FISH SURVEY OF BALLONA WETLANDS

Areas B and D
of the
Playa Vista Project

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INTRODUCTION

Ballona Wetlands is a remnant salt marsh on Santa Monica Bay that has been highly modified by humans activities. Yet, it is the largest coastal wetland system remaining in Los Angeles County. There is an extensive system of relic diked tidal sloughs running throughout the salt marsh (Figure 1). These sloughs have had very restricted tidal flushing for over 60 years, since tide gates were installed which greatly restrict seawater access from Ballona Channel.

As part of the Playa Vista Project, Maguire Thomas Partners is planning to restore the wetland by modifying the openings to the ocean, via Ballona Channel, and restoring either mid-tidal (partial) or full-tidal flushing.

The purpose of this study is to survey the fishes in the relic diked tidal sloughs, channels, and Centinela Ditch on a quarterly basis and, thereby, to determine the current status of the estuarine fish community in Ballona Wetlands. Coastal sloughs, small lagoons and tidal creeks of Southern California have been studied infrequently and their community structure is poorly know. Larger bays and lagoons have been characterized and their fish communities studied to varying extents; e.g. Anaheim Bay (Lane and Hill 1977), Mugu Lagoon (Onuf and Quammen 1983, Onuf 1987), Newport Bay (Allen 1980, 1983, Horn and Allen 1981), and Tijuana Estuary (Zedler 1977, 1982, Zedler and Nordsby 1986). The fish communities of two small lagoons on the coast of Los Angeles County have been characterized, e.g. Alamitos Bay (Allen and Horn 1975) and Malibu Lagoon (Soltz 1986). None of these habitats have small relict sloughs similar to those in Ballona Wetlands. However, Swift (1981) conducted an extensive monthly survey of fishes in the sloughs and channels throughout Ballona Wetlands.

The study by Swift (1981) provides an excellent baseline for the present study of the fishes of Ballona Wetlands. The present study was funded for only 4 quarterly samples from Summer 1990 through Spring 1991, whereas the previous study sampled fishes monthly for a full year. It should be noted that one of the large tide gates was broken during the entire Swift (1981) study allowing considerably more tidal flushing (not directly measured by Swift,1981), and therefore access for fishes and their eggs and larvae, than during this study. The tide gate was repaired in 1982 (S. Lockhart, pers. comm.) and, although occasionally propped partially open by vandals, greatly restricted the flushing and tidal range in the remnant sloughs throughout the present study. The tidal range in the sloughs never exceeded one meter and diminished considerably with distance from Ballona Channel during the study period (Boland and Zedler 1991).

This study characterizes the fish community in the relic sloughs and channels of Ballona Wetland during an extended period of highly restricted tidal flushing. The baseline study (Swift

1981), in contrast, was conducted during a period of less restricted flushing because of the broken flap gate. The conditions present in 1980-81 were an exception to the 60 year history of Ballona Wetlands since the installation of tide gates into Ballona Channel.

PROJECT AREA

The proposed Playa Vista project site has been divided into four areas. Only two of the areas, Area B and D, contain sufficient water to support fishes.

Area B

Area B is bounded by the Ballona Channel to the north, the community of Playa del Rey to the West, the Playa del Rey Bluffs to the south and Lincoln Boulevard to the east. Centinela Ditch enters the area from Area D and continues along the base of the Playa del Rey Bluffs to merge with the relict slough system. Jefferson Drain empties into the area southeast of the Jefferson/Culver Boulevards intersection. These two drainages provide most of the freshwater, with some additional urban runoff coming from the Playa del Rey Bluffs, entering the wetlands.

Ballona Wetlands, the largest contiguous wetland remaining in Los Angeles County, is entirely within Area A. The main tidal channels into the wetland have been cut-off from full tidal flows for approximately 60 years by four tide gates in the south levee of the Ballona Channel. Tidal range has been reduced by over 60% (Boland and Zedler 1991) and saltwater entry is almost entirely from leakage around the flap gates. Therefore, access for fishes, fish eggs and larvae is also greatly reduced. Salinity of the water in the tidal channels near the tide gates is approximately that of seawater (30 to 35 ppt). The wetlands north and south of Culver Boulevard are linked by two culverts under the roadway. The channels south of Culver Boulevard vary from freshwater to hypersaline (e.g. 0 to 40 ppt) depending upon season and amount of urban runoff, principally form the Jefferson Drain.

Area D

Area D is bounded by Lincoln Boulevard to the west, the Westchester Bluffs to the south, commercial/industrial parcels to the east and Jefferson Boulevard and the Ballona Channel to the north. It is the most developed of the four areas. Centinela Ditch, the channelized remnant of Centinela Creek, runs along the bluffs in the southwestern portion of the area. Centinela Ditch is an intermittent freshwater stream carrying urban runoff.

METHODS

The 13 sampling stations in Area B used by Swift (1981) were visually surveyed and dipnet sampled in July 1990. The 3 stations on Centinela Ditch upstream of station 10 (nos. 11-13) were dry. The other 2 stations south of Culver Boulevard were so choked with emergent vegetation that there was no open water. Therefore, only station 10 was sampled in the relatively non-tidal area of the salt marsh south of Culver Boulevard. Two of the 7 stations north of Culver Boulevard were not sampled in this study. Station 5 was excluded because it was not flooded on a +4.1 ft high time in July 1990. Station 2 was so shallow, algae filled and warm (32.4 C) that it contained only a few mosquitofish (Gambusia afffinis) and California killifish (Fundulus parvipinnis). Stations 1, 3, 4, 6 and 7 were considered appropriate for characterizing the remnant tidal sloughs north of Culver Boulevard. Station 7 was a deeper hole at the end of the culvert under Culver Boulevard along the ditch originating at the Jefferson Drain. The other stations were relatively shallow remnant sloughs characteristic of the wetland. In summary, we conducted quarterly samples of 6 of the 13 stations sampled in the Swift (1981) fish survey of Ballona Wetland (Figure 1). One (no. 10) was in the upper salt marsh south of Culver Boulevard. Six (nos. 1, 3, 4, 6 and 7) were in the remnant tidal sloughs north of Culver Boulevard.

Each of the six stations were 25 m long and were sampled with the following protocol:

Salinity (in parts per thousand with a refractometer), temperature and dissolved oxygen (in mg/liter with a YSI Oxygen meter) of 3 surface samples were taken at two locations with in the 25 m station and averaged.

Fish sampling -- Both ends of the 25 m long stations were blocked with a 3.2 mm mesh seine. Four hauls of the entire length of the channel were taken and the fish collected from each haul were processed separately. Typically the first 2 hauls were with a 10 x 1.8 m, 6.3 mm mesh seine that spanned the entire channel. The second 2 hauls were with a 5 x 1.8 m, 3.2 mm mesh seine that did not span the channel at the wider stations (nos. 3 and 4). When appropriate only 2 hauls were taken with the smaller net from the narrower and/or shallower stations (e.g. nos. 6, 7, and 10). Most collections were made within 2 1/2 hours of low time, however, water level usually did not fluctuate more than 0.6 m due to the functional tide gates.

Fishes were counted, measured to the nearest 2 mm standard length, weighed if sufficient mass was available and released. A subsample of 100 individuals of abundant species were measured and the entire sample was counted. Occasional representative samples and specimens difficult to identify in the field were preserved in 10% formalin and returned to the laboratory of ichthyology at CSULB.

Centinela Ditch, in Area D, was surveyed visually and with a dipnet during a preliminary reconniscence trip in late April 1990. At that time it contained a shallow flow 3 - 10 cm for the entire distance along the south side of Teale Street and through the culvert under Lincoln Boulevard into Area B. During the Summer and Fall 1990 sampling periods the entire ditch in Area D was dry. A 25 m section, approximately 50 m east of Lincoln Boulevard, was seined (1 haul with the 3.2 mm mesh net) in April 1991.

RESULTS AND DISCUSSION

Salinity, Temperature and Dissolved Oxygen

The salinity of the water was rather consistant within 3 of the 4 seasons, amoung the 6 stations in Area B (Figure 2). In Summer all stations had typical seawater salinities, except station 10, the furthest from Ballona Creek, which was hypersaline (40 ppt). There was no freshwater entering Ballona Wetland at the time of sampling. The Winter pattern was similar with the only station 7 with an average salinity significantly below seawater (21 ppt). Station 7 is directly connected with the channel from Jefferson Drain, one of the two primary sources of freshwater input into the wetland.

The Spring salinity profile was indicative of significant freshwater input from Centinela Ditch rather than Jefferson Drain. Salinities were below 10 ppt at the upper 2 stations (nos. 6 and 10). There was a mixing zone at station 4 (25 ppt), and also station 7 on the channel from Jefferson Drain. The stations near the tide gates (nos. 1 and 3) were nearly full seawater.

The Fall salinity profile was very different and atypical. A dewatering project upstream along Jefferson Boulevard discharged 500 gal of water per minute (~1.1 cfs) into Jefferson Drain which discharges directly into Ballona Wetland approximately 1000 m upstream of station 7. The October average salinities ranged from a low of 4 ppt at station 7 to a high of only 11 ppt at stations 1 and 3, the two stations nearest the tide gates from Ballona Channel.

This unusual and unfortunate large discharge of freshwater into the wetland system in late summer and fall probably had a detrimental effect on the abundance and diversity of the fishes living in the channels and relict sloughs (see below). The impacts are due both to the prolonged period of low salinity in what is normally a seawater system and the flushing and scourering effects of a strong current, particularly at low tides. These factors make it difficult to compare the results of the fall and probably winter fish surveys with those of Swift(1981). The Ballona Wetland system is normally a seawater system in the north section, except for relatively brief periods after winter rain storms. At these times, such as April 1991, there is a salinity gradient from full seawater near Ballona Channel (35 ppt at station 1) to brackish at the stations furthest from the tide gates (6 ppt at station 6). The section south of Culver Boulevard varies from hypersaline to freshwater (Boland and Zedler 1991) depending upon ther amount of freshwater input, be it from rainfall or urban runoff.

Summer water temperatures varied from slightly above normal ocean temperatures (e.g. 23 - 26 C) at stations most influenced by tidal flushing (stations 1, 3, and 4) to above 30 C at stations 6, 7 and 10. Fall water temperatures were moderate throughout the system (e.g. 19 - 23 C). Spring water temperatures were also moderate (e.g. 16 - 26 C), with a greater range than Fall, and depended upon seawater influence and water depth. Water temperatures during the Winter sampling period were very cold throughout the wetland (e.g. 12.5 - 16), with temperature decreasing with increased distance from Ballona Channel. The cold winter temperatures, associated with a period of unusually cold coastal air temperatures, probably contributed to the very low number of fishes (243 individuals total) collected suring this period. The extremes of temperature at the upper marsh stations (nos. 6, 7, 10) were 12.5 C in winter and 32 C in summer. These extreme thermal conditions limit the diversity of fishes in upper marsh habitats (Horn and Allen 1981, Zedler 1982). The greatly restricted tidal flushing further exascerbates these effects in Ballona Wetlands under present conditions.

The dissolved oxygen levels amoung all stations were never at levels stressful to fishes during the day. No station had an average dissolved oxygen reading of less than 5.5 mg/l at any season or water temperature. Areas with dense algal growth (e.g. nos. 7 and 10) often had supersaturated levels. These areas may go to very low (<2 mg/l) oxygen levels before dawn. Fishes in area with low oxygen would be able to migrate into open water.

Fish Diversity and Abundance

A total of 9726 individuals of 11 species of fishes were collected in four quarters of sampling (Table 2). The total sample was strongly dominated by mosquitofish, an introduced exotic species. This species accounted for 61% of all individuals collected, and comprised 46.5% to 65.5% of the quarterly total samples. Mosquitofish were present at all 6 station (Table 3). They were strongly dominant at the upper marsh stations (nos. 6, 7 and 10), with total abundances of 241 to 1740 fish per 10 meters of channel. At the 3 lower marsh stations mosquitofish total abundances were less than 10 fish per 10 meters of channel. There presence in the lower marsh was associated with lowered salinity in Fall 1990 and Spring 1991.

The other numerically dominant species was the California killifish, a common resident of small bays and tidal sloughs in Southern California. California killifish accounted for 25% of the individuals collected and together with the mosquitofish made up 86% of the total sample of fishes. They were collected at all 6 stations and were the numerically dominant species at the most tidally influenced stations (nos. 1, 3 and 4) in Summer 1990. In Spring 1991, California killifish were numerically dominant only at station 4 and were absent from the stations nearest Ballona Channel where their abundance had been extremely high the previous summer. A similar pattern of marked change in abundance and distribution of California killifish among seasons and years has been reported for Malibu Lagoon (Soltz and Feldmeth 1986).

Three additional species characteristic of sloughs and shallow bays, i.e. longjaw mudsucker (Gillichthy mirabilis), topsmelt (Atherinops affinis) and striped mullet (Mugil cephalis) accounted for an additional 11% of the fish community (Table 2). The next most abundant species was an introduced, exotic species, the sailfin molly (Poecilia latipinna), which accounted for approximately 2% of the fishes collected. This recent introduction, it was not collected by Swift (1981), was essentially restricted to station 7 which had the greatest input of freshwater.

The arrow goby (Clevelandia ios), normally an abundant species in similar shallow systems with mud substrates, was uncommon in our collections (52 individuals or 0.54%). The shadow goby (Quietula y-cauda), a regionally less common species (Miller and Lea, 1972) typically occurring on mudflats, was present in Spring 1991 only (Table 1). The 34 shadow gobies collected at station 7 ranged from post-larvae to small adults. Their absence in other seasons suggests that they pass through the leaking tide gates irregularly and in limited numbers as larvae. As a mudflat species they should be able to survive the high summer temperatures in this shallow, muted tidal system. The least abundant species, i.e. yellowfin goby (Acanthogobius flaviimanus), staghorn sculpin (Leptocottus armatus) and an unidentified goby, accounted for only 0.1% of the total collection. One of these species, staghorn sculpin, is typically common in similar systems.

Seasonality

Seventy percent of the fishes (6802) were collected in the Summer quarter (Table 1). The dramatic decline in abundance of virtually all species in Fall quarter (only 13% of the number of individuals collected in Summner) was artificially induced by the 3 month period of excessive freshwater input into the system. The decline was probably due to a combination of osmotic stress, flushing, and scouring of the substrate. The species comprising the Ballona Wetland fish community are characteristically abundant during the fall months in similar systems. Of the native fishes present in the system, only longjaw mudsucker and California killifish, the two most stress tolererent species, were common in the Fall quarter collections.

Much lower fish abundance in Winter, as found in this study, is typical of similar systems (Malibu Lagoon - Soltz 1986; Upper Newport Bay -- Allen 1983, Horn and Allen 1931) and was the case during the 1980-81 fish surveys of Ballona Wetland (Swift 1981). Ballona Wetland in Winter 1991 had the typical pattern of absence of topsmelt and presence of young of the year striped mullet (Swift 1981).

Spring 1991 was the only season when all 10 identified, species were collected in the wetlands. A total of 1775 individuals, or 18% of all fishes collected, were taken in Spring (Table 1). Of these, 411 (23%) were striped mullet. There presence in the system in high numbers was an anamoly. They were traped by the tide gates. Thousands of small (3-5 cm standard length) striped mullet were present in the culverts between station 3 and Ballona Channal at low tide. They had entered the sloughs in the Winter as post-larvae and could not return to the ocean throught the tide gates. Striped mullet juveniles characteristicly enter sloughs and lower reaches of streams in winter and return to the deeper water of bays and offshore after a few months (Allen 1983, Soltz 1986).

<u>Distribution</u>

The distributions and abundance of fishes within Ballona Wetland (Area B) is summarized in Table 3 and illustrated in Figure 3A-F. Table 3 ranks the 6 sampling stations by abundance given as a rough density measure -- fish per 10 meters of channel. Figure 3 presents the same information in absolute abundance per station.

The greatest number of species were found at stations 3 (9 species) and 4 (7 species) which are along the main channel connecting with Ballona Channel through the two larger tide gates. Topsmelt were collected at these two stations only. California killifish were the numerical dominant species at both stations. Arrow goby, which was the most abundant fish collected by Swift (1981) was present only at stations 3 and 4 in this study and only 52 individuals were collected. There were as many shadow gobies present at station 3 as there were arrow gobies. The abundance of fishes at the two stations varied dramatically. Station 4 had the second lowest overall fish abundance of 249 fishes per 10 m, whereas, station 3 had the second highest abundance (720/10m). This difference is due to the presence of a deeper hole near the flap gates at station 3, as compared to shallow habitat at station 4 that drains almost completely at low tide. The density pattern reversed in the Winter quarter when few fishes were present at either station and a group of small juvenile striped mullet were collected at station 4.

Station 10, in the upper marsh, south of Culver Boulevard, had the lowest species diversity (3 species) and the lowest abundance (248/10m). This station had the most stressful habitat with very high summer temperatures (32.5 C) and low winter temperatures (12.5 C). The high summer temperatures were combined with hypersalinity (40 ppt), dense algae and presumably anoxic conditions at night. Consequently, the extremely environmentally tolerant mosquitofish made up 97% of the total collection. The two most temperature and salinity tolerant native bay species, longjaw mudsucker and California killifish, were represented by only 6 and one individuals respectively.

Station 1 is located near the smaller set of tide gates which had less seepage of seawater than the larger gates (near station 3) during the study. As a result fewer fishes had access to the area and it drained rapidly and almost completely at low tide. Although 5 species of fishes were collected, 95% were California killifish. Arrow goby should normally be present at a station this near the ocean with a mud substrate. The absence of arrow goby was probably due to the long periods of exposure of most of the substrate at low tide.

Station 6 was downstream of Station 10, just below the culvert under Culver Boulevard. It was also dominated by mosquitofish, which represented 97% of the collection. Killifish were underrepresented in the Summer quarter collection because they would move upstream into the culvert when the blocking seine was placed in the channel.

Station 7 contained a large, relatively deep (to 0.8 m) hole just below the culvert under Culver Boulevard connecting it to the channel from Jefferson Drain. This section had the highest overall fish abundance (2003/10m) due largely to the tremendously high density of mosquitofish (1315/10m) present in Summer 1990. Almost all of the recently established, sailfin molly were collected from station 7. Interestingly, this station had the second highest density of longjaw mudsucker (41/10m). It also supported a very high density of striped mullet in Spring (127/10m). The deep hole at this station acts as a refuge for fishes at low tide.

The following is a brief summary of the distribution of the dominant species. Mosquitofish were dominant at the upper marsh stations (nos. 6, 7 and 10). They were collected from all 6 stations during the low salinity event in Fall 1990. California killifish were the dominant species at the 3 stations nearest Ballona Channel (nos. 1, 3 and 4) which receive the greatest tidal flushing. Longjaw mudsucker were collected from all 6 stations. They were common at one lower station (no. 3) and one upper station (no. 7) and were the dominant native species during the low salinity event in Fall 1990. Striped mullet were relatively abundant in the 2 deep water habitats (stations 3 and 7) in Spring because they could not leave the sloughs through the tide gates. No other species made up more than 2% of the overall collections. Topsmelt were uncommon due to a combination of restricted access through the tide gates for reproductive adults and general lack of water column space required by this species. Arrow goby were uncommon and had declined dramatically since the 1980-81 fish survey (Swift 1981).

Area D

Mosquitofish were present in Centinela Ditch during a preliminary field survey in late April 1990. However, Centinela Ditch within Area D was completely dry during the Summer, Fall and Winter quarter sampling periods. The ditch again contaned water in Spring 1991. Only 3 mosquitofish were collected, along with 9 crayfish and 2 hylid tadpoles. All 3 mosquitofish were large, gravid females, suggesting that they had been recently introduced for mosquito control.

GENERAL DISCUSSION

The composition of the fish community of the relic tidal sloughs and channels of Ballona Wetland in this study is similar to the fish community present 10 years earlier (Swift 1981). Nine of the 10 species of fish present as adults in 1980-81 were present in 1990-91. The species not collected in this study, diamond turbot (Hypsopsetta guttulata), was considered to be rare by Swift (1981). Sailfin molly have become established in the system since the 1980-81 surveys.

In comparison to the fish community present in 1980-81 there has been a general decline in abundance and diversity. Mosquitofish were the second most abundant species. Now they are highly numerically dominant, representing 61% of all species collected. The arrow goby, which was the numerically most abundant species (Swift 1981) is now rare (i.e. only 0.54% of the total fish collect). Topsmelt, the third most abundant species in 1980-81, were represented by only a few juveniles in Summer and Fall 1990 and numerous post-larvae in Spring 1991 (i.e. 1.87% of the total fish collected). Although the fish community at Ballona Wetland still has the overall species composition found in similar systems, there are generally fewer species and the native species are less abundant (Allen 1983, 1990; Allen and Horn 1975; Boland and Zedler 1991; Horn and Allen 1981; Soltz 1986).

There are several probable reasons for the continued decline of the fish community at Ballona Wetland. They are all directly or indirectly related to the greatly restricted tidal flushing of the sloughs and channels because of the tide gates. One of the large flap gates was broken during the period of the Swift (1981) study and for an unknown period before, allowing for greater flushing and fish access. The reasons for the decline in the past 10 years and the generally depauperate condition of the fish community include, but are not restricted to:

- restricted access for fish, fish eggs and larvae
- lack of water column habitat
- lack of access to the pickleweed flats except at the highest tides
- exposure of much of the substrate to air and dessication for extended periods of time
- decreased salinity following rainstorms and unusual urban runoff events
- hypersalinity, particularly in the upper marsh, during summer and drought periods
- increased diurnal temperature fluctuations
- extreme seasonal high and low temperatures
- excessive algal growth and associated smothering of the benthos and anoxia in the water at night
- increase effects of toxic components of urban runoff due to the reduced water volume.

Any increase in tidal flushing of Ballona Wetlands is expected to improve all of the above conditions and consequentlylead to increased abundance and diversity of the fish community.

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FIGURE LEGENDS

Figure 1. Distribution of fishe sampling stations in Ballona Wetland. The 13 sampling stations from Swift (1981) are indicated and the numbers of the 6 stations sampled in this study are enclosed in triangles. The map is modified from Swift (1981).

Figure 2. Seasonal distribution of mean salinity of the 6 fish sampling stations in Ballona Wetland.

Figure 3. Absolute abundance of fishes by season for the 6 sampling stations in Ballona Wetland.

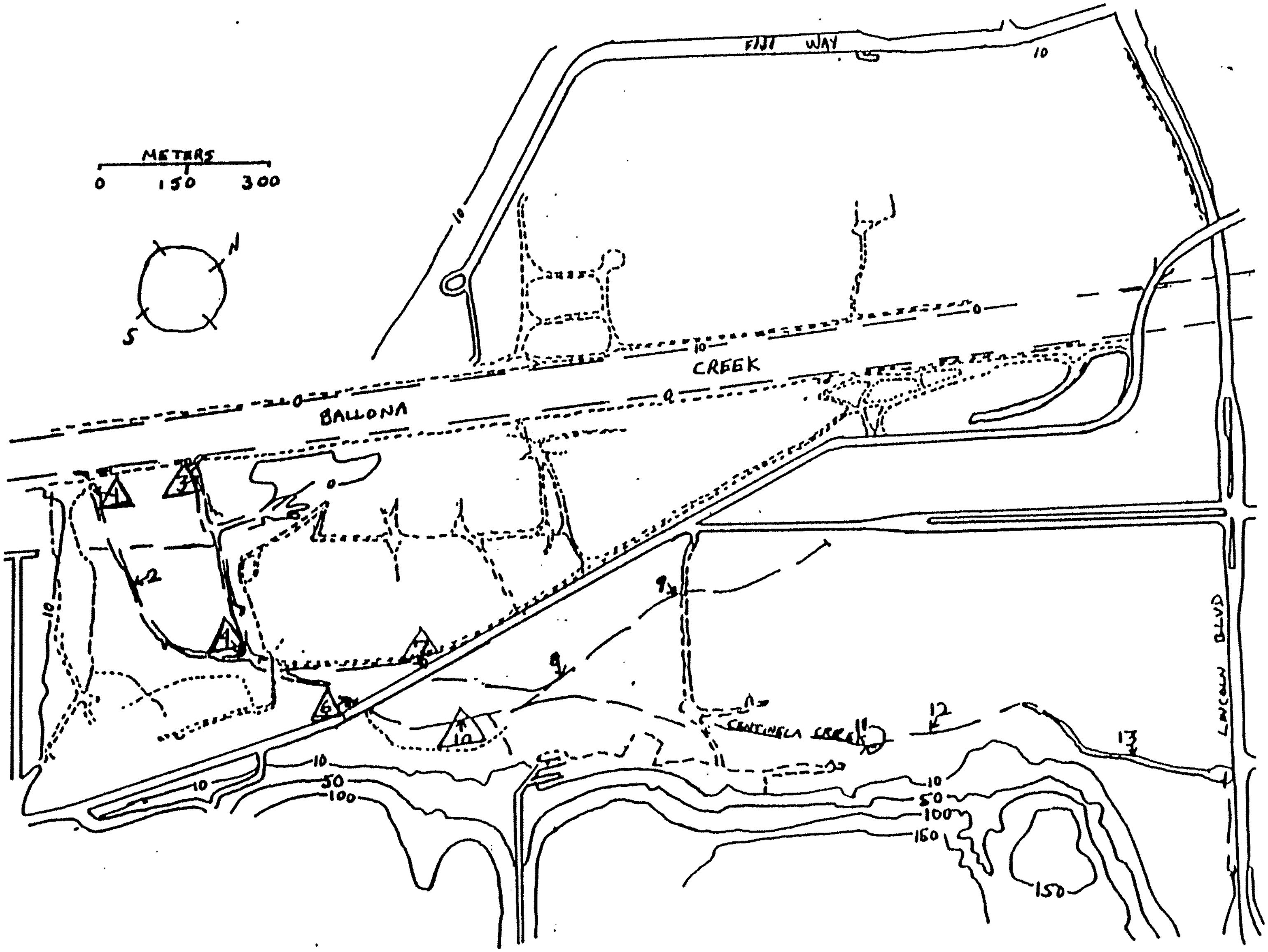

FIGURE 1.

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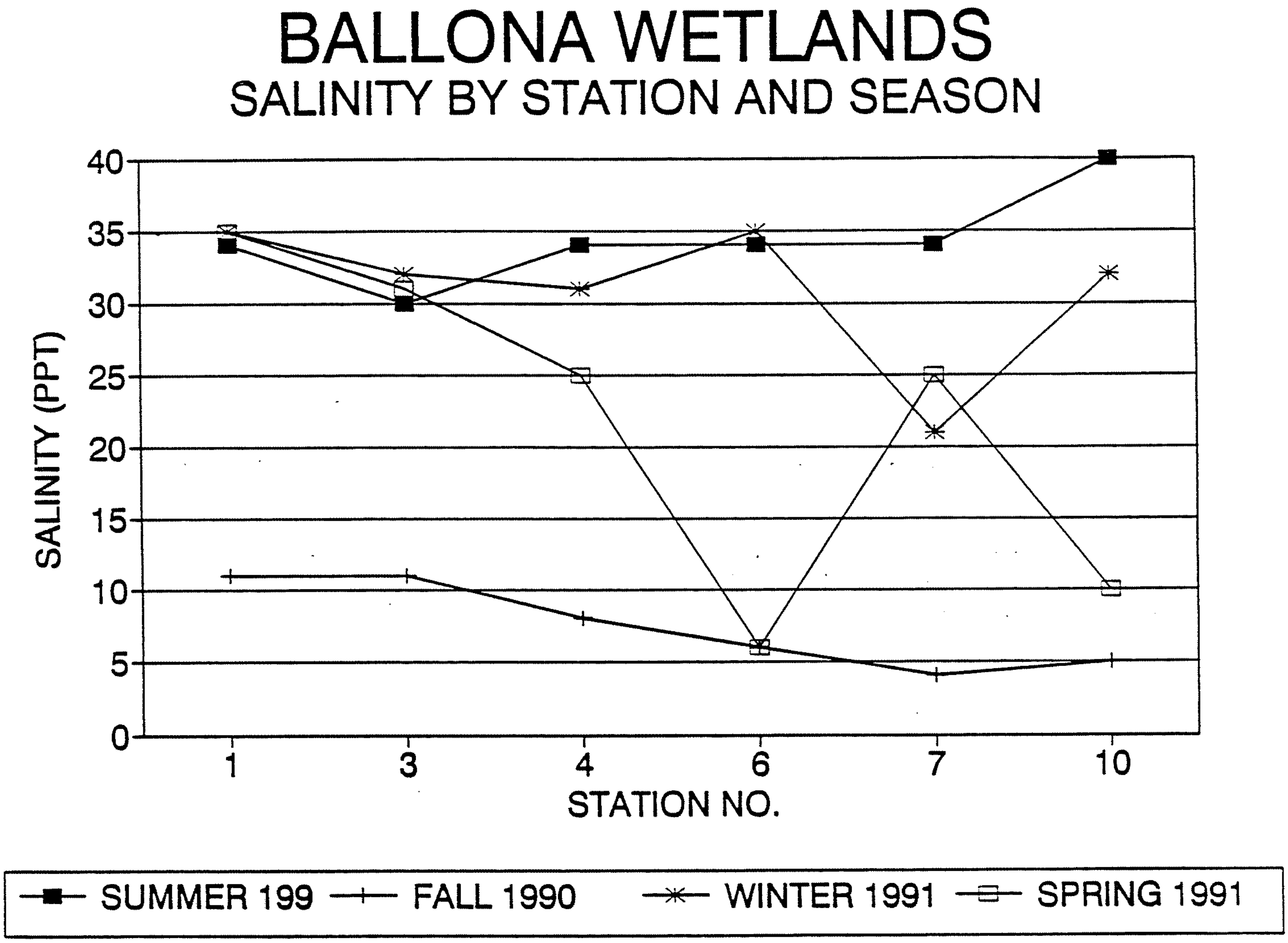

BALLONA WETLANDS
SALINITY BY STATION AND SEASON
SALINITY (PPT)
40
35
30
25
20
15
10
5
0
1
3
4
6
7
10
STATION NO.
SUMMER 199
FALL 1990
WINTER 1991
SPRING 1991

FIGURE 2.

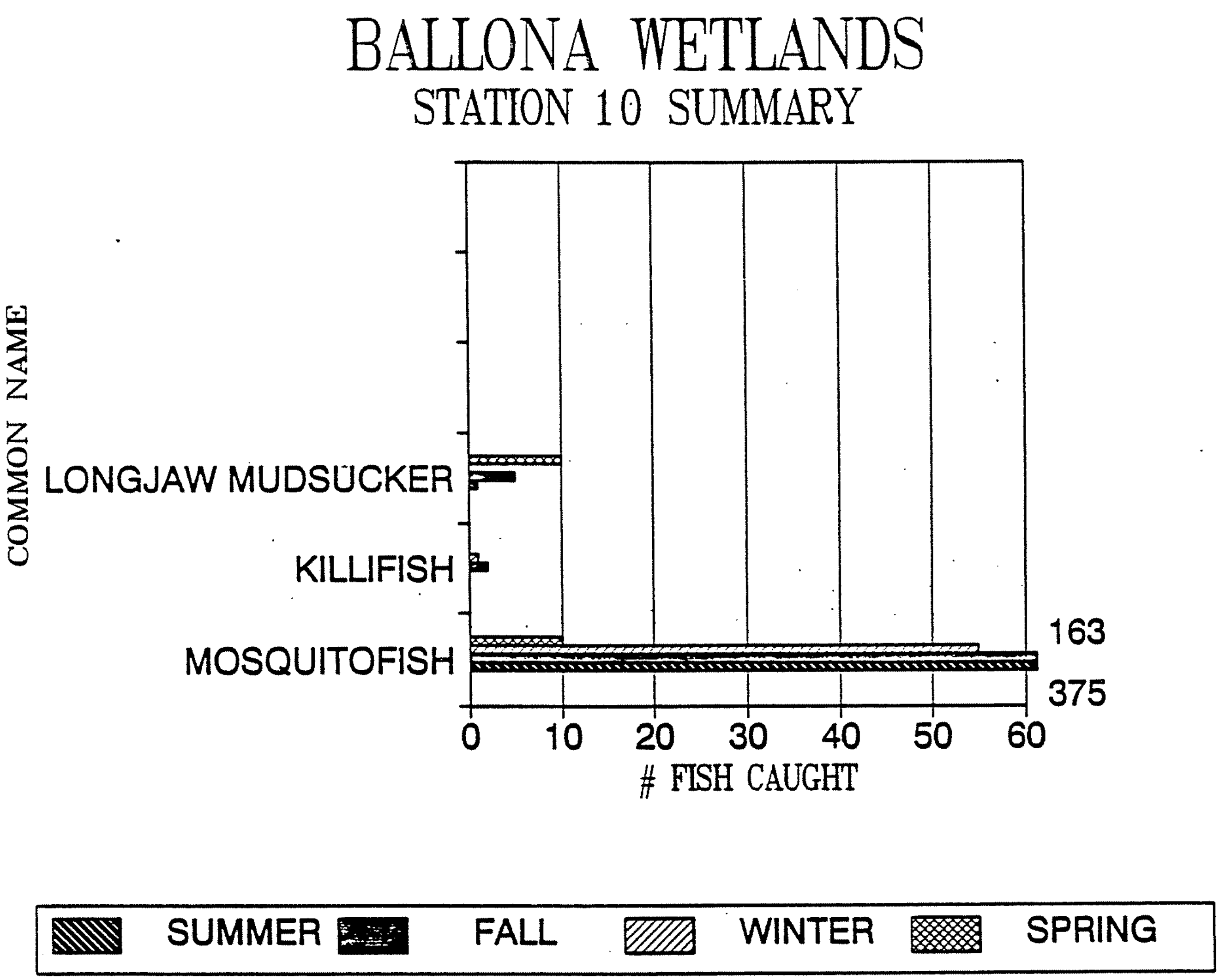
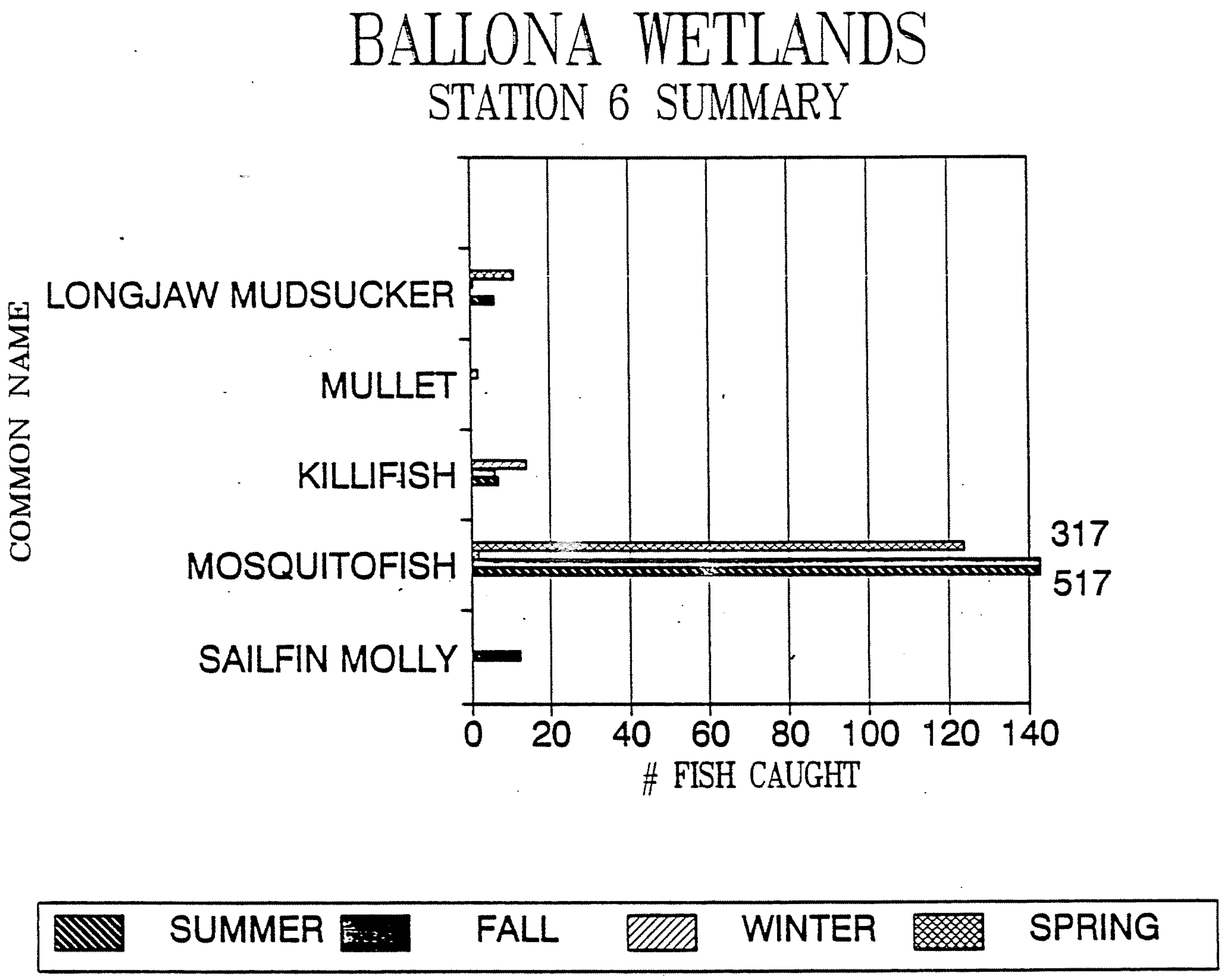

BALLONA WETLANDS
STATION 10 SUMMARY
COMMON NAME
LONGJAW MUDSUCKER
KILLIFISH
MOSQUITOFISH
163
375
0
10
20
30
40
50
60
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3A.



BALLONA WETLANDS
STATION 6 SUMMARY
COMMON NAME
LONGJAW MUDSUCKER
MULLET
KILLIFISH
MOSQUITOFISH
SAILFIN MOLLY
317
517
0 20 40 60 80 100 120 140
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3B.

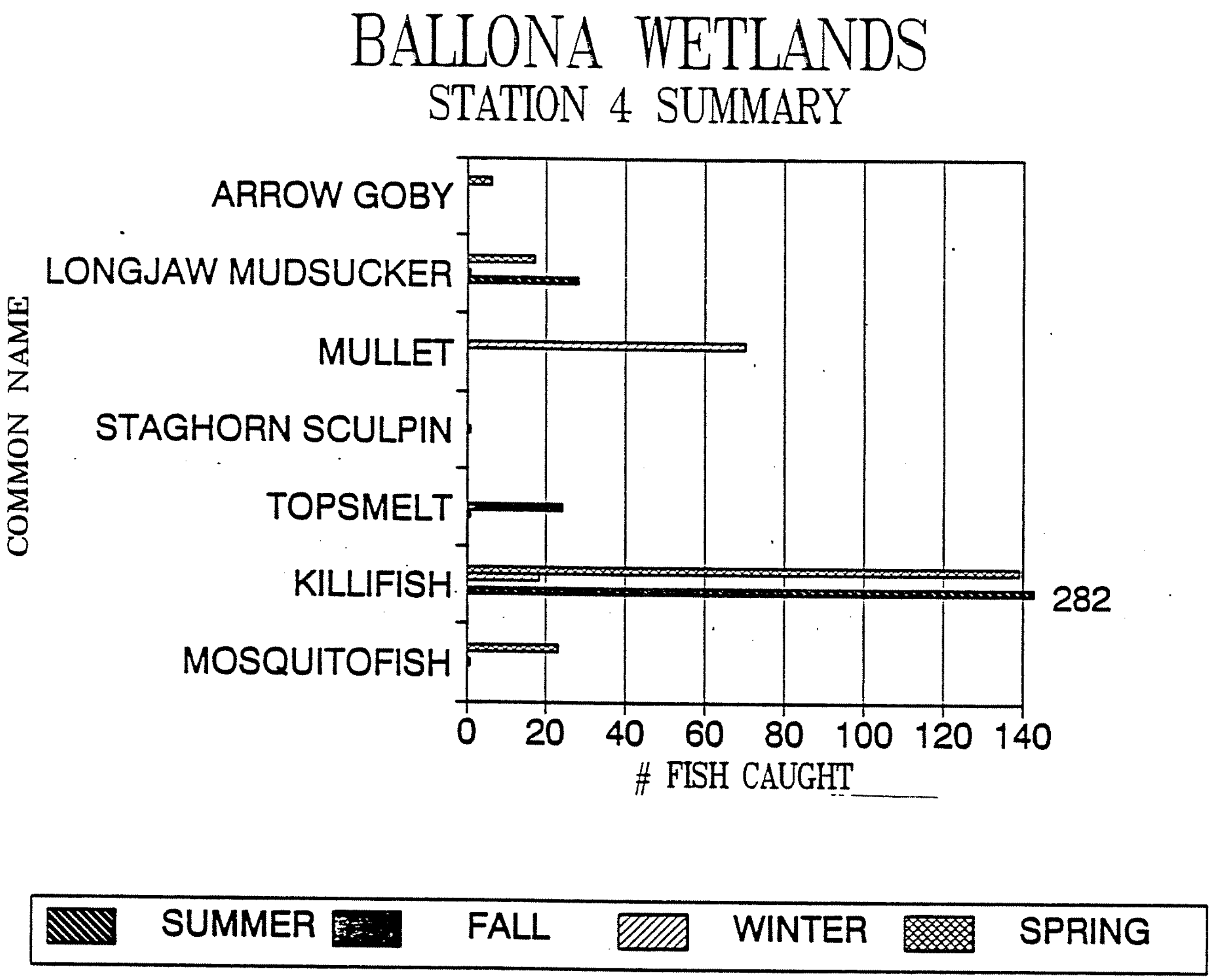

BALLONA WETLANDS
STATION 4 SUMMARY
ARROW GOBY
LONGJAW MUDSUCKER
MULLET
STAGHORN SCULPIN
TOPSMELT
KILLIFISH
MOSQUITOFISH
COMMON NAME
282
0 20 40 60 80 100 120 140
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3C.

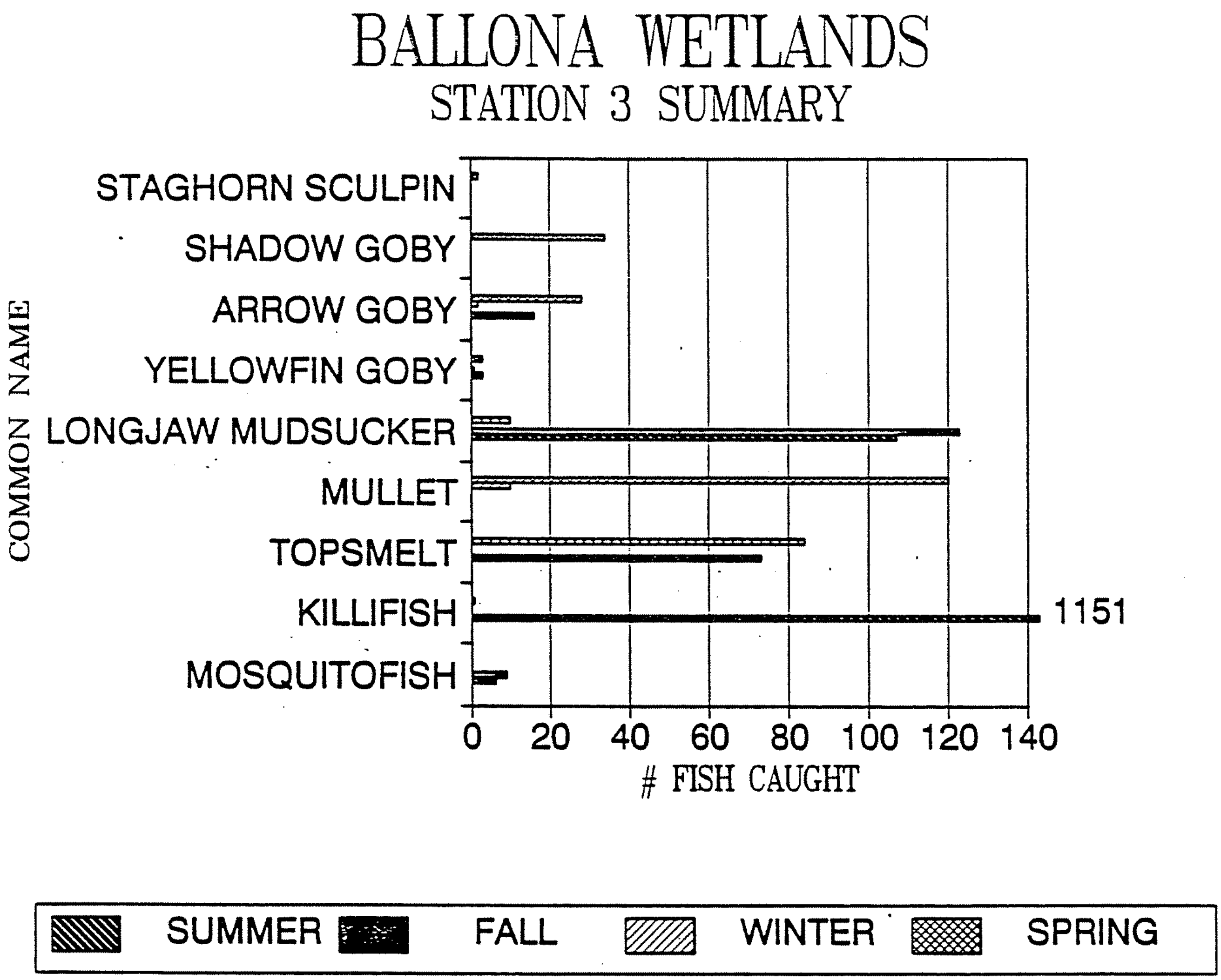

BALLONA WETLANDS
STATION 3 SUMMARY
STAGHORN SCULPIN
SHADOW GOBY
ARROW GOBY
YELLOWFIN GOBY
LONGJAW MUDSUCKER
MULLET
TOPSMELT
KILLIFISH
MOSQUITOFISH
COMMON NAME
1151
0
20
40
60
80
100
120
140
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3D.

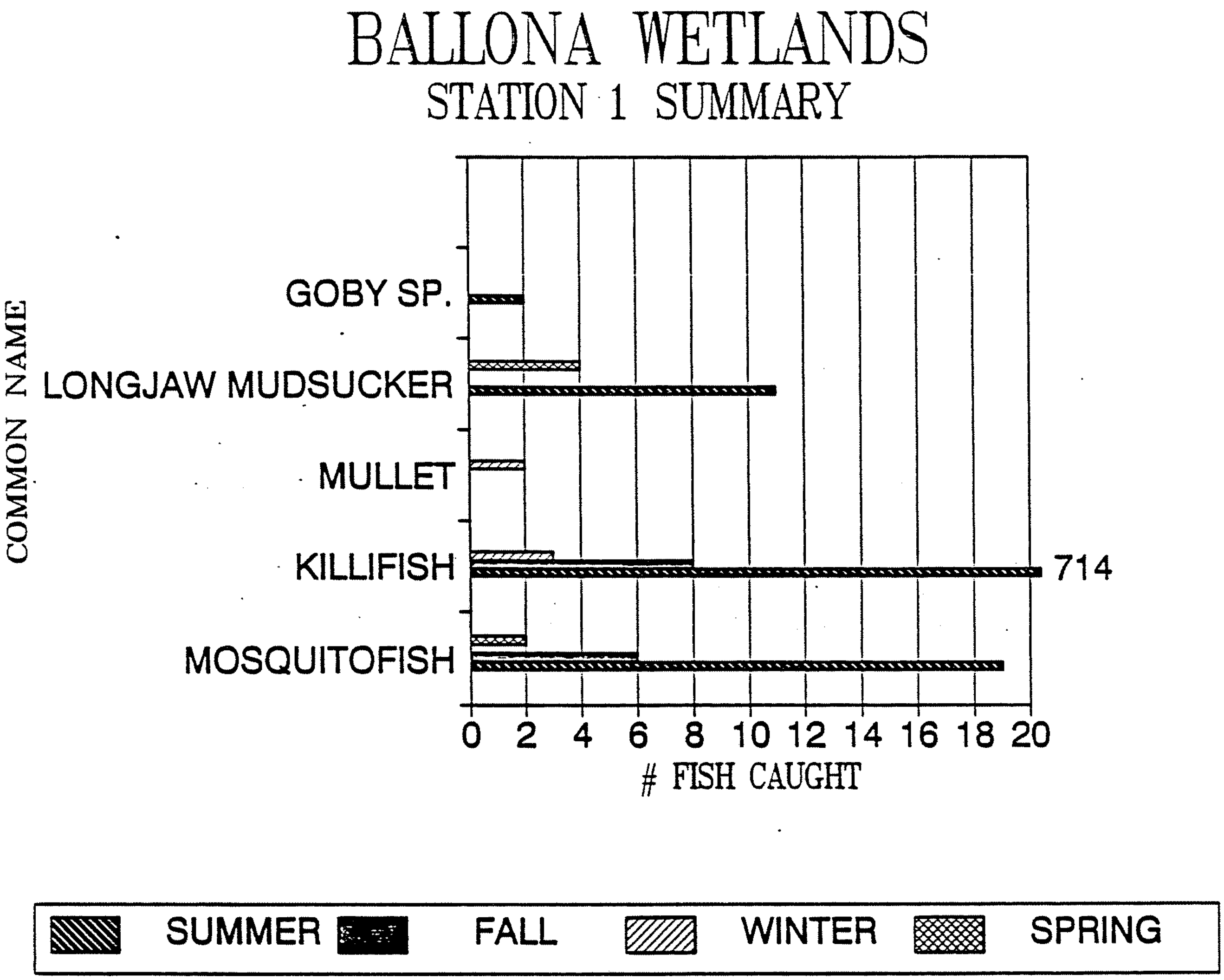

BALLONA WETLANDS
STATION 1 SUMMARY
COMMON NAME
GOBY SP.
LONGJAW MUDSUCKER
MULLET
KILLIFISH
MOSQUITOFISH
714
0 2 4 6 8 10 12 14 16 18 20
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3E.

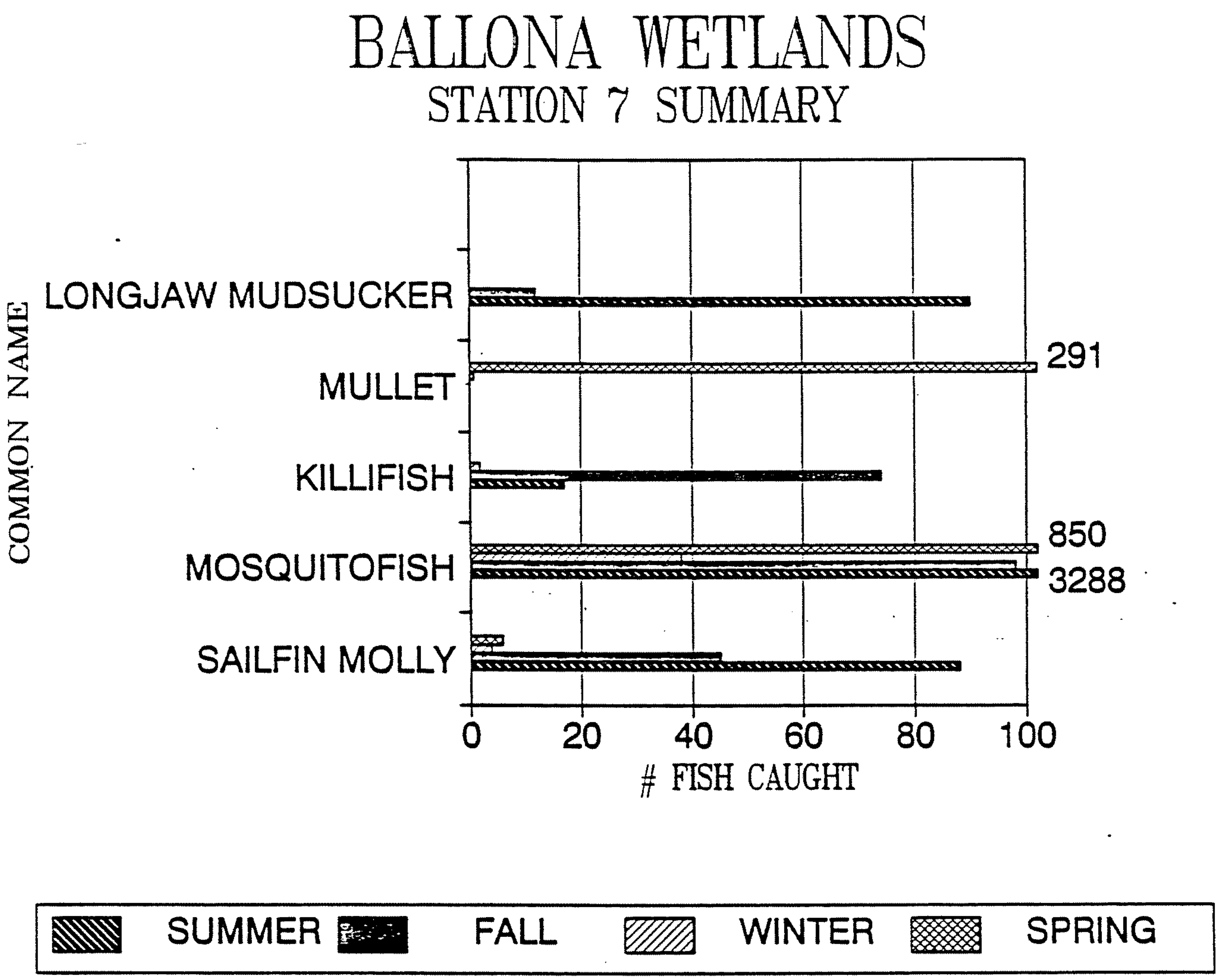

BALLONA WETLANDS
STATION 7 SUMMARY
COMMON NAME
LONGJAW MUDSUCKER
MULLET
KILLIFISH
MOSQUITOFISH
SAILFIN MOLLY
291
850
3288
0
20
40
60
80
100
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3F.

TABLE 1.
BALLONA WETLANDS, FISH SURVEY
SEASONAL SUMMARY - RANKED BY TOTAL NUMBER OF INDIVIDUALS

SPECIES	SUMMER 1990 NO.	SUMMER 1990 %	SPECIES	FALL 1990 NO.	FALL 1990 %
Mosquitofish	4205	61.82	Mosquitofish	594	65.56
California killifish	2171	31.92	Longjaw mudsucker	141	15.56
Longjaw mudsucker	243	3.57	California killifish	88	9.71
Sailfin molly	88	1.29	Sailfin molly	57	6.29
Topsmelt	74	1.09	Topsmelt	24	2.65
Arrow goby	16	0.24	Yellowfin goby	1	0.11
Yellowfin goby	3	0.04	Staghorn scupin	1	0.11
Goby sp.	2	0.03			
TOTAL	6802		TOTAL	906	
NO. SPECIES	8		NO. SPECIES	7	

SPECIES	WINTER 1991 NO.	WINTER 1991 %	SPECIES	SPRING 1991 NO.	SPRING 1991 %
Mosquitofish	113	46.50	Mosquitofish	1009	56.84
Striped mullet	85	34.98	Striped mullet	411	23.15
California killifish	38	15.64	California killifish	140	7.89
Sailfin molly	4	1.65	Topsmelt	84	4.73
Arrow goby	2	0.82	Longjaw mudsucker	52	2.93
Longjaw mudsucker	1	0.41	Arrow goby	34	1.92
			Shadow goby	34	1.92
			Sailfin molly	6	0.34
			Yellowfin goby	3	0.17
			Staghorn sculpin	2	0.11
TOTAL	243		TOTAL	1775	
NO. SPECIES	6		NO.SPECIES	10	

TABLE 2.
BALLONA WETLANDS FISH SURVEY
4 SEASONS COMBINED
RANKED BY TOTAL NUMBER OF INDIVIDUALS

SPECIES	4 SEASON TOTAL NO.	%
Mosquitofish	5921	60.88
California killifish	2437	25.06
Striped mullet	496	5.10
Longjaw mudsucker	437	4.49
Topsmelt	182	1.87
Sailfin molly	155	1.59
Arrow goby	52	0.54
Shadow goby	34	0.35
Yellowfin goby	7	0.07
Staghorn sculpin	3	0.03
Goby sp.	2	0.02
TOTAL	9726	
NO. SPECIES	11	

TABLE 3.
BALLONA WETLANDS, FISH SURVEY
OVERALL SUMMARY - RANKED BY INCREASING TOTAL ABUNDANCE PER STATION
NUMBER GIVEN IS FOR THE NUMBER OF FISH PER 10 METERS

STATION 10

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	150	65	22	4	241
KILLIFISH	0	1	<1	0	1
LONGJAW MUDSUCKER	<1	2	0	4	6
TOTAL PER SEASON	150	68	22	8	248

STATION 4

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	0	<1	0	10	10
KILLIFISH	113	0	7	60	180
TOPSMELT	<1	10	0	0	10
STAGHORN SCULPIN	0	<1	0	0	<1
MULLET	0	0	28	0	28
LONGJAW MUDSUCKER	11	0	0	7	18
ARROW GOBY	0	0	0	3	3
TOTAL PER SEASON	124	11	35	80	249

STATION 1

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	8	2	0	<1	10
KILLIFISH	286	3	1	0	290
MULLET	0	0	1	0	1
LONGJAW MUDSUCKER	4	0	0	2	6
GOBY SP.	1	0	0	0	1
TOTAL PER SEASON	298	6	2	2	308

STATION 6

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
SAILFIN MOLLY	0	5	0	0	5
MOSQUITOFISH	207	127	1	54	388
KILLIFISH	3	2	6	0	11
MULLET	0	0	1	0	1
LONGJAW MUDSUCKER	2	0	<1	5	7
TOTAL PER SEASON	212	134	8	59	412

STATION 3

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	2	4	0	0	6
KILLIFISH	460	0	0	<1	460
TOPSMELT	29	0	0	37	66
MULLET	0	0	4	52	56
LONGJAW MUDSUCKER	43	49	0	4	96
YELLOWFIN GOBY	1	<1	0	1	2
ARROW GOBY	6	0	1	12	19
SHADOW GOBY	0	0	0	15	15
STAGHORN SCULPIN	0	0	0	<1	0
TOTAL PER SEASON	542	53	5	121	720

STATION 7

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
SAILFIN MOLLY	35	18	2	3	58
MOSQUITOFISH	1315	39	15	370	1740
KILLIFISH	7	30	1	0	37
MULLET	0	0	<1	127	127
LONGJAW MUDSUCKER	36	5	0	0	41
TOTAL PER SEASON	1393	92	18	500	2003