CREEL CENSUS OF SPORTFISHERMEN AT A WARM WATER DISCHARGE INTO GALVESTON BAY, TEXAS

by

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ABSTRACT

Creel census data were taken at the warmwater discharge site of Houston Power and Lighting Company's P.H. Robinson Generating Station during June 1977 through February 1978. Fifty five surveys were conducted during which 535 sportfishermen were interviewed. These fishermen caught 1,675 fish of which 527 were returned in creels. Sea catfish (Arius felis) were caught in high numbers during the summer through early winter, but were discarded by most fishermen. Sheephead (Archosargus probatocephalus) were caught in high numbers during November. Highest catch rates for sand seatrout (Cynoscion arenarius) occurred during July, October, November and December. Catch rates for Atlantic croaker (Micropogon undulatus) were good from June through October, but were low during the winter. Black drum (Pogonias cromis) were caught during all months but June. Catch rates for red drum (Scianops ocellata) were highest from November through January. Comparison with creel census data taken by Landry and Strawn (1973) at the Robinson outfall area indicated that summer catch rates of popular game fish had increased. Summer increases in catch rates since the Landry and Strawn (1973) census are attributed to lower water temperatures in the discharge area. Consistant fishing pressure throughout the year reflects good catch rates which occurred at the discharge canal.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Discharge of heated water from fossil fuel and nuclear generating stations may profoundly effect distribution of fish communities. More and Frisbie (1972) reported that greater fishing pressure at a heated discharge in Maryland occurred between January and April than for the rest of the year. Marcey and Galvin (1973) found that there was a correlation between the number of fish caught per rod-hour of effort and temperature of a heated discharge canal in Maryland. Higher catch rates at the canal than at non heated areas in the vicinity suggests that fish are attracted to warm water effluents. Gibbons, Hook and Forney (1972) reported that significantly more largemouth bass were caught near a power plant when the discharge was heated than when it was not heated.

Houston Lighting and Power Company's P.H. Robinson Generating Station located between Houston and Galveston, Texas is one of the largest fossil fuel generating plants in the United States. With a maximum flow rate of 1.7 billion gallons per day, considerable quantities of heated sea water are discharged into Galveston Bay. Location, warm climate and heavy power consumption in the Houston-Galveston area make the Robinson site particularly suited for thermal discharge studies.

Gallaway and Strawn (1975) conducted a fish species diversity study of the Robinson discharge site during 1968 and 1969. Trawl data

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Format and style follow that of the Transactions of the American Fisheries Society.

taken from the discharge area, up-bay, and down-bay control areas indicated that there were difinite seasonal fluctuations in species diversity. Mean discharge water temperatures exceeded 35C during August 1968 and July through September of 1969. Species diversity indicies during these hot water periods were lower for the discharge area than they were for control areas exhibiting water temperatures below 32C. Reductions in species diversity were only temporary. During cooler months species diversity appeared to have been higher in the discharge area than either of the control areas.

A census of sport fishing activity at the outfall area of the P.H. Robinson Generating Station was conducted in 1969 (Landry and Strawn 1973). This study showed significant decreases in angling pressure and success during summer months which corresponded with increased flow rates and temperature of the discharge water. During the winter, good catch rates and heavy fishing pressure occurred. Monthly mean discharge water temperature ranged from 20.0 to 38.7C in January and July, respectively.

A 750 megawatt generating unit and cooling towers have been added to the Robinson Generating Station since the Landry and Strawn (1973) census. Addition of the 750 megawatt unit has resulted in a 50% increase in the plant's generating capacity as well as a substantial increase in volume of heated water discharged into Galveston Bay (Fig. 1). Cooling towers are operated during May through October to ensure that outfall water temperatures do not exceed 35.0C (95F) (Fig. 2).

This study provides additional census data on fishing intensity and catch rates of shore based fishermen at the Robinson discharge area.

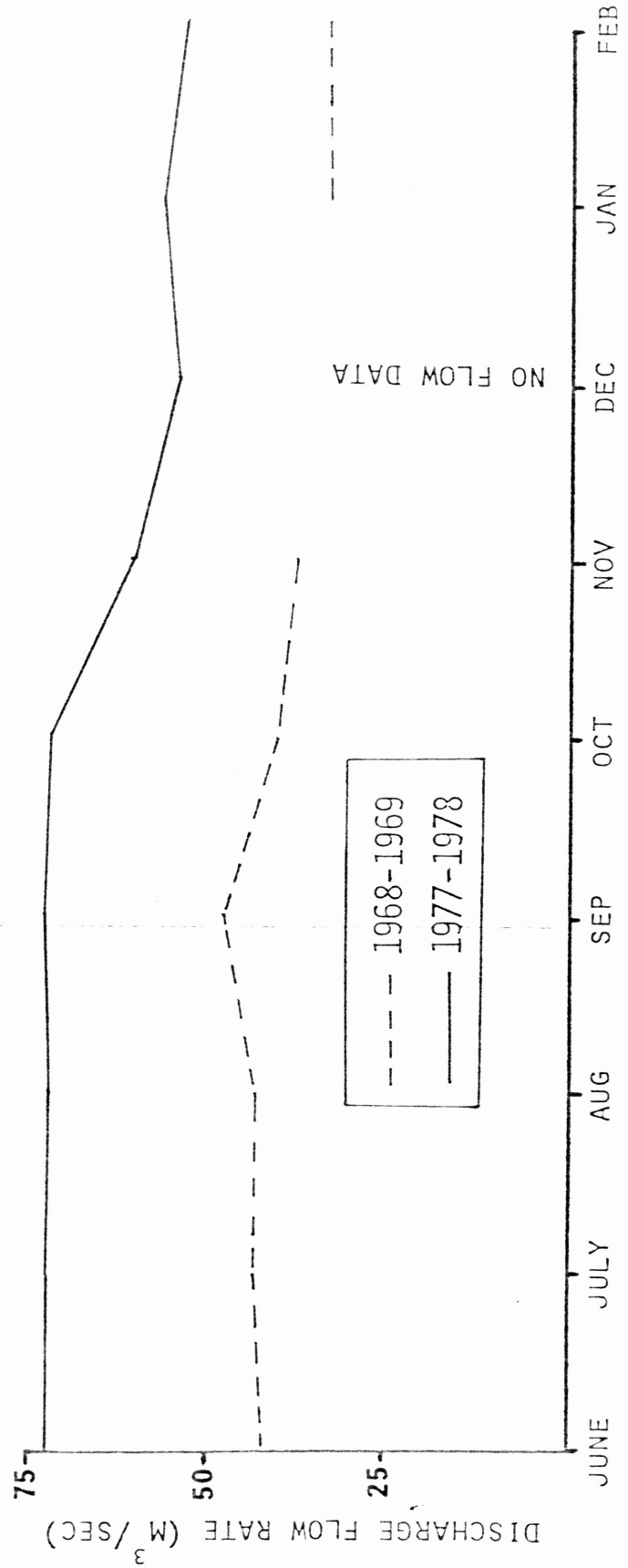

Figure 1. Monthly mean discharge flow rate (m^3/sec) at the P.H. Robinson outfall area during June through February 1968-1969 and 1977-1978.

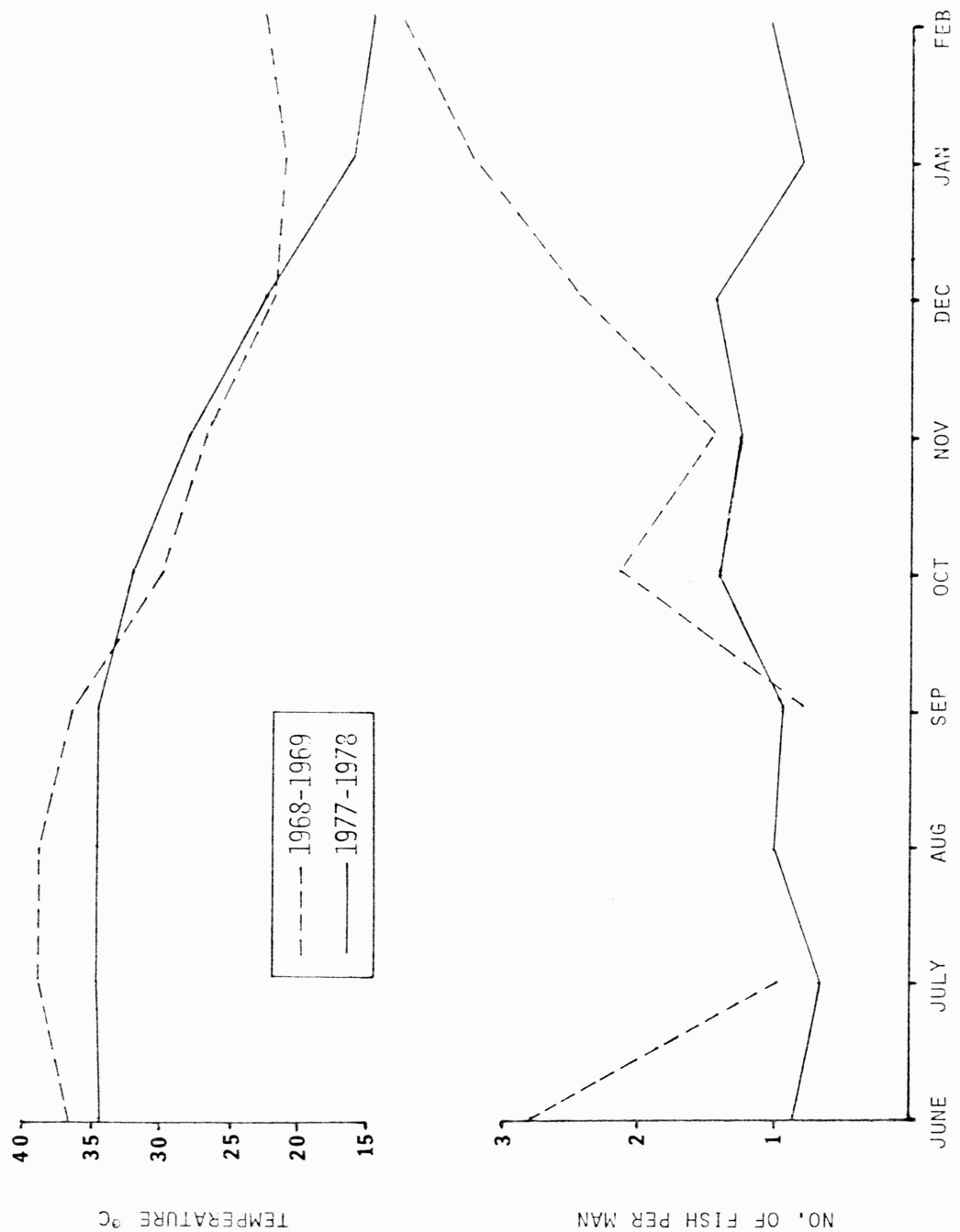

Figure 2. Monthly mean discharge water temperature and mean number of fish per fisherman at the P.H. Robinson outfall area during June through February 1968-1969 and 1977-1978.

The primary objective of the study was to determine the effect of the additional generating unit and associated increases in flow rates, and cooling tower operation upon angling pressure and success. Comparisons between results from this study and those of Landry and Strawn (1973) also are presented.

STUDY AREA AND METHODS

Houston Lighting & Power Company's P.H. Robinson Generating Station is located near Bacliff, Texas on the western shore of Galveston Bay (Fig. 3). The plant is composed of twin 450-MW generating units, one 565-MW unit, and one 750-MW unit. These units are capable of pumping a total of 4.5×10^6 l/min. through condensers and are designed for a cooling water ΔT of 9.8 C. Cooling water is pumped from a 3.7-km intake canal from Dickinson Bay (a subsidiary bay of the Galveston Bay System), flows through condensers and is discharged into Galveston Bay through a 3.2-km canal. Cooling towers are located approximately 1.2 km down the discharge canal from the plant.

The outfall area of the discharge canal is bounded by two rock lined shores and two sheet metal groins (Fig. 3). East and west shores of the outfall area extend for 245 and 218 m, respectively. A 200-m sheet metal groin located on each side of the outfall area extends out into the bay perpendicular to the natural shoreline. These groins contain the heated water and direct the plume out into the bay. The outfall area covers 9.9 hectares (24.5 acres) and is approximately 5 m deep. A Galveston County park has been established at the discharge area. Picnic areas, restrooms, ample parking and easy access to the water render the outfall area a popular shore based fishing site.

Creel censuses were taken at irregular times during the June through July survey period. Each survey consisted of interviewing and recording catch statistics of all anglers fishing at the time of each survey. Creel census data recorded during each survey included

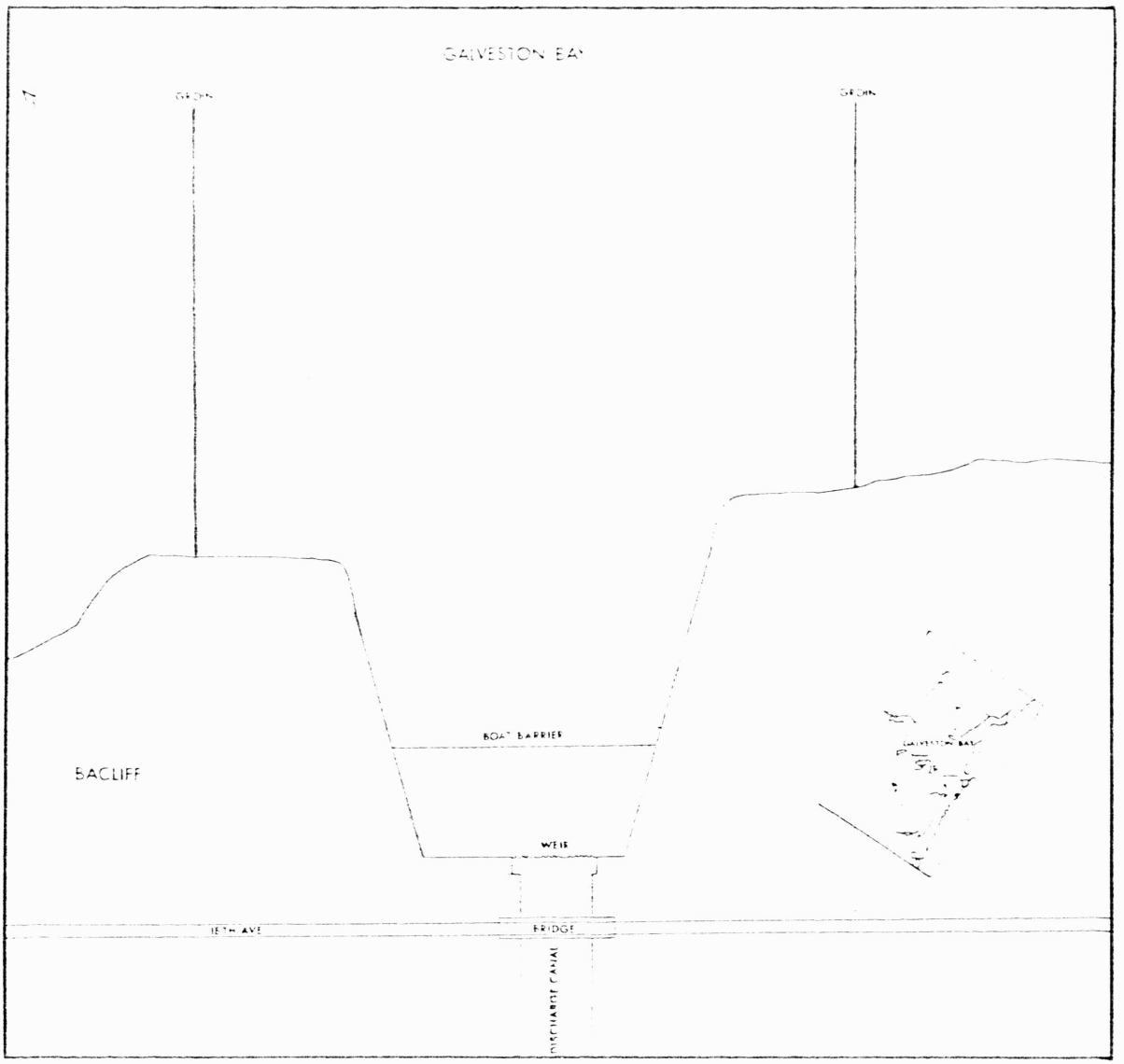

Fig. 3. Map of Houston Power & Lighting Company's P.H. Robinson Generating Station outfall area.

the following:

a. number of shore based fishermen

b. number of boat fishermen

c. number of crabbers

d. duration of fishing effort

e. species caught

f. total number of individuals and total weight (g) of each species

g. standard length (mm) of each fish

h. number of fishing poles used

i. type of bait (live, dead or artificial)

j. fishing depth (surface or bottom)

All census information was recorded on a creel data sheet (Fig. 4). Discharge water temperature and flow rate data as well as information on weather and tidal conditions also were recorded for each creel survey. Duration of each survey was dependent on number of fishermen at the outfall. Survey durations ranged from 0.25 to 3 hours.

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Creel Census - P. H. Robinson Generating Station Discharge Canal

DATE: _____ STARTING TIME: _____ FINISHING TIME: _____

Temperature: Air _____ Water-Field _____ Plant _____ Tide _____ Water _____

Weather _____

No. of Fishing Boats: _____ No. of Boat Fishermen _____ No. of Crabbers _____

No. in Party	Bait	Elapsed Fishing Time	No. of Poles (hooks)	Depth of Capture	Species	Total No.	Total wt.(g)	Standard Length (mm)	Estimated No. of Fish Discarded

Figure 4. Form used for recording data taken during creel censuses at the discharge area of Houston Power & Lighting Company's P.H. Robinson Generating Station.

RESULTS

Fifty five creel censuses were conducted from June 1977 through February 1978. The 635 fishermen interviewed caught a total of 1,673 fish. Six hundred and twenty seven fish were retained by fishermen (Table 1). Fishermen discarded or returned to the water 1,046 which they considered as undesirable. Fishermen interveiwed during the census had fished a total of 631 hours. Most fishermen (greater than 90%) used dead bait and fished off the canal bottom.

Considering only those fish retained by fishermen, the overall catch rate during the 9-month census period was 1.00 fish per man hour of fishing. Highest monthly retained catch rate (1.6 fish per man hour) occurred in December 1977 while the lowest monthly retained catch rate (0.6 fish per man hour) occurred in October 1977 (Fig. 5). For June through September 1977 monthly discharge water temperatures were approximately 34.5C (Fig. 2). Monthly retained catch rates for these 4 months ranged from 0.9 to 1.2 fish per man hour (Fig. 5)

Total catch rates (fish retained plus fish discarded or returned to the water) ranged from 0.7 to 4.6 fish per man hour (Fig. 5). High total catch rates (2.8 to 4.6 fish per man hour) occurred from June through November 1977. Sea catfish (Aruis felis) accounted for 56% of the total catch during June through November. This species was not considered a game fish by most fishermen and usually was culled from creels. Culling of sea catfish and small fish caused retained catch rates to be substantially lower than total catch rates from June through November 1977 (Fig. 5).

Comparisons between retained catch rates obtained during this

Table 1. Monthly and combined totals for species present in creel, number of creel censuses taken, number of shore fishermen interviewed, number of boat fishermen and number of crabbers present during census taken at the P.H. Robinson outfall area during June 1977 through February 1978.

SPECIES	J	J	A	S	O	N	D	J	F	TOTAL
Arius felis	37	30	9	5	12	7	16	14	4	134
Archosargus probatocephalus	4	3		1	1	5	7	4	3	28
Lagodon rhomboides	1	1	2	23	4					31
Cynoscion arenarius	1	6	1		10	3	11			32
Cynoscion nebulosus				1		6	43		3	53
Leiostomus xanthurus			1							1
Menticiarrhus americanus			1				1			2
Menticirrhus littoralis				2						2
Micropogon undulatus	19	22	39	23	9		5	3	3	123
Pogonias cromis	1	17	17	7	1	5	41	10	76	175
Sciaenops ocellata	1	1	2	2		9	5	4		24
Chaetodipterus faber						3	1			4
Mugil cephalus			1					2	12	15
Paralichthys lethostigma						1	1	1		3
Number of Fish	64	80	73	64	37	39	131	38	101	627
Number of Creel Censuses	5	10	7	6	5	4	5	6	6	55
Number of Shore Fishermen	76	122	72	68	28	31	90	48	100	635
Number of Boat Fishermen	12			2	4	5	11		4	38
Number of Crabbers	16	7	12	13	6					54

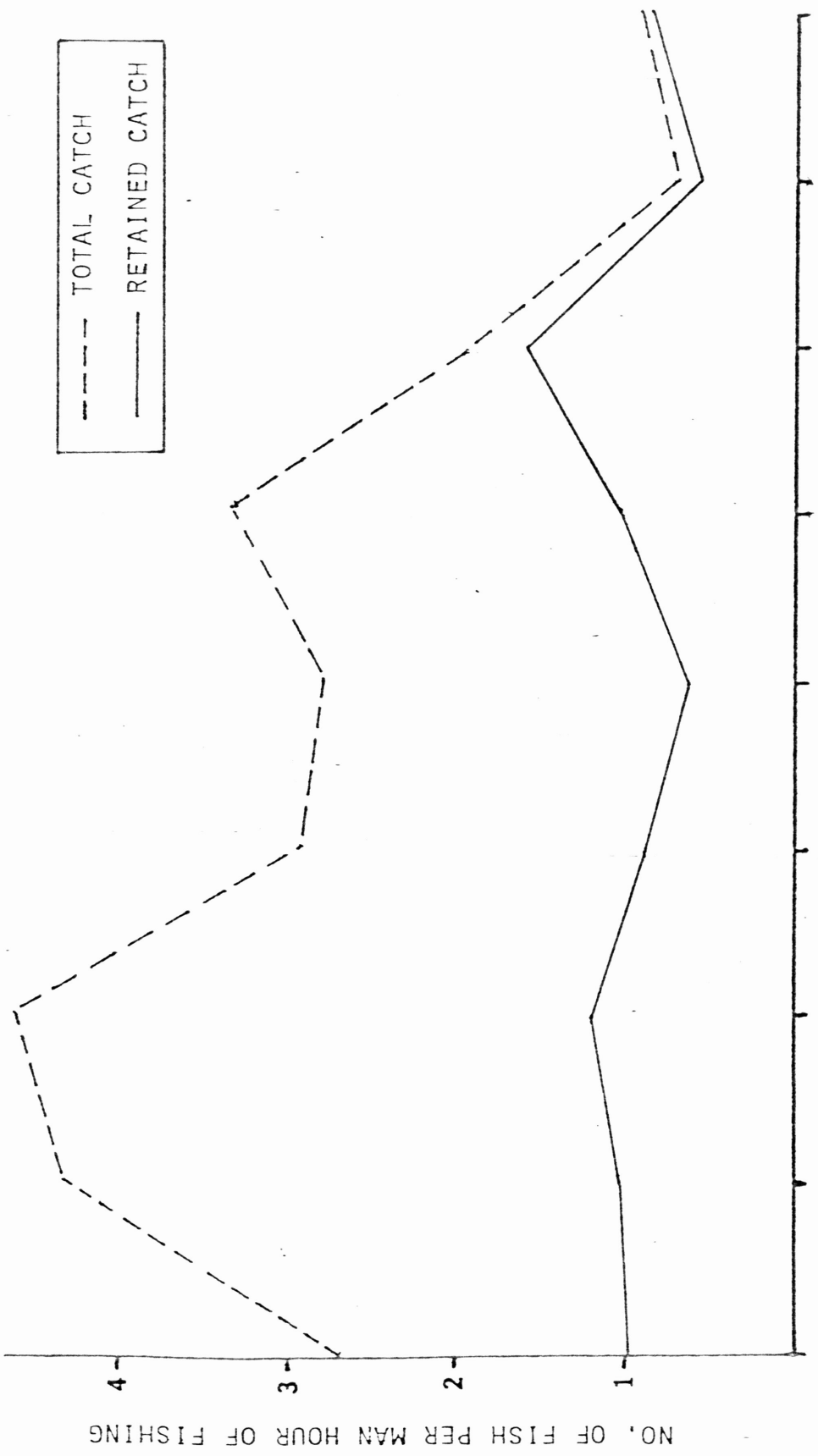

Figure 5. Monthly mean total and retained catch per man hour of fishing at the P.H. Robinson outfall area during June 1977 through February 1978.

study with those obtained by Landry and Strawn (1973) give an indication of how fishing has changed. Only retained catch per fisherman can be compared because data on total catch and hours fished were not recorded during the 1968-1969 census. Total numbers of fish caught and retained per fisherman appears to have decreased since the 1968-1969 census. Overall retained catch rate for the current census was 0.99 fish per man as compared to 2.6 fish per man for a similar 9-month period during 1968 and 1969. Decreases in retained catch rates for Atlantic croaker (Micropogon undulatus) and red drum (Sciaenops ocellata) accounted for most of the decline in overall retained catch rate since 1968-1969 (Table 2). Retained catch rate for Atlantic croaker decreased from 1.89 fish per man (1968-1969) to 0.19 fish per man (1977-1978). Red drum catch rate decreased from 0.14 fish per man (1968-1969) to 0.04 fish per man (1977-1978).

Increased plant capacity has resulted in higher flow rates during the present census than for the Landry and Strawn (1973) census. Mean monthly flow rates ranged from 34 to 48 ft^3/min. during the 1968-1969 census (Fig.1), while during the 1977-1978 census flow rates ranged from 55 to 73 ft^3/min. One of the coldest winters in Galveston's history caused discharge water temperatures to be substantially cooler during January and February of the 1977-1978 census as compared to the 1968-1969 census (Fig. 2). Lowest monthly mean temperatures were 14.8C for the 1977-1978 census and 21.0C for the 1968-1969 census.

Comparisons between monthly catch rates obtained during the current census with those obtained by Landry and Strawn (1973) indicate

Table 2. Monthly and combined mean catch per fisherman for species present in creels at the P.H. Robinson outfall area during June through February 1968-1969 and 1977-1978. (*) denotes less than 0.01 fish per man. (68) denotes 1968-1969 census data and (77) denotes 1977-1978 census data.

	JUNE		JULY		AUG.		SEP.		OCT.		NOV.		DEC.		JAN.		FEB.		MEAN	
SPECIES	68	77	68	77	68	77	68	77	68	77	68	77	68	77	68	77	68	77	68	77
Brevoortia patronus															*		*		*	
Ictalurus melas																	*		*	
Arius felis	1.23	0.49		0.24		0.12	0.63	0.07	0.77	0.42	0.34	0.23	0.01	0.18	0.26	0.29	0.05	0.04	0.27	0.21
Bagre marinus			1.00				0.13												*	
Caranz Hippos									0.02										*	
Archosargsargus probatocephalus		0.05		0.02				0.01	0.02	0.04	0.06	0.16	0.06	0.08		0.08		0.03	0.02	0.04
Lagodon rhomboides		0.01		0.01		0.03		0.34		0.14							0.01		*	
Birdiella chrysura															0.08		0.02		0.02	
Cynoscion arenarius		0.01		0.05		0.01			0.36	0.36	0.03	0.10		0.12					0.06	0.05
Cynoscion nebulosus								0.01				0.20		0.48			0.01	0.03	*	*
Leiostomus xanthurus						0.01							0.06		0.16		0.08		0.07	*
Menticiarrhus americanus						0.01								0.01						*
Menticirrhus littoralis								0.03												*
Micropogon undulatus	1.62	0.25		0.18		0.54		0.34	0.82	0.32	0.45		1.74	0.06	2.18	0.06	3.05	0.03	1.89	0.19
Pogonias cromis		0.01		0.14		0.24		0.10	0.02	0.04	0.14	0.17	0.31	0.46	0.24	0.21	0.40	0.76	0.25	0.28
Scaenops ocellata		0.01		0.01		0.03		0.03	0.08		0.34	0.29	0.22	0.06	0.17	0.08	0.02		0.14	0.04
Chaetodipterus faber											0.03	0.10		0.01					*	*
Mugil cephalus						0.01									0.07	0.04	0.04	0.12	0.02	0.02
Paralichthys lethostigma												0.10		0.01		0.02				*
Monthly Mean	2.85	0.84	1.00	0.66		1.01	0.75	0.94	2.08	1.32	1.40	1.23	2.39	1.45	3.17	0.79	3.70	1.01	2.55	0.99

that seasonal changes have occurred for many species.

Catch rates for sheepshead (Archosargus probatocephalus) were 0.05, 0.02, and 0.01 fish per man during June, July and September 1977 (Table 2 and Fig. 6). No sheepshead were taken during June through August 1969. Discharge water temperature for June through September 1977 was maintained at or below 35C by cooling tower operation while during the same period of 1969 water temperatures were as high as 40.6C.

Retained catches of sand seatrout (Cynoscion arenarius) during this study were less seasonal than those observed during the 1968-1969 census (Table 2 and Fig. 6). Sand seatrout were caught for all months of the 1977-1978 census except September, January and February. For the same 9-month period Landry and Strawn reported sand seatrout only in October and November. Catch rates during June through August 1977 ranged from 0.01 to 0.05 fish per man. Highest monthly catch rate during both 9-month censuses occurred in October (0.36 fish per man for both censuses).

Monthly retained catch rates for Atlantic croaker (Table 2 and Fig. 6) were much higher from July through September 1977 than for the same period of 1969. No Atlantic croaker were reported by Landry and Strawn during July through September 1969. In contrast, retained catch rates of 0.18, 0.54, and 0.34 fish per man occurred during June, July and August 1977, respectively, when cooling towers were operational. Catch rates were low (less than 0.06 fish per man hour) during November 1977 through February 1978. Winter catch rates were high for Atlantic croaker during the 1968-1969 census - 1.74, 2.18, and 3.05 fish per man in December 1968 and January and February 1969, respectively.

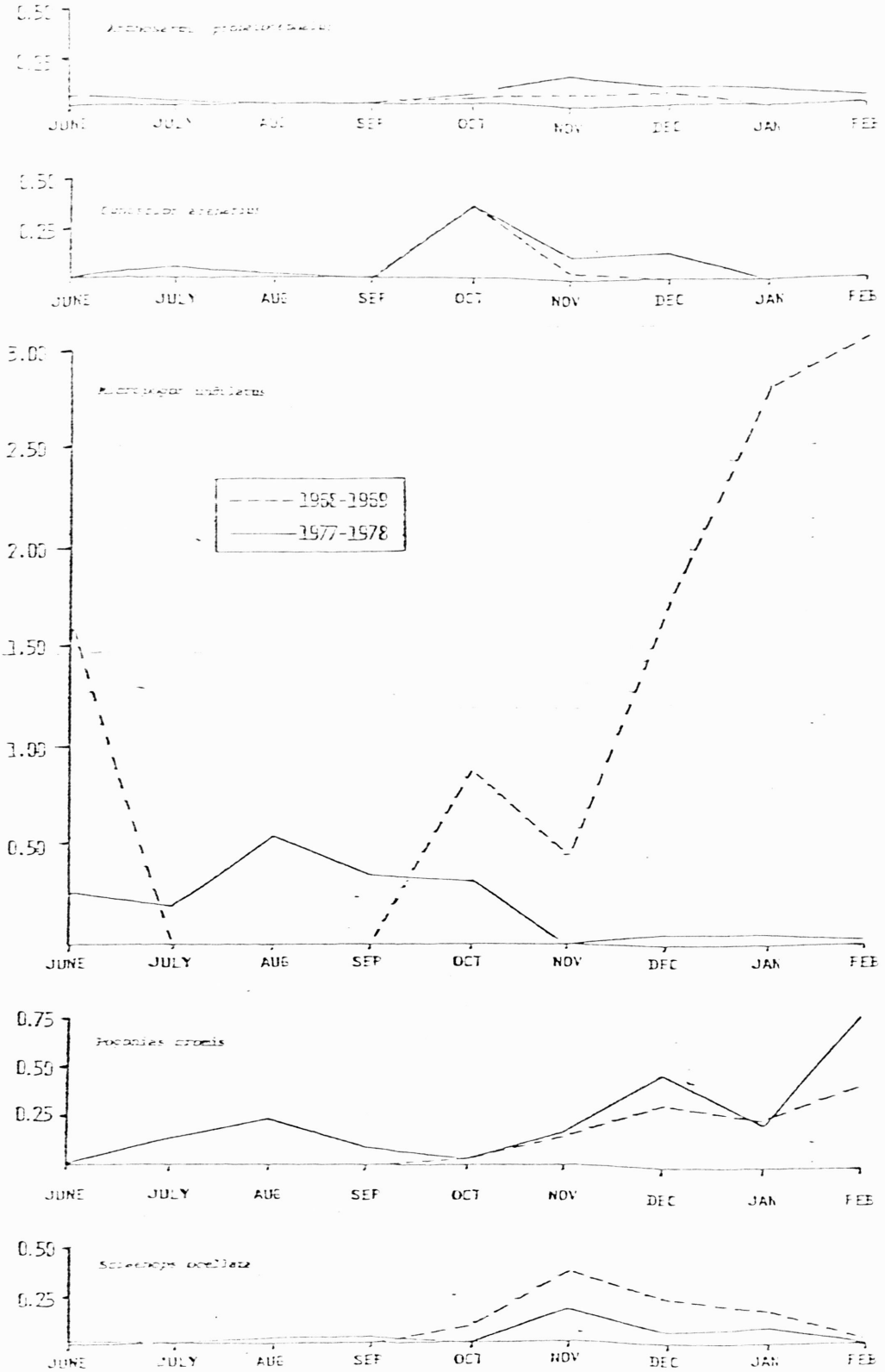

Figure 6. Monthly mean number of Archosargus probatocephalus, Cynoscion arenarius, Micropogon undulatus, Pogonias cromis and Sciaenops ocellata per fisherman at the P.H. Robinson outfall area during June through February 1968-1969 and 1977-1978.

Black drum (Pogonias cromis) were caught during the summer and winter of 1977. Monthly retained catch rates for June, July, August and September 1977 (Table 2 and Fig. 6) were 0.01, 0.14, 0.24, and 0.10 fish per man, respectively. In contrast, Landry and Strawn (1973) reported no black drum taken during June through September 1969. Catch rates during November 1977 through February 1978 ranged from 0.17 to 0.76 fish per man. Catch rates ranged for the same period of 1968-1969 ranged from 0.14 to 0.40 fish per man.

Retained catch rates for red drum (Sciaenops ocellata) were less than 0.03 fish per man during July through September 1977 (Table 2 and Fig. 6). No red drum were caught during this same period in 1969. Red drum catch rates were lower during October 1977 through February 1978 than for the same period of 1968-1969. Highest monthly catch rates for red drum (0.35 fish per man for 1968-1969, 0.17 fish per man for 1977-1978) occurred in November for both censuses.

Angling pressure was higher during summer 1977 than during summer 1969 (Fig. 7). Fishing pressure during July, August and September 1977 was 12.2, 10.3, and 11.3 shore fishermen per census, respectively. In contrast, Landry and Strawn (1973) reported 0.2, 0.0, and 4.0 shore fishermen per census for July, August and September 1969, respectively. Fishing pressure during the present study and the Landry and Strawn (1973) census was generally higher during the winter than during the summer.

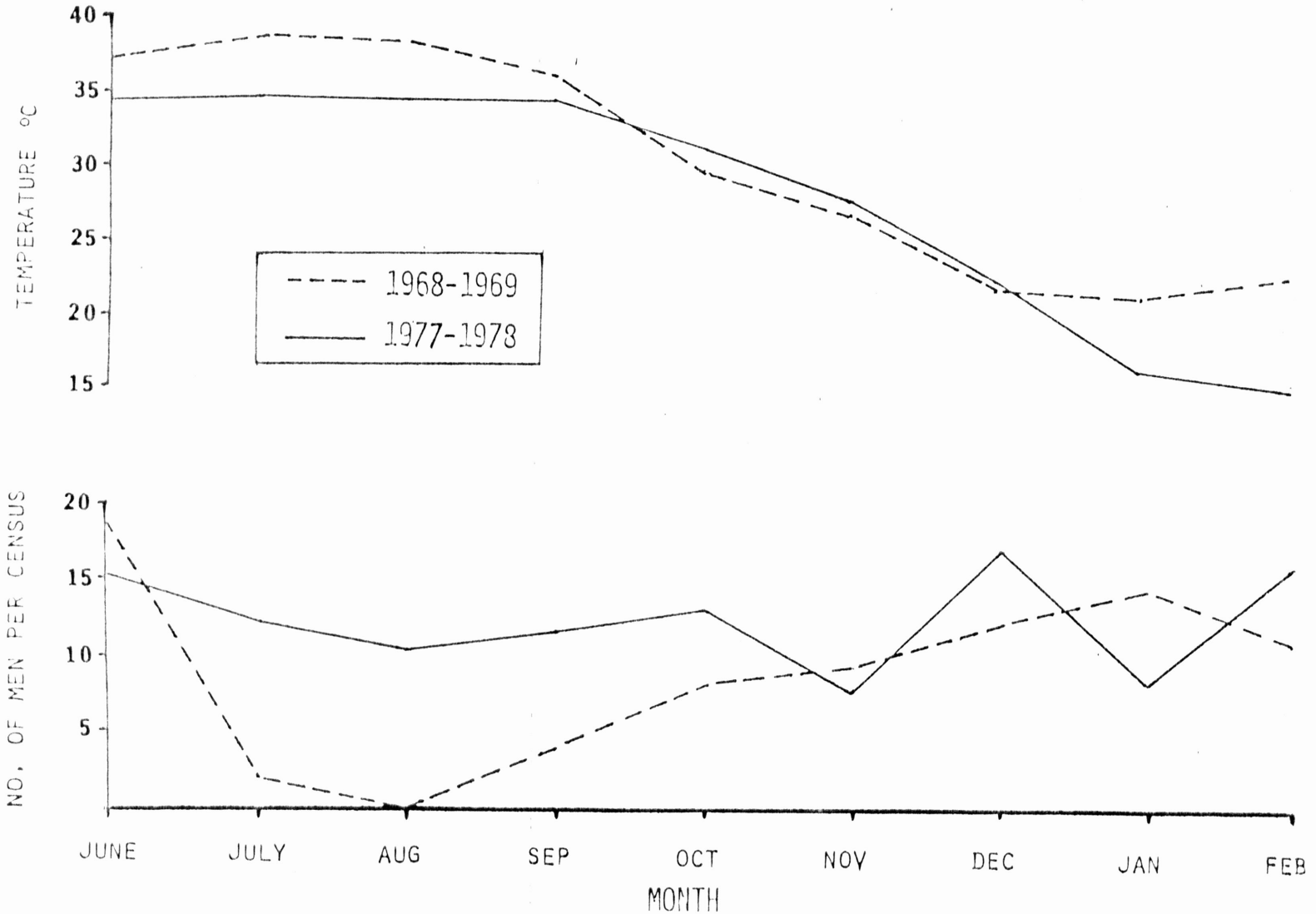

Figure 7. Monthly mean discharge water temperature and mean number of fishermen per census at the P.H. Robinson outfall area during June through February 1968-1969 and 1977-1978.

DISCUSSION

Comparison of census data before and after installation of cooling towers at the P.H. Robinson Generating Station indicates that a reduction in discharge water temperature during summer months effectively increased catch rates of popular game fish at the outfall area. Atlantic croaker and black drum were caught in July, August and September of the present study. Sand seatrout were caught in July and August and a few red drum were caught in August and September. None of these species were reported during creel surveys taken in July, August, and September 1968 prior to the installation of cooling towers. During the present study cooling towers were effective in maintaining water temperature below 35.0C whereas 1968 temperatures were as high as 40.5C. Water temperatures in excess of 35C during June through September 1969 appeared to cause game fish such as sheephead, sand seatrout, Atlantic croaker, black drum, and red drum to move out of the outfall area.

Winter catch rates for black drum, sheephead, and sand seatrout during the present study were generally higher than rates recorded during the Landry and Strawn (1973) census. Increased flow rates of heated water resulting from addition of a 750-MW generating unit may have attracted greater numbers of these fish into the discharge area. Winter catch rates for red drum and Atlantic croaker during 1977-1978 were lower than similar catch rates in 1968-1969. High flow rates and/or the extremely cold winter of 1977-1978 possibly caused movement of these fish away from the discharge area. Reduced feeding due to lower metabolic rates may have occurred during the severe winter of 1977.

Increased fishing intensity during the summer reflects the in-

creased catch rates for popular game fish which have occurred since the installation of cooling towers and the Landry and Strawn (1973) census. Poor fishing conditions due to inclimate weather during the winter 1977 probably caused fishing pressure to be lower than it otherwise would have been. Heavy fishing pressure and good catch rates throughout the year indicate that the Robinson discharge area is still a good shore based fishing site.

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