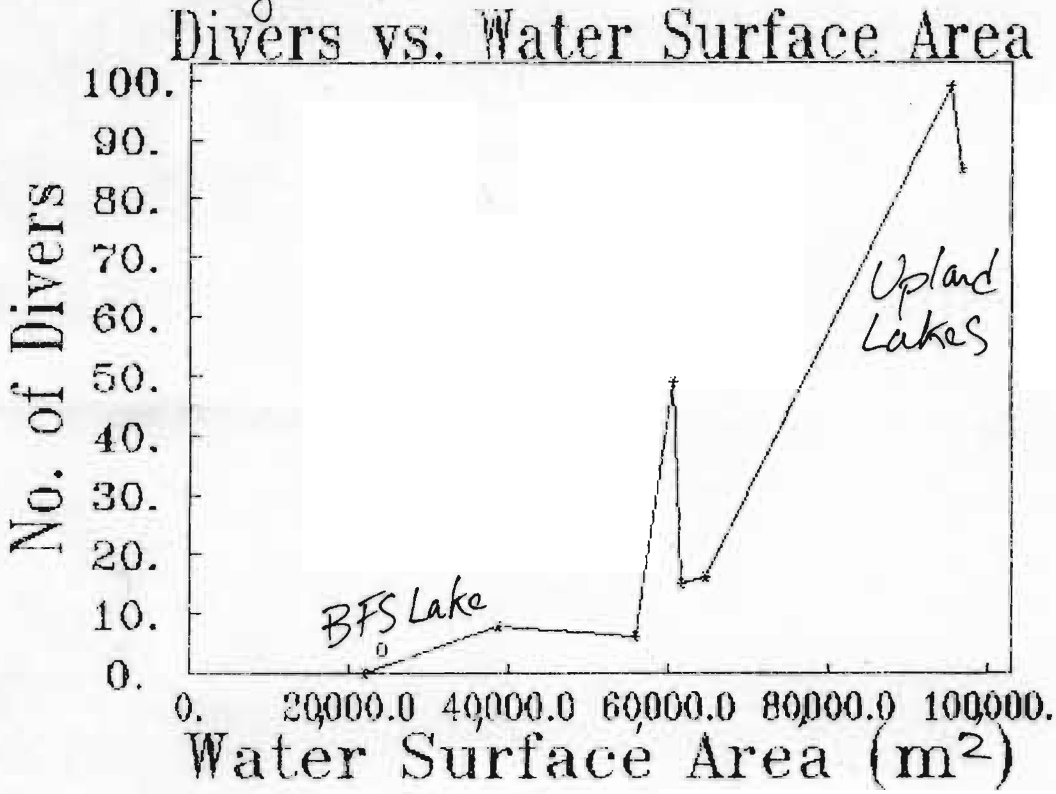

Figure 15:

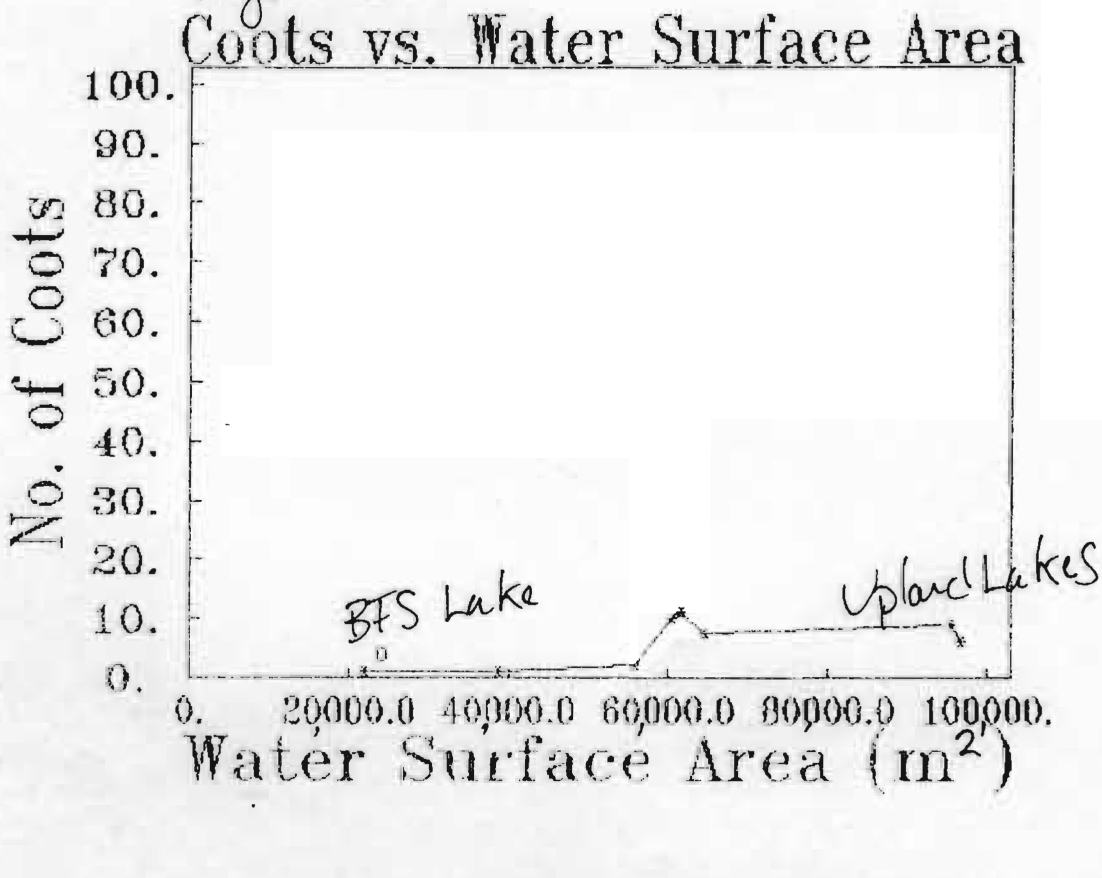

Figure 16:

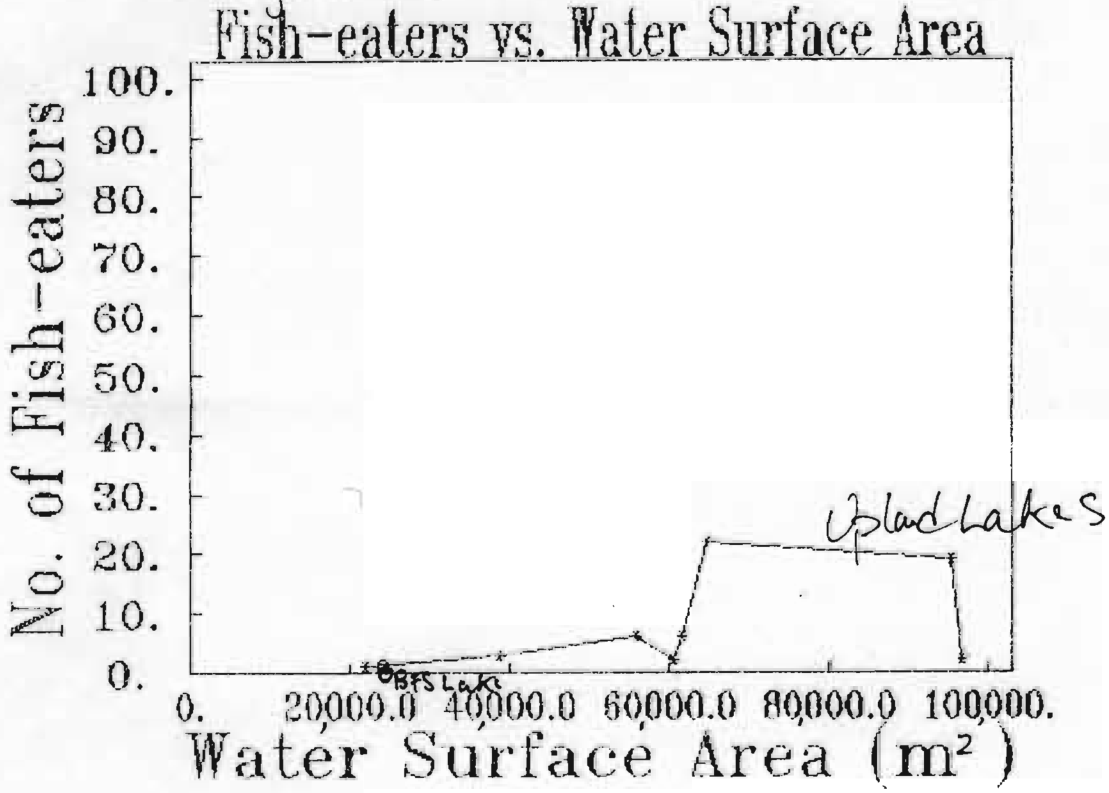

Figure 17:

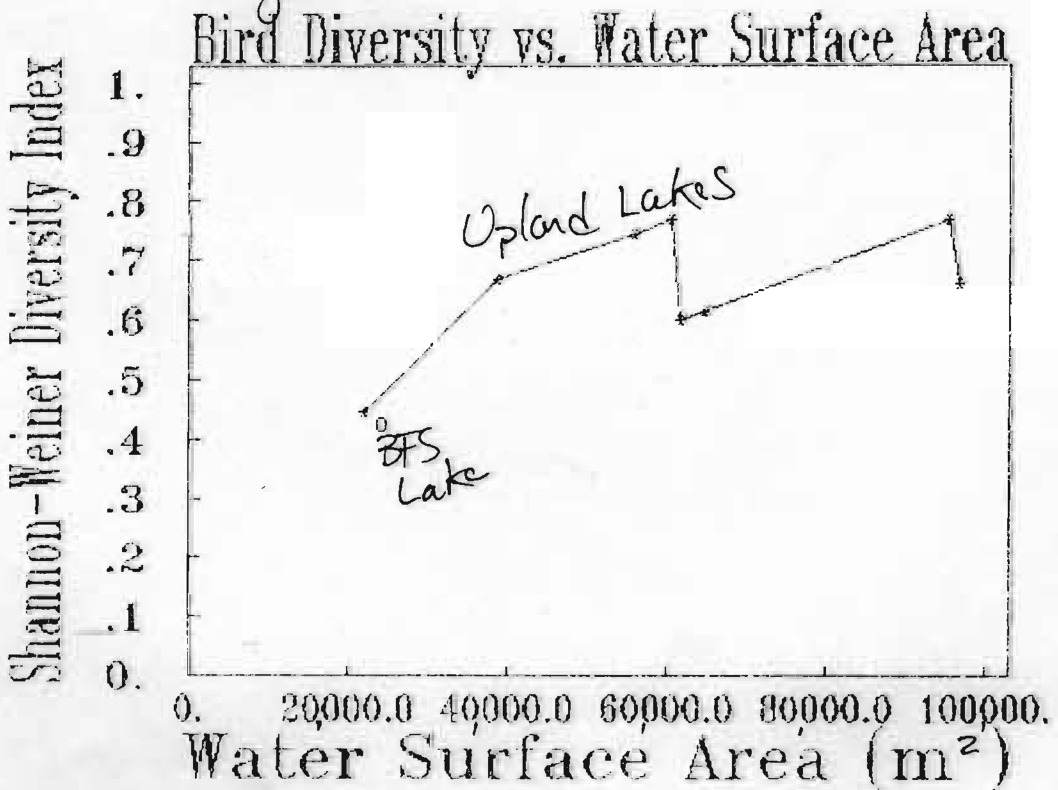

Figure 18:

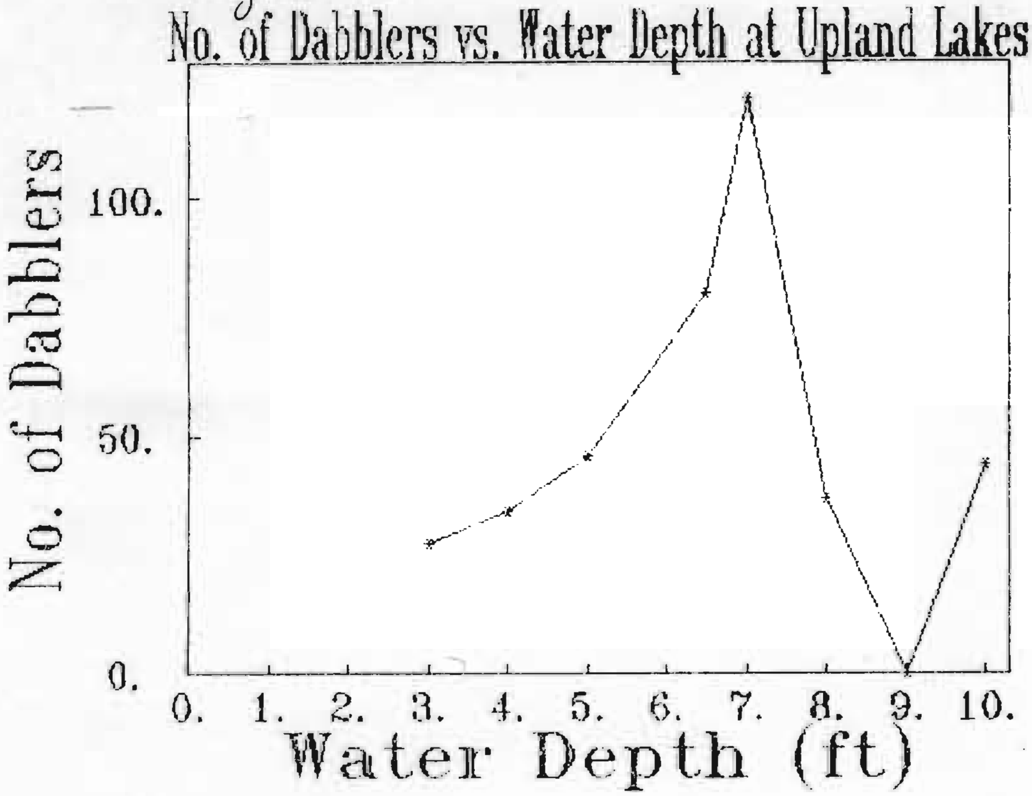

Figure 19:

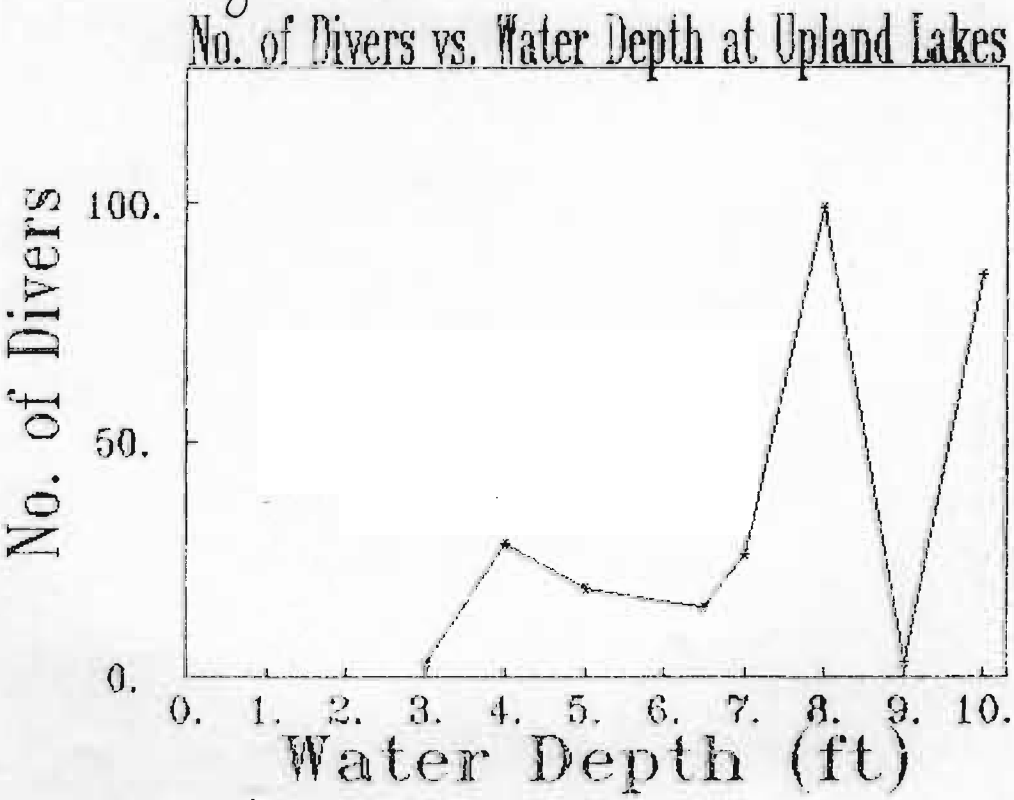

Figure 20:

No. of Coots vs. Water Depth at Upland Lakes

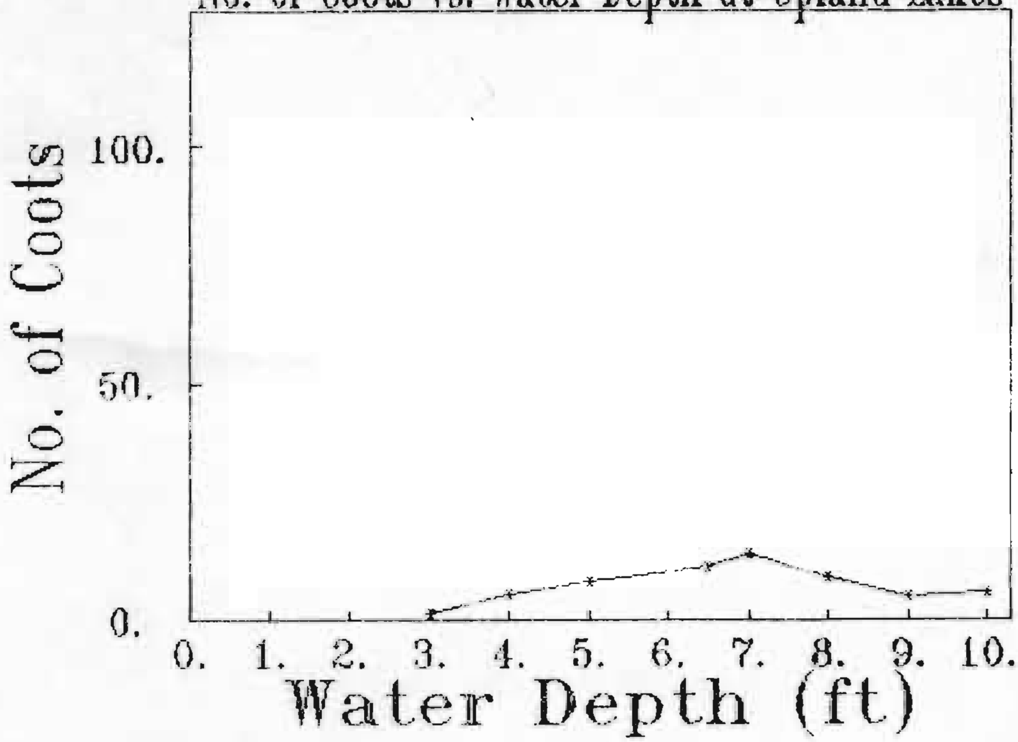

Figure 21:

No. of Fish-eaters vs. Water Depth at Upland Lakes

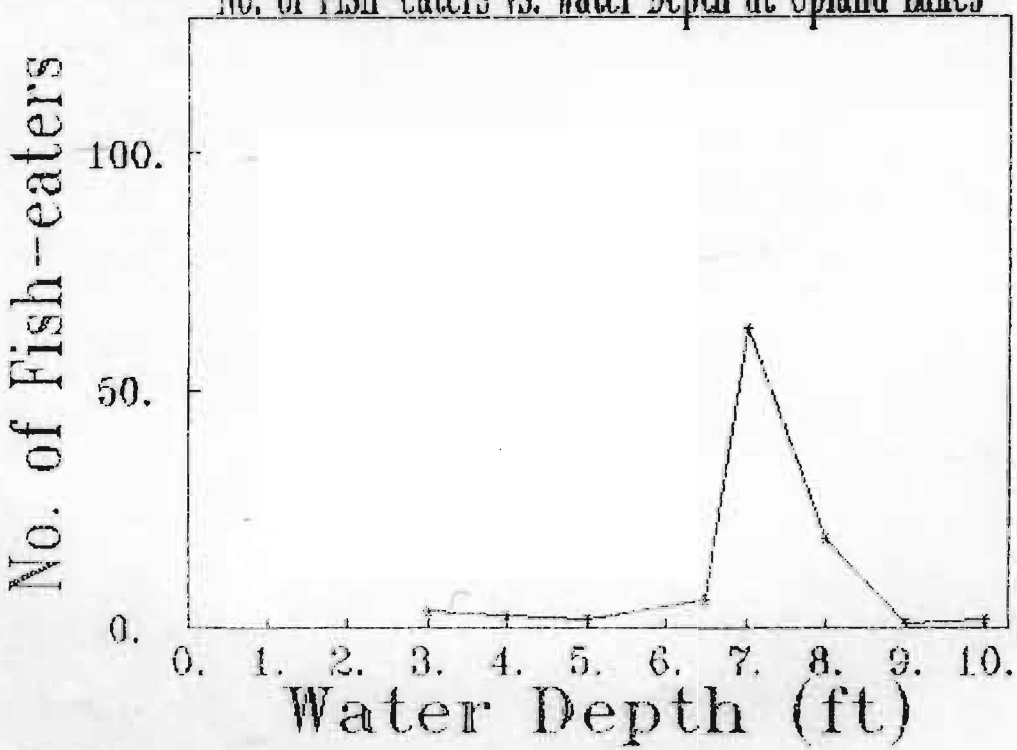

Figure 22:

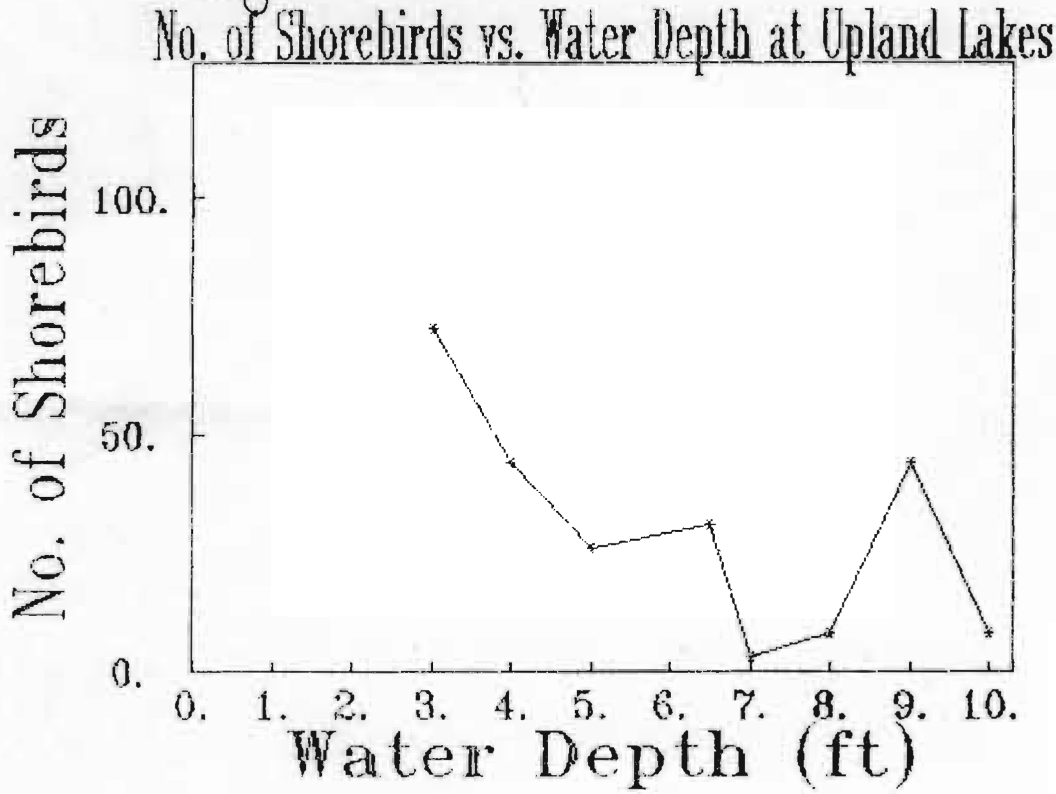

Figure 23:

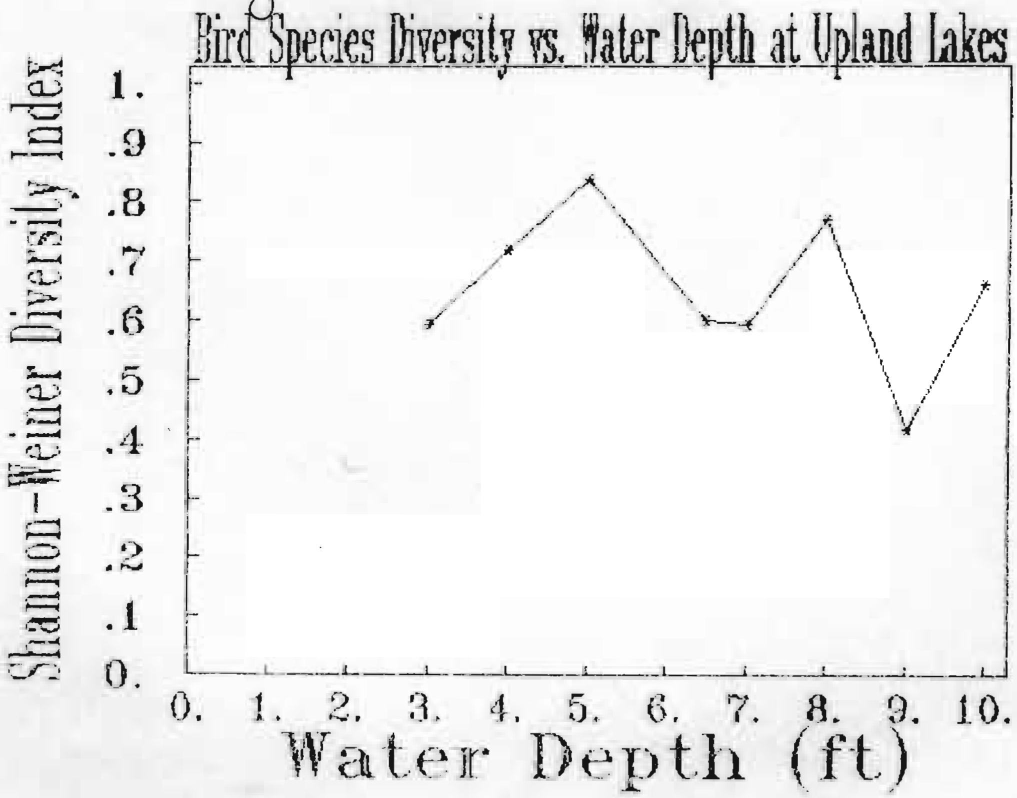

Figure 24:

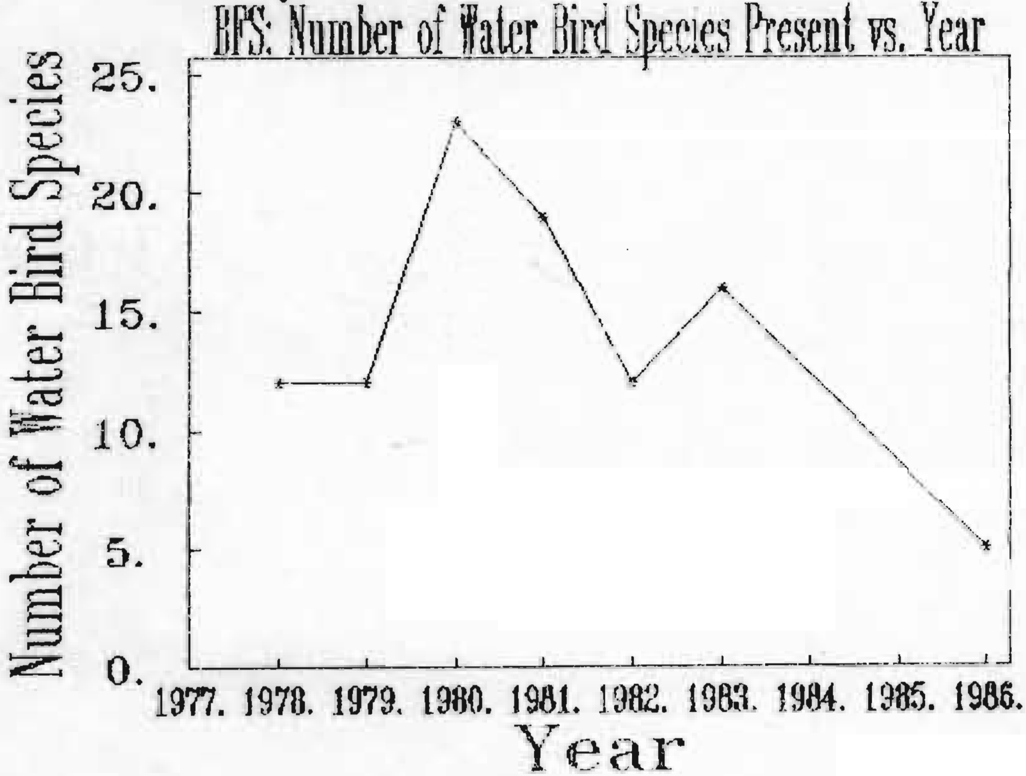
BFS: Number of Water Bird Species Present vs. Year
Number of Water Bird Species
25.
20.
15.
10.
5.
0.
1977. 1978. 1979. 1980. 1981. 1982. 1983. 1984. 1985. 1986.
Year

Table 1

Plant Species of the BFS Lake

Submergent:	Description:
Chara sp.	Muskgrass. Chlorophyte (green algae), common in shallow (1 to 3 ft.) water, wholly submerged.
Ludwigia palustris	Water primrose. Floating or creeping stemmed, almost emergent plant, common in shallow (1 to 3 ft.) water.
Emergent:	
Typha latifolia	Common cattail. Very common in shallow water, see Figure 1. Emergent to 2.5 m above water level.
Scirpus acutus	Hard-stem bulrush. Common in shallow water, see Figure 1. Emergent to 2.5 m above water level.
Juncus textilis	Wire-grass. Occasional in shallow water, see Figure 1. Emergent to 1 m above water level.
Cyperus virens	Umbrella sedge. Rare in shallow water, with Juncus textilis, but only on water's edge.
Eleocharis palustris	Spike-rush. Rare in shallow water. Emergent to 1 m above water level.
Marginal:	
Salix lasiolepsis	Arroyo willow. Small tree on shore's edge, often overhanging water. Very common, see Figure 1.
Rhus laurina	Laurel sumac. Large shrub on shore's edge. Common, see Figure 1.
Alnus rhombifolia	White alder. Tree occasional near water's edge, see Figure 1.
Baccharis sp.	Scrubby shrub, 1 m tall. Rare, on peninsula.
Gnaphalium beneolens	Cudweed. Stout perennial. On drier ground about 1 m from water's edge, occasional.

continued

Table 1 (cont'd.)

Plant Species of the BFS Lake

Marginal:

Lotus scoparius	Bird's foot trefoil. With grasses and cudweed, about 1 m from water's edge, occasional.
Various grasses	Found near shore, occasional, especially near bare ground shoreline, see Figure 1.

Table 2

Plant Species of the Upland Lakes

Submergent:	Description:
No true submergents, only submerged, dying terrestrial plants	Since only the west lake has year-round water, only it contains algae and other aquatic plants.
Emergent:	
<u>Typha latifolia</u>	Common cattail. Found only in the west lake, extending to 2.5 m above water level.
Terrestrial:	
<u>Baccharis</u> sp.	Scrubby shrub, 1 to 3 m high. Common in and around the west lake, becoming increasingly rare to the east. Some are partially submerged.
<u>Brassica nigra</u>	Common annual, up to 1 m tall, near edge of water and in drier soil far from water.
<u>Enceliopsis covillei</u>	Occasional perennial, most frequent near west lake water's edge.
<u>Cyperus esculentus</u>	Nut-grass. Occasional in shallow water, and in mud near west lake.
<u>Lobularia maritima</u>	Sweet-alyssum. Low perennial, occasional in moist, gravelly soil near edge of west lake.
<u>Lotus scoparius</u>	Bird's foot trefoil. With small annuals in dry, rocky soil a few meters from water's edge. Occasional.
<u>Frasera parryi</u>	Green gentian. Rare, with <u>Lotus scoparius</u>, in dry, rocky soil, a few meters from stream's edge.
<u>Mimulus guttatus</u>	Monkey-flower. Small perennial in moist, sandy soil around 1 m from water's edge, near west lake. Rare.
<u>Gnaphalium palustre</u>	Cudweed. Small annual in mud near stream's edge, and near lake edges. Common.
Various grasses.	More frequent towards main water and stream.

continued

Table 2 (cont'd.)

Plant Species of the Upland Lakes

Terrestrial:

Erodium cicutarium	Red-stem filaree. Small annual. Common on dry ground between lakes.

Table 3

<u>Fish-eaters</u>
PBGR, Pied-Billed Grebe, <u>Podilymbus podiceps</u>
GBHE, Great Blue Heron, <u>Ardea herodias</u>
GREG, Great Egret, <u>Casmerodius albus</u>
BCNH, Black-Crowned Night Heron, <u>Nycticorax nycticorax</u>
DCCO, Double-Crested Cormorant, <u>Phalacrocorax auritus</u>
BEKI, Belted Kingfisher, <u>Ceryle alcyon</u>
RBGU, Ring-Billed Gull, <u>Larus delawarensis</u>

<u>Dabblers</u>
MALL, Mallard Duck, <u>Anas platyrhynchos</u>
PINT, Pintail Duck, <u>Anas acuta</u>
AMWI, American Widgeon, <u>Anas americana</u>
CITE, Cinnamon Teal, <u>Anas cyanoptera</u>

<u>Divers</u>
RNDU, Ring-Necked Duck, <u>Aythya collaris</u>
CANV, Canvasback, <u>Aythya valisineria</u>
LESC, Lesser Scaup, <u>Aythya affinis</u>
BUFF, Bufflehead, <u>Bucephala albeola</u>
RUDU, Ruddy Duck, <u>Oxyura jamaicensis</u>

<u>Coots</u>
AMCO, American Coot, <u>Fulica americana</u>

<u>Shorebirds</u>
KILL, Killdeer, <u>Charadrius vociferus</u>
SPSA, Spotted sandpiper, <u>Actitis macularia</u>
GRYE, Greater Yellowlegs, <u>Tringa melanoleuca</u>
LESA, Least Sandpiper, <u>Calidris minutilla</u>
SBDO, Short-Billed Dowitcher, <u>Limnodromus griseus</u>
BNST, Black-Necked Stilt, <u>Himantopus mexicanus</u>

Table 4

Birds Per Hour of Observation at Both Sites

Date:	10/20 UP	11/02 UP	11/19 BFS	11/23 UP	11/30 BFS	12/13 UP	1/13 UP	1/15 BFS	1/19 UP
PBGR	0	0	0	0	0	0	0	0	0
GBHE	0.50	1.25	0	0.67	0	0.39	0.55	0	0.55
GREG	0	0.63	0	0	0	0.39	0	0	0
BCNH	0	0	0	0	0	0	0.55	0	0
DCCO	0	0	0	0	0	0	0	0	0
MALL	0	18.13	0	0	0	0.78	14.75	0	18.56
PINT	2.48	0	0	53.33	0	46.12	10.38	0	2.73
AMWI	0	0	0	0	0	0	0	0	0
RNDU	0	0	0	0	0	0	0	0	0
CANV	0	0	0	0	0	6.59	6.56	0	22.95
LESC	0	0	0	1.25	0	0	0	0	0
BUFF	0	0	16.00	5.33	2.13	2.33	2.73	0	1.64
RUDU	0	3.75	6.0	4.67	10.64	1.16	1.09	4.00	2.19
CITE	0	0	0	0	0	0	0	0	0
AMCO	0.50	0.63	10.00	7.33	14.89	5.43	4.37	8.00	5.46
KILL	22.77	25.00	0	18.67	0	0.78	3.28	0	4.37
SPSA	4.95	0	0	2.00	0	0	0	0	0
GRYE	1.98	0.63	0	0	0	0.39	0	0	0
LESA	0	0	0	0	0	0	10.93	0	8.20
SBDO	0	14.38	0	0	0	0	0	0	0
BNST	0	0.63	0	0	0	0	0	0	0
RBGU	0	0	0	3.33	0	23.64	0	0	0
BEKI	0	0	0	0	0	0	0	0	0.55

Continued

Table 4 (cont'd.)

Birds Per Hour of Observation at Both Sites

Date:	1/24 BFS	1/26 UP	2/01 UP	2/22 UP	2/25 BFS	3/02 UP	3/23 BFS	ALL BFS	DATES UP
PBGR	0	0	0	0	0	0	1.33	0.29	0
GBHE	0	0.80	1.00	0.59	0	0	0	0	0.59
GREG	0	0	0	0	0	0	0	0	0.12
BCNH	0	0.80	0	0	0	0	0	0	0.12
DCCO	0	0	0	0	0	3.0	0	0	0.29
MALL	4.00	36.00	0	0.59	0	6.99	0	0.74	8.78
PINT	0	2.40	0	1.18	0	1.80	0	0	13.89
AMWI	0	1.60	0	2.94	0	1.80	0	0	0.59
RNDU	2.00	0	0	0	0	49.70	0	0.37	4.89
CANV	0	0	0	0	0	0	0	0	4.18
LESC	0	0	2.00	42.94	0	0	0	0	4.48
BUFF	0	3.20	0	4.12	0	9.58	0	3.31	2.89
RUDU	16.00	1.60	1.00	2.94	18.00	0	5.33	9.22	1.77
CITE	0	0	0	21.18	4.0	11.98	1.33	0.87	3.30
AMCO	12.00	1.60	5.00	3.53	14.00	5.39	5.33	10.09	3.95
KILL	0	10.40	2.00	0	0	1.20	0	0	8.66
SPSA	0	0	0	0	0	0	0	0	0.77
GRYE	0	2.40	2.00	0	0	3.59	0	0	1.01
LESA	0	44.80	40.00	4.71	0	0	0	0	8.19
SBDO	0	10.40	0	0	0	0	0	0	2.12
BNST	0	0	0	0	0	0	0	0	0.06
RBGU	0	3.20	0	0.59	0	8.38	0	0	5.01
BEKI	0	0	0	0	0	0	0	0	0.06

Table 5

Percent Abundance of Plant Species of the BFS Lake Shoreline

Plant Species:	Total Shoreline Area:	Percent Shoreline Area:
Willow, *Salix lasiolepsis*	795 ± 45 m^2	37.1%
Cattail, *Typha latifolia*	735 ± 45 m^2	34.3%
Bulrush, *Scirpus acutus*	210 ± 45 m^2	9.8%
Laurel sumac, *Rhus laurina*	165 ± 45 m^2	7.7%
Wire-grass, *Juncus textilis*	45 ± 15 m^2	2.1%
White alder, *Alnus rhombifolia*	30 ± 15 m^2	1.4%
Baccharis emoryi	< 15 m^2	$<$ 0.7%
Bare ground	150 ± 45 m	7.0%

Total Shoreline Area: 2145 ± 100 m^2, arbitrarily chosen to include all area around the lake with plants that directly affect the lake, thus the width of this area varies with the nature of the vegetation, see Figure 1.

Table 6

Upland Lakes Vegetation Transect Results

Plant Species:	Relative Density	Relative Dominance	Relative Frequency	Importance Value
Bare ground	35.7%	80.0%	28.6%	144.3
<u>Brassica nigra</u>	36.8%	8.5%	28.6%	73.9
<u>Erodium cicutarium</u>	14.6%	7.8%	14.3%	36.7
<u>Gnaphalium palustre</u>	4.7%	0.4%	8.6%	13.7
Various grasses	7.6%	3.2%	17.1%	27.9
Unidentified small annuals	0.6%	.04%	2.9%	3.5

Definitions: Relative Density= $\frac{\text{total individuals of sp.}}{\text{total individuals of all spp.}}$ x 100

Relative Dominance= $\frac{\text{total interval length for sp.}}{\text{total interval lengths for all spp.}}$ x100

Relative Frequency= $\frac{\text{frequency value of sp.}}{\text{total frequency of all spp.}}$ x 100

Importance Value= relative density + relative dominance + relative frequency

Table 7

Chemical Analyses

	BFS Lake, 11/30/85	Upland Lakes, 11/23/85
Color, Forel-Ule Scale	3	4
pH	7.5	7.9
Alkalinity, ppm	114.0	62.5
PO_4^{-3}, mg/l	1.0	1.0
NO_3^{-1}, mg/l	.04	.36
CO_2, ppm	5.0	2.5
SiO_3, ppm	10.0	3.5
SO_4^{+2}, ppm	175.0	70.0
Ca^{+2}, mg/l	171.0	103.0
Mg^{+2}, mg/l	103.0	34.0
Total hardness, mg/l	274.0	137.0
Total dissolved solids, mg/l, $CaCO_3$	295.0, 3/20/86	50.0, 3/20/86

Table 8

Coppell Bird Census Data for the BFS Lake, 11/1979 to 5/1981

Species:	1979 Fall	1980 Jan	Feb	Mar	Apr	May	Summer	Oct	Nov	Dec	1981 Jan to April
EAGR	None seen on any date										
HOGR				M							
PBGR	R				R		R	R	R	R	R
GBHE					?			?			
GRHE					R		R	R		R	R
BCNH							?				
CAGU	None seen on any date										
MALL								M		M	M
AMWI								M	M	M	M
PINT	M									M	
AGWT											M
CITE											M
NOSH	M										
CANV									M	M	M
LESC									M	M	
BUFF		M	M						M		M
RUDU							M	M	M	M	M
RNDU	M							M		M	M
HOME									M	M	
OSPR	M										M
SORA											R
AMCO	R	R			R		R	R	R	R	R
KILL	R	R	R	R		R	R	R	R	R	R
COSN	?								?		?
GRYE				M					M	M	M
LEYE				M							M
RBGU	M		M		M						
SPSA							M				
SBDO					M						
BEKI	?		?	?			?	?	?	?	?

R= resident species; M= migrant species; ?= uncertain status;

Species not in Table 3: EAGR, Eared Grebe; HOGR, Horned Grebe; CAGU, California Gull; AGWT, American Green-Winged Teal; NOSH, Northern Shoveler; HOME, Hooded Merganser; OSPR, Osprey; SORA, Sora; COSN, Common Snipe; LEYE, Lesser Yellowlegs;

Data from Coppell, R. and K. Corey. 1981.

Table 9

Bird Census Data from Oglesby for the BFS Lake, Fall 1978 to Dec 1983

Species:	1978		1979			1980					1981		
	Fall	Mar	Fall	Jan	Feb	Fall	Feb	Apr	Nov	Dec	Fall	Jan	Feb
EAGR	P	P											
HOGR													
PBGR			P			P	P				P	P	
GBHE						P			P				
BCNH													
CAGU													
MALL													
AMWI						P			P	P			
PINT													
AGWT													
CITE													
NOSH													
CANV													
LESC			P		P								
BUFF			P	P									
RUDU	P	P	P		P	P			P	P	P	P	
RNDU						P	P		P	P			
HOME													
OSPR													
SORA											P		
AMCO	P		P						P	P	P	P	P
LESA	P												
KILL	P	P			P	P	P		P	P	P	P	P
COSN											P		
GRYE						P				P	P	P	
LEYE	P		P			P		P					
RBGU			P		P	P	P	P			P		
SPSA	P												
SBDO													
BEKI	P					P		P	P	P	P	P	
BNST										P			
GRHE						P		P	P	P	P	P	P

P= Present; Only months when censusing was done are included.

Data from Oglesby, 1983.
Species not in Tables 3 or 8: GRHE, Green Heron.

Continued

Table 9 (cont'd.)

Bird Census Data from Oglesby for the BFS Lake, Fall 1978 to Dec 1983

Species:	1981							1982						
	Apr	May	June	July	Aug	Sept	Nov	Jan	Feb	Mar	May	Oct	Nov	Dec
EAGR														
HOGR														
PBGR	P	P	P		P		P		P					
GBHE														
BCNH														P
CAGU									P					
MALL												P		
AMWI														
PINT														
AGWT														
CITE												P		
NOSH														
CANV														
LESC														
BUFF													P	
RUDU								P	P			P		
RNDU									P			P	P	
HOME														
OSPR														
SORA														
AMCO	P	P	P	P	P	P	P	P	P	P	P	P	P	P
LESA														
KILL	P	P			P				P	P				
COSN						P								
GRYE														
LEYE														
RBGU							P		P	P				P
SPSA														
SBDO														
BEKI												P		
GRHE	P		P	P	P	P	P	P	P	P	P	P	P	P

Continued

Table 9 (cont'd.)

Bird Census Data from Oglesby for the BFS Lake, Fall 1978 to Dec 1983

Species:	1983 Jan	Feb	Mar	Apr	May	June	Oct	Dec
DCCO								P
EAGR								
HOGR	P							
PBGR								
GBHE								
BCNH								
CAGU		P						
MALL		P	P		P		P	P
AMWI								P
PINT								P
AGWT								P
CITE								P
NOSH								P
CANV								
LESC							P	P
BUFF								
RUDU		P	P		P	P	P	P
RNDU								P
HOME								
OSPR								
SORA								
AMSO	P	P	P	P	P	P	P	P
LESA								
KILL			P		P		P	
COSN								
GRYE								
LEYE								
RBGU	P	P	P					P
SPSA								
SBDO								
BEKI								
GRHE	P	P	P		P		P	
CAEG								P

Species not in Tables 3 or 8: CAEG, Cattle Egret.

Appendix

Information on Bird Species in This Study

Fish-eaters

PBGR, Pied-Billed Grebe, *Podilymbus podiceps*

U.S. Range: Widely distributed throughout U.S., known to breed in Southern California. Resident or migrant here. 26 Egg dates in So. Cal. : April 23 to August 6.

Habitat: Prefers small, sheltered ponds and slow-moving streams with reeds or tall grasses along the shore.

Food: Largely animal matter such as small fish, snails, small frogs, tadpoles, aquatic worms, leeches, and water insects. Also takes seeds and soft parts of aquatic plants.

Behavior: Very awkward on dry land, thus spends little time out of water.

Reference: Bent, 1919, *Life Histories of North American Diving Birds*.

GBHE, Great Blue Heron, *Ardea herodias*

U.S. Range: Widely distributed throughout the U.S., known to breed in So. Cal. Migrant or resident here. Egg dates in So. Cal.: March 30 to May 30.

Habitat: Prefers water areas with cliffs and areas of open, muddy shore but clear water.

Food: Principally fishes of all kinds. Prefers to fish at night. Also takes lizards, snakes, small mammals, insects, crustaceans, and even small shorebirds (rails).

Behavior: Very wary of humans. "Hunts" fish by standing motionless in shallow water for extended periods of time or stalking fish in shallow water, then pouncing.

Reference: Bent, 1926, *Life Histories of North American Marsh Birds*.

Fish-eaters, cont'd.

GREG, Great Egret or Common Egret, Casmerodius albus

U.S. Range: Southern and Western U.S. only. Known to breed in So. Cal. Migrant or resident here.

Habitat: Prefers marshy shores of lakes or ponds.

Food: Largely small fishes. Also frogs, lizards, small snakes, mice, moles, crabs, snails, grasshoppers, and some vegetable matter.

Behavior: Uses bill to skewer fish when foraging.

Reference: Bent, 1926, Life Histories of North American Marsh Birds.

BCNH, Black-Crowned Night Heron, Nycticorax nycticorax

U.S. Range: Migratory, wintering in So. Cal., breeding as far north as Oregon.

Habitat: Marshes.

Food: Prefers fish and eels. Also takes salamanders, frogs, crustaceans, insects, mice, and even occasionally vegetable food: sea lettuce and algae. Will scavenge, taking dead fish and frogs.

Behavior: Forages mainly at night, dusk, and dawn. Active hunter, does not wait for prey. Spends daylight hours perched in tree near water, resting.

Reference: Bent, 1926, Life Histories of North American Marsh Birds.

DCCO, Double-Crested Cormorant, Phalacrocorax auritis

U.S. Range: Migratory along west coast.

Habitat: Found on inland lakes and rivers, but mainly on coast.

Food: Almost entirely fish. Dives to great depths to capture fish. Also takes eels and crabs.

DCCO, cont'd.

Behavior: Slow and heavy flight. Quiet at most times.

Reference: Bent, 1922, Life Histories of North American Petrels and Their Allies.

BEKI, Belted Kingfisher, Ceryle Alcyon

U.S. Range: Found throughout most of U.S. Resident in So. Cal. Egg dates in So. Cal.: April 7 to June 24, 16 records.

Habitat: Sea coasts, estuaries, lakes, and ponds. Perches on trees or other outlooks over water. Uses only areas with clear water.

Food: Fish, usually less than 6" long. When fish are not available, will take crustaceans, molluscs, toads, lizards, large insects, small rodents, and even young birds.

Behavior: Dives from overhanging perch into water to seize fish.

Reference: Bent, 1940, Life Histories of North American Cuckoos, Goatsuckers, Hummingbirds, and Their Allies. Part 1.

RBGU, Ring-Billed Gull, Larus delawarensis

U.S. Range: Found throughout U.S. Most widely distributed and common of the large gulls. Winters in So.Cal. then migrates north to Southern Canada to breed.

Habitat: Ubiquitous. Often frequents garbage dumps and garbage-ridden harbors.

Food: Scavenges. Will fish. Steals fish from other birds also. Captures insects and small rodents. Takes eggs of other species on breeding grounds. Picks through garbage for animal

Fish-eaters, cont'd.

RBGU, cont'd.

Food: matter.

Behavior: Disrupts other species by food stealing and destruction of eggs on breeding grounds. Highly gregarious, congregating in large flocks of its own species.

Reference: Bent, 1921, Life Histories of North American Gulls and Terns.

Dabblers

MALL, Mallard Duck, Anas Platyrhynchos

U.S. Range: Widely distributed throughout U.S. Winters in So. Cal. Migrates north to breed.

Habitat: Freshwater lakes and ponds, streams and swamps of interior, also feeds in grain fields.

Food: Vegetable matter accounts for 9/10 of food taken. In decreasing order of preference, these foods are taken: sedges, grasses, smartweeds, pondweeds, duckweeds, coontail, wild celery, water elms, hackberries, acorns, willow seeds, and bulrush. Animal matter eaten: some insects, crustaceans, molluscs, and very small fishes. Sometimes cultivated crops are eaten.

Behavior: Active and wary of humans. Feeds by tipping up, tail in air, head in water. Will dive only when threatened.

Reference: Bent, 1923, Life Histories of North American Wildfowl, Part 1.

PINT, Pintail, Anas acuta

U.S. Range: Winters in So. Cal., migrates north to breed, leaves

Dabblers, cont'd.

PINT, cont'd.

U.S. Range: earlier than most other waterfowl migrants, as early as late February.

Habitat: Freshwater lakes, ponds, streams, and marshes.

Food: Feeds on tender shoots and roots of aquatic plants at surface of water. Bent's stomach analysis showed vegetable matter to be 87.15% of the diet and found the following foods in decreasing order of abundance: pondweeds, sedges, grasses, smartweeds, arrow grass, muskgrass, other algae, arrowheads, water plantain, goosefoot, water lilies, duckweeds, water milfoil, and miscellaneous vegetable matter and grains. Animal matter: molluscs, crustaceans, and insects.

Behavior: Tips to feed. Usually flocks only with own species on migrations. Dives only when threatened.

Reference: Bent, 1923, Life Histories of North American Wildfowl, Part 1

AMWI, American Widgeon or Baldpate, Anas americana

U.S. Range: Winters in So. Cal. Breeds further north. Leaves So. Cal. in April usually.

Habitat: Freshwater lakes, ponds, streams, and marshes.

Food: Feeds by tipping at water's surface or in shallow mud. Takes 93.3% vegetable food (Bent 1923) in decreasing order of abundance: pondweeds, grasses, algae, sedges, wild celery, waterweed, milfoil, duckweeds, smartweeds, arrow grass, water lilies, coontail, and miscellaneous. Also takes snails and insects.

Behavior: Feeds by dabbling but is fond of roots of wild celery

<u>Dabblers</u>, cont'd.

AMWI, cont'd.

Behavior: which are easily obtained only by diving, thus associate with CANV, stealing roots they acquire by diving. Also steal from REDH, LESC, and AMCO exciting them. Not gregarious, travels in pairs or alone on migrations.

Reference: Bent, 1923, <u>Life Histories of North American Wildfowl, Part 1</u>.

CITE, Cinnamon Teal, <u>Anas cyanoptera</u>

U.S. Range: Confined to Western U.S. Winters and breeds in So. Cal. Short migration. Egg dates in So. Cal.: 37 records April 18 to July 14; 19 records May 14 to June 17.

Habitat: Prefers shallow ponds and overflowed areas rather than deep lakes.

Food: Feeds entirely above water, mostly on margins of ponds or even on banks. Bent's stomach analysis results: vegetable matter: 80% of diet, plant foods in decreasing order: seeds and other parts of sedges, seeds and other parts of pondweeds, grasses, smartweeds, mallows, goosefoot, milfoil, and miscellaneous. Animal matter: insects and molluscs.

Behavior: Rarely, if ever, dives. Makes summer homes in tule-bordered lakes and marshes with luxuriant vegetation in which it can hide if threatened. May breed in fields.

Reference: Bent, 1923, <u>Life Histories of North American Wildfowl, Part 1</u>.

Divers

RNDU, Ring-Necked Duck, Aythya collaris

U.S. Range: Inland U.S. Winters in interior of So. Cal., arriving in October, leaving in March.

Habitat: Freshwater marshes and sloughs preferred to open lakes and streams.

Food: Takes seeds of duckweed and pondweed, bulbs of water lily, seeds of burreed, bayberry, sawgrass, Vallisneria sp., Lymnobium sp., Ziziana sp., Piper sp., Elymus sp., Iris sp., Nymphaea sp., Myriophyllum sp., Callitriche sp., and Utricularia sp. But also takes high proportion of animal matter: minnows, small frogs, tadpoles, crawfish, snails, and insects.

Behavior: Will feed in shallow water but also dive for food, and can dive deep.

Reference: Bent, 1923, Life Histories of North American Wildfowl, Part 1.

CANV, Canvasback, Aythya vallisneria

U.S. Range: Throughout U.S. Winters just below frost line. Is an early returning migrant, leaving So. Cal. in early March.

Habitat: Lakes and marshy ponds, especially.

Food: Prefers wild celery (Vallisneria spiralis), also called eel-grass, to other plants. Takes roots of this plant by diving to obtain them. AMWI and AMCO may steal these roots from CANV. On inland lakes it must take other foods: other aquatic plants, wild oats, grains, water lily seeds, lotus seeds, small fishes, crustaceans, molluscs, and insects and their larvae.

Divers, cont'd.

CANV, cont'd.

Behavior: Expert diver. Can obtain food at depths down to 30 feet.

Reference: Bent, 1923, Life Histories of North American Wildfowl, Part 1.

LESC, Lesser Scaup, *Aythya affinis*

U.S. Range: Essentially inland. Winters in So. Cal., leaving in late February or March to breed further north.

Habitat: Feeds almost wholly in freshwater. Prefers open lakes. Will also feed in grain fields.

Food: Vegetable: seeds of burreed, bayberry, sawgrass, *Vallisneria* sp., *Lymnobium* sp., *Ziziana* sp., *Piper* sp., *Elymus* sp., *Iris* sp., *Nuphar* sp., *Nymphaea* sp., *Myriophyllum* sp., *Callitriche* sp., and *Utricularia* sp. Animal: small fry and fish spawn, tadpoles, pond snails, worms, crawfish, aquatic insects and their larvae, and ants.

Behavior: Expert diver. Can remain submerged for long periods of time foraging on bottom for food. Often migrates and feeds in large flocks.

Reference: Bent, 1923, Life Histories of North American Wildfowl, Part 1.

BUFF, Bufflehead, *Bucephala albeola*

U.S. Range: Winters in So. Cal., breeds in Canada. Leaves So. Cal. in February or March, returning in October or November. One of the later migrants of the ducks.

Habitat: Variety of lakes, ponds, streams, and seacoast habitats.

Divers, cont'd.

BUFF, cont'd.

Food: Mostly animal: small fish, shellfish, crayfish, snails, leeches, and grasshoppers. Some vegetable matter: grasses, *Lymnobium* sp., *Myriophyllum* sp., *Callitriche* sp., *Utricularia* sp., and *Pontederia* sp. Usually only takes vegetable matter during the summer.

Behavior: Travels in small irregular flocks, feeds together by diving to catch fish or probing bottom for shellfish. Can swim swiftly enough underwater to catch small fish. Excellent diver.

Reference: Bent, 1923, *Life Histories of North American Wildfowl Part 2*.

RUDU, Ruddy Duck, *Oxyura jamaicensis*

U.S. Range: Winters and breeds in So. Cal. Egg dates: 30 records, April 26 to August 11, 15 records, May 22 to June 10.

Habitat: Prefers breeding/courtship grounds on quiet, sheltered ponds surrounded by cattails. Has been known to utilize abandoned coot nests.

Food: Obtains most food on lake bottoms, takes mostly vegetable food. In inland ponds feeds on: seeds, roots, and stems of grasses; bulbs and leaves of aquatic plants such as cattails, teal moss, wild rice, pond lilies, duckweed, and rye. Also eats animal matter: small fishes, slugs, snails, mussels, larvae, fish spawn, worms, and insects.

Behavior: Flying, swimming, and diving habits resemble those of grebes more than those of any other American ducks.

Reference: Bent, 1923, *Life Histories of North American Wildfowl Part 2.*

Coots

AMCO, American Coot, Fulica americana

U.S. Range: Widely distributed throughout U.S. Breed everywhere except Eastern U.S. Resident in So. Cal. So. Cal. egg dates: April 11 to August 2.

Habitat: Prefers to nest in bulrushes or cattails around the borders of sloughs or marshy ponds.

Food: Omnivorous. Takes leaves, fronds, seeds, and roots of aquatic vegetation, mainly. Obtains much of its food by diving to moderate depths. Prefers wild celery which it may steal from diving ducks such as CANV. Eats grain. Also eats algae.

Animal food: small fishes, tadpoles, snails, worms, water bugs, other insects, and their aquatic larvae. Has been seen eating dead vertebrates, such as ducks.

Behavior: Often makes noise by flying low enough over water to splash, may use this behavior to frighten away enemies or warn other birds to keep their distance. Good diver. Will walk on land.

Reference: Bent, 1926, Life Histories of North American Marsh Birds.

Shorebirds

KILL, Killdeer, Charadrius vociferus

U.S. Range: Resident in So. Cal. Most widely distributed and best known shorebird. So. Cal. egg dates: 73 records, March 15 to July 2.

Habitat: Frequent at all sorts of water areas. Also found occasionally in dry uplands many miles from water. Nests in open

Shorebirds, cont'd.

KILL, cont'd.

Habitat: pastures, meadows, cultivated fields, and on bare, gravelly ground.

Food: According to stomach analysis by Bent, 97.72% was insect and other animal matter. In decreasing order of abundance: beetles, grasshoppers, caterpillars, ants, bugs, caddis-flies, dragonflies, two-winged flies, centipedes, spiders, ticks, oysterworms, earthworms, snails, crabs, crayfish, and other crustaceans. Small amount of weed seeds are taken.

Behavior: Has unusual habit of alternately running then standing still when feeding.

Reference: Bent, 1927, Life Histories of North American Shorebirds Part 2.

SPSA, Spotted Sandpiper, *Actitis macularia*

U.S. Range: Widely distributed throughout the U.S. Breeds in So. Cal. mountains, or may only winter there. So. Cal. egg dates: June 7 to July 7.

Habitat: When inland, prefers margins of sandy ponds, sluggish meadow streams, and rushing mountain streams. In agricultural areas, may wander into meadows, fields, and gardens.

Food: Chiefly insects of all sorts, aquatic and terrestrial. Can even capture them on the wing.

Behavior: When alarmed will fly in semicircular course, often then heading back to original location. Can swim and even dive in an emergency.

Shorebirds, cont'd.

SPSA, cont'd.

Reference: Bent, 1927, Life Histories of North American Shorebirds, Part 2.

GRYE, Greater Yellowlegs, *Tringa melanoleuca*

U.S. Range: Migratory through So. Cal., winters there. Leaves in April.

Habitat: Prefers shallow water to feed in.

Food: Small minnows, mainly, and water insects. Occasionally feeds in damp, grassy meadows on insects or their larvae, snails, worms, and crustaceans.

Behavior: Swift, strong flight. Associates well with other shorebirds and ducks, often seen with teals, which also feed in shallow water.

Reference: Bent, 1927, Life Histories of North American Shorebirds Part 1.

LESA, Least Sandpiper, *Calidris minutilla*

U.S. Range: Found throughout the U.S. Winters in So. Cal., breeds in northern Cal. and up to Alaska.

Habitat: Prefers mudflats, marshes, and damp grassy areas.

Food: In marshes takes insects and their larvae. On beaches takes small crustaceans and worms.

Behavior: Gregarious, collecting in flocks and mixing sociably with all other shorebirds.

Reference: Bent, 1927, Life Histories of North American Shorebirds Part 1.

<u>Shorebirds</u>, cont'd.

SBDO, Short-Billed Dowitcher, *Limnodromus griseus*

U.S. Range: Widely distributed throughout the U.S. Resident in So. Cal.

Habitat: Preferred feeding areas are mudflats and sandflats in protected bays and estuaries, or edges of shallow ponds and marshes.

Food: Probes bill quickly in mud, sand, or shallow water to capture grasshoppers, beetles, flies, maggots, marine worms, oyster-worms, leeches, water bugs, fish eggs, small molluscs, seeds of aquatic plants, and roots of eelgrass.

Behavior: Usually travels in compact flocks of only its species. Skilled at swimming, does so only if necessary, and is partially web-footed.

Reference: Bent, 1927, *Life Histories of North American Shorebirds, Part 1*.

BNST, Black-Necked Stilt, *Himantopus mexicanus*

U.S. Range: Found throughout U.S. Resident in So. Cal.

Habitat: Prefers freshwater bodies with muddy shores and shallow water areas.

Food: Insects, mainly aquatic bugs and beetles. Also eats dragon-fly nymphs, caddisflies, mayfly nymphs, flies, billbugs, mosquito larvae, grasshoppers, crayfish, snails, tiny fishes, and a few seeds of aquatic and marsh plants.

Behavior: Is a very specialized wader. Also can swim and even dive if threatened, but is very awkward at both.

Reference: Bent, 1927, *Life Histories of North American Shorebirds, Part 1*.

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