

Report of the
LAKE ERIE YELLOW PERCH TASK GROUP
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Presented to:

Standing Technical Committee of the Lake Erie Committee
Great Lakes Fishery Commission

The Yellow Perch Task Group (YPTG) was charged with describing yellow perch stock status, producing population size estimates and recommending allowable harvest for 1991 in each of four management units (Figure 1). For 1991, the task group was charged with the review of methodologies including exploitation policies. This report summarizes yellow perch status, population size and recommended allowable harvests (RAH) for 1991. A joint report with the Statistics and Modeling Task Group is planned for release later this year that details the methodology review.

Fisheries Review

The reported harvest of yellow perch from lake Erie in 1990 totaled 4,367 t (Table 1), which was 41% less than the 1989 harvest. All agencies reported declines in perch catches in 1990. The largest reductions were in New York (-69%) and Ohio (-49%) waters, which were followed by Ontario (-39%), Michigan (-30%) and Pennsylvania (-12%). Ontario harvested 73% of the lakewide reported catch, while Ohio accounted for 22%, and Michigan, Pennsylvania and New York caught the remaining 5%.

The reported harvest did not exceed the RAH in 1990 for Units 1 and 4. However, the RAH was exceeded in Unit 2 by 6% and in Unit 3 by 26% (Table 2). RAHs are meant to be achieved on a Unit basis (i.e. the harvest of all agencies combined for a Unit should not exceed the RAH for that Unit). Individual agency RAHs are calculated using a surface area sharing formula. However, Ontario determines internal quotas based on the task group recommendations and historical harvest levels. The Ontario commercial fishery adheres to internal quotas set by the agency. In 1990, the fishery harvested

only 60% of the Ontario internal quota in both Units 1 and 2, and reached its quota in Units 3 and 4.

Catch, fishing effort, and catch rate are summarized by Unit, year, agency, and gear type in Tables 3a-d. Commercial gillnet effort increased in all Units. Increases in effort were 44%, 23%, 78% and 49% respectively for Units 1 to 4. Total trapnet effort increased by 16%, with most of the increase in Unit 2 as a result of re-direction of effort from Units 1 and 3. Dramatic declines in 1990 yellow perch sport fishing effort in all Units were attributed to seasonally prolonged foul weather, which in part accounted for the significant reductions in perch sport catches. The reduction in sport harvest can also be attributed to declines in yellow perch stock abundance. Commercial and sport catch rates declined in all Units. 1990 catch rates have returned to levels comparable to those found prior to the recruitment of the 1984 year class to the fisheries.

The 1986 year class of yellow perch contributed strongly to the harvest in all Units (32% to 52% of the harvest) (Table 4). The 1984 year class was well represented in the catches in all Units (12% to 36% of the harvest). No previous year class has had such a significant contribution to the harvest as age-6 fish. Recruitment of the 1987 and 1988 year classes (age-2 and 3 fish) was relatively weak and will not support harvest levels observed in the late 1980s.

Stock Assessment

Catch-at-Age-Analysis (CAGEAN) - To estimate 1990 population size, a three gear version of the CAGEAN model was used. In the past, a one gear model was

used and all harvest and effort reported using a standardized effort. The three gear model allows inputs into the model such as catchabilities and selectivities to be entered as gear specific values.

CAGEAN estimates (based upon $M=0.2$) of yellow perch stocks differed from the 1990 stock size projections presented in last year's report (Table 5). There are two sources of error accounting for these differences. First, trawl indices of recruitment apparently overestimated the strength of the 1988 year class. Second, catch rates in the fisheries in 1990 impact the trend of age-specific catch per unit effort for previously recruited year classes and therefore the estimated abundance. CAGEAN estimates revealed the 1990 stock size was lower in Unit 1 and higher in Unit 3 and Unit 4.

Traditionally, a value of 0.2 was used as a natural mortality (M) rate when estimating population size. Based on our review, a value of 0.4 appears to be more reasonable for yellow perch in Lake Erie. Trends in stock size were similar for both values on M . Stock size estimates were higher at $M=0.4$ but less than the proportional change from $M=0.2$ to $M=0.4$ (i.e. a doubling of M did not produce a doubling of stock size). Only results from $M=0.4$ will be presented in this report.

Stock size estimates are approaching historical low levels (Table 6 Fig. 2). Age composition of the stock size estimates for 1982-1991 are summarized in Table 7. Stock size estimates were totaled for age-2 and older, and age-3 and older fish. Although age-3 and older stock size represents the fully

vulnerable population, age-2 is included because it represents a portion of the stock that is exploited by the fisheries. Age-2 exploitation is determined by gear selectivity and the relative size of the year class.

Population parameters such as survival rate and exploitation rate are more conservative if age-2 fish are included in the population description. Survival and exploitation rates are presented for age-2 and older fish (Table 6 and Figure 3). Yellow perch survival rates are less than 50% in all Units and in general show a decline from the mid-1980s. Rates are approaching 40% in Units 1, 2 and 4, and approaching 20% in Unit 3. The corollary is that exploitation rates have been increasing in all Units (Table 6 and Figure 4). Exploitation values from each Unit are 30%, 45%, 59% and 26% respectively.

Recruitment - A strategy similar to previous years was used for estimating age-2 population size from index trawling values. Updates to the method included: an expanded data series (more years and more trawling projects), the use of geometric mean index values (number per trawl-hour), regressing CAGEAN age-2 population size estimates of age-2 abundance (Table 8).

There has been poor to fair recruitment of yellow perch in all Units subsequent to the 1986 year class (Figure 5). The 1987 and 1988 year classes were poor. Based on recruitment regressions, it appears that the 1989 and 1990 year classes are fair (Table 9).

Population Size Projection - Stock size estimates for 1991 (age-3 and older) were projected by simulating the effect of fishing and natural mortality on

the CAGEAN estimates of stock size for 1990. Recruitment of the 1989 year class in 1991 (age-2 fish) was estimated from various agency trawling indices of age-0 and age-1 yellow perch.

Projections of stock size for 1991 indicate significant decline in the stock size of age-2 and older fish in all units (Table 10). The declines in stock size were due to high mortality rates and low estimates of recruitment for the 1989 year class. Projections of age-3 and older stock size decreased from 1990 levels in all units except Unit 4. These declines ranged from 40% - 77% in Units 1 - 3 and increased by 57% in Unit 4.

The large perch stock size that supported relatively robust catches in Units 1, 2 and 3 from 1986 through 1989 were composed primarily of the 1982, 1984 and 1986 year classes. Only remnants of these year classes will be available in 1991. The 1991 population size estimates in all Units are largely comprised of age-2 fish.

Recommended Allowable Harvest

Recommended allowable harvests were calculated from the 1991 stock size for three exploitation policies; optimal yield, 1990 rate of fishing, and target effort rate of fishing. The optimal yield exploitation model balances natural mortality and growth rates to calculate the fishing mortality level (F_{opt}) necessary to achieve the "best" use of each year class (See Appendix). It assumes there is no spawner-recruit relationship. A scaled F_{opt} was used to determine a RAH for each Unit. The second option explored was harvesting the 1991 population at the 1990 exploitation rate. The third policy reported, target effort, was fishing the 1991 population at exploitation rates equal to

an effort level 20% less than that observed in 1981. The exploitation policies were applied to the 1991 population size estimate in numbers to produce harvest in number-at-age. This was converted to harvest weight by using mean weight-at-age in the harvest averaged for years 1986-1990.

The 1991 recommended allowable harvests derived from exploitation at the various policies are summarized in Table 11. Also in Table 11 is a comparison of exploitation rates derived from the three policies. The task group is recommending adoption of optimal yield as an exploitation policy. The optimal yield exploitation rates are similar to recent levels.

A summary of 1991 recommended allowable harvests by agency was based on the relative percentage of water surface area within each Unit (Table 13).

Recommendations and Conclusion

We recommend that a natural mortality rate of $M=0.4$ be adopted as a more realistic value for Lake Erie yellow perch. All stock size predictions and exploitation values were based on this value.

An initial exploitation strategy was established in 1985 to attain a reduction in fishing mortality by 1990. This objective has been reached. More reasonable exploitation strategies associated with sustainable yields are recommended for implementation in 1991 because of declining perch stock sizes and projected high exploitation rates. The recommended allowable harvest was calculated based on an exploitation strategy, defined as an optimum sustainable yield, described by the appropriate fishing rate, F_{opt} . The use of the optimum yield exploitation strategy is recommended.

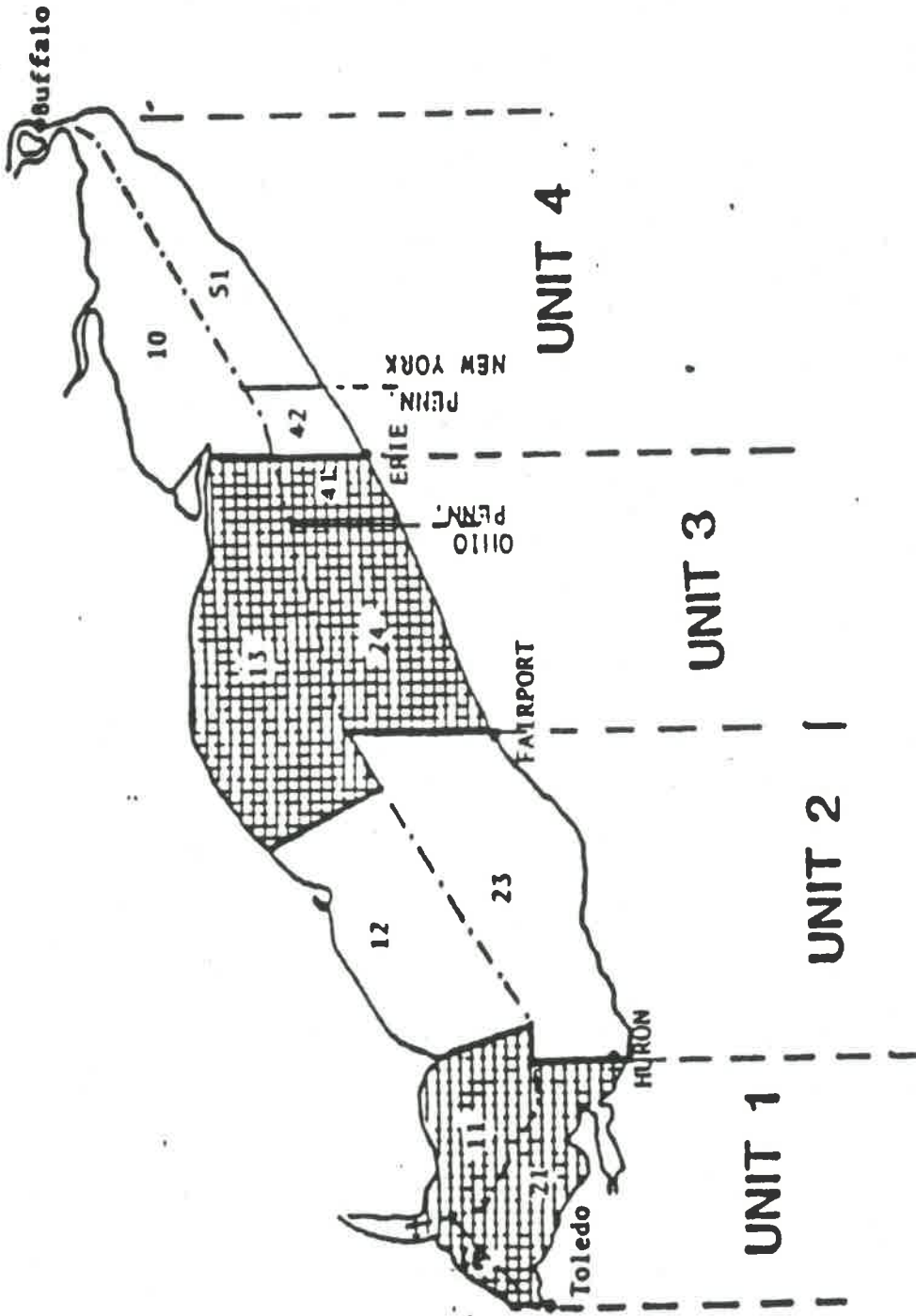


Figure 1. Geographical boundaries of management units for yellow perch task group.

Year classes entering the fishery since 1989 have not been impressive in size. The trend of declining perch stock sizes indicates that sustaining exploitation rate at levels as high as the ones observed in the past few years will likely foster further deterioration of yellow perch stocks and fisheries. The coincidental high abundance of white perch at a time of low yellow perch population levels is also a cause for concern when examining yellow perch status.

Finally, we continue to encourage agencies to adopt some form of standardized assessment practice for juvenile and adults to reduce the impact of variability which induces a background of higher risk management, especially when perch stocks exhibit historically low levels.

Table 1. Summary of total catch* of yellow perch by management unit and agency, Lake Erie 1980-90.

Unit	Year	Ontario		Ohio		Michigan		Pennsylvania		New York		Total
		Catch	(%)	Catch	(%)	Catch	(%)	Catch	(%)	Catch	(%)	
1	1980	1,873	(56)	1,326	(41)	74	(02)	--	--	--	--	3,323
	1981	1,180	(55)	924	(43)	34	(02)	--	--	--	--	2,138
	1982	983	(49)	972	(49)	46	(02)	--	--	--	--	2,001
	1983	326	(47)	358	(51)	17	(02)	--	--	--	--	701
	1984	1,208	(65)	608	(33)	30	(02)	--	--	--	--	1,846
	1985	1,347	(73)	476	(26)	22	(01)	--	--	--	--	1,845
	1986	1,360	(61)	775	(35)	82	(04)	--	--	--	--	2,217
	1987	1,298	(59)	785	(36)	102	(05)	--	--	--	--	2,185
	1988	1,445	(61)	846	(36)	76	(03)	--	--	--	--	2,367
	1989	1,432	(59)	862	(35)	151	(06)	--	--	--	--	2,445
1990	808	(67)	296	(24)	105	(09)	--	--	--	--	1,209	
2	1980	2,877	(71)	1,175	(29)	--	--	--	--	--	--	4,052
	1981	1,603	(67)	784	(33)	--	--	--	--	--	--	2,387
	1982	2,162	(86)	356	(14)	--	--	--	--	--	--	2,518
	1983	1,466	(85)	258	(15)	--	--	--	--	--	--	1,724
	1984	2,117	(85)	378	(15)	--	--	--	--	--	--	2,495
	1985	2,127	(87)	308	(13)	--	--	--	--	--	--	2,435
	1986	2,289	(89)	289	(11)	--	--	--	--	--	--	2,578
	1987	2,512	(88)	344	(12)	--	--	--	--	--	--	2,856
	1988	2,538	(93)	191	(07)	--	--	--	--	--	--	2,729
	1989	2,530	(84)	486	(16)	--	--	--	--	--	--	3,016
1990	1,303	(75)	432	(25)	--	--	--	--	--	--	1,735	
3	1980	478	(68)	144	(20)	--	--	86	(12)	--	--	708
	1981	505	(68)	131	(18)	--	--	103	(14)	--	--	739
	1982	615	(80)	89	(12)	--	--	64	(08)	--	--	768
	1983	519	(94)	21	(04)	--	--	15	(03)	--	--	555
	1984	466	(86)	44	(08)	--	--	32	(06)	--	--	542
	1985	370	(81)	43	(09)	--	--	43	(09)	--	--	456
	1986	1,101	(92)	60	(05)	--	--	30	(03)	--	--	1,191
	1987	908	(84)	108	(10)	--	--	64	(06)	--	--	1,080
	1988	1,128	(78)	239	(17)	--	--	81	(06)	--	--	1,448
	1989	1,095	(63)	544	(31)	--	--	96	(06)	--	--	1,735
1990	965	(76)	229	(18)	--	--	84	(06)	--	--	1,278	
4	1980	303	(78)	--	--	--	--	42	(11)	42	(11)	387
	1981	355	(80)	--	--	--	--	33	(07)	53	(12)	441
	1982	253	(76)	--	--	--	--	29	(09)	52	(16)	334
	1983	175	(81)	--	--	--	--	13	(06)	28	(13)	216
	1984	365	(78)	--	--	--	--	35	(07)	67	(14)	467
	1985	190	(75)	--	--	--	--	14	(05)	51	(20)	255
	1986	143	(88)	--	--	--	--	16	(11)	2	(01)	161
	1987	260	(90)	--	--	--	--	23	(08)	6	(02)	289
	1988	258	(98)	--	--	--	--	1	(<1)	4	(02)	263
	1989	199	(78)	--	--	--	--	0	(00)	55	(22)	254
1990	128	(88)	--	--	--	--	0	(00)	17	(12)	145	

*Catch is in tonnes.

Values in parentheses represent each agency's percentage of management unit catch.

Table 2. Lake Erie 1990 recommended allowable harvests (RAH) and measured harvest of yellow perch by Management Unit and Agency.

UNIT	AGENCY	RAH (t)	HARVEST (t)	DIFFERENCE	
				(t)	(%)
1	Ontario	1,193	808	-385	-32.2
	Ohio	1,399	296	-1,103	-78.8
	Michigan	228	105	-123	-53.9
	TOTAL	2,820	1,209	-1,611	-57.1
2	Ontario	693	1,303	+610	+88.0
	Ohio	937	432	-505	-53.9
	TOTAL	1,630	1,735	+105	+6.4
3	Ontario	570	965	+395	+69.3
	Ohio	324	229	-95	-29.3
	Pennsylvania	121	84	-37	-30.6
	TOTAL	1,015	1,278	+263	+25.9
4	Ontario	96	128	+32	+33.3
	Pennsylvania	30	0	-30	-100.0
	New York	52	17	-35	-67.5
	TOTAL	178	145	-33	-18.5

Table 3a. Catch and effort summaries for Lake Erie yellow perch fisheries in Management Unit 1, 1981-90.

	Year	Ohio		Michigan	Ontario	
		Trap	Sport	Sport	Gill Net	Sport
CATCH (tonnes)	1981	93	831	34	1180	-- ^a
	1982	54	922	46	983	--
	1983	26	330	17	327	--
	1984	14	594	30	1208	--
	1985	27	449	24	1206	--
	1986	73	704	82	1361	--
	1987	139	646	102	1298	--
	1988	284	562	76	1447	--
	1989	392	470	151	1432	--
	1990	210	86	105	808	--
EFFORT ^b	1981	9,830	2,676,326	271,000	24,908	--
	1982	5,272	3,036,979	151,900	27,627	--
	1983	5,086	1,302,203	74,914	11,456	--
	1984	3,451	1,159,599	57,980	28,746	--
	1985	4,141	935,645	46,782	16,139	--
	1986	5,279	1,404,286	469,368	20,909	--
	1987	7,078	1,046,115	452,460	14,730	--
	1988	6,900	1,153,182	494,158	9,616	--
	1989	8,418	1,028,551	696,937	12,716	--
	1990	6,299	400,676	634,255	18,305	--
CATCH RATE ^c	1981	9.46	0.31	0.13	47.37	--
	1982	10.24	0.30	0.30	35.58	--
	1983	5.11	0.25	0.23	28.54	--
	1984	4.06	0.51	0.51	42.02	--
	1985	6.52	0.48	0.51	74.73	--
	1986	13.83	0.50	0.17	65.09	--
	1987	19.64	0.62	0.23	88.12	--
	1988	41.16	0.49	0.15	150.48	--
	1989	46.57	0.46	0.22	112.61	--
	1990	33.34	0.21	0.17	44.14	--

^a Not measured.

^b Sport effort in angler-hours; gill net effort in km; trapnet effort in lifts.

^c Sport (kg/hour), gill net (kgs/km), trap net (kgs/lift).

Table 3b. Catch and effort summaries for Lake Erie yellow perch fisheries in Management Unit 2, 1981-90.

	Year	Ohio			Ontario	
		Gill Net	Trap Net	Sport	Gill Net	Sport
CATCH (tonnes)	1981	711	12	65	1,603	-- ^a
	1982	35	10	314	2,163	--
	1983	82	0	176	1,466	--
	1984	0	5	373	2,118	--
	1985	0	8	300	2,208	--
	1986	0	0	289	2,291	--
	1987	0	11	334	2,512	--
	1988	0	21	170	2,538	--
	1989	0	91	395	2,530	--
	1990	0	309	137	1,303	--
EFFORT ^b	1981	17,810	713	437,816	27,782	--
	1982	1,400	801	1,277,417	41,868	--
	1983	3,632	0	739,325	44,692	--
	1984	0	466	894,109	44,524	--
	1985	0	212	728,763	34,187	--
	1986	0	0	461,273	30,920	--
	1987	0	630	429,239	20,940	--
	1988	0	448	402,180	17,315	--
	1989	0	1,403	702,976	25,679	--
	1990	0	6,238	349,775	31,613	--
CATCH RATE ^c	1981	39.92	16.83	0.15	57.70	--
	1982	25.00	12.48	0.25	51.66	--
	1983	22.58	0	0.24	32.80	--
	1984	--	10.73	0.42	47.57	--
	1985	--	37.74	0.41	64.59	--
	1986	--	0	0.63	74.09	--
	1987	--	17.46	0.78	119.96	--
	1988	--	46.88	0.42	146.58	--
	1989	--	64.86	0.56	98.52	--
	1990	--	47.29	0.39	41.22	--

^a Not measured.

^b Sport effort in angler-hours; gill net effort in km; trapnet effort in lifts.

^c Sport (kg/hour), gill net (kgs/km), trap net (kgs/lift).

Table 3c. Catch and effort summaries for Lake Erie yellow perch in Management Unit 3, 1981-90.

Year	Ohio			Ontario		Pennsylvania	
	Gill Net	Trap Net	Sport	Gill Net	Sport	Gill Net	Sport
CATCH (tonnes)	1981	86	0	45	506	103	---
	1982	19	0	71	616	64	---
	1983	14	0	7	519	15	---
	1984	0	0	44	466	32	---
	1985	0	2	42	325	43	---
	1986	0	0	60	1,102	30	---
	1987	0	21	87	908	64	---
	1988	0	150	89	1,128	81	---
	1989	0	288	256	1,095	96	---
	1990	0	203	26	965	84	---
EFFORT ^b	1981	2,377	0	237,691	12,685	2,735	---
	1982	710	0	308,826	16,438	2,737	---
	1983	802	0	181,030	18,199	1,521	---
	1984	0	0	149,602	14,153	1,197	---
	1985	0	136	144,309	10,635	2,175	---
	1986	0	0	122,007	12,440	2,185	---
	1987	0	668	129,316	6,667	1,538	---
	1988	0	4,781	172,490	6,203	1,418	---
	1989	0	7,281	248,530	7,098	1,037	---
	1990	0	7,376	31,881	12,472	1,978	---
CATCH RATE ^c	1981	36.18	0	0.19	39.89	37.66	---
	1982	26.76	0	0.23	37.47	23.38	---
	1983	17.46	0	0.04	28.52	9.86	---
	1984	--	0	0.29	32.93	26.73	---
	1985	--	14.71	0.29	30.56	19.77	---
	1986	--	0	0.49	88.59	13.73	---
	1987	--	31.44	0.67	136.19	41.61	---
	1988	--	31.37	0.52	181.85	57.12	---
	1989	--	39.56	1.03	154.27	92.57	---
	1990	--	27.52	0.82	77.37	42.47	---

^a Not measured.

^b Sport effort in angler-hours; gill net effort in km; trapnet effort in lifts.

^c Sport (kg/hour), gill net (kgs/km), trap net (kgs/lift).

Table 3d. Catch and effort summaries for Lake Erie yellow perch in Management Unit 4, 1981-90.

	Year	Ontario		Pennsylvania		New York		
		Gill Net	Sport	Gill Net	Sport	Gill Net	Trap Net	Sport
CATCH (tonnes)	1981	357	-- ^a	0	--	86	0	--
	1982	254	--	0	--	81	0	--
	1983	178	--	13	--	28	0	--
	1984	365	--	36	--	68	0	--
	1985	139	--	14	--	52	0	--
	1986	143	--	48	--	--	2	--
	1987	260	--	23	--	--	6	--
	1988	260	--	1	--	--	4	--
	1989	199	--	0	--	--	8	47
	1990	128	--	0	--	--	9	8
EFFORT ^b	1981	19,130	--	0	--	3,142	0	--
	1982	14,637	--	0	--	3,430	0	--
	1983	12,832	--	1,329	--	1,160	0	--
	1984	19,368	--	1,211	--	1,826	0	--
	1985	8,582	--	486	--	3,133	0	--
	1986	8,797	--	569	--	--	3,513	--
	1987	4,908	--	632	--	--	1,602	--
	1988	2,719	--	8	--	--	2,132	--
	1989	2,628	--	0	--	--	1,136	65,370
	1990	3,924	--	0	--	--	981	24,463
CATCH RATE ^c	1981	18.66	--	0	--	27.37	0	--
	1982	17.35	--	0	--	23.62	0	--
	1983	13.87	--	9.78	--	24.14	0	--
	1984	18.85	--	29.73	--	37.24	0	--
	1985	16.20	--	28.81	--	16.60	0	--
	1986	16.26	--	84.36	--	--	0.57	--
	1987	52.97	--	36.39	--	--	3.75	--
	1988	95.62	--	125.00	--	--	1.88	--
	1989	75.72	--	0	--	--	7.04	0.72
	1990	32.62	--	0	--	--	9.17	0.33

^a Not measured.

^b Sport effort in angler-hours; gill net effort in km; trapnet effort in lifts.

^c Sport (kg/hour), gill net (kgs/km), trap net (kgs/lift).