# FINAL REPORT ON AN ELECTROSHOCKING FISHERIES INVESTIGATION IN THREE WATER BODIES ON NAVAL AIR STATION, JACKSONVILLE, FLORIDA

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## INTRODUCTION

Environmental Consulting & Technology, Inc. (ECT) was contracted to collect fisheries specimens from within three separate water bodies on the property of Naval Air Station (NAS) Jacksonville. Casa Linda Lake designated as surface water station 1 (SW-1, see Figure 1), Lake Scotlis designated as SW-2, and a lagoon system referred to as the Polishing Pond designated SW-3. Fisheries sampling was performed to obtain tissue samples for laboratory analysis to detect the presence of contaminants. Specimens were to be obtained from within three separate trophic levels representing the top-predator piscivores, the middle level omnivores and the lower level foraging species which feed primarily upon phytoplankton, vegetation or detritus. The total sample size per species group was to equal or exceed 600 grams (gms) from each water body. Electroshocking was the principal methodology for sample collection, augmented as necessary utilizing dipnets and seines. The physical characteristics of each water body were evaluated concurrent with fisheries sample collection.

## METHODOLOGY

For fisheries sample collection ECT utilized an aluminum hulled "Jon-boat" equipped with a Honda 240 volt generator and a Smith-Root® Electrofisher. For fisheries population surveys and small-size sample collection, ECT utilizes direct current (DC) voltage. The reaction of fish to direct current is to turn and swim toward the anode (extended copper probes), a reaction referred to as galvanotaxis (Smith-Root, Inc.). Eventually the fish becomes incapable of further forward movement and turns on its side, a reaction known as galvanonarcosis. Larger fish (within a species group) are stunned at a greater distance from the field than small fish, since the effect increases proportionally with surface area. Small fish often reach, or nearly reach the anode prior to experiencing galvanonarcosis. Differences between species are related to the conductivity of the fish being compared. Electrofishing current will most greatly affect fish with conductivities at or above the ambient conductivity. Aquatic species

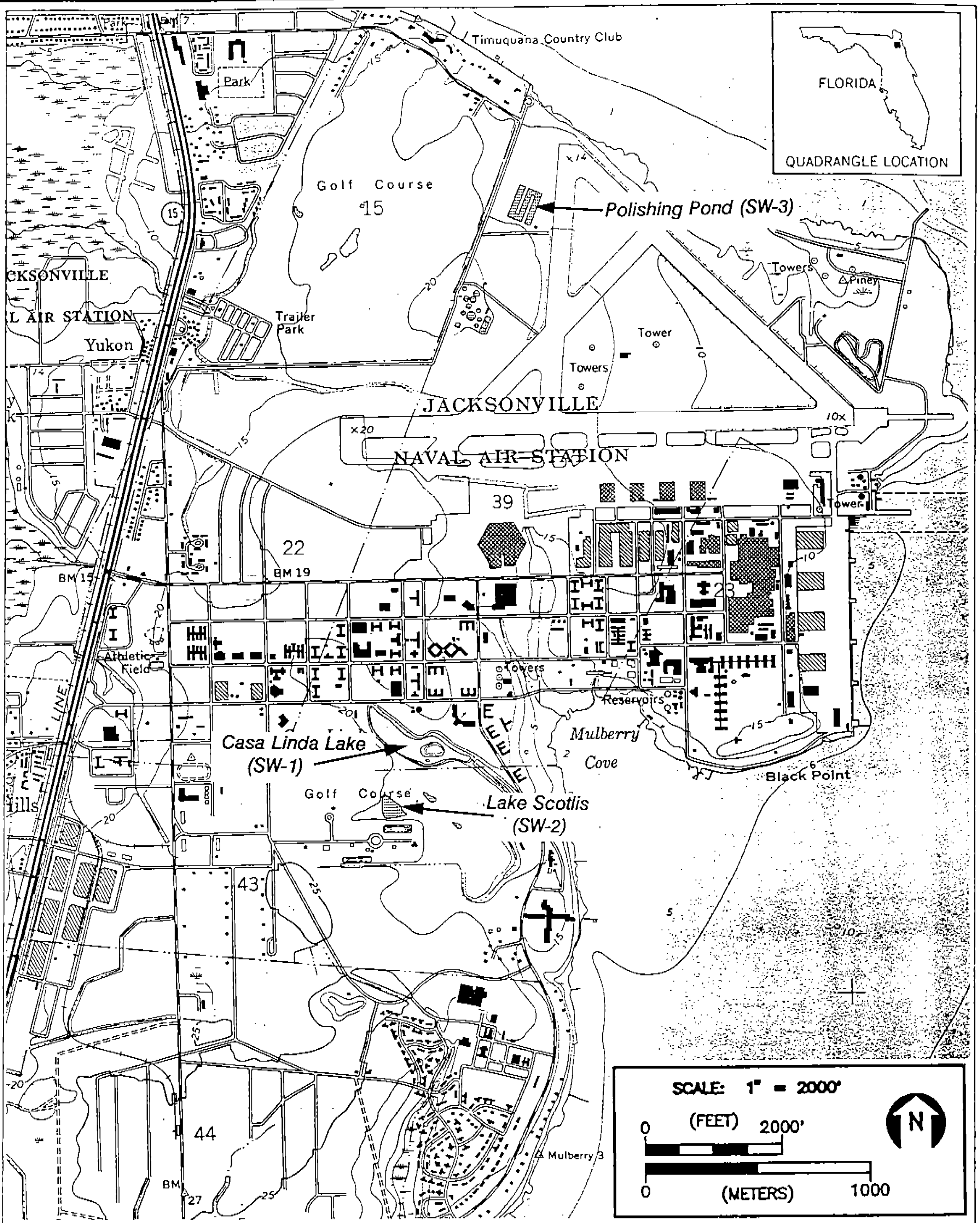


FIGURE 1.
PROJECT LOCATION MAP
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA
Source: USGS Quad. Orange Park, Fl. Rev. 1981; ECT, 1993.

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which have conductivity values well below the ambient value can be missed as the current selectively travels through the more conductive water (Smith-Root, Inc.). However, species adapted to freshwater habitat almost always have much greater solute concentrations (and thus conductivity) than their environment, to the extent that energy is expended in either active salt uptake or excessive urination (Hainsworth, 1981). A rare exception to this rule occurs in the lamellibranch species Anodontia, a freshwater bivalve (Potts and Parry, 1963). In addition to the previously mentioned enhanced susceptibility of larger specimens, ECT personnel have observed that species which typically inhabit the lower end of the water column (e.g., gars, catfish, and carp) are the most greatly affected by any given field. These observations have been confirmed in conversation with other experienced electrofishers. This may be due to a higher natural density per unit volume (and thus conductivity) associated with bottom dwelling.

The physical characteristics of the water bodies were measured with a Hydrolab® Surveyor II which was calibrated each morning before sampling.

Prior to obtaining the requisite specimens, electrofishing was conducted in each water body to determine the most productive locations and to select the appropriate species to represent the respective trophic levels. Once collected, specimens were identified to the level of genus and species, wrapped whole in aluminum foil, placed in labelled Ziploc® bags, and then stored on dry ice. Once hard-frozen, the fish samples were transferred to coolers containing wet ice for transport to a laboratory facility within 24 hours of collection.

## RESULTS

### Casa Linda Lake

Casa Linda Lake (SW-1) is an approximately 8.9 acre lake with highly altered shorelines, receiving drainage from surrounding golf course, multi-family residential, and office-complex land use. The northern shoreline is maintained lawn with a canopy of secondary growth mixed-oak hardwoods and occasional wax myrtle (Myrica cerifera) shrubbery. A sharp dropoff at the water's edge precludes emergent vegetation except in the northeastern corner. Along the northeastern shoreline, a limited emergent flora includes duck potato (Sagittaria latifolia) and penny wort (Hydrocotyle umbellata). The southern shoreline is more heavily vegetated in wax myrtle and Carolina willow (Salix caroliniana), which tend to protrude into the lake. A sharp drop in the shoreline limits aquatic emergent vegetation along most of the southern shoreline. Exceptions occur in the southeastern corner of the lake where a small island abuts the shoreline and bridging for golf cart access and other fill provide a substrate for aquatic emergents dominated by penny wort.

The physical characteristics of Casa Linda Lake during sample collection were evaluated February 3, 1993 (see Figure 2), with measurements being recorded at approximately 1.5 feet (ft) of depth.

Utilization of Casa Linda Lake by aquatic avifauna was low. This may result from the combination of an abundance of human disturbance as well as the sharply sloping shoreline. A great blue heron (Ardea herodias) was observed foraging along the northern shore, and double-crested cormorants (Phalacrocorax auritus) were occasionally observed feeding within the lake.

Fisheries species diversity appeared to be low during sample collection and the assemblage observed did not include any species which are not frequently stocked into lakes to improve recreational fishing. Foraging species observed within the lower trophic level included gizzard shad (Dorosoma cepedianum), the exotic grass carp (Ctenopharyngodon idella), and golden shiners (Notemigonus crysoleucas). The Florida Game and Freshwater Fish Commission (FGFWFC, 1992) observed mosquitofish (Gambusia affinis) during a December 1992 electroshocking event;

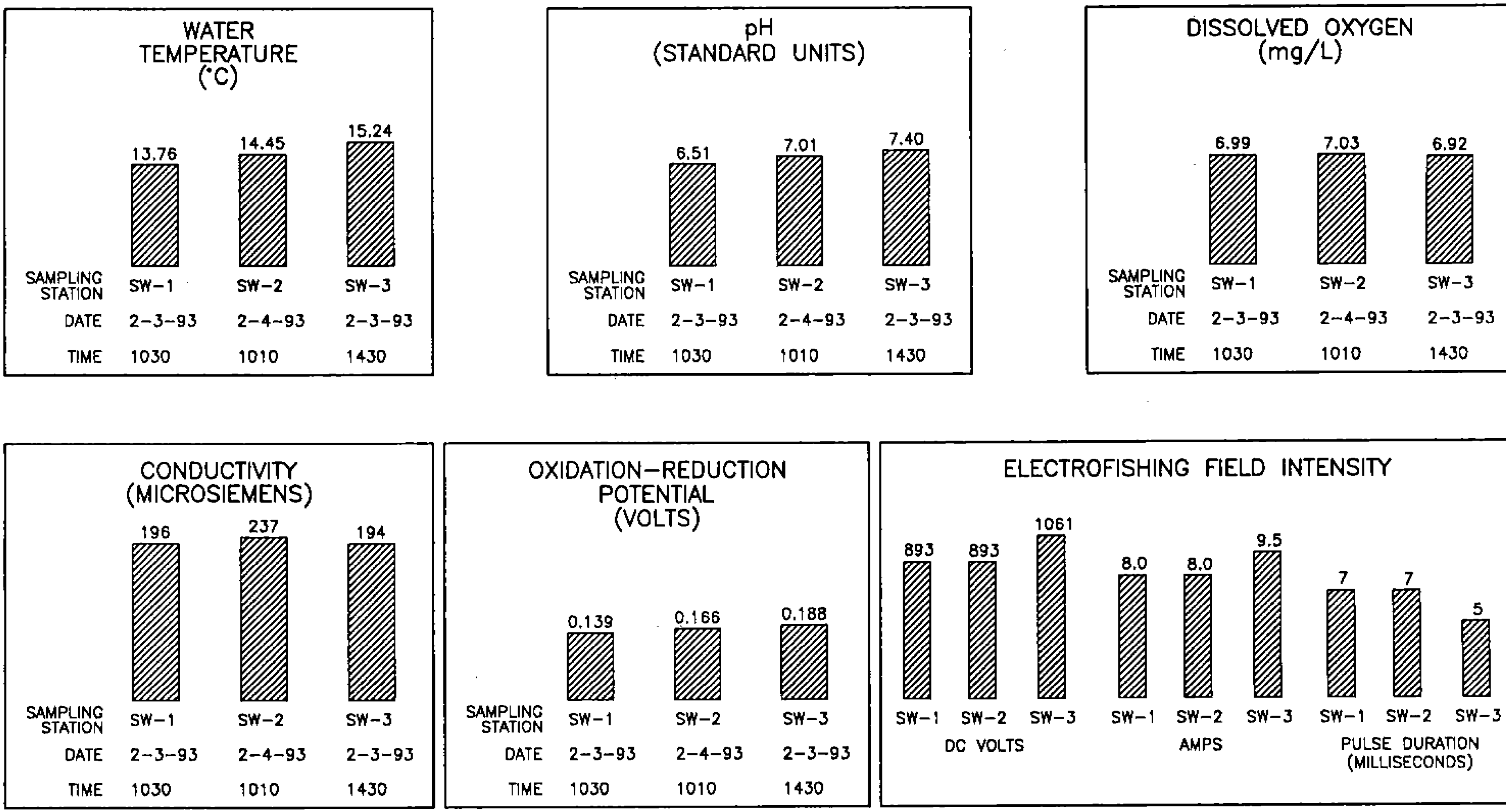


FIGURE 2
PHYSICAL CHARACTERISTICS OF THE WATER IN CASA LINDA LAKE (SW-1), LAKE SCOTLIS (SW-2) AND THE POLISHING POND (SW-3)
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA
Source: ECT, 1993.

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however, none were observed during this sampling event. Omnivorous species included numerous bluegills (Lepomis macrochirus), and warmouth (Lepomis gulosus), as well as occasional redear (Lepomis microlophus) and redbreast (Lepomis auritus) sunfish. Top predators observed were numerous largemouth bass (Micropterus salmoides). The focus of ECT's fisheries sampling effort was to obtain specific quantities of specific species groups, rather than qualitative and quantitative population assessments. In general, ECT's investigation yielded similar results to those documented by the FGFWFC in December 1992. Bluegills were the most frequently observed species during electrofishing and largemouth bass were reasonably abundant. Largemouth bass were also frequently large, with the most sizeable individual weighing nearly 3 kilograms (kg). ECT recovered much greater numbers of golden shiners than were obtained by the FGFWFC; however, the FGFWFC was attempting to standardize fishing effort throughout the lake for quantitative sampling, whereas ECT was specifically targeting golden shiners. Species selected to represent the three trophic levels in Casa Linda Lake were the golden shiner (forager), the bluegill (omnivore), and largemouth bass (piscivore). The collected golden shiners were young of year and generally less than 5 centimeters (cm) in length (see Table 1). Collected bluegills were also young of year and varied between 6 and 12 cm in length Largemouth bass were only included if they were less than 24 cm so that several individuals would comprise the desire 600 gms sample size.

## Lake Scotlis

Lake Scotlis (SW-2) is a small (approximately 1.3 acre) lake within a secondary growth pine flatwood community. Shoreline vegetation includes wax myrtle and Carolina willow, which are particularly dense along the western edge. The eastern shore has some limited emergent vegetation comprising sedges (Carex sp.) and pennywort. The northeastern and southeastern corners of the lake have a mixture

Table 1. Fish Species and Approximate Size Ranges for Samples Collected From Three Water Bodies on Naval Air Station, Jacksonville, Florida

| | Foraging Species | Size Range | Omnivorous Species | Size Range | Piscivorous Species | Size Range |
|---|---|---|---|---|---|---|
| Casa Linda Lake (SW-1) | Golden Shiner<br>Notemigonus crysoleucas | <5 cm | Bluegill<br>Lepomis macrochirus | 6 to 12 cm | Largemouth Bass<br>Micropterus salmoides | <24 cm |
| Lake Scotlis (SW-2) | Gizzard Shad<br>Dorosoma cepedianum | 20 cm | Bluegill<br>Lepomis macrochirus | 6 cm | Largemouth Bass<br>Micropterus salmoides | 12 to 18 cm |
| Polishing Pond (SW-3) | None Collected | N/A | None Collected | N/A | None Collected | N/A |

Source: ECT, February 1993.

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of wax myrtle and Carolina willow stands with an understory of emergent species; these areas were particularly rich in young omnivore species.

The physical characteristics of Lake Scotlis during sampling were evaluated on February 4, 1993, with measurements being taken at approximately 1.5 ft of depth (see Figure 2).

There was no observed utilization of Lake Scotlis by aquatic avifauna. The western and southern shorelines drop sharply, limiting access by wading birds. The eastern shore completing the triangular lake is more gradually sloped, but was continually disturbed by the presence and movement of joggers and recreational fishermen during sampling. In addition to these factors, the noise of the electroshocking boat's outboard motor and generator probably kept avifauna at a distance.

The fisheries species composition in Lake Scotlis was nearly identical to that of Casa Linda Lake. Notable exceptions were the absence of golden shiners or grass carp in the foraging group. The FGFWFC discuss catfish stocking in their December 1992 report, but none were recorded as observed by them and catfish were not observed during this sampling event. ECT and the FGFWFC observed similar numbers and sizes of fish in Lake Scotlis. Bluegills were the most abundant, and were mostly quite small; largemouth bass were frequently observed, but were smaller on average than those found in Casa Linda Lake; gizzard shad were infrequently encountered by ECT, but when found were much more numerous than they were in December 1992. Species selected for analysis were gizzard shad (forager), bluegills (omnivore) and largemouth bass (piscivore). Collected gizzard shad were approximately 20 cm in length (see Table 1), bluegills were mostly near 6 cm in length, and largemouth bass ranged from 12 to 18 cm in length.

## Polishing Pond

The Polishing Pond (SW-3) is a medium sized (approximately 3.8 acre) meandering lagoon which receives drainage from flatwoods, maintained grassy fields near the flightline, and formerly through an outfall from a wastewater treatment system. The lagoon discharges to a treatment facility at its northwestern end, with an approximately 1,000 ft path length from the pipe at the former wastewater treatment outfall. Upon reaching the end of the lagoon's treatment facility, water discharges to the St. John's River. Vegetation within the lagoon is sodded bank to the shoreline, with a sparse emergent zone of sedges and pennywort. There are occasional shrubby emergents within the lagoons including Carolina willow and the stems of apparently dead shrubs that may be over-wintering or herbicided primrose willow (Ludwigia sp.).

The physical characteristics of the Polishing Poind during sampling were evaluated on February 3, 1993, with measurements taken at approximately 2 ft of depth (see Figure 2).

An abundant aquatic avifauna utilizes the lagoon system, primarily concentrated in the north-central portion near a small stand of Carolina willow. Observed species include the great egret (Casmerodius albus) and white ibis (Eudocimus albus) roosting in the shrubs, as well as laughing gulls (Larus atricilla) and ring-billed gulls (Larus delawarenis) paddling on the surface of the lagoon. Also abundant throughout the lagoon are nutrias (Myocastor coypus), which could be observed swimming and foraging along the banks. These mammals were introduced to North America for the fur trade, but have escaped and become naturalized throughout the southeast.

No fish species were observed within the Polishing Pond. The shoreline was walked with a dipnet and no small minnows of any sort were observed in the shallow grassy edge. Electroshocking was attempted throughout the lagoon, up to maximum field intensity (1,061 volts, 9.5 amps), and no stunned fish appeared at the surface. The water depth in the Polishing Pond appeared to be an average of 4 ft so it is unlikely that fish were able to escape the field at depth. A 110 ft seine (2 cm mesh) was dragged through the southwestern corner of the lagoon two times; no fish were trapped or observed escaping. The seine frequently snagged on the submerged stems of the dead or overwintering shrubs, allowing for the possibility of escape beneath the lead line.

## DISCUSSION

As we previously noted, species diversity was low in both Casa Linda Lake and Lake Scotlis. Those species which were present are those which are commonly stocked into water bodies to enhance recreational fishing or, in the case of the grass carp, control the aquatic vegetation growth response due to the runoff of fertilizer from the surrounding lawns and golf course. Particularly noticeable by their absence were Florida spotted gars (Lepisosteus platyrhynchus) and minnows other than golden shiners. It would be reasonable to conclude that neither water body has, nor perhaps has ever had a natural fishery. One explanation for this condition, may be that neither lake ever existed as a natural lake previously. These lakes may have developed as a result of excavation or damming within uplands, or within wetlands which were only seasonally flooded historically. It is common for fisheries to develop in entirely artificial water bodies. This can occur when transient wading birds inoculate the new lakes with fish eggs that become attached to their legs during visits to lakes which have existing fisheries. The fisheries within Casa Linda Lake and Lake Scotlis may have developed in this manner, but the dominance of popular gamefish suggests that this has not been the case. The fisheries community in both lakes most likely represents the result of purposely stocking these lakes with a community that will support a recreational fishery.

The apparent absence of any fishery in the Polishing Pond is not surprising given the obvious unnatural shape, origin, and function of the system. However, it is extremely unusual for a water body that has existed for a long time (as the Polishing Pond presumably has), to have no fish species of any sort observed. The Polishing Pond supports some vegetation and provides habitat for birds and mammals which associate closely with the lagoon. However, neither the birds nor the mammals are entirely aquatic. Entirely aquatic invertebrates (e.g., creeping waterbug, Ambrysus femoratus) were observed swimming in the lagoon. In the absence of specific sediment and surface water quality data no conclusions can be reached which may explain the apparent absence of any fisheries.

During the collection of samples from Casa Linda Lake and Lake Scotlis, fish specimens were observed to have skin lesions. These lesions were observed in various locations on the body, although they were most frequently found on the lateral or ventral surfaces. Lesions were observed most frequently on the omnivores and piscivores; this is most likely because omnivore and piscivores were the most frequently encountered species. Lesions were more frequently observed on fish collected from Casa Linda Lake than they were on those from Lake Scotlis.

A review of the literature available on fisheries pathology suggests that the lesions are a manifestation of Ulcerative Disease Syndrome (UDS). The most likely causative agent is the bacterium Aeromonas hydrophila. This bacterium appears in the blood of both diseased and undiseased fish, and may be a normal part of the fish's flora (McGarey, 1991). Numerous causative agents may be implicated in UDS, including nematodes, fungi, and Vibrio viruses. However, in low salinity or freshwaters the density of Aeromonas hydrophila is greatest (Hazen J.C., *et al.* 1978). The related bacterium Aeromonas sobria also occurs in freshwater and also has been documented as causing UDS at a control temperature of 30 degrees Celsius (°C). However, at lower temperatures (down to 10°C), only Aeromonas hydrophila continued to produce the hemolysin associated with UDS, a value much closer to the water temperature in either lake (Olivier, G.R., *et al.* 1981). The disease may not be associated with water temperatures below 9.4°C (Austin and Austin, 1987; Gronberg, W.H., *et al.* 1978).

Although both species of Aeromonas have been recovered from fish samples near NAS Jacksonville throughout the year, UDS occurs almost exclusively in the winter months (December through March) (McGarey, 1991). The presence of the bacteria in the blood of healthy fish over a widely distributed geographical area indicates that the bacteria (or other biological pathogens) by themselves are not responsible for the increase in reported UDS outbreaks. Ongoing investigations are examining the roles of heavy metals and organic loads in either debilitating fish from combating infections, or the triggering of latent infectious agents causing an outbreak (Sinderman, C.J., 1990).

ECT is currently recommending against the consumption of fish exhibiting UDS. Minimization of risks is achieved through avoiding consumption of fish during the previously mentioned winter months; although the bacteria appears in the blood of both healthy and diseased fish year round, except during the winter the bacterium may not be present in the fillet tissue. Alternatively, recreational fishermen may be advised to thoroughly cook any fish to kill any bacteria present before consumption. ECT recommends that some management of the fishery from this perspective be implemented since consumption of fish may expose humans to the bacterium (Potter and Baker, 1961), and an exposure to Aeromonas hydrophila can cause a variety of illnesses including gastroenteritis, diarrhea, bacteremia, and wound infections (Dahle and Nordstogg, 1968; Janda and Duffey, 1988; von Graevenitz and mensch, 1978; and Weinstock *et al.* 1982).

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