

**Fishing at Chesterfield Pier, Lake St. Clair,  
and an Evaluation of Tires and Soybean Meal  
as Fish Attractors**

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES  
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FISHING AT CHESTERFIELD PIER, LAKE ST. CLAIR, AND  
AN EVALUATION OF TIRES AND SOYBEAN MEAL  
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<sup>1</sup>Contribution from Dingell-Johnson Project F-35-R, Michigan

## Abstract

Chesterfield (Brandenburg) Pier was constructed on Anchor Bay, Lake St. Clair, in 1976 at a cost of \$400,000. It was popular with shore fishermen initially and generated over 64,000 hours of fishing pressure the first year. However, pressure dropped to 4,000 hours by the seventh year, mainly due to the realization that fishing was consistently poor. Pier catch rates averaged only 0.1 fish per hour, considerably less than for other shore fishing sites. Addition of old tires and soybean meal did not attract enough fish to the pier area to improve fishing. The tires and soybean meal probably were not added in sufficient quantities to create an attractive fish habitat. The pier area lacks rivers or canals and rock riprap which characterize better shore fishing sites.

## Introduction

There are many anglers in large urban areas who cannot afford to buy boats and trailers for fishing in public waters. This is especially true in large bodies of water (e.g., Great Lakes and connecting waters) where larger and more expensive boats are often necessary to insure safety. Access to these waters can be provided either by shoreline access or by the more costly means of building piers which extend out into deeper water. In Lake St. Clair, located near the metropolitan area of Detroit, it was thought that construction of piers would provide urban residents with additional fishing access to the lake and at the same time improve fishing quality over that of shore anglers.

Late in the summer of 1974 construction began on a fishing pier to provide the non-boating public with easy access to the deeper, more open water of Anchor Bay. The pier, then known as Chesterfield Pier and now called Brandenburg Pier, was built on the shoreline property of Brandenburg Park -- a township park. The park is located in the northwest corner of Anchor Bay, approximately 25 miles north of the center of Detroit. The shoreline for miles on either side of the park, although heavily settled, is a mixture of both urban and rural areas.

The park is open from 6 A.M. to 10 P.M. during high-use periods. Admission is charged for cars and trailers. The fee has gradually increased from 1 to 3 dollars. Night fishing, which might be productive for channel catfish, walleye, and crappie, is largely excluded by the 10 P.M. closing.

The pier was constructed in the form of a "T" on clay soil (Fig. 1). It extends approximately 500 feet out from shore to where the water is 5 feet deep. The bottom on either side of the pier was dredged approximately 5 feet deeper than the existing lake bottom in order to attract fish. Because the bottom in the vicinity of the pier was

very barren, especially after dredging, it was anticipated that the pier alone would not attract enough fish for heavy angler usage. Therefore, it was decided to provide additional fish cover or attractors with the expectation of improving fishing quality.

Prior to the initiation of this study it was known from the literature (Steimle and Stone 1973; Colunga and Stone 1974) that artificial cover and reefs do attract and congregate game fish both in salt water and fresh water habitats. Reefs constructed of old tires have been especially successful and relatively cheap. Automobile tires have been used for reef construction in many areas of the country, but not as an additional fish attractor at an already established fishing pier. Furthermore, few studies have evaluated the true effects of fish shelters on fishing quality both before and after their installation. Prince and Maughan (1979) made counts of fish both before and after tire reefs were installed but did not measure the changes in the quality of fishing at these reefs. Wilbur (1978) compared the quality of fishing at fish attractors in Lake Tohopekaliga, Florida, with the quality of fishing in other parts of the lake but, like other investigators, did not measure differences in fishing quality at the structures both before and after their installation.

Soybean meal is also reported to be a fish attractor (Wilbur 1978). In Lake Tohopekaliga, fishing was much improved when sacks of soybean meal were anchored along with fish shelters. The Chesterfield Pier was considered a good place to further test the attractiveness of the meal.

This report describes the fishery created by construction of the pier and evaluates the addition of tires and soybean meal as fish attractors.

## Procedures

A preliminary study was conducted in 1975. All 26 shore fishing sites on Anchor Bay and its canals were spot censused in April-September. Estimates of monthly fishing pressure, catch, and catch per hour appear in Table 1. From this study it was determined that most of the fishing occurred at only three of the sites and that these three would adequately serve as controls for the pier studies.

For the pier studies, fishing was monitored by means of spot census from May or June through September 1976-82. Census clerks sampled anglers at the following sites:

1. Chesterfield Pier, Brandenburg Park (referred to as "pier"). Pier angling.
2. Brandenburg Park (referred to as "shore"). Shore angling.
3. Ensign Memorial Access Site (referred to as "Ensign"). Located at the mouth of the Clinton River. Only shore fishermen were interviewed.
4. Metropolitan Beach Metropark (referred to as "Metro Beach"). Located along the west shore and the mouth of Black Creek. Only shore fishermen were interviewed.
5. Selfridge Field Access Site (referred to as "Selfridge"). All angling from shore. Only fishing pressure data were collected during 1976-77; all types of census data were collected in 1978-82, after the site was fully developed.

Fishing at the pier was compared with fishing at these other sites. For the evaluation of the tire reef, Ensign and Metro Beach served as control sites. For the evaluation of soybean meal, Ensign, Metro Beach, and Selfridge served as controls.

At the pier, anglers were counted randomly within three

stratified time periods (6-11 A.M., 11 A.M.-5 P.M., and 5-10 P.M.). At the control sites the fishing day was the same duration but angler counts were not stratified into time periods. All counts of anglers were instantaneous. Monthly estimates of hours fished were based on the product of the mean instantaneous counts, the fishing hours in a time period, and the number of days in the month. Estimates of catch per hour were based on randomly interviewed anglers within the same time period and were derived from both complete and incomplete interviews. Both estimates of hours fished and of catch per hour represent the sum of estimates calculated separately by weekend and weekday periods within each month. Estimates of hours per trip were based only on completed interviews. Estimates of the total number of trips were obtained by dividing total hours fished by average hours per trip. A grand mean and its confidence limits ( $p = 0.05$ ) were calculated based on the yearly averages.

After collecting baseline data on the fishing quality at the pier, shore, and control stations for 2 years, 1976 and 1977, car tires were installed at the end of the pier in May 1978 to attract more fish. Divers placed 212 14-inch tires, in units of 10 each, both under the end of the pier and on a perimeter 30 feet out from the edge of the pier (Fig. 1). Each tire was weighted down by a bag of cement. The units were placed on the lake bottom on their running surfaces and arranged in a daisy-like configuration (James Walton, personal communication).

After the effect was evaluated the tires were left in the lake and mill-ground soybean meal was added from July to September 1981, and from June to September 1982. To simplify the presentation of data, the soybean meal application period has been designated as June to September 1981-82. The meal was applied by suspending three 25-pound burlap bags under the pier. The bags were inspected monthly and the meal was replenished. The contents would dissolve

in about 1 month. Some trouble was experienced the second year because fishermen hooked some of the bags and cut them loose or ripped them open. The bags and meal were replaced as soon as the problem was discovered. It was anticipated that the meal would attract forage fish which would, in turn, attract sport fish.

In order to determine if there were any yearly or seasonal changes in abundance of fishes around the pier which might affect fishing quality, two 4-foot high trap nets with 100 foot leads were set and lifted each month. The nets were set perpendicular to shore, about 100 feet from each side of the pier. During the middle of every month, May through October, each net fished for two 48-hour periods and one 72-hour period (weekend). Fish were fin clipped and returned to the lake to determine if they stayed near the pier or were transient.

The names of the fish referred to in the report are from the American Fisheries Society Special Publication No. 12, "A list of common and scientific names of fishes from the United States and Canada", fourth edition (1980).

## Results

Fish species at the pier.--Trap netting revealed the kinds of fish which frequented the pier area (Table 2). The major sport species in May and June were yellow perch, channel catfish, white bass, pumpkinseed, rock bass, and black crappie. During July and August channel catfish, white bass, white and black crappie, and brown bullhead were most abundant. In September-October, yellow perch, walleye, and drum increased.

Fish were highly transient. Only about 2% of the fin-clipped fish were recaptured.

Generally, the quality of fishing for a given species was correlated with its abundance around the pier. However, some of the best yellow perch fishing occurred during July,



even though few were caught in nets then, and white bass and crappies were caught by angler mostly in June even though they were abundant throughout the year.

Pier fishing.--Construction of the pier created fishing opportunities where none previously existed for anglers without boats. The facility was attractive, popular, and a good spot to socialize, but census data showed it was a poor place to catch fish.

A questionnaire was administered to over 3,600 pier anglers in 1976, the first year the pier opened. Nearly all (96%) users believed that building the pier was a good or excellent project for fishermen, but they were about equally divided as to whether pier fishing was better, equal to, or worse than fishing at other shoreline sites. Most anglers were seeking any type of fish. Nearly all of the anglers lived in surrounding communities, and about 50% were from Detroit, Mt. Clemens, Sterling Heights, and Warren.

Records for 1977 show that 95% of the anglers came to the pier only once that year. Because so few users made repeat visits to the pier, hours of fishing pressure took a strong downward trend, declining from 64,000 in 1976 to 26,000 in 1977-80, to 4,000 in 1981-82 (Table 3). Fishing pressure at the control sites (shore, Metro Beach, and Ensign) declined less. Use of the Selfridge site jumped in 1978-80 when the site was improved.

Catch from the pier declined as pressure declined (Table 4). Catch of all species fell from over 4,000 in 1976 to less than 400 in 1981-82.

The quality of fishing was consistently poor at the pier (Table 5). On the average it took over 10 hours to catch a fish worth keeping. Shore fishermen at the foot of the pier had a similar poor success rate, whereas, shore fishing at the control sites was up to four times better. Pier success peaked in May (0.13 fish per hour) and dipped in August (0.04 fish per hour).

Effect of tires.--Netting results indicated that fish were attracted by the tires (Table 2). The average number of game fish caught per net set increased, especially during May, June, and July. Yellow perch, rock bass, and black crappie were considerably more abundant, whereas bluegill and gizzard shad clearly declined.

However, the effect of the tire reef on the pier fishery was negligible (Table 6). Fishing quality was  $0.07 \pm 0.01$  fish per hour before the tires were installed and  $0.08 \pm 0.03$  afterwards -- a statistically insignificant increase. Furthermore, fishing quality for shore and control sites improved much more. Total catch and fishing pressure declined at the pier relative to both the before period and to other sites. Some improvements occurred in the perch fishery at the pier, however, perch fishing improved at the other sites also (Tables 7 and 8). Crappie fishing did not improve. The catch per hour of rock bass doubled but the number harvested declined.

In summary, the tire reef may have attracted more fish to the pier but only a very slight improvement in rock bass fishing success took place.

Effect of soybean meal.--The effect of adding soybean meal to the water around the pier was evaluated by comparing fishing quality and net catches before (June-September 1978-80) and after (June-September 1981-82). The tire reef was in place during both periods.

Application of soybean meal did not attract more fish to the pier. Actually, net catches declined during the years the meal was applied (Table 2). This decline was probably due to a natural decline in the fish population rather than to repulsion by the meal. Schools of minnows were observed around the meal bags but apparently significant numbers of game fish were not attracted.

Pier fishing pressure fell to 16% of the 1978-80 level in 1981-82 (Table 9). This decline is believed to be due to

a combination of: (1) the realization that pier fishing was not as good as elsewhere, and (2) high unemployment reducing the willingness of anglers to travel further than necessary. Fishing pressure at the control sites remained stable.

Total catch declined correspondingly (Table 9). Catch rate improved very slightly, to 0.10 fish per hour, but fishing quality also improved at the control sites. Some minor increases occurred in species catches and catch rates, but similar changes occurred at the control sites (Tables 10-13).

In summary, addition of soybean meal did not attract sport fish or improve fishing at Chesterfield Pier. Minnows were frequently observed around the meal bags.

#### Discussion

Chesterfield Pier was built at a cost of \$400,000 (Ned Fogel, personal communication). Benefits have been marginal so far, but will continue to accrue over the long life span of the structure. To date, each hour of fishing has cost over \$2.00. The pier was popular initially and generated over 64,000 hours of fishing pressure in the first year, but pressure dropped to 4,000 hours annually by the sixth and seventh years. The decline was probably due to the realization that fishing was poor there. The catch rate of 0.10 fish per hour was about one-third that of other Lake St. Clair shore fishing sites and one-tenth that of the average inland lake (Schneider and Lockwood 1978).

Addition of tires and soybean meal did not attract significantly more fish to the pier or improve the fishery. The channels which were dredged alongside the pier when it was built were not evaluated separately but obviously did not help enough. The transient nature of the fish population was confirmed by the low (2%) rate of recapture. The failure of these techniques to attract and hold enough fish was surprising. Lake St. Clair is very shallow, flat-

bottomed, and relatively featureless. Fishing is generally best around channels, weed beds, old dock pilings, and stream mouths because fish are attracted to any irregularity.

The failure of these techniques at Chesterfield Pier contrasts with the bulk of the scientific literature. Usually artificial reefs attract fish, increase biological productivity, and improve fishing -- especially for sunfishes, bass, and crappie (Prince and Maughan 1978; Prince et al. 1975; Stone 1978; Wilbur 1978). All of these species are common to Lake St. Clair. Soybean meal was effective for attracting fish elsewhere (Wilbur 1978).

Another reef, constructed of rock, was placed in Lake Michigan off Muskegon. This reef has received very little fishing pressure, but netting in 1983 established that it attracted yellow perch (Merna and Galbraith 1984). Breakwalls along Lake Michigan have produced better catch rates than either the Muskegon Reef or Chesterfield Pier. In 1981, catch per hour estimates (mostly yellow perch) were 0.76 for the Muskegon Breakwall and 0.36 for the Grand Haven Breakwall.

Chesterfield Pier lacks natural features which attract fish. The better fishing sites -- Ensign, Metro Beach, Selfridge, Muskegon, and Grand Haven -- are all associated with rivers and canals. Most of these sites also have rock riprap which may be more attractive to fish and fish food organisms than tires or pier structures. Tires and meal may not have been added on a large enough scale at Chesterfield Pier to overcome the deficiency and create an attractive habitat and fishery.

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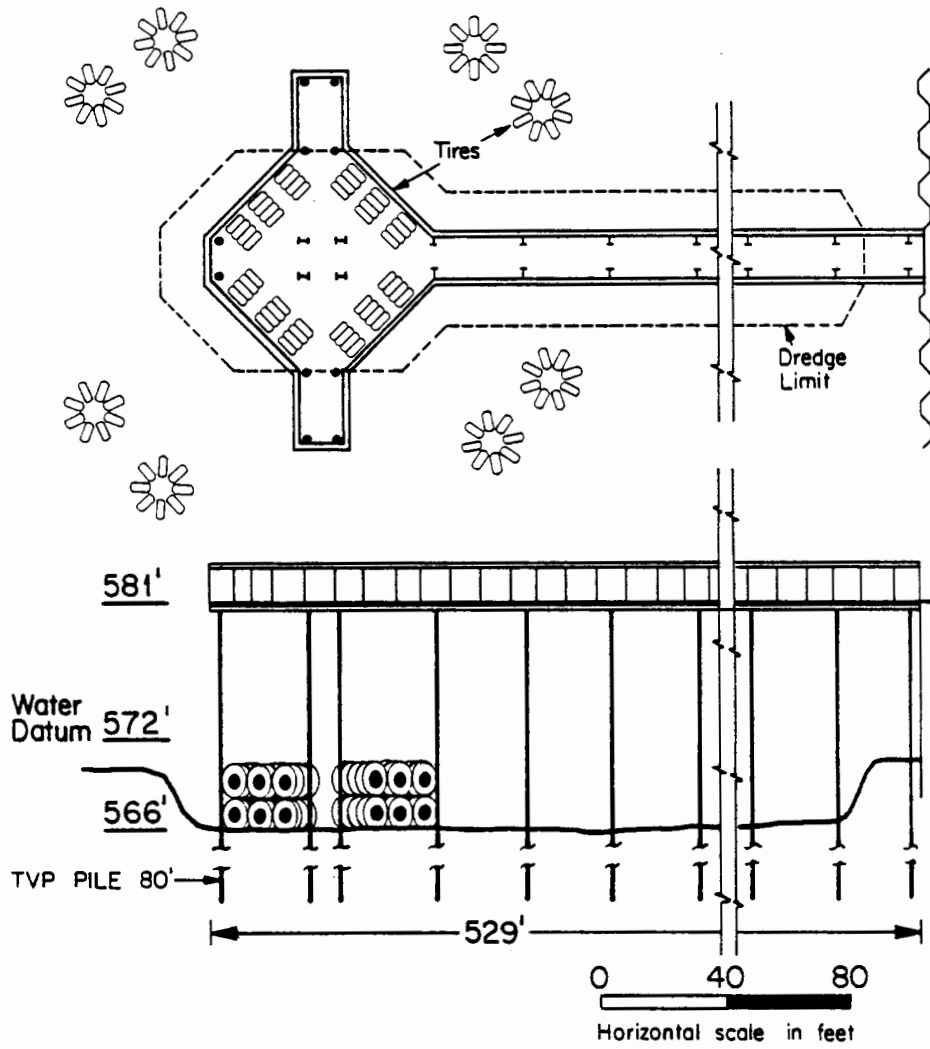


Figure 1. Schematic diagram of Chesterfield (Brandenburg) Pier, dredged area, and tire fish attractors.

Table 1. Shore fishing estimates for Anchor Bay in 1975 (26 sites, including Metro Beach, Ensign, and Selfridge).

Census parameters	Month						Total
	Apr	May	Jun	Jul	Aug	Sep	
Catch							
Perch	156	2,582	30	84	122	8	2,982 ±2,328
Drum	0	824	356	6,483	149	25	7,837 ±5,344
Rock bass	1,855	2,094	677	130	52	2	4,810 ±2,465
Largemouth bass	0	80*	70	117	0	0	267 ±143
Smallmouth bass	0	24*	0	182	0	0	206 ±129
Bluegill	310	473	334	727	34	0	1,878 ±926
Sunfish	0	342	174	13	93	29	651 ±377
Carp	0	125	2	0	2	0	129 ±133
Walleye	0	79	0	0	0	0	79 ±83
White bass	0	129	1,716	11	21	0	1,877 ±715
Catfish	0	51	48	122	7	0	228 ±186
Crappie	931	43	37	0	0	0	1,011 ±654
Suckers	0	99	81	0	0	3	183 ±123
Bullhead	0	87	76	11	0	0	174 ±115
Other	414	0	0	0	0	5	419 ±404
Total fish	3,666 ±1,897	7,032 ±3,017	3,601 ±893	7,880 ±5,354	480 ±308	72 ±65	22,731 ±6,501
Angler hours	19,269 ±5,853	21,858 ±2,834	14,788 ±7,434	33,314 ±15,767	5,646 ±2,126	663 ±367	95,538 ±18,730
Catch per hour	0.19 ±0.11	0.32 ±0.14	0.24 ±0.14	0.24 ±0.20	0.08 ±0.03	0.11 ±0.012	0.24 ±0.08

\*Illegal catch.

Table 2. Average number of fish caught per trap net lift per year at Chesterfield site before attractors were used (1976 and 1977), when only tires were used (1978-80), and when tires plus soybean meal were used (July-September 1981 and June-September 1982).

Species	May			June		
	1976-77 Before	1978-80 Tires only	1981-82 Tires only	1976-77 Before	1978-80 Tires only	1981-82 Tires + meal
Yellow perch	8.4	39.7	19.6	0.8	11.6	6.4
Channel catfish	1.2	5.8	1.0	9.4	11.8	2.8
White bass	7.5	6.1	8.5	3.5	12.3	11.4
Pumpkinseed	9.2	7.9	9.8	7.3	12.1	12.6
Rock bass	12.9	40.2	23.0	4.2	7.8	7.5
Bluegill	2.8	0.6	0.0	5.9	0.3	0.5
Drum	0.1	0.7	0.2	1.5	1.3	3.4
Northern pike	0.4	0.7	0.2	0.8	1.1	0.5
Walleye	0.2	0.9	0.8	0.8	1.6	1.6
White crappie	0.7	0.6	0.0	1.4	0.9	0.5
Black crappie	2.2	14.8	9.8	5.0	14.8	15.2
Brown bullhead	0.1	0.8	0.1	2.6	0.8	1.0
Smallmouth bass	0.1	0.1	0.4	0.2	0.1	0.4
Largemouth bass	0.1	0.1	0.1	0.0	0.0	0.0
Alewife	255.9	1.4	8.6	450.2	133.7	19.3
Quillback	6.1	8.6	10.7	2.9	9.2	3.6
Carp	1.2	1.4	0.4	1.4	2.5	4.5
Goldfish	0.2	0.1	0.0	0.9	0.0	0.1
Longnose gar	7.0	6.5	3.0	1.9	0.9	0.2
Redhorse sp.	0.7	0.4	0.6	0.4	0.1	0.2
Bowfin	0.4	0.1	0.2	2.4	0.7	0.9
White sucker	0.0	0.0	0.0	0.1	0.1	0.0
Gizzard shad	1.0	0.8	0.4	7.2	1.6	1.5
Total game fish <sup>a</sup>	47.5	120.5	77.6	47.2	79.7	71.3



Table 2. Continued:

Species	July			August		
	1976-77 Before	1978-80 Tires only	1981-82 Tires + meal	1976-77 Before	1978-80 Tires only	1981-82 Tires + meal
Yellow perch	1.9	1.2	1.8	1.8	3.3	3.1
Channel catfish	14.7	10.2	2.8	1.6	4.7	0.4
White bass	6.8	37.0	4.8	2.8	3.9	1.6
Pumpkinseed	3.4	4.8	3.4	1.4	1.3	1.2
Rock bass	1.1	2.2	2.0	0.8	1.2	1.2
Bluegill	8.8	0.7	1.5	5.4	1.9	1.6
Drum	1.2	2.5	4.3	1.0	1.1	0.8
Northern pike	0.4	0.3	0.4	0.8	0.6	0.0
Walleye	1.2	1.6	0.5	1.1	0.9	0.2
White crappie	3.3	2.2	0.8	6.0	4.8	0.4
Black crappie	7.4	13.5	8.8	4.7	9.0	4.6
Brown bullhead	2.3	4.3	1.1	2.5	4.3	0.6
Smallmouth bass	0.0	0.1	0.0	0.1	0.0	0.1
Largemouth bass	0.1	0.0	0.1	0.4	0.1	0.1
Alewife	4.2	0.2	0.1	0.1	0.1	0.0
Quillback	2.8	3.5	4.0	1.2	1.1	0.3
Carp	1.7	1.9	2.6	2.0	1.3	0.8
Goldfish	0.8	0.2	0.0	0.2	0.1	0.0
Longnose gar	0.3	0.3	0.4	0.2	0.2	0.1
Redhorse sp.	0.4	0.3	0.2	0.0	0.4	0.2
Bowfin	1.0	2.1	1.0	0.8	0.8	0.6
White sucker	0.1	0.0	0.2	0.1	0.5	0.6
Gizzard shad	7.6	0.6	0.5	22.1	2.2	0.8
Total game fish <sup>a</sup>	55.3	84.6	36.3	33.2	39.2	17.2

Table 2. Continued:

Species	September			October		
	1976-77 Before	1978-80 Tires only	1981-82 Tires + meal	1976-77 Before	1978-80 Tires only	1981-82 Tires only
Yellow perch	1.7	3.7	1.6	3.2	16.9	7.4
Channel catfish	4.0	2.7	0.8	1.6	2.2	0.2
White bass	5.0	5.7	2.4	5.0	6.3	6.4
Pumpkinseed	1.0	3.8	4.4	0.9	3.3	7.2
Rock bass	0.5	1.2	0.9	4.0	6.4	5.2
Bluegill	6.0	1.9	3.9	1.1	0.2	2.3
Drum	3.6	0.4	0.4	6.3	5.2	3.0
Northern pike	0.9	0.7	0.0	2.8	1.3	1.9
Walleye	1.9	1.2	0.4	4.6	4.2	2.2
White crappie	6.1	5.5	0.9	1.8	0.9	0.6
Black crappie	9.0	18.8	8.1	7.2	8.2	14.8
Brown bullhead	5.6	2.7	0.2	2.6	0.8	1.1
Smallmouth bass	0.2	0.1	0.1	0.0	0.0	0.0
Largemouth bass	0.0	0.2	0.2	0.3	0.2	0.4
Alewife	0.4	0.0	0.0	0.1	0.0	0.0
Quillback	1.4	1.3	0.1	0.5	0.4	1.3
Carp	2.8	1.1	4.5	0.9	1.2	0.9
Goldfish	0.4	0.1	0.0	0.1	0.0	0.2
Longnose gar	0.2	0.3	0.0	0.2	0.1	0.2
Redhorse sp.	0.6	0.0	0.0	0.0	0.5	0.4
Bowfin	0.9	0.9	0.5	0.5	0.3	0.1
White sucker	0.9	0.6	0.1	1.4	1.2	1.2
Gizzard shad	22.4	8.9	3.2	49.4	10.8	7.3
Total game fish <sup>a</sup>	49.2	50.6	29.4	42.8	57.6	53.1

<sup>a</sup> Total game fish are all fishes above except alewife, quillback, redhorse, goldfish, longnose gar, white sucker, and gizzard shad.

Table 3. Average annual hours of fishing pressure ( $\pm 95\%$  confidence limits), by site and month, before fish attractors were used at the pier (1976 and 1977), when only tires were used (1978-80), and when tires plus soybean meal were used (1981-82).

Site and period	Month						Total
	May <sup>1</sup>	Jun	Jul	Aug	Sep	Oct	
<u>Pier</u>							
1976	11,167 $\pm 1,225$	11,345 $\pm 1,488$	16,961 $\pm 1,224$	14,327 $\pm 1,377$	9,496 $\pm 1,236$	1,116 $\pm 143$	64,412 $\pm 2,672$
1977	5,277 $\pm 351$	6,052 $\pm 382$	6,916 $\pm 539$	4,585 $\pm 321$	2,732 $\pm 228$	618 $\pm 68$	26,180 $\pm 848$
1978-80	3,501 $\pm 210$	6,707 $\pm 462$	8,528 $\pm 445$	5,155 $\pm 418$	2,219 $\pm 189$	---	26,110 $\pm 816$
1981-82	---	879 $\pm 368$	1,268 $\pm 515$	933 $\pm 390$	523 $\pm 265$	---	3,602 $\pm 789$
<u>Shore</u>							
1976	2,119 $\pm 170$	341 $\pm 90$	2,922 $\pm 194$	2,135 $\pm 453$	63 $\pm 60$	57 $\pm 34$	7,637 $\pm 606$
1977	2,027 $\pm 181$	2,569 $\pm 254$	2,922 $\pm 367$	1,818 $\pm 210$	672 $\pm 78$	186 $\pm 59$	10,460 $\pm 534$
1978-80	951 $\pm 83$	2,064 $\pm 150$	2,723 $\pm 281$	931 102	319 $\pm 157$	---	6,038 $\pm 370$
1981-82	---	578 $\pm 241$	408 $\pm 186$	395 $\pm 209$	398 $\pm 195$	---	1,778 $\pm 418$
<u>Control, Metro Beach</u>							
1976	3,364 $\pm 1,599$	5,191 $\pm 885$	5,939 $\pm 1,837$	4,181 $\pm 917$	3,365 $\pm 1,359$	1,974 $\pm 562$	24,014 $\pm 3,117$
1977	3,009 $\pm 929$	5,582 $\pm 456$	4,005 $\pm 646$	2,816 $\pm 597$	1,063 $\pm 452$	34 $\pm 19$	16,509 $\pm 1,432$
1978-80	1,387 $\pm 178$	4,762 $\pm 384$	5,446 $\pm 388$	1,892 $\pm 177$	654 $\pm 93$	---	12,755 $\pm 582$
1981-82	---	4,764 $\pm 449$	4,335 $\pm 326$	2,592 $\pm 290$	923 $\pm 176$	---	12,615 $\pm 650$

Table 3. Continued:

Site and period	Month						Total
	May <sup>1</sup>	Jun	Jul	Aug	Sep	Oct	
<u>Control, Ensign</u>							
1976	12,531 ±2,044	14,744 ±2,182	15,866 ±2,313	12,913 ±1,729	8,168 ±2,313	934 ±351	65,267 ±4,771
1977	9,868 ±1,139	14,150 ±2,039	15,230 ±1,789	12,652 ±1,471	3,682 ±790	1,736 ±200	57,318 ±3,388
1978-80	7,380 ±254	15,713 ±439	17,516 ±997	8,855 ±445	3,879 ±245	---	45,962 ±1,202
1981-82	---	17,704 ±972	14,850 ±837	10,294 ±614	5,079 ±507	---	47,927 ±1,510
<u>Control, Selfridge</u>							
1976	2,375 ±628	2,608 ±903	1,924 ±1,064	---	---	---	6,907 ±1,530
1977	272 ±97	1,422 ±458	746 ±417	192 ±43	256 ±387	0	2,888 ±522
1978-80	2,820 ±154	6,627 ±357	7,680 ±630	3,827 ±335	3,627 ±3,004	---	24,626 ±3,112
1981-82	---	6,031 ±437	5,769 ±439	4,385 ±301	2,364 ±223	---	18,549 ±724

<sup>1</sup> Data for May are incomplete.

Table 4. Average annual total fish caught ( $\pm 95\%$  confidence limits), by site and month, before fish attractors were used at the pier (1976 and 1977), when only tires were used (1978-80), and when tires plus soybean meal were used (1981-82).

Site and period	Month						Total
	May <sup>1</sup>	Jun	Jul	Aug	Sep	Oct	
<u>Pier</u>							
1976	1,415 $\pm 657$	1,405 $\pm 493$	871 $\pm 304$	409 $\pm 173$	60 $\pm 46$	58 $\pm 47$	4,218 $\pm 895$
1977	714 $\pm 521$	128 $\pm 141$	640 $\pm 769$	190 $\pm 118$	217 $\pm 147$	72 $\pm 31$	1,961 $\pm 959$
1978-80	425 $\pm 391$	720 $\pm 300$	693 $\pm 708$	192 $\pm 91$	94 $\pm 48$	--- ---	2,124 $\pm 869$
1981-82	--- ---	152 $\pm 110$	82 $\pm 29$	88 $\pm 63$	46 $\pm 27$	--- ---	368 $\pm 133$
<u>Shore</u>							
1976	422 $\pm 201$	59 $\pm 26$	298 $\pm 241$	67 $\pm 61$	3 $\pm 5$	2 $\pm 1$	851 $\pm 320$
1977	65 $\pm 121$	53 $\pm 40$	122 $\pm 134$	129 $\pm 87$	0	0	369 $\pm 210$
1978-80	38 $\pm 53$	360 $\pm 608$	203 $\pm 185$	14 $\pm 20$	1 $\pm 1$	--- ---	578 $\pm 635$
1981-82	--- ---	102 $\pm 90$	20 $\pm 15$	16 $\pm 25$	18 $\pm 19$	--- ---	157 $\pm 97$
<u>Control, Metro Beach</u>							
1976	1,519 $\pm 1,256$	2,081 $\pm 1,209$	1,896 $\pm 1,054$	0	613 $\pm 562$	0	6,109 $\pm 2,113$
1977	534 $\pm 435$	135 $\pm 138$	649 $\pm 823$	341 $\pm 23$	62 $\pm 37$	0	1,720 $\pm 942$
1978-80	354 $\pm 236$	2,227 $\pm 884$	1,534 $\pm 592$	423 $\pm 267$	100 $\pm 135$	--- ---	4,284 $\pm 1,106$
1981-82	--- ---	1,899 $\pm 428$	1,867 $\pm 467$	657 $\pm 255$	320 $\pm 135$	--- ---	4,744 $\pm 696$

Table 4. Continued:

Site and period	Month						Total
	May <sup>1</sup>	Jun	Jul	Aug	Sep	Oct	
<u>Control, Ensign</u>							
1976	3,426 ±1,351	4,101 ±1,704	3,468 ±1,425	1,388 ±1,015	908 ±512	0	13,291 ±2,838
1977	2,077 ±2,011	6,785 ±1,471	2,189 ±2,137	1,618 ±1,239	441 ±325	202 ±206	13,312 ±4,040
1978-80	1,911 ±797	3,783 ±1,233	4,983 ±2,147	2,099 ±939	1,231 ±1,084	---	12,095 ±2,672
1981-82	---	5,483 ±961	3,136 ±513	2,702 ±488	2,458 ±436	---	13,778 ±1,271
<u>Control, Selfridge</u>							
1976-77	---	---	---	---	---	---	---
1978-80	892 ±567	523 ±270	622 ±281	364 ±147	690 ±468	---	3,091 ±626
1981-82	---	1,032 ±372	924 ±203	558 ±177	240 ±95	---	2,754 ±469

<sup>1</sup> Data for May are incomplete.

Table 5. Average annual catch per hour ( $\pm 95\%$  confidence limits), by site and month, before fish attractors were used at the pier (1976 and 1977), when only tires were used (1978-80), and when tires plus soybean meal were used (1981-82).

Site and period	Month						Mean
	May <sup>1</sup>	Jun	Jul	Aug	Sep	Oct	
<u>Pier</u>							
1976	0.13 $\pm 0.06$	0.12 $\pm 0.05$	0.05 $\pm 0.02$	0.03 $\pm 0.01$	0.01 $\pm 0.01$	0.05 $\pm 0.04$	0.07 $\pm 0.01$
1977	0.14 $\pm 0.10$	0.02 $\pm 0.02$	0.09 $\pm 0.11$	0.04 $\pm 0.03$	0.08 $\pm 0.05$	0.12 $\pm 0.05$	0.08 $\pm 0.04$
1978-80	0.12 $\pm 0.11$	0.11 $\pm 0.04$	0.08 $\pm 0.08$	0.04 $\pm 0.02$	0.04 $\pm 0.02$	--- ---	0.08 $\pm 0.03$
1981-82	--- ---	0.17 $\pm 0.14$	0.06 $\pm 0.04$	0.09 $\pm 0.08$	0.09 $\pm 0.07$	--- ---	0.10 $\pm 0.04$
<u>Shore</u>							
1976	0.20 $\pm 0.10$	0.17 $\pm 0.09$	0.10 $\pm 0.08$	0.03 $\pm 0.03$	0.05 $\pm 0.09$	0.04 $\pm 0.03$	0.11 $\pm 0.04$
1977	0.03 $\pm 0.06$	0.02 $\pm 0.02$	0.04 $\pm 0.04$	0.07 $\pm 0.05$	0.00 $\pm 0.00$	0.00 $\pm 0.00$	0.04 $\pm 0.02$
1978-80	0.04 $\pm 0.06$	0.17 $\pm 0.30$	0.08 $\pm 0.07$	0.02 $\pm 0.02$	tr tr	--- ---	0.10 $\pm 0.11$
1981-82	--- ---	0.18 $\pm 0.17$	0.05 $\pm 0.04$	0.04 $\pm 0.07$	0.05 $\pm 0.05$	--- ---	0.09 $\pm 0.06$
<u>Control, Metro Beach</u>							
1976	0.45 $\pm 0.43$	0.40 $\pm 0.24$	0.32 $\pm 0.20$	0.00 $\pm 0.00$	0.18 $\pm 0.18$	0.00 $\pm 0.00$	0.25 $\pm 0.09$
1977	0.18 $\pm 0.16$	0.02 $\pm 0.02$	0.16 $\pm 0.21$	0.12 $\pm 0.03$	0.06 $\pm 0.05$	0.00 $\pm 0.00$	0.10 $\pm 0.06$
1978-80	0.26 $\pm 0.17$	0.47 $\pm 0.19$	0.28 $\pm 0.11$	0.22 $\pm 0.14$	0.15 $\pm 0.21$	--- ---	0.34 $\pm 0.09$
1981-82	--- ---	0.40 $\pm 0.10$	0.43 $\pm 0.11$	0.25 $\pm 0.10$	0.35 $\pm 0.16$	--- ---	0.38 $\pm 0.06$

Table 5. Continued:

Site and period	Month						Mean
	May <sup>1</sup>	Jun	Jul	Aug	Sep	Oct	
<u>Control, Ensign</u>							
1976	0.27 ±0.12	0.28 ±0.12	0.22 ±0.10	0.11 ±0.08	0.11 ±0.07	0.00 ±0.00	0.20 ±0.05
1977	0.21 ±0.29	0.48 ±0.12	0.14 ±0.14	0.13 ±0.10	0.12 ±0.06	0.12 ±0.12	0.23 ±0.07
1978-80	0.26 ±0.11	0.24 ±0.08	0.28 ±0.12	0.24 ±0.11	0.32 ±0.12	--- ---	0.26 ±0.06
1981-82	--- ---	0.31 ±0.06	0.21 ±0.04	0.26 ±0.05	0.48 ±0.10	--- ---	0.29 ±0.03
<u>Control, Selfridge</u>							
1976-77	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---
1978-80	0.32 ±0.20	0.08 ±0.04	0.08 ±0.04	0.10 ±0.04	0.19 ±0.20	--- ---	0.13 ±0.04
1981-82	--- ---	0.17 ±0.06	0.16 ±0.04	0.13 ±0.04	0.10 ±0.04	--- ---	0.15 ±0.03

<sup>1</sup> Data for May are incomplete.

tr = <0.005.



Table 6. Average annual (May-September) total catch, catch per hour, and total hours fished ( $\pm 95\%$  confidence limits) for Chesterfield Pier, shore, and control sites (Metro Beach, Ensign, and Selfridge) before (1976-77) and after (1978-80) tires were installed at the pier.

Site and period	Total fish	Catch per hour	Total hours
<u>Pier</u>			
1976-77	3,025 $\pm$ 655	0.07 $\pm$ 0.01	44,429 $\pm$ 1,399
1978-80	2,124 $\pm$ 869	0.08 $\pm$ 0.03	26,110 $\pm$ 816
<u>Shore</u>			
1976-77	609 $\pm$ 191	0.07 $\pm$ 0.02	8,927 $\pm$ 410
1978-80	615 $\pm$ 638	0.09 $\pm$ 0.09	6,989 $\pm$ 379
<u>Controls</u>			
1976-77	17,115 $\pm$ 2,725	0.20 $\pm$ 0.03	79,160 $\pm$ 3,404
1978-80	19,603 $\pm$ 3,009	0.29 $\pm$ 0.04	67,485 $\pm$ 3,401

Table 7. Average annual (May-September) catch per hour ( $\pm 95\%$  confidence limits), by species, at Chesterfield Pier, shore, and control sites (Metro Beach, Ensign, and Selfridge) before (1976-77) and after (1978-80) tires were installed at the pier.

Species	Site and period					
	Pier		Shore		Controls	
	1976-77	1978-80	1976-77	1978-80	1976-77	1978-80
Drum	0.027 $\pm 0.005$	0.028 $\pm 0.019$	0.036 $\pm 0.020$	0.008 $\pm 0.001$	0.071 $\pm 0.020$	0.080 $\pm 0.023$
Rock bass	0.009 $\pm 0.005$	0.015 $\pm 0.014$	0.011 $\pm 0.006$	0.005 $\pm 0.007$	0.031 $\pm 0.012$	0.037 $\pm 0.020$
Perch	0.016 $\pm 0.008$	0.028 $\pm 0.023$	0.010 $\pm 0.010$	0.069 $\pm 0.054$	0.019 $\pm 0.006$	0.048 $\pm 0.017$
White bass	tr tr	tr tr	0.000 $\pm 0.000$	0.001 $\pm 0.002$	0.018 $\pm 0.007$	0.036 $\pm 0.026$
Bluegill	0.003 $\pm 0.003$	0.001 $\pm 0.001$	0.004 $\pm 0.003$	0.001 $\pm 0.002$	0.012 $\pm 0.005$	0.010 $\pm 0.005$
Crappie	0.001 $\pm 0.001$	tr tr	0.000 $\pm 0.000$	0.001 $\pm 0.001$	0.002 $\pm 0.003$	0.004 $\pm 0.002$
Pumpkinseed	0.008 $\pm 0.007$	0.005 $\pm 0.004$	0.004 $\pm 0.002$	0.002 $\pm 0.002$	0.026 $\pm 0.019$	0.034 $\pm 0.009$
Other	0.005 $\pm 0.003$	0.004 $\pm 0.003$	0.008 $\pm 0.005$	0.003 $\pm 0.004$	0.025 $\pm 0.009$	0.036 $\pm 0.014$

tr =  $<0.005$ .

Table 8. Average annual (May-September) total number of fish caught per year ( $\pm 95\%$  confidence limits), by species, at Chesterfield Pier, shore, and control sites (Metro Beach, Ensign, and Selfridge) before (1976-77) and after (1978-80) tires were installed at the pier.

Species	Site and period					
	Pier		Shore		Controls	
	1976-77	1978-80	1976-77	1978-80	1976-77	1978-80
Drum	1,210 $\pm 488$	744 $\pm 491$	294 $\pm 157$	57 $\pm 70$	5,893 $\pm 1,628$	5,372 $\pm 1,527$
Rock bass	502 $\pm 285$	385 $\pm 362$	91 $\pm 45$	33 $\pm 51$	2,745 $\pm 1,088$	2,467 $\pm 1,401$
Perch	614 $\pm 221$	736 $\pm 603$	92 $\pm 87$	480 $\pm 631$	1,610 $\pm 503$	3,232 $\pm 1,128$
White bass	3 $\pm 3$	3 $\pm 6$	0 $\pm 0$	6 $\pm 11$	1,358 $\pm 559$	2,452 $\pm 1,784$
Bluegill	153 $\pm 108$	31 $\pm 32$	33 $\pm 27$	6 $\pm 13$	1,084 $\pm 441$	694 $\pm 333$
Crappie	56 $\pm 67$	1 $\pm 3$	0 $\pm 0$	4 $\pm 8$	232 $\pm 270$	256 $\pm 200$
Pumpkinseed	320 $\pm 187$	130 $\pm 112$	37 $\pm 17$	10 $\pm 17$	2,132 $\pm 1,465$	2,270 $\pm 629$
Other	205 $\pm 101$	92 $\pm 74$	64 $\pm 38$	19 $\pm 26$	2,163 $\pm 784$	2,461 $\pm 560$

Table 9. Average annual (June-September) total catch, catch per hour, and total hours fished ( $\pm 95\%$  confidence limits) for Chesterfield Pier, shore, and control sites (Metro Beach, Ensign, and Selfridge) before (1978-80) and during (1981-82) soybean meal feeding at the pier.

Site and period	Total fish	Catch per hour	Total hours
<u>Pier</u>			
1978-80	1,699 $\pm$ 776	0.08 $\pm$ 0.03	22,609 $\pm$ 789
1981-82	368 $\pm$ 133	0.10 $\pm$ 0.04	3,602 $\pm$ 789
<u>Shore</u>			
1978-80	577 $\pm$ 635	0.10 $\pm$ 0.11	6,038 $\pm$ 370
1981-82	157 $\pm$ 97	0.09 $\pm$ 0.06	1,778 $\pm$ 418
<u>Controls</u>			
1978-80	17,578 $\pm$ 2,959	0.23 $\pm$ 0.04	80,523 $\pm$ 3,383
1981-82	21,276 $\pm$ 1,523	0.27 $\pm$ 0.02	79,091 $\pm$ 1,796

Table 10. Average annual catch for June-September ( $\pm 95\%$  confidence limits), by site and species, before (1978-80) and during (1981-82) application of soybean meal at the pier. Tires were present in both periods.

Species	Site and period					
	Pier		Shore		Controls	
	1978-80	1981-82	1978-80	1981-82	1978-80	1981-82
Drum	744 $\pm 491$	65 $\pm 28$	57 $\pm 70$	34 $\pm 33$	5,618 $\pm 1,549$	5,856 $\pm 939$
Rock bass	111 $\pm 69$	60 $\pm 35$	5 $\pm 11$	24 $\pm 50$	1,906 $\pm 1,273$	2,212 $\pm 419$
Perch	667 $\pm 591$	146 $\pm 109$	480 $\pm 631$	43 $\pm 68$	3,579 $\pm 1,163$	4,095 $\pm 610$
White bass	3 $\pm 6$	2 $\pm 4$	6 $\pm 11$	6 $\pm 8$	2,344 $\pm 1,777$	1,138 $\pm 375$
Bluegill	20 $\pm 24$	36 $\pm 57$	6 $\pm 13$	12 $\pm 17$	774 $\pm 338$	1,280 $\pm 387$
Crappie	1 $\pm 3$	3 $\pm 4$	4 $\pm 8$	0 $\pm 0$	206 $\pm 192$	100 $\pm 83$
Pumpkinseed	60 $\pm 38$	26 $\pm 18$	0 $\pm 0$	18 $\pm 25$	2,125 $\pm 620$	4,568 $\pm 668$
Other	34 $\pm 31$	30 $\pm 15$	19 $\pm 26$	18 $\pm 11$	2,463 $\pm 572$	2,026 $\pm 381$

Table 11. Average annual catch per hour for June-September ( $\pm 95\%$  confidence limits), by site and species, before (1978-80) and during (1981-82) application of soybean meal at the pier. Tires were present in both periods.

Species	Site and period					
	Pier		Shore		Controls	
	1978-80	1981-82	1978-80	1981-82	1978-80	1981-82
Drum	0.033 $\pm 0.022$	0.018 $\pm 0.009$	0.009 $\pm 0.012$	0.019 $\pm 0.019$	0.070 $\pm 0.020$	0.074 $\pm 0.012$
Rock bass	0.005 $\pm 0.003$	0.017 $\pm 0.010$	0.001 $\pm 0.002$	0.013 $\pm 0.028$	0.024 $\pm 0.016$	0.028 $\pm 0.005$
Perch	0.030 $\pm 0.026$	0.040 $\pm 0.032$	0.080 $\pm 0.105$	0.024 $\pm 0.039$	0.044 $\pm 0.015$	0.052 $\pm 0.008$
White bass	tr tr	0.001 $\pm 0.001$	0.001 $\pm 0.002$	0.003 $\pm 0.005$	0.029 $\pm 0.022$	$\pm 0.014$ $\pm 0.005$
Bluegill	0.001 $\pm 0.001$	0.010 $\pm 0.016$	0.001 $\pm 0.002$	0.007 $\pm 0.010$	0.010 $\pm 0.004$	0.016 $\pm 0.005$
Crappie	tr tr	0.001 $\pm 0.001$	0.001 $\pm 0.001$	0.0 $\pm 0.0$	0.003 $\pm 0.002$	0.001 $\pm 0.001$
Pumpkinseed	0.003 0.002	0.007 $\pm 0.005$	0.000 $\pm 0.000$	0.010 $\pm 0.014$	0.026 $\pm 0.008$	0.058 $\pm 0.009$
Other	0.001 $\pm 0.001$	0.008 $\pm 0.005$	0.003 $\pm 0.004$	0.010 $\pm 0.007$	0.031 $\pm 0.007$	0.026 $\pm 0.005$

tr =  $< 0.005$ .

Table 12. Average annual catch per hour for June-September ( $\pm 95\%$  confidence limits), by control site and species, before (1978-80) and during (1981-82) application of soybean meal at the pier. Tires were present in both periods.

Species	Site and period					
	Metro Beach		Ensign Memorial		Selfridge	
	1978-80	1981-82	1978-80	1981-82	1978-80	1981-82
Drum	0.070 $\pm 0.036$	0.061 $\pm 0.018$	0.085 $\pm 0.031$	0.085 $\pm 0.018$	0.037 $\pm 0.020$	0.054 $\pm 0.016$
Rock bass	0.031 $\pm 0.019$	0.055 $\pm 0.020$	0.031 $\pm 0.027$	0.030 $\pm 0.007$	0.003 $\pm 0.003$	0.005 $\pm 0.002$
Perch	0.060 $\pm 0.035$	0.038 $\pm 0.016$	0.052 $\pm 0.023$	0.064 $\pm 0.011$	0.020 $\pm 0.014$	0.029 $\pm 0.012$
White bass	0.076 $\pm 0.059$	0.059 $\pm 0.027$	0.030 $\pm 0.035$	0.006 $\pm 0.003$	0.002 $\pm 0.002$	0.005 $\pm 0.004$
Bluegill	0.032 $\pm 0.022$	0.058 $\pm 0.027$	0.006 $\pm 0.004$	0.005 $\pm 0.002$	0.004 $\pm 0.003$	0.017 $\pm 0.009$
Crappie	0.016 $\pm 0.015$	0.001 $\pm 0.002$	tr tr	0.001 $\pm 0.001$	0.000 $\pm 0.000$	0.002 $\pm 0.003$
Pumpkinseed	0.024 $\pm 0.015$	0.058 $\pm 0.022$	0.033 $\pm 0.012$	0.073 $\pm 0.012$	0.014 $\pm 0.009$	0.018 $\pm 0.010$
Other	0.030 $\pm 0.012$	0.046 $\pm 0.013$	0.035 $\pm 0.019$	0.023 $\pm 0.007$	0.021 $\pm 0.013$	0.019 $\pm 0.007$

tr =  $<0.005$ .

Table 13. Average annual total catch for June-September ( $\pm 95\%$  confidence limits), by control site and species, before (1978-80) and during (1981-82) application of soybean meal at the pier. Tires were present in both periods.

Species	Site and period					
	Metro Beach		Ensign Memorial		Selfridge	
	1978-80	1981-82	1978-80	1981-82	1978-80	1981-82
Drum	889 $\pm 464$	765 $\pm 224$	3,913 $\pm 1,436$	4,094 $\pm 864$	816 $\pm 431$	998 $\pm 292$
Rock bass	399 $\pm 237$	692 $\pm 247$	1,447 $\pm 1,249$	1,427 $\pm 337$	74 $\pm 60$	93 $\pm 40$
Perch	761 $\pm 443$	480 $\pm 199$	2,389 $\pm 1,035$	3,082 $\pm 533$	429 $\pm 291$	534 $\pm 220$
White bass	967 $\pm 757$	749 $\pm 342$	1,371 $\pm 1,607$	288 $\pm 139$	40 $\pm 45$	101 $\pm 66$
Bluegill	408 $\pm 286$	732 $\pm 335$	285 $\pm 171$	236 $\pm 89$	81 $\pm 55$	312 $\pm 173$
Crappie	198 $\pm 192$	16 $\pm 26$	8 $\pm 11$	47 $\pm 63$	0 $\pm 0$	36 $\pm 47$
Pumpkinseed	303 $\pm 197$	732 $\pm 279$	1,524 $\pm 553$	3,504 $\pm 579$	298 $\pm 201$	332 $\pm 182$
Other	377 $\pm 154$	577 $\pm 162$	1,624 $\pm 870$	1,101 $\pm 322$	461 $\pm 269$	348 $\pm 122$



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