Proceedings Of The
Second Annual
Hackensack River Symposium

1988

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The First Hackensack River Symposium was held on September 17, 1987; regretably, the proceedings were not published. The Second Hackensack River Symposium was held on September 13, 1988. Eight talks were given and there were 45 registrants. The enclosed papers, abstracts and titles describe the presentations.

We plan to publish the proceedings of all subsequent symposia, and thereby build up a valuable repository of information on the Hackensack River and on environmental studies in general.

The New Jersey Marine Sciences Consortium has provided financial support for these symposia.

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FISHES OF THE LOWER HACKENSACK RIVER

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INTRODUCTION

The Hackensack River originates in the Palisades near Haverstraw, New York and flows approximately south for some 50 miles to its mouth at Newark Bay (Kassner, 1971). In 1922 a 2.85 billion gallon reservoir was formed by a dam built above the head of tide at Oradell. This effectively separated the river into a controlled, freshwater area above, and an estuarine, brackish area below the dam (McCormick and Associates, 1977). The tidal portion of the river, from its confluence with Newark Bay to New Milford, New Jersey reaches some 22.5 miles and flows through heavily industrialized and populated Bergen and Hudson counties.

The Oradell Dam has severely restricted freshwater flow into the Hackensack River. At this time approximately 50% of the freshwater input is derived from precipitation, while treated sewage discharges account for approximately 30%, and the remainder is derived from the release of water held in the Oradell reservoir (Cheng and Konsevick, 1988). Three hundred years ago this system was a freshwater white *cedar (Chamaecyparis thyoides)* bog, but repeated attempts to drain the marshes by ditches and dikes, using the wetlands as a repository for solid waste, and municipal and industrial discharges have resulted in the present condition of the river and its surrounding wetlands (Kraus and Smith, 1988).

In order to improve the fishery resource knowledge of this estuary, the Hackensack Meadowlands Development Commission began collecting water quality and fisheries data in February 1987. Twenty one sampling sites were selected, based on habitat diversity and compatibility with fishing gear (Figure 1).

MATERIALS AND METHODS

Four different gear types were used. A 16 foot otter trawl (3/4 inch square body mesh, 5/8 inch square cod-end mesh, 1/4 inch mesh cod-end liner) was towed for 3' minutes at 2300 r.p.m. at 9 sites, with 2 repetitions per site. A 20 foot commercial Privateer with a 120 h.p. outboard motor was used for towing. Trawls were towed unbridled with 5/8 inch polydacron rope fastened to the transom of the vessel, and deployed with the vessel in forward motion, with tension on the tow ropes and against the prevailing surface current. A minimum 5: 1 ratio of tow rope length to station depth was maintained. The net was retrieved by hand.

A 60 foot long by 6 foot high by 1/4 inch bag seine was used at 3 sites. The seine was walked through the water in a semi-circular pattern against the shoreline.

A 200 foot long by 8 foot high experimental sinking gill net consisting of four 50 foot panels of 3/4 inch, 1 3/4 inch, 3 1/2 inch, and 4 inch square mesh was used at 3 sites. It was deployed with cinder blocks attached to both leadlines and two bouys attached to the blocks for marking. Sets were fished for approximately 24 hours.

An Indiana Trap Net with a 50 foot leader, made up of 1/2 inch square mesh was fished at 6 sites. The nets were deployed at or near low tide and staked with three wooden dowels 1 5/8 inch in diameter and approximately 14 feet long, one at the lead end and two at the first frame brace. A cinder block was attached to the cod-end. The net was pulled taut until it stood erect and was perpendicular to the shore by means of a floatline attached to the cod-end cinder block. These nets were also fished for approximately 24 hour sets.

Fishes were identified and counted, and a subsample was measured in the field. Most fish were released, but some specimens were preserved in 10% formalin and taken back to the laboratory for further identification or as reference specimens. Numbers in large catches of fish or invertebrates were estimated by counting a subsample.

During each sampling event basic water quality parameters were measured. Dissolved oxygen was measured using a Yellow Spring Instrument Company (Y.S.I.) model 57 oxygen meter. The pH was measured using either a Cole-Parmer electronic pH pen or a Beckman model 21 pH meter. Salinity was measured using either a Y.S.I. model 33 Salinity-Temperature-Conductivity meter or an American Optical model 10419 temperature compensated refractometer. Water clarity was measured using a one foot diameter Secchi disk and temperature was measured using either the Y.S.I. oxygen meter or the Beckman pH meter.

RESULTS

Data from the first year of the study period, from February 1987 through January 1988 (when each site was sampled monthly), showed that the surface water temperature ranged from 2.9-37.0 °C. The dissolved oxygen levels ranged from 1.0-15.5 mg/l, and salinity ranged from O-16 parts per thousand (0/00) (see Figures 2 to 4 for monthly averages).

During this period a total of 339 collections were made, and these consisted of 211 trawl hauls, 61 trap net collections, 36 seine hauls and 31 gill net sets. Thirty one species of fish were taken. The 10 most abundant and commonly occurring fish were the mummichog (*Fundulus heteroclitus*), Atlantic silverside (*Menidia menidia*), inland silverside (*Menidia beryllina*), white perch (*Morone americana*), blueback herring (*Alosa aestivalis*), Atlantic tomcod (*Microgadus tomcod*), brown bullhead (*Ictalurus nebulous*), pumpkinseed (*Lepomis gibbosus*), American eel (*Anguilla rostrata*) and bay anchovy (*Anchoa mitchilli*). The mummichog comprised 91% of the total catch of 43,393 fish, followed by Atlantic silverside (2.5%), inland silverside (1.4%), and white perch (1.3%). The other 27 species combined constituted 3.8% of the total catch. Also collected were 23 species of invertebrates. From these incidental catches it is evident that there are large populations of apparent prey species, such as white fingered mud crab (*Rhithropanopeus harrisii*), mysid (*Neomysis americana*), sand shrimp (*Crangon septemspinosa*), shore shrimp (*Palaemonetes pugio*) and several species of amphipod. Also taken were 103 blue crab (*Callinectes sapidus*), 49 northern diamondback terrapin (*Malaclemys t. terrapin*) and 4 common snapping turtle (*Chelydra s. serpentina*).

During the second year of the study, from February 1988 through August 1988 (when each site was sampled quarterly), 26 species of fish were taken. Three of these were not captured prior to January 1988; spotted hake (*Urophycis regia*), striped mullet (*Mugil cephalus*) and yellow bullhead (*Ictaluris natalis*). Sixty seven collections consisted of 26 trawl hauls, 28 trap net collections, 6 seine hauls, and 7 gill net sets. The most abundant fishes during the second year were the mummichog, inland silverside, white perch, brown bullhead, striped killifish (*Fundulus majalis*), blueback herring, Atlantic silverside, striped bass (*Morone saxatilis*) and pumpkinseed. The mummichog comprised 85% of our total catch of 11,562 fish, followed by inland silverside (9.2%), white perch (2%), and brown bullhead (1.4%). The remaining 22 species combined comprised 2.4% of the total catch for this period. We also collected 191 blue crab, 18 northern diamondback terrapin, and 2 eastern painted turtle (*Chrysemys p. picta*), along with 11 species of invertebrates as part of our incidental catches.

A total of 34 species of fishes were taken from February 1987 to August 1988 (Table 1).

DISCUSSION

The water quality of the Hackensack River fluctuates during the course of the year. During the spring the salinity is generally low, water temperatures begin increasing toward their summer peak and the dissolved oxygen levels are relatively high. As summer approaches the water quality seriously declines (see Figures 2-4). This is due to low freshwater input, increased water temperatures and extremely low dissolved oxygen levels, conditions which are probably stressful to the biota of the river. Beginning in autumn and continuing into winter, water temperatures decline and dissolved oxygen levels rebound to levels more hospitable to aquatic life.

Based on our first year of data the fish community seemed to vary on a seasonal basis, almost regardless of water quality. This is evident when the total number of all fish taken (mmnrnichog excluded) are plotted by month (Figure 5). Two catch peaks are noted, one in May (when water quality is declining), and another larger peak in October (when water quality is starting to improve). These peaks also correspond to periods of seasonal use, such as spring and fall migrations. Fishes using the estuary as a refuge from preadators, and/or as a nursery area due to the abundant supply of food also contributed to these peaks.

Fishes found in the spring included migrants such as the alewife (*Alosa pseudoharengus*), Atlantic tomcod, blueback herring, and striped bass, and those seeking food and shelter, the Atlantic menhaden (***Brevoortia tyrannus***) and bluefish (***Pomatomus saltatrix***). Some of these fishes occurred most of the year, the alewife was caught during 10 months of the year and the tomcod was caught during 9 months. Some species (Atlantic tomcod, blueback herring, and bluefish) were not collected during July and August, because they either moved out of our sampling area or left the estuary altogether, perhaps due to poor water quality (possibly low dissolved oxygen). These fishes returned in the fall, as most of the spring migratory species were leaving the river. This, along with other species that were just beginning to enter the estuary, such as the weakfish (***Cynoscion regalis***) and winter flounder (***Pseudopleuronectes americana***), yielded a larger fall peak. It should be noted that resident species such as the white perch, inland silverside, brown bullhead, pumpkinseed, ***carp*** (*Cyprinus carpio*) and American eel also contributed to the seasonal peaks.

After the first year of study it seemed apparent, on the basis of salinity and types of fish taken, that there were “sections” in the portion of the river studied. Therefore we divided the river into upper, middle and lower zones, based on our sampling locations. Each zone contained one trawl, seine, gill net, and trap net station (Figure 1). An average annual surface salinity was calculated by averaging all of the observed surface salinities from the four stations within each zone. In addition a species list was generated for each zone (Table 2). In the “lower” river the average annual salinity was 9.4 O/OO. Twenty-two species of fish were taken; seven were marine, six diadromous (either migrating from the ocean to freshwater, or from freshwater to the ocean), five estuarine and four freshwater. Blue crab and diamondback terrapin were also taken in this area. In the “middle” river the average annual salinity was 5.6 O/OO. Twenty-one species of fish were taken; six marine, seven diadromous, four estuarine and four freshwater. Blue crab and diamondback terrapin were also present. At our upper sampling limit, the average annual salinity was 3.4 O/OO. Fourteen species of fish were taken here; none were marine, but three were diadromous, four estuarine and seven were freshwater. No blue crab were taken, and the snapping turtle replaced the diamondback terrapin here.

The "lower" and "middle" zones of the river proved similar in terms of the number of species and fish groups found. The salinities here are in the mesohaline range (18.0 to 5.0 0/00). The "upper" zone differs from the others in terms of number and groups of fish species, as well as salinity. Salinity here is oligohaline (5.0 to 0.5 0/00). In general the mesohaline zone exists from River Mile (RM) O-10 (the mouth of the river to Cromakill Creek), the oligohaline zone from RM 10- 16 (Cromakill Creek to just upriver of Hackensack) and the tidal freshwater zone from RM 16 to Oradell Dam. The freshwater segment is the longest generally during winter and spring, due to rain, snow and ice melt, and it shrinks in summer and autumn, during periods of low freshwater input and increased evaporation. As the freshwater segment shrinks, the meso- and oligohaline segments expand upstream, at times upriver to the dam (P.S.E.&G., 1988). Further upstream, outside of the Hackensack Meadowlands District, we would have encountered an increasingly freshwater system and fish community.

CONCLUSIONS

The Hackensack River and its associated wetlands have been greatly impacted by man. Construction of a dam at Oradell has greatly altered the original river hydrology, and consequently it no longer functions as a "normal" estuarine river. It is now essentially a canal, open fully only at the end adjacent to Newark Bay. Although the river is not fishable due to restrictions imposed by the New Jersey Department of Environmental Protection, this estuary is a refuge and nursery area for several important commercial and recreational species, such as striped bass, Atlantic menhaden, wealdish, winter flounder, alewife, and blueback herring, and for two species listed threatened by the State of New Jersey, the Atlantic tomcod and American shad. Contrary to the misconception that the Hackensack River is "dead", our data show that the river is very much alive and supports moderately diverse fish and invertebrate communities.

LITERATURE CITED

Cheng, C. and E. Konsevick. 1988. Trends in the water quality of an urban estuary: Hackensack Meadowlands, N.J. Proceedings of the Symposium on Coastal Water Resources. AWRA, TPS-88-l: 147-154.

Kasner, J. J. and Co. 1971. Feasibility report, water pollution control systems in connection with the development of the Hackensack Meadowlands, Bergen and Hudson counties. Prepared for State of New Jersey, Hackensack Meadowlands Development Commission. 148pp.

Kraus, M.L. and D.J. Smith. 1988. Competition and succession in a perturbed urban estuary: the effects of hydrology. Proceedings of the National Wetland Symposium: Mitigation of Impacts and Losses, ASWM Technical Report 3: 325-327.

McCormick, J., and Associates. 1977. Draft Assessment of the potential environmental impact of the construction and operation of a New Jersey sports and exposition complex at a site in East Rutherford, Bergen County, New Jersey. 91pp.

P.S.E.&G. 1988. Hudson Generating Station Units 1 & 2 and Kearny Generating Station Units 7 & 8, Supplemental 316(a) Demonstration. Newark, N.J. 30 April, 1988. 179pp.

Table 1. Species list of fish, by alphabetical order by genus, collected from the Hackensack River, Sawmill Creek, Berrys Creek Canal, Mill Creek and Cromakill Creek, February 1987 to August 1988.

Scientific name	common name
Alosa aestivalis	blueback herring
Alosa pseudoharengus	alewife
Alosa sapidissima	American shad
Anchoa mitchilli	bay anchovy
Anguilla rostrata	American eel
tyrannus	Atlantic menhaden
caranx hippos	crevalle jack
Carassius auratus	goldfish
Cynoscion regalis	weakfish
Cyprinus carpio	carp
Dorosoma cepedianium	gizzard shad
Fundulus heteroclitus	mummichog
Fundulus majalis	striped killifish
Gobiosoma ginsbergi	seaboard goby
Ictalurus natalis	vellow bullhead
Ictalurus nebulosus	down bullhead
Leiostomus xanthurus	spot
Lepomis gibbosus	pumpkinseed
Lepomis machrochirus	bhiegill
Menidia beryllina	inland silverside
Menidia menidia	Atlantic silverside
Microgadus tomcod	Atlantic tomcod
Morone americana	white Perch
Morone saxatilis	striped bass
Mugil cephalus	striped mullet
Notemigonus crysoleucas	golden shiner
Osmerus mordax	rainbow smelt
Pefca flavescens	yellow perch
Pomatomus saltatrix	bluefish
Pomoxis nigromaculatus	black crappie
Pseudopleuronectes americana	winter flounder
Sygnathus fuscus	northern pipefish
Urophycis regia	spotted hake
Lepomis sp. ?	unidentified sunfish

Table 2. Average annual surface salinity and list of fish species taken in each of the three river "zones".

"LOWER" RIVER
AVERAGE SURFACE SALINITY = 9.4 0/00

MARINE	ESTUARINE	DIADROMOUS	FRESHWATER
Atlantic menhaden	inland silverside	alewife	black crappie
Atlantic silverside	mummichog	American eel	bluegill
bay anchovy	northern pipefish	Atlantic tomcod	carp
bluefish	striped killifii	blueback herring	pumpkinseed
crevalle jack	white Perch	rainbow smelt	
weakfiih		striped bass	
winter flounder			

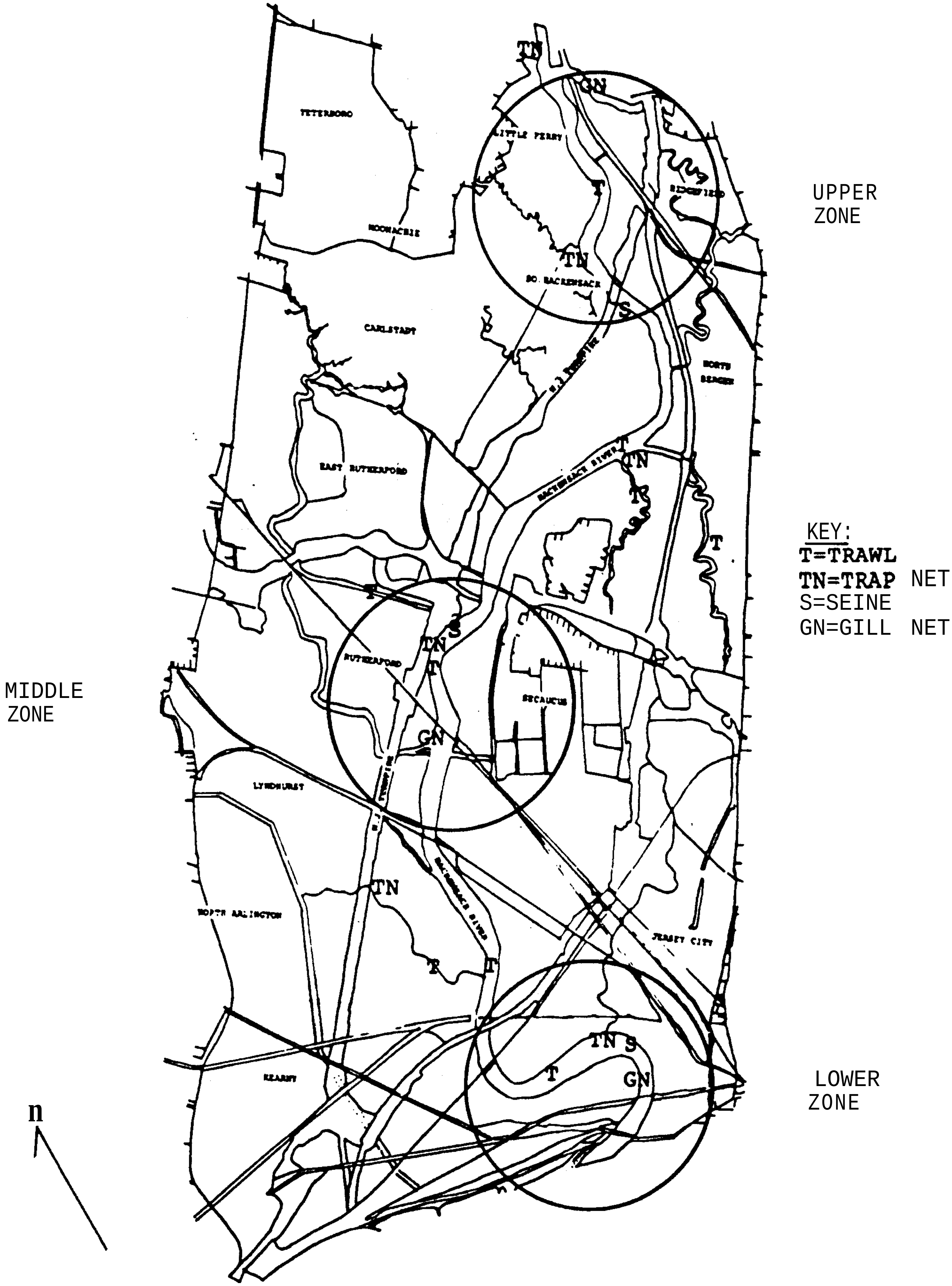
"MIDDLE" RIVER
AVERAGE SURFACE SALINITY = 5.6 0/00

MARINE	ESTUARINE	DIADROMOUS	FRESHWATER
Atlantic menhaden	inland silverside	alewife	brown bullhead
Atlantic silverside	mummichog	American eel	carp
bay anchovy	striped killifish	American shad	pumpkinseed
crevallc jack	white perch	Atlantic tomcod	unidentified sunfish
weakfiih		blueback herring	
winter flounder		seaboard goby	
		striped bass	

"UPPER" RIVER
AVERAGE SURFACE SALINITY = 3.4 0100

MARINE	ESTUARINE	DIADROMOUS	FRESHWATER
	inland silverside	alewife	black crappie
	mummichog	American eel	brown bullhead
	striped killifish	blueback herring	carp
	white perch		gizzard shad
			golden shiner
			pumpkinseed
			unidentified sunfish

Figure 1. Map of The Hackensack River within the Hackensack Meadowlands District, showing fishery sites.



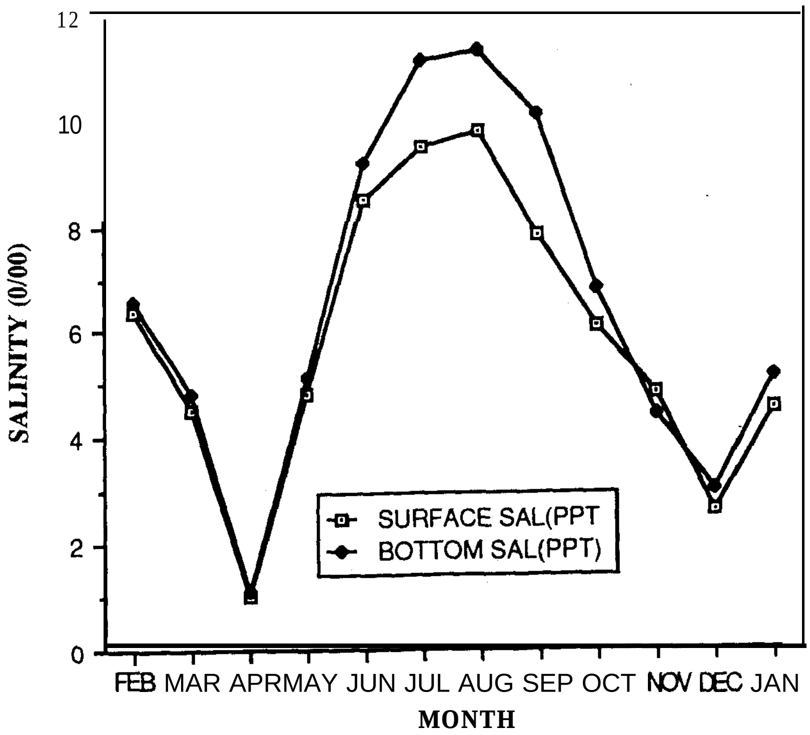


Figure 2. Average monthly salinity, Hackensack River, February 1987-January 1988.

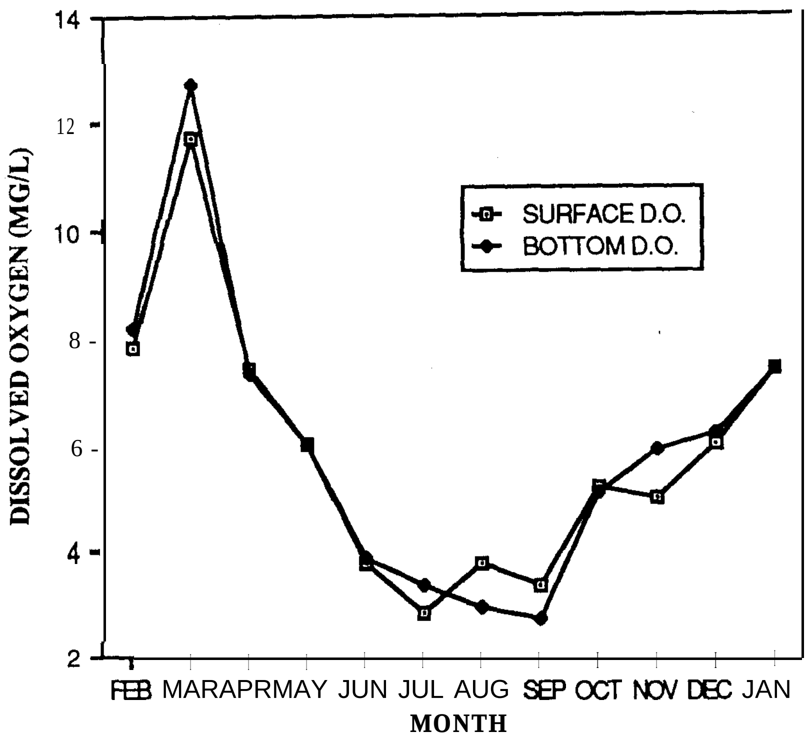


Figure 3. Average monthly dissolved oxygen, Hackensack River, February 1987-January 1988.

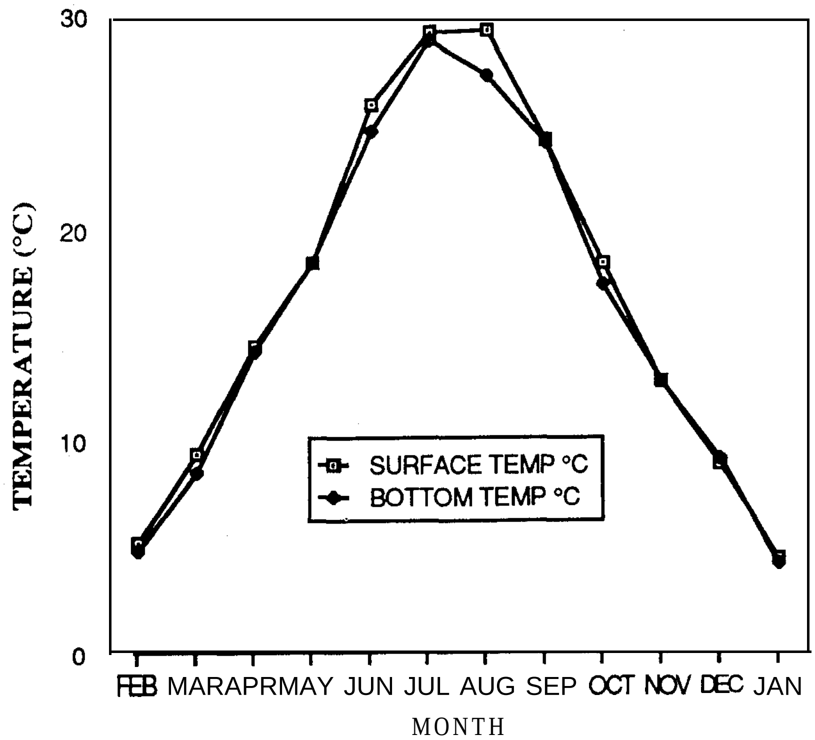


Figure 4. Average monthly temperature, Hackensack River, February 1987-January 1988.

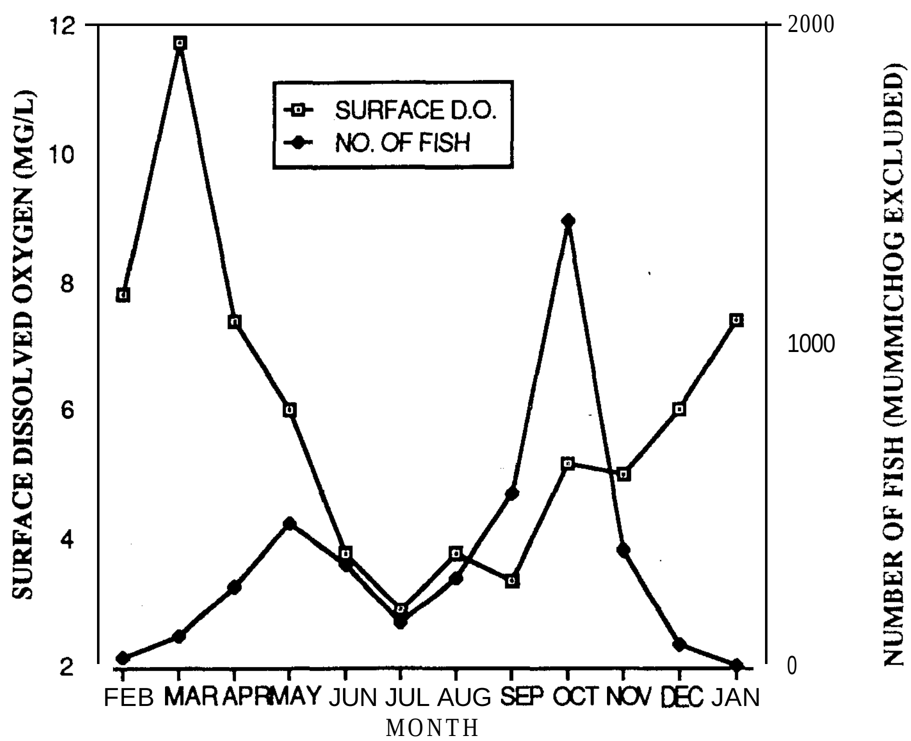


Figure 5. Number of all fish caught and dissolved oxygen levels, Hackensack River, February 1987-January 1988.