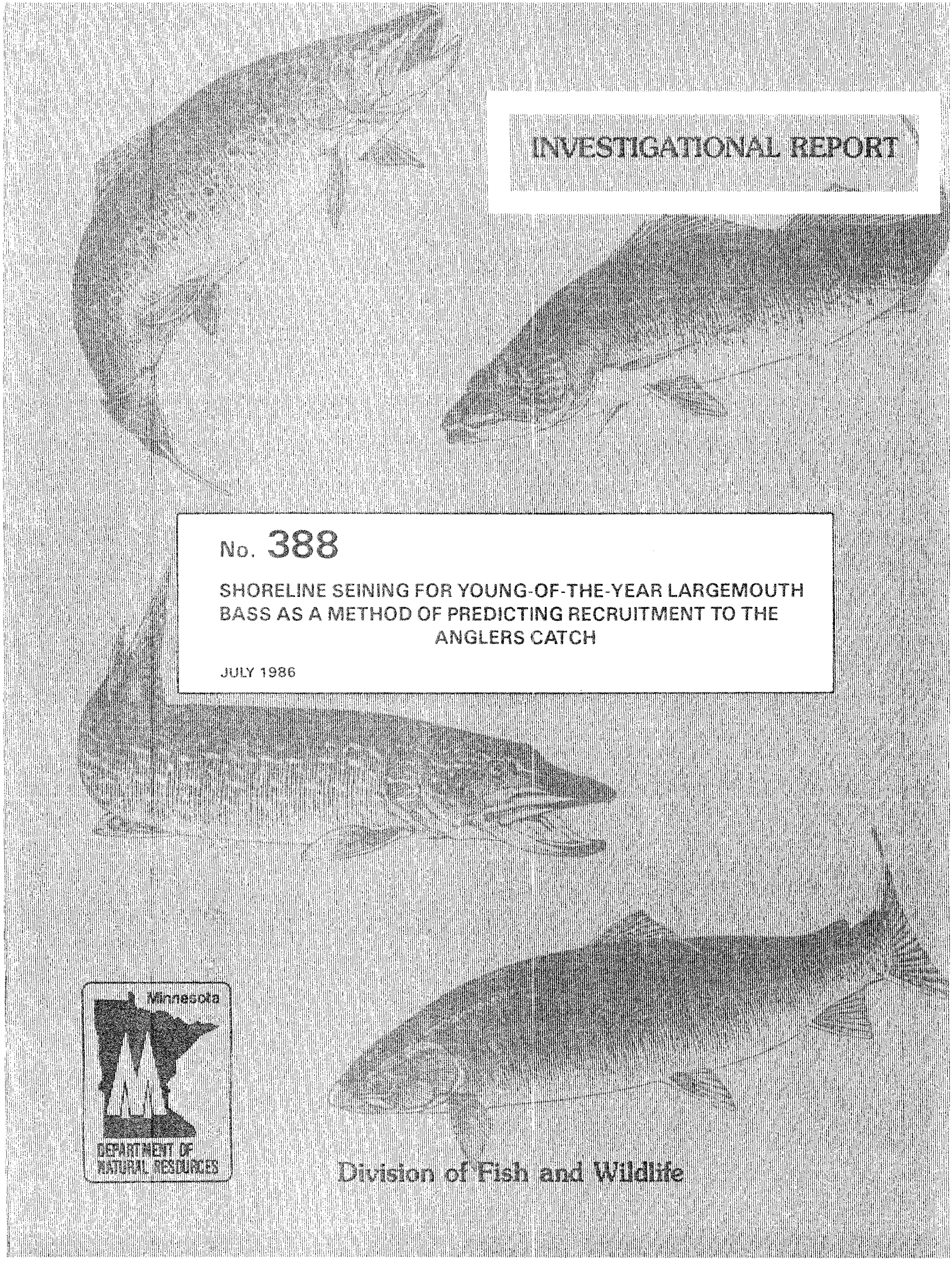

INVESTIGATIONAL REPORT

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SHORELINE SEINING FOR YOUNG-OF-THE-YEAR LARGEMOUTH BASS AS A METHOD OF PREDICTING RECRUITMENT TO THE ANGLERS CATCH

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DEPARTMENT OF NATURAL RESOURCES

Division of Fish and Wildlife

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SHORELINE SEINING FOR YOUNG-OF-THE-YEAR LARGEMOUTH BASS AS A METHOD OF PREDICTING RECRUITMENT TO THE ANGLERS CATCH[1]

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ABSTRACT

A relatively inexpensive 15 m x 1.8 m, 6.4 mm mesh bag seine can be used to determine the strength of a young largemouth bass year-class. The size of young bass going into their first winter rather than abundance appears to be critical in the development of the year-class. Strong year-classes developed from bass that reached mean TL >50 mm by the first week in August. First-year growth rates and mean TL attained by given dates were strongly correlated with mean air temperatures measured near the lake.

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1 This project was funded in part by Federal Aid Restoration (Dingell-Johnson) Program. Completion Report, Study 112, Project D-J F-26-R Minnesota.

INTRODUCTION

The Minnesota Section of Fisheries has spent considerable time and money on annual shoreline seining for assessment of abundance of young-of-the-year (hereafter referred to as young) largemouth bass (Micropterus salmoides) to estimate reproductive success and potential recruitment to the catchable stock. Estimates of reproductive success for a given lake are usually based on the catch in three to eight seine hauls made during one day in July or August about a month after brood dispersal. Past experience and individual judgment are then used to assign ratings of poor, fair or good reproductive success based on the numbers of young caught. The assumption is that large catches are indicative of large year-classes and vice-versa. Newburg (1969) attempted to quantify these subjective ratings based on 15 years of seining from several lakes.

Kramer and Smith (1962) showed a positive relationship between relative year-class strengths of bass during their first summer and as yearlings based on seining. They also concluded that year-class strength was set before fingerlings were two weeks old. An index to year-class strength could be obtained at anytime during the summer after brood dispersal by sampling the poorest habitat in Lake Powell (Miller 1971; Miller and Kramer 1971). They qualified their findings by stating that validation of their procedure must be done by observing the contribution of each year-class to the creel. An abundance of young bass was indicative of a strong year-class in Alabama ponds (Elrod 1971); however, large numbers of fry do not necessarily result in the formation of a strong year-class (Bennett 1969). The largest year-class of catchable bass in Geneva Lake, Minnesota, was represented by a zero catch in shoreline seining five years earlier (Newburg 1969). Year-class strength may not be set until the second summer in Dryden Lake, New York (Green 1971). Shoreline seining appeared to be more satisfactory for assessing the status of young bass than pulsed DC electrofishing (Newburg 1973).

Seining is a relatively inexpensive method for sampling young bass; however, catches can vary considerably between stations on the same lake and within stations from sample to sample. The reliability of such data for prediction of year-class strength is uncertain. The objective of this study was to develop more definitive guidelines for evaluating seine catch data.

STUDY AREA

Geneva Lake, Douglas County, Minnesota (Fig. 1), was formed by an ice block in a glacial outwash plain associated with the Alexandria Moraine. The western half of the lake lies within the city limits of Alexandria. The inlet and outlet are open to boat travel and free passage of fish. It is one of several lakes known as the "Alexandria Chain of Lakes" which are good largemouth bass fishing waters.

Physical characteristics of the lake include an area of 255 ha, littoral area of 107 ha (42%), maximum depth of 19.0 m, mean depth of 6.3 m, median depth of 7.3 m, shoreline distance of 8.2 km and a shoreline development of 1.4. Secchi disc readings during the summer months range between 1.4 and 2.3 m and vary with moderate blooms of planktonic algae. Abundant growths of macrophytes occur in the littoral zone.

It is a hardwater lake typical of the area with a total alkalinity of 170 mg/l. During the summer months, the lake stratifies and oxygen depletion occurs in the hypolimnion. Nitrate and phosphate levels were 0.125 and 0.025 mg/l, respectively.

The ecological and fishery management classification of Geneva Lake is "centrarchid". Largemouth bass, northern pike (*Esox lucius*) and walleye

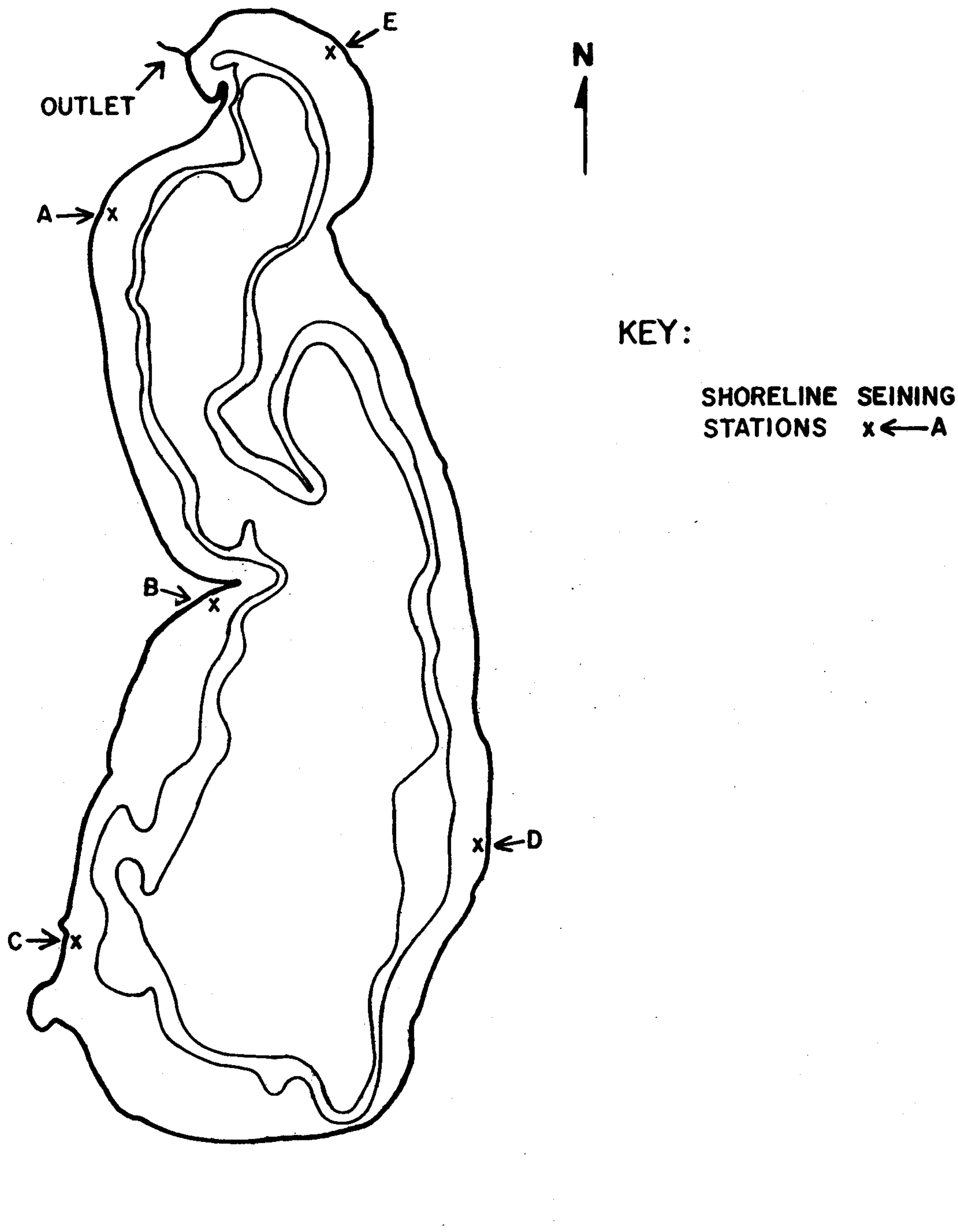

Figure 1. Contour map of Geneva Lake with location of shoreline seining stations A through E and 1.5 and 6.1 m contours indicated.

(Stizostedion vitreum vitreum) are the major fish predators. Black crappie (Pomoxis nigromaculatus) and sunfish (Lepomis spp.) are very abundant. Carp (Cyprinus carpio) were not reported in assessment netting in 1948, 1966 and 1974 but were reported in 1980.

From 1910 through 1955, steelhead trout (Salmo gairdneri), walleye, black crappie, largemouth bass, northern pike and sunfish were stocked. Pike were stocked in 1964 and 1965. A 4 ha improved pike spawning area with a water control structure was first used in 1971 and has made an annual contribution ranging from 12,000 to 116,000 fingerlings and 55 to 210 adult pike to the lake. A 1.2 ha "posted" bass spawning area was established in 1953 in the southwest corner of the lake. Fishing is not allowed within its boundaries from the time of posting in early May through 1 July. The lake was closed to dark house spearing during the winters of 1944-45, 1945-46 and 1949-50.

METHODS

Shoreline seining for young bass with a standard 15 m x 1.8 m, 6.4 mm mesh bag seine was done from 8 July through 15 September each year from 1973 through 1979. Seining was done once a week during July and September and twice a week during August. Five permanent shoreline seining stations were established (Fig. 1). The seine was stretched parallel to shore in 1.3 m of water and hauled perpendicularly in-shore. Bottom types at four of the five stations were marl over sand while Station D was a mixture of sand and gravel. Three stations (A, D, E) were densely vegetated while Station B had moderate and Station D sparse vegetation. Station E was the only station at which vegetation density changed (dense to moderate) during the course of the study. Since all stations were seined each sampling day, catches from all stations were combined. Young bass were counted and measured to the nearest millimeter.

Age 2 and older bass were sampled each year during the spring from 1975 through 1981. Thus all year-classes sampled as young were sampled at least once as Age 2 fish. Seining began at ice-out and continued until mean water temperature reached 15.6 C., the temperature at which male bass start seeking spawning sites (Smith, Franklin, and Kramer 1958). A seine 244 m x 5.5 m composed of a 122 m x 5.5 m center section of 19 mm mesh with a centered 9.1 m x 3.0 m bag of 19 mm mesh and a 61.0 m x 5.5 m section of 25.4 mm mesh seine attached to each end of the 122 m section was used. The seine was laid parallel to shore along the 5.5 to 6.1 m contour and hauled perpendicularly in-shore using two gasoline powered winches.

All areas around the lake without moderate to dense stands of hardstem bulrush (*Scirpus acutus*) or underwater obstructions were seined. Sixteen to 37 seine hauls were made each year. The fewest number of hauls were made during 1975 and 1976 when another lake was included in the study. Captured fish were bagged and staked in 1.0 to 1.2 m of water. Bass were sorted into live boxes and/or bags and were then measured (TL), scale-sampled, marked and released at the capture site.

Bass were fin-clipped or marked with serially numbered Floy FD-68C[1] or FD-67 anchor tags, or with FD-67F unnumbered anchor tags with the paddles cut off. Tags were inserted on the left side of the fish at the base of the spiney dorsal fin to anchor them between interneural bones. Different colors and lengths of tags were used each year. Population estimates of bass 149 mm TL and larger were made each year using Chapman's modification of the Schnabel method (Ricker 1975).

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[1] Purchased by the Viking Sportsmen, Incorporated, Alexandria, MN in their support of the bass research program.

A completed trip creel census based on a modification of the Moyle and Franklin (1957) method was done during the summer from 1975 through 1981. The census began on opening day of the bass season in late May and ended on 30 September. Six consecutive days of every eight were censused unless a 40-hr work week would be exceeded. In those weeks where the basic census schedule exceeded 40 hr, one day was randomly eliminated. Sampling hours on even-numbered days were between 0600-1400 hrs and on odd-numbered days between 1400-2200 hrs. The total catch of contacted anglers was counted and weighed by species and individual bass were weighed, measured and scale-sampled. Marked bass in the catch were recorded.

Standard statistical methods (Bazigos 1974; Snedecor and Cochran 1967) were used to test the following comparisons: (1) CPUE of young bass between stations and between years; (2) CPUE vs. estimated population and contribution to the creel at ages 2 through 5; (3) CPUE vs. first-year growth; (4) first-year growth vs. estimated population and contribution to the creel; and (5) first-year growth vs. mean air temperatures from 1 May through 28 August each year.

Records of air temperatures were obtained and compiled from the Federal Aviation Administration's Flight Service Station two miles southwest of the lake.

RESULTS

Shoreline Seining

Peak catches of young bass occurred on widely different dates and at widely different sizes in different years. The earliest date of maximum catch was 8 July 1977 and the latest date 15 August 1974. The mean TL at time of peak catch ranged from 30.2 mm in 1979 to 52.8 mm in 1975.

Catches of young bass declined steadily each year from peaks to the end of seining. Linear regressions of young bass per ha on time indicated that the declines in catch were significant (t-test, $P < 0.05$) (Table 1). Analysis of covariance indicated that the slopes between years did not differ significantly (F-test, $P < 0.05$).

Table 1. Summary of linear regressions of young bass/ha on time and analysis of covariance of summer seine catches of young bass, Geneva Lake, 1973-1979.

	Slopes				Analysis of covariance		
Year	n	b	s	t[a]	F-test slopes	F-test means	Adjusted mean bass/ha
1973	10	6.629	2.705	2.45			305.7
1974	9	14.766	2.870	5.14			354.8
1975	13	5.415	1.806	3.00			105.0
1976	13	6.950	1.378	5.04			243.1
1977	13	6.413	1.130	5.68			198.2
1978	14	6.249	1.716	3.64			168.1
1979	12	5.258	0.865	6.08			115.0
All					1.56	21.04[b]	212.8

[a] All t values significant, $P < 0.05$.
[b] $P < 0.01$

The adjusted mean catches of young bass/ha indicated that differences in abundance could be detected by shoreline seining (Tables 1 and 2). Ten of 21 possible comparisons of differences between year-classes were significant ($P < 0.01$). The 1973 and 1974 catches were significantly higher than the adjusted mean for all years combined (212.8) while the 1975 and 1979 catches were significantly lower.

Growth of Young Bass

Growth rates of young bass were linear throughout the seining period in all years and varied greatly between years (Table 3). Growth rates for all

Table 2. Between years differences in adjusted mean catches (from analysis of covariance) of young bass/ha and tests of significance, Geneva Lake, 1973-1979.

Year-class	Year-class 1975	1979	1978	1977	1976	1973
1974	249.8[a]	239.8[a]	186.7[a]	156.6	111.7[a]	49.1
1973	200.7[a]	190.7[a]	137.6[a]	107.5	62.6	
1976	138.1[a]	128.1[a]	75.0	44.9		
1977	93.2[a]	83.2	30.1			
1978	63.1	53.1				
1979	10.0					

[a] $P < 0.01$.

Table 3. Linear regressions of growth rate (mm/day) of young bass on time, July through September, Geneva Lake, 1973-79.

Year	Growth rate mm/day	S.E.	R^2	Date mean TL (mm) was attained 45 mm	50 mm	55 mm	60 mm
1973	0.451	0.004	0.917	2 Aug	13 Aug	24 Aug	5 Sep
1974	0.480	0.006	0.848	4 Aug	14 Aug	25 Aug	4 Sep
1975	0.800	0.013	0.828	20 Jul	27 Jul	2 Aug	8 Aug
1976	0.661	0.004	0.946	31 Jul	8 Aug	16 Aug	23 Aug
1977	0.528	0.005	0.910	20 Jul	29 Jul	8 Aug	17 Aug
1978	0.520	0.004	0.928	5 Aug	15 Aug	24 Aug	3 Sep
1979	0.566	0.009	0.929	18 Aug	27 Aug	5 Sep	14 Sep

years, with one exception, differed significantly (F-test, $P < 0.01$). No difference between growth rates of the 1977 and 1978 year-classes could be detected.

Air temperatures (Table 4) in late July were related to growth rate. The correlation between growth rate and mean air temperature during the

Table 4. Mean air temperatures (C) from 1 May through 28 August for the years 1973-79, Alexandria, Minnesota.

	Time of year								
Year	1 May 15 May	16 May 31 May	1 Jun 15 Jun	15 Jun 30 Jun	1 Jul 15 Jul	15 Jul 31 Jul	1 Aug 15 Aug	16 Aug 28 Aug	1 May 28 Aug
1973	10.7	15.4	20.6	19.3	22.4	19.7	21.2	21.1	18.0
1974	7.4	14.2	17.3	20.0	25.0	22.6	19.3	18.9	17.9
1975	11.9	17.6	15.5	21.5	22.5	24.6	21.8	19.0	18.9
1976	11.5	16.4	22.6	18.8	23.1	22.8	21.5	23.8	19.2
1977	16.9	19.6	18.6	20.0	22.1	22.4	18.1	17.2	19.9
1978	11.8	17.8	16.6	20.0	20.5	21.1	21.8	21.1	18.0
1979	6.3	14.2	16.7	17.6	21.3	20.9	19.5	17.5	16.2

period 16-31 July was 0.797 $P < 0.05$ (Table 5).

Strong correlations were also found between air temperatures and the dates young bass first attained a given mean TL (Table 5). Low mean air temperatures from May through July were associated with later dates of attainment of given lengths.

Spring Seining and Population Estimates

Estimates of the spring population of largemouth bass >149 mm TL varied by a factor of more than two (Table 6). The numbers marked ranged from 5.3 to 21.6 /ha/yr with a mean of 11.6/ha for the years 1975-1981. Population estimates ranged from 27.9 to 68.9/ha and averaged 45.1.

The 1975 and 1977 year-classes were the most abundant and ranked first or second for all sample years (Tables 7 and 8). The 1973 year-class ranked lowest in abundance at ages 2, 4, 5 and 6 and fourth of six at age 3. The 1974 year-class ranked second lowest in abundance at ages 3 through 6 and third of seven at age 2.

Table 5. Correlation matrix of various indices of largemouth bass year-class strength (1st year CPUE and growth), population size, harvest and air temperatures during the first growth year, Geneva Lake, 1973-81.

	Summer seine	Indices of growth					Spring population		Harvest		Mean temperature	
			Days to attain mean TL[a]									
		mm/day	45 mm	50 mm	55 mm	60 mm	Age 2	Age 3	Age 2	Age 3	Late July	May-July
Summer seining	1.00											
Growth mm/day	-0.67	1.00										
Days to 45 mm	0.14	-0.41	1.00									
Days to 50 mm	0.21	-0.50	0.99[b]	1.00								
Days to 55 mm	0.32	-0.62	0.97[b]	0.99[b]	1.00							
Days to 60 mm	0.38	-0.70	0.93[b]	0.97[b]	0.99[b]	1.00						
Population, age 2	-0.56	0.69	-0.74	-0.80[b]	-0.83[b]	-0.86[b]	1.00					
Population, age 3	-0.76	0.79	-0.68	-0.72	-0.78	-0.78	0.81[b]	1.00				
Harvest, age 2	-0.08	0.41	-0.58	-0.59	-0.60	-0.58	0.65	0.79	1.00			
Harvest, age 3	-0.37	0.68	-0.67	-0.69	-0.71	-0.70	0.77	0.86[b]	0.87[b]	1.00		
Mean temp., late July	-0.34	-0.80[b]	-0.62	-0.69	-0.75	-0.81[b]	0.82[b]	0.68	0.67	0.72	1.00	
Mean temp., May-July	0.00	0.28	-0.92[b]	-0.91[b]	-0.88[b]	-0.84[b]	0.56	0.22	0.30	0.21	0.53	1.00

[a] Day 1 = July 1.
[b] $P < 0.05$.

Table 6. Modified Schnabel population estimates (number/ha) of largemouth bass >149 mm TL, spring seining, Geneva Lake, 1975-81 with 95% confidence limits.

Year	Number of seine hauls	Total	Population estimates Lower	Upper
1975	16	27.9	23.3	34.7
1976	22	34.9	31.8	38.6
1977	33	41.4	38.6	44.7
1978	34	68.9	63.4	75.5
1979	28	36.9	33.7	40.7
1980	27	50.2	44.2	58.8
1981	37	55.5	52.5	57.8

Sport Fishery

Creel surveys indicated that there was a relatively stable largemouth bass fishery from 1975 through 1981 (Table 10). Mean bass angling mh/ha, numbers of bass harvested/ha and yield/ha were 34.5, 10.9 and 4.7, respectively. Coefficients of variation of these estimates were 0.09, 0.13 and 0.14, respectively. Rates of exploitation ranged from 0.170 to 0.276 and averaged 0.215.

Age classes 3 and 4 were usually the largest contributors to the bass harvest (Table 10). Age 4 provided 28.1% of the estimated harvest during the study while age 3 provided 24.9%. The harvest of age 4 bass accounted for 72% of the variation in total annual harvest, 55% of the variation in yield and 68% of the variation in catch/mh.

The 1977 year-class ranked first in numbers harvested at ages 2 and 3 while the 1975 year-class ranked first at ages 4 and 5 (Table 8). The 1973 year-class ranked lowest in numbers harvested at ages 2 through 5.

Table 7. Modified Schnabel population estimates of largemouth bass (number/ha) by year-class and age-class, Geneva Lake, 1975-81 with 95% confidence limits.

Year-class	Age	Estimate	Lower	Upper
1973	2	0.1	-	-
1974	2	17.0	13.2	23.9
1975	2	60.4	49.8	78.9
1976	2	14.5	10.1	28.4
1977	2	46.3	23.5	1416.7
1978	2	10.0	7.7	14.4
1979	2	13.6	11.6	16.4
1973	3	8.7	7.4	10.5
1974	3	8.3	6.9	10.4
1975	3	43.1	38.2	49.5
1976	3	6.8	5.1	10.0
1977	3	14.1	10.9	20.0
1978	3	12.9	11.8	14.3
1973	4	3.4	2.9	3.9
1974	4	6.6	5.6	7.9
1975	4	14.1	12.5	16.2
1976	4	10.1	7.5	15.2
1977	4	15.3	14.2	16.6
1973	5	2.5	1.9	3.4
1974	5	3.4	2.8	4.2
1975	5	7.2	5.7	9.5
1976	5	4.3	3.8	4.9
1973	6	1.7	1.2	2.6
1974	6	1.7	1.1	3.4
1975	6	5.3	4.7	6.0

Predicting Year-Class Strength

No relationship was evident between estimates of abundance of young bass and harvest of the same year-classes at ages 2 and 3 (Table 5). Growth rate of young bass was the best predictor of the contribution of a year-class to

Table 8. Rankings of the 1973-79 largemouth bass year-classes by first-year abundance and growth, population numbers and harvest, and of mean air temperatures during selected time periods, Geneva Lake.

Year-class	Summer seining	Indices of growth					Spring population at age					Summer harvest at age					Mean air temperature	
		mm/day	45 mm	50 mm	55 mm	60 mm	2	3	4	5	6	2	3	4	5	6	16 Jul 31 July	1 May 28 Aug
1973	2	7	4	4	4	6	7	4	5	4	3	7	6	5	4	2	7	4
1974	1	6	5	5	6	5	3	5	4	3	2	3	4	4	2	3	3	6
1975	7	1	1	1	1	1	1	1	2	1	1	2	3	1	1	1	1	3
1976	3	2	3	3	3	3	4	6	3	2		4	2	3	3		2	2
1977	4	4	1	2	2	2	2	2	1			1	1	2			4	1
1978	5	5	6	6	4	4	6	3				6	5				5	5
1979	6	3	7	7	7	7	5					5					6	7

Table 9. Summary of selected statistics from the largemouth bass sport fishery, Geneva Lake, 1975-81.

Statistics	Year							Mean	C.V.
	1975	1976	1977	1978	1979	1980	1981		
Manhours/ha	118.2	141.2	140.5	128.2	140.5	140.0	116.6	132.2	0.08
Anglers/ha	12.0	15.2	15.8	14.7	15.7	13.4	12.1	14.1	0.12
Manhours/ha	31.7	35.0	39.1	35.0	37.5	33.0	30.0	34.5	0.09
Harvest, no/ha	9.1	10.2	11.9	11.3	13.2	10.9	9.8	10.9	0.13
Yield, kg/ha	4.6	4.6	5.3	4.4	6.0	4.1	4.3	4.7	0.14
Mean weight, kg	0.49	0.45	0.45	0.39	0.45	0.38	0.44	0.43	0.09
Bass/manhour	0.29	0.29	0.30	0.32	0.35	0.33	0.33	0.32	0.07
Rate of exploitation	0.17	0.28	0.24	0.22	0.25	0.17	0.18	0.22	0.20

Table 10. Estimated harvest (numbers) of largemouth bass by age-class, Geneva Lake, 1975-81.

Year	Age						Total
	1	2	3	4	5	6+	
1975	53	239	163	536	591	742	2,324
1976	44	451	706	339	479	586	2,605
1977	9	598	859	616	277	680	3,039
1978	12	141	1,498	701	196	338	2,886
1979	0	272	588	1,915	596	400	3,771
1980	6	262	756	671	827	262	2,784
1981	5	110	383	821	558	626	2,503
Mean	18.4	296.1	707.6	799.9	503.4	519.1	2,844.6
%	0.6	10.4	24.9	28.1	17.7	18.3	

the creel. The two largest year-classes (1975 and 1977) attained mean total lengths of 50 mm by 27 July and 29 July, respectively. The weak 1979 year-class did not attain 50 mm until 27 August (Table 3).

All correlations between indices of first-year growth and harvest of these year-classes at ages 2 and 3 were positive though not statistically significant. Lengths achieved at 5-day intervals from 15 July through 20 August were all positively correlated with estimates of harvest of the same year-classes at ages 2 through 4 (Tables 3 and 10). The highest correlations tended to occur in early August. Mean lengths attained by young bass on 5 August accounted for 57%, 36% and 75% of the variation in estimated harvest of the same year-classes at ages 2, 3 and 4, respectively.

Mean air temperatures in late July of the first growth year were also moderately correlated with harvests in subsequent years (Table 5). Temperatures in late July explained 44% of the variation at ages 2 and 3.

DISCUSSION

The finding that growth rate indices during the first summer of life were better predictors of largemouth bass year-class strength than abundance indices suggests that year-class strength is set sometime between late summer and the following spring. This is in contrast to the findings of Kramer and Smith (1962) that year-class strength was set before fingerlings were two weeks old. Extremes in abundance of young bass between years were detected at Geneva Lake using shoreline seines. This had been demonstrated previously by Kramer and Smith (1962), Miller (1971) and Miller and Kramer (1971) but Wigtil (1981) pointed out that abundance may not be a good measure of year-class strength.

The inverse relationship between abundance of young bass and the abundance and contribution to the creel of the same year-classes in later years has also been observed by other investigators. An inverse relationship between abundance of young bass and their abundance at age 1 was noted in Beaver Reservoir, Arkansas (Martin et al. 1981). Lantz (1978) presented data from shoreline seining and cove rotenone samples that indicated an inverse relationship between abundance of young bass and their abundance at ages 1 through 3. On the other hand, Kramer and Smith (1962) reported a positive relationship between abundance of young bass and abundance at age 1 in shoreline seines.

The strong correlations between indices of growth of young bass and air temperatures also supports other studies. The total length of young bass at the end of the season was fully indicated by the size of the fish on 1 August and this size was strongly related to their accumulated temperature experience (Kramer and Smith 1960). Green (1982) also noted that growth was at least partially influenced by temperature. These relationships have also been observed for other species. Year-class strengths of smallmouth bass (Micropterus salmoides) (Fry and Watt 1957), northern pike and Eurasian perch (Perca fluviatilis) (LeCren, in press) have also been positively related to fast growth rates influenced by temperature.

The size of young bass at the end of the first growing season appears to be critical to the development of a year-class. Temperature acts largely through growth, influencing both the rate of growth and the length into the autumn season (LeCren, in press). This finding is supported by a number of other investigators (Pasch 1975; Adams et al. 1982; Aggus and Elliot 1975; Shelton et al. 1979; and Green 1982).

The cause of the apparent disappearance of smaller young bass is not clear. Bivings and Noble (1980) postulated that predation was the major factor in the low over-winter survival of bass less than 150 mm TL that reduced bi-modal fall samples to a single mode in spring. An apparently normal length distribution of young bass in autumn was truncated on the smaller end the following spring in Rebecca Lake, Minnesota (D. Shodeen, MN DNR, personal communication 1985) where an abundant population of small northern pike was present and the abundance of alternate prey species was low. Oliver et al. (1979) showed that long fingerling smallmouth bass had a higher over-winter survival rate than short fish. Their data lent some support to the hypothesis that the energy reserves of smaller fingerlings were exhausted before those of larger fish.

MANAGEMENT IMPLICATIONS

Young bass captured by shoreline seining can be used to predict the subsequent strength of a year-class but it appears that the mean length on a given date may be the best criterion to use. A measured sample of 100 young bass (Table 11) taken on approximately the same date each year should provide adequate data to predict the relative strength of the year-class at ages 2 through 4. The mean standard deviation of lengths of bass sampled from 25 July through 18 August, 1973-79 was 9 mm. For standard deviations ranging from 2 through 10, sample sizes of 100 young bass measured would provide estimates of the true mean length within 2 mm or less at the 95% probability level (Table 11).

Optimum seining dates in Minnesota appear to be from 20 July through 1 September. Where basswood trees are present, the blooming of these trees can be used as a phenological indicator of the time to commence seining.

Population estimates and harvest estimates will rarely be available for comparing first-year growth indices to abundance at older ages as they were in this study. However, Ebbers (in press) showed that age and length samples from spring electrofishing and from bass fishing contests held in the same

Table 11. Estimated sampling error (mm) of mean TL of young largemouth bass at the 95% confidence level for various sample sizes and standard deviations, Geneva Lake.

Sample	Standard deviation (mm)							
size	2	4	6	7	8	9	10	15
25	0.80	1.60	2.40	2.80	3.20	3.60	4.00	6.00
50	.57	1.13	1.70	1.98	2.26	2.55	2.83	4.24
100	0.40	0.80	1.20	1.40	1.60	1.80	2.00	3.00
250	0.25	0.51	0.76	0.89	1.01	1.14	1.26	1.90
500	0.18	0.36	0.54	0.63	0.72	0.80	0.89	1.34
1,000	0.13	0.25	0.38	0.44	0.51	0.57	0.63	0.95

year led to similar conclusions about the age and size structure in Lake Minnetonka, Minnesota. First-year growth indices can be compared to data from electrofishing, fishing contests or individual fishing diaries of cooperating bass anglers.

At Geneva Lake, a mean length of 50 mm appeared to be a critical size for determining if a strong year-class would result. This critical size may vary over the wide range of latitudes in Minnesota and may have to be established for each management area or lake sampled.

The use of a relatively small measured sample of young bass from a lake as a predictor of year-class strength should enable fishery managers to sample several lakes in one day. Samples of older bass from electrofishing, fishing contests or fishing diaries combined with the shoreline seining samples can provide a relatively efficient and inexpensive means of monitoring a large number of largemouth bass fisheries. The high correlations between first-year growth indices or air temperatures and subsequent year-class strength suggest that useful predictive models could be developed. Data over a series of years from the same lake or from a number of lakes would be required.

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Appendix Table 1. CPUE of young bass (numbers/ha) captured by shoreline seining for all seining stations combined, Geneva Lake, 1973-79.

Date		1973	1974	1975	1976	1977	1978	1979
Jul	8					400.0*		
	9							
	10	23.5						
	11		70.6					
	12					317.6		
	13							
	14				388.2*			
	15			152.9				
	16							0.0
	17	223.5					559.2*	
	18		117.6					
	19							
	20							
	21							
	22			164.7	294.1	305.9		
	23	352.9						268.1*
	24						247.7	
	25		317.8					
	26							
	27							
	28					200.0		
	29				341.2			
	30	458.8*		411.8*				268.1
	31		423.5				143.1	
Aug	1							
	2				400.0	58.8		
	3							
	4			223.5		70.6	143.1	
	5		494.1*		329.4			
	6							172.2
	7	376.5		82.4			299.2	
	8		541.2			105.9		
	9	282.4			141.2			
	10						143.1	153.2
	11					47.1		
	12		470.6	141.2	364.7			
	13	352.9						210.8
	14						260.2	
	15		552.9	164.7		82.4		
	16	329.4			94.1			57.6
	17						39.3	
	18					47.1		
	19		341.2	94.1	188.2			

Appendix Table 1. Continued.

Date	1973	1974	1975	1976	1977	1978	1979
20	388.2						114.9
21		458.8					
22			82.4		117.6	65.0	
23	423.5		152.9	153.0			114.9
24						130.0	
25					23.5		
26			105.9	129.4			
27	376.5	211.8					134.2
28						78.1	
29		270.8	58.8				
30	141.2						19.3
31						39.0	
Sep 1				35.3	58.8		
2							
3		82.4	70.6				
4	117.6						57.6
5						117.2	
6							
7							
8				35.3		94.1	
9							
10							19.3
11							
12							
13							
14						0.0	
15							
16							
17			47.1				
18							
19							
20							
21							
22							
23							
24							
25						00.0	

Appendix Table 2. Lengths (TL mm) of young largemouth bass sampled each year, Geneva Lake, 1973-79.

Date	n	Mean	S.E	Median	Range
8 Jul 1977	32	38.7	1.1	38.0	29-57
10 Jul 1973	2	34.0	1.9	34.0	29-39
11 Jul 1974	6	20.7	0.9	21.0	18-23
14 Jul 1976	33	33.7	1.1	35.0	30-40
15 Jul 1977	12	39.3	0.9	39.0	34-45
17 Jul 1973	19	36.1	0.7	36.0	32-49
17 Jul 1978	43	36.2	0.8	36.0	28-47
18 Jul 1974	10	38.3	0.9	38.5	35-44
22 Jul 1975	13	40.7	1.4	42.0	32-48
22 Jul 1976	25	39.0	1.0	38.0	30-50
22 Jul 1977	26	47.7	2.6	43.0	33-85
23 Jul 1973	31	40.3	0.8	40.0	33-49
23 Jul 1979	14	30.4	0.7	31.5	26-34
24 Jul 1978	19	38.2	1.4	36.0	31-51
25 Jul 1974	27	40.4	1.6	39.0	34-51
28 Jul 1977	17	48.8	2.0	46.0	38-71
29 Jul 1976	29	45.2	1.3	46.0	31-62
30 Jul 1973	39	43.4	1.0	43.0	32-52
30 Jul 1975	35	54.4	1.9	54.0	35-72
30 Jul 1979	14	33.5	1.4	33.0	25-46
31 Jul 1974	36	44.4	1.1	42.5	31-61
31 Jul 1978	11	40.3	2.7	37.0	30-49
2 Aug 1977	5	55.0	7.0	51.0	32-76
4 Aug 1975	19	58.0	2.5	53.0	39-77
4 Aug 1977	6	52.8	5.9	48.5	40-80
4 Aug 1978	11	40.6	1.8	40.0	34-53
5 Aug 1974	42	43.5	1.4	40.5	31-70
5 Aug 1976	28	46.4	1.3	46.5	36-59
6 Aug 1979	9	36.7	2.7	33.0	28-54
7 Aug 1973	32	49.3	1.4	46.5	40-69
7 Aug 1975	7	50.7	3.7	46.0	39-67
7 Aug 1978	23	44.9	1.8	45.0	31-63
8 Aug 1974	46	49.3	1.9	45.0	34-79
8 Aug 1977	9	48.0	2.6	44.0	44-63
9 Aug 1973	24	48.2	1.2	48.0	39-57
9 Aug 1976	12	50.7	3.3	49.0	38-73
10 Aug 1978	11	50.3	3.3	51.0	34-66
10 Aug 1979	8	44.4	2.7	44.0	32-56
11 Aug 1977	4	61.8	5.2	59.5	52-76
12 Aug 1974	40	45.1	1.5	40.0	35-68
12 Aug 1975	12	60.8	3.4	62.0	46-80
12 Aug 1976	31	52.2	1.7	52.0	37-72

Appendix Table 2. Continued.

Date	n	Mean	S.E	Median	Range
13 Aug 1973	30	50.7	1.6	48.5	40-71
13 Aug 1979	11	42.1	1.9	41.0	36-57
14 Aug 1978	20	50.2	2.1	50.0	35-71
15 Aug 1974	47	51.6	1.9	52.0	36-73
15 Aug 1975	14	76.3	3.9	73.0	56-105
15 Aug 1977	7	56.6	3.5	51.0	46-69
16 Aug 1973	28	49.5	1.5	47.5	37-75
16 Aug 1976	8	50.9	2.3	50.5	42-58
16 Aug 1979	3	41.3	0.3	41.0	41-42
18 Aug 1978	3	59.7	3.4	62.0	53-64
19 Aug 1974	29	51.0	2.5	46.0	35-78
19 Aug 1975	8	69.0	4.2	73.0	50-83
19 Aug 1976	8	50.9	2.3	57.5	42-83
20 Aug 1973	33	53.3	1.6	50.0	40-72
20 Aug 1979	6	45.5	1.9	47.0	37-51
21 Aug 1974	39	54.2	2.0	53.0	35-76
22 Aug 1975	7	76.1	7.3	70.0	58-107
22 Aug 1977	10	64.9	5.1	62.0	39-90
22 Aug 1978	5	50.6	4.0	45.0	44-65
23 Aug 1973	36	51.8	1.3	49.0	42-72
23 Aug 1976	16	60.1	3.3	61.0	49-100
23 Aug 1979	6	47.7	3.6	47.5	38-64
24 Aug 1978	10	53.0	3.6	49.5	40-78
25 Aug 1977	2	64.5	6.5	64.5	58-71
26 Aug 1975	9	77.7	3.5	81.0	66-95
26 Aug 1976	10	66.1	3.9	63.0	47-89
27 Aug 1973	32	59.6	3.0	53.0	39-109
27 Aug 1974	18	54.3	2.9	55.5	36-76
27 Aug 1979	7	50.4	2.1	51.0	44-58
28 Aug 1978	6	60.3	7.3	53.0	43-89
29 Aug 1974	23	56.2	2.8	56.0	37-77
29 Aug 1975	5	64.8	3.4	67.0	52-72
30 Aug 1973	12	56.3	6.1	47.0	39-115
30 Aug 1979	1	41.0	-	-	-
31 Aug 1978	3	50.3	4.6	51.0	42-58
1 Sep 1976	3	60.3	3.3	62.0	54-65
3 Sep 1974	7	53.3	4.6	61.0	37-67
3 Sep 1975	6	73.2	4.4	76.5	58-81
4 Sep 1973	10	56.1	2.2	56.0	48-67
4 Sep 1979	3	54.0	3.6	52.0	49-61
5 Sep 1978	9	63.7	5.3	60.0	46-93
8 Sep 1976	3	68.7	10.8	79.0	47-80
8 Sep 1978	8	63.3	4.8	60.5	50-92
10 Sep 1979	1	64.0	-	-	
16 Sep 1975	4	84.3	2.5	84.5	78-90