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ASSESSMENT OF THE MARGAREE RIVER GASPEREAU FISHERY, 1990

by

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ABSTRACT

Fisheries regulations in 1990 were identical to those imposed in 1984 and included one day per week closures staggered over the two geographic zones of the river below Lake Ainslie. Of 62 licenses registered in 1990, 41 traps were fished resulting in a harvest of 1,016 t, which is 9% less than the previous 5 year mean. In 1990, the migration of gaspereau into the Margaree River was delayed by almost two weeks. The largest daily catch occurred on June 4, the latest date since 1983 and 80% of the catch was landed over a period of 22 days, the longest time since 1983. The 1987 year class was the dominant component of the catch and new recruitment was 75% of the catch. The 1986 year class was weak as noted in the 1989 fishery. The abundance index for 1990, calculated from logbook reports using multiplicative model procedures, was the lowest since 1984. Recruitment of the 1987 year class was strong in 1990. Staggered weekend closures introduced in 1984, have succeeded in reducing the fishing effort while stabilising harvests at levels equal to those obtained in the 1970's when the fishery was unregulated.

RESUME

Les règlements de pêches en 1990 étaient semblables à ceux en vigueur depuis 1984 et imposaient une fermeture obligatoire d'une journée par semaine décoffée suivant les deux zones de la rivière. En 1990, 41 de 62 détenteurs de permis ont éxercé leur droit de pêche. Les prises se sont situées à 1,016 tonnes, une baisse de 9% par rapport à la moyenne des cinq années précédentes. La montaison de gaspareau en 1990 était retardée de près de 2 semaines par rapport aux années précédentes. Le maximum des prises journalières fut enrégistré le 4 juin, date la plus tardive depuis 1983 tandis que et la durée de la pêche (80% du débarquement total) était la plus longue, 22 jours. La plus forte proportion des prises revenait de poissons de la cohorte de 1987 et 75% des prises étaient de nouvelles recrues. La cohorte de 1986 s'est avèrée aussi faible que prévue en 1989. Des carnets de pêche où etaient enrégistrés les prises et l'effort ont servi à estimer l'abondance de gaspareau en utilisant un modèle multiplicatif. L'abondance estimée était inférieure à toutes celles estimées depuis 1984. Le recrutement de la cohorte de 1987 était fort en 1990. Les fermetures de fin de semaine ont réduit l'effort de pêche d'une part tout en stabilisant les prises à un niveau comparable à celui des années 70 à l'époque où la pêche n'était pas règlementée.

INTRODUCTION

Annual assessments of the gaspereau fishery in the Margaree River have been presented since 1983 (Alexander 1984; Alexander and Vromans 1985, 1986, 1987 1988; Chaput and LeBlanc 1989, 1990). The river has been partitioned into two zones: a lower zone encompassing all waters downstream of NS provincial highway#19 bridge and an upper zone encompassing all waters upstream of the bridge (Fig. 1). Fishery regulations in 1990 were similar to those imposed in 1984: a one day staggered closure per week with the fishery closed from Friday 6:00 pm to Sunday 8:00 am for the lower river zone and Saturday 6:00 pm to Monday 8:00 am for the upper zone. The fishing season closed on June 30, as in previous years.

This document provides descriptions of the 1990 gaspereau fishery and presents the input parameters for the cohort analysis, under Type I assumptions, used to estimate the fishing mortality on the spawning stock. An abundance index was estimated from catch and effort logbook reports.

MATERIALS AND METHODS

Sampling of the commercial catch was undertaken on a daily basis in both management zones of the river, stratified randomly into AM & PM periods. Fishing locations sampled in each zone were randomly selected for each day within the constraints of the traps fishing on a particular day and site accessibility. Length stratified sampling was undertaken and a subsample of 3 and 5 fish per half cm length group were retained for fish less than 28.0 cm and greater/equal to 28.0 cm respectively. A majority of the detailed samples were frozen for later analysis, others were processed fresh. Locations sampled, dates, time periods and numbers measured for length are summarized in Table 1.

Detailed Processing of Samples

Biological characteristics collected include fork length (neasrest quarter cm), whole weight (nearest gram), species (alewife, Alosa pseudoharengus; or blueback herring Alosa aestivalis) and sex. Scales were removed from the left side of the fish, in the region midway between the dorsal fin and the ventral scutes. Species were distinguished on the basis of external appearance and peritoneum colour (Scott and Crossman 1973). Total age and age of first spawning were determined from scales according to criteria described by Cating (1953).

Fish lengths of frozen fish were adjusted to fresh lengths using the linear equation:

adjusted lgth (mm) = 4.557 + 1.1043 X frozen length (mm)

r-square = 0.96 N = 49.

Catch at age was obtained using the program AGELEN (Wright 1990). The catch at age from each of the two zones was calculated seperately. A total of 5 age/length keys were constructed for each zone (Table 1). Estimation of the catch at age was performed as follows:

1) individual length samples were weighted by the respective logbook catch for the day,
2) the appropriate age/length key was applied to the weighted length sample,
3) catch by age for each sampled day was summed for each age/length key period,
4) catch at age for each age/length key period was calculated by projecting to logbook catch within period,
5) catch at age for all logbook catch was estimated by summing across all age/length key periods,
6) catch at age expanded to total catch by multiplying by ratio of total catch to logbook catch.

Logbook catch and effort analysis

Logbooks collected from individual fishing locations were processed for catch and effort (hours and days) by location.

Total Landings

Total catch for 1990 was calculated from the sum of the bait sales and from total pail counts of cured, packed gaspereau (a 50 lb pail was estimated to represent 32 kg of fresh fish).

Abundance Index

A catch rate index using catch and effort logbook data was estimated using the multiplicative model approach (Gavaris 1980). Catch and effort data from the logbooks were treated in the following manner:

1. The 10 to 90% catch interval for the entire river was identified and catches outside the interval were eliminated. This was done to remove the effects of scouting and opportunistic fishing towards the end of the season. Blueback herring enter the river in the latter part of the season and thus would not be included in this catch interval. Days with effort but no catch were eliminated from the analysis.

2. Catch per unit effort was calculated as the quotient of total catch (kg) to total effort (days) for each trap during the catch interval estimated in step 1. Natural log of catch per unit effort was the dependent variable in the multiplicative model analysis.

The catch rate model was fitted using SAS GLM procedures and model diagnostics were obtained using SAS REG procedures (SAS 1985). Diagnostics included the DFFITS calculation which estimates the change in the predicted value of an observation when it is included in the model relative to when it is not included in the model. Cumulative probability plots of the residuals were used to assess the normality of the residual term. These procedures are described by Neter et al. (1983) and Freund and Littell (1986). The backtransformed values were estimated from the model solutions to the year factor using the transformation equation described by Gavaris (1988a).

Natural Mortality

As per the previous two assessments, a composite non-inriver fishing mortality component, calculated as $Mc=0.44$ for alewife during the first spawning migration and $Mc=1.05$ for subsequent spawning years was used (Chaput and Alexander 1989).

Cohort Analysis

Cohort analysis was performed under Type I fishery assumptions, i.e. the natural mortality occurs at a time of year other than the fishing season and the population decreases during the fishing season as a result of catch removals only. For convenience, the biological year begins when the fishing commences and natural mortality occurs after the fishing ends (Ricker 1975: p.10-11). The cohort model utilized in this document uses a modification of the catch equations documented by Rivard (1982). Specifically, population numbers of the last age group are considered equal to the catch with fishing complete. The population numbers refer to numbers just prior to the beginning of the fishery. The cohort analysis of the alewife population was performed seperately on age 3 and age 4 recruits. This type of analysis eliminates the requirement of a partial recruitment vector since in each simulation, all the fish included are fully recruited to the fishery. Alewife aged as 2 and 5 year old recruits, constitute a minor component of the population and are not considered further.

The ADAPT formulation (Gavaris 1988b), modified for Type I fishery was used. A no-intercept log

model was used. The input parameters and the objective function are summarized below.

Parameters:

- Year-class estimates: Ni, 1990 i = 3 to 6, 4 to 7

- Calibration coefficients for logbook catch rates
  Ki i = 3 to 6, 4 to 7

Structure:

- Natural mortality varied with previous spawning history, set at 0.44 for first age group of catch matrix, 1.05 for other ages;
- F for oldest age group infinitely large (i.e. no survivors past the fishery);
- Error in catch at age assumed negligible;
- Model did not include an intercept term.

Input:

- Catch (i,t)and weight (i,t) i = 3 to 6, 4 to 7
  t = 1984 to 1990
- CPUE (i,t) (catch per day per trap) i = 3 to 6, 4 to 7
  t = 1984 to 1990

Objective function:

Minimize: sum [(obs CPUE (i,t) - pred CPUE (i,t)]**2
i = 3 to 5, 4 to 6
t = 1984 to 1990

Summary:

- number of observations = 21
- number of parameters = 6

RESULTS

In 1990, 62 licenses were issued although only 41 tiptrap sites were actually fished. Landings of gaspereau from the Margaree River fishery for 1950 to 1990 are presented in Table 2. The 1990 catch for Margaree, estimated at 1,016 metric tons is 9% less than the previous 5 year mean harvest. Relative to gaspereau fisheries within Gulf Region, the Margaree River remains the dominant stock exploited in Nova Scotia and has represented approximately 15 to 38% of the total landings from the Gulf (Table 3).

1990 Fishery

The 1990 fishery stands out as most unusual compared to the 1983 to 1989 fisheries, in terms of timing of catches and duration. Based upon logbook reports, the largest daily catch occurred on June 4, when 134 tons of gaspereau were landed (17% of total logbook catch) (Fig. 2). The date of 50% catch occurred on May 29 and the total duration of the fishery was the longest recorded to date, 22 days for the 10 to 90% catch duration (Table 4).

The 1990 gaspereau catch was estimated to consist of 99% alewife by weight. This is similar to previous year fisheries and consequently a blueback herring assessment has not been provided. Catch at age of blueback

herring is presented in Table 5.

Catch at Age Matrices

The catches at age for alewife are presented, by age of recruitment, for the years 1983 to 1990 (Table 6). The 1987 cohort was dominant representing 68% of the alewife catch by number. New recruitment represented over 75% of the catch. As was noted in the 1989 assessment, the 1986 year class was weak representing as either new recruit or previous spawner 4 year olds less than 8% of the catch. Previous contributions to the catch by 4 year olds ranged between 15 and 88% (Table 6).

Weight at Age Matrix

The weight at age matrix for alewife for 1983 to 1990 is presented in Table 7. For 1983 to 1989, weights at age were calculated using the measured weights of individual fish. In 1990, mean weights at age were calculated from AGELEN output using mean length at age and length/weight relationship from previous years.

Abundance Index

Reference categories for the model were year 1989 and lower zone. With all logbooks included for the years 1983 to 1990, the year factor accounted for less than 11% of the variance. After the removal of 15 of 201 original observations because of excessive influence, the explained variance by the year factor was 23%. Inclusion of the zone variable (lower vs upper management region) increased the R-square value to 0.31. After removal of influential observations (18 in total), the final model explained 45% of the total variance. The 1983 data were omitted from the model since for that year, only 2 data values remained. Omission of the 1983 data altered neither the parameter coefficients nor the R-square value. The final model is summarized in table 8 and the model diagnostics are presented in figures 3 & 4. The backtransformed values are summarized below:

		kg/day		
Year	N	Mean	Std Error	C.V.
1984	30	2585	368.1	14%
1985	8	7070	1728.2	24%
1986	9	2606	617.9	24%
1987	20	4923	815.5	17%
1988	35	5437	704.2	13%
1989	32	4403	602.4	14%
1990	30	1441	193.4	13%

Because of the unusually long migration period, the model indicates that 1990 had the lowest abundance of alewife since 1984. The mean catch rate estimated for 1985 and 1986 are not reliable due in large part to the small sample sizes.

In previous assessments, cohort analysis was undertaken to estimate the prefishery population numbers. Attempts to tune the 1990 fishing mortality (F) using the above catch rate index and linear regressions were unsuccessful. Biomass to index linear regressions on catch of 3 year old recruitment, 4 year old recruitment and combined matrices did not provide any models whose slopes were significantly different from 0. Log/log models did provide significant slopes but the sum of the squared residuals decreased monotonically with increasing F as did the sum of squared residuals with 1985 and 1986 excluded.

The 'ADAPT' software, modified to incorporate Type I fisheries characteristics was used to estimate the 1990 fishing mortality but the process was not successful. Age 3 and 4 recruit matrices both converged after

18 iterations. The parameter estimates of population were not significantly different from 0 for both the 3 and 4 year old recruit matrices (Table 9). Parameters were also highly correlated (approx. -0.4) (Table 9). The 1985 and 1986 catch rate were excluded from the tuning process because of the high coefficient of variation. With 1985 and 1986 included, parameter estimates were even less significant.

Prognosis

In 1990, the migration of gaspereau into the Margaree River was delayed by almost two weeks. The effect of this delayed and prolonged migration period on the estimation of the abundance for 1990 is unknown. The low catch rate value derived for 1990 may be the result of low population numbers returning to the river. However, it may also represent a population more dispersed in time yet equally abundant in number as in previous years. If the fishery had occurred over a more usual length of time, between 12 and 15 days, we would have a better indication of the population abundance.

Larval sampling conducted in 1990 in Lake Ainslie indicated that the average larval density was less than one-third the density estimated in 1989 (R. Crawford, NS Dept. of Fisheries, Halifax, NS). This suggests that egg deposition and/or egg and early larvae survival in 1990 was reduced dramatically from 1989.

The new recruitment in 1991 would probably be somewhat higher than average based on the high returns noted in 1987 and 1988 and the high recruitment of the 1987 year class (as inferred from catches) already noted. Thus, returns would be expected to be higher than average and harvests could therefore exceed 1000 tons. The weak 1986 year class will be most conspicuous in 1991 and 1992 as the catch reverts to almost exclusively the smaller 3 and 4 year olds.

The volatile nature of recruitment in this species is becoming more evident. The staggered one day closures and restricted entry of new participants should be maintained. This management strategy, introduced in 1984, appears to have been effective in reducing overall fishing mortality (reduced effort) and stabilising harvests. Harvests since 1984 have been as high as those obtained in the 1970's when the effort was unregulated.

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Summary Sheet - Gaspereau - Margaree River

Year Recommend TAC	1984	1985	1986	1987	1988	1989	1990	Min.	Max	Mean
Act. Landing (t)	883	1223	545	1259	1666	1123	1016	58	1776	865
Catch Rates (tons/day)	2.59	7.07	2.61	4.92	5.44	4.40	1.44			
% New Recruits	84	73	68	86	58	61	76	51	86	
Dominant Year Class	1981	1981	1983	1984	1984	1985	1987			

* Min., Max. and Mean for 1950 to 1989 period

Catches: Catches have remained high since 1972 and have averaged 1,122 tons in the past five years.

Data and Assessment: Analysis of catch-at-age using a catch rate index from voluntary logbooks, Type I fisheries assumptions and variable natural mortality rate. Terminal F values for 1990 could not be determined.

Recruitment: Indication of recruitment available for 4 year old recruits based on numbers recruiting at age 3. The 1986 year class is weak. The 1987 year class appears to be of average recruitment strength.

State of Stock: Returns have been extremely variable because of dominance of new recruitment. Exploitation is close to or exceeds F0.1.

Forecast for 1991: No quantitative forecast available. Average catch of 1987 year class in 1990 and weak 1986 year class indicates that catch in 1991 would not exceed previous 5 year average catch.

Table 1. Locations, dates and periods sampled during the 1990 Margaree River gaspereau fishery. Vertical bars indicate sample aggregations for the age/length keys constructed for each zone in 1990.

		Lower			Upper		
		Site #	Period	No. Meas.	Site #	Period	No. Meas.
	May 1						
	2						
	3						
	4						
Saturday	5						
Sunday	6						
	7	12	PM	157			
	8	5	PM	152			
	9	8	AM	227			
	10	8	PM	226	48	PM	150
	11	4	PM	169	34	AM	218
Saturday	12				56	PM	214
Sunday	13						
	14	23	AM	177	67	PM	217
	15	12	PM	224	33	AM	183
	16	1	AM	166	35	PM	201
	17	26	PM	209	48	AM	188
	18	26	AM	225	33	PM	129
Saturday	19				28	AM	179
Sunday	20	12	AM	151			
	21	9	AM	202	64	PM	267
	22						
	23	5	AM	236			
	24	1	AM	188			
	25	2	PM	215	28	AM	184
Saturday	26				49	AM	188
Sunday	27	9	PM	256			
	28	6	PM	215	33	AM	233
	29	2	PM	224	38	AM	216
	30	4	AM	236	35	PM	228
	31	8	PM	271	52	AM	206
	June 1	7	PM	227	29	AM	232
Saturday	2				48	AM	236
Sunday	3	26	AM	223			
	4	8	PM	245	37	AM	221
	5	15	PM	233	35	AM	241
	6	25	AM	229	56	PM	193
	7				64	PM	184
	8				64	AM	174
Saturday	9						
Sunday	10						
Number of gaspereau measured				5283			4682

Table 2. Gaspereau landings from District 2 and Margaree River, 1950 to 1990. Historical, recent 10 year and 5 year means (95% confidence intervals) are also presented.

Year	Landings (mt) District 2		Margaree River only
1950	713		
1951	755		
1952	964		
1953	638		
1954	1,275		
1955	1,163		
1956	859		
1957	58		
1958	395		
1959	496		
1960	531		
1961	423		
1962	558		
1963	551		
1964	640		
1965	875		
1966	320		
1967	185		
1968	188		
1969	251		
1970	408		
1971	620		
1972	965		
1973	1,113		
1974	1,681		
1975	1,238		
1976	497		
1977	1,202		
1978	1,713		
1979	1,776		
1980	1,069		
1981	1,369		
1982	1,445		
1983	580		
1984	883 *		883 *
1985	1,223 *		1,223 *
1986	545 *		545 *
1987	1,259 *		1,259 *
1988	1,912		1,666 *
1989	1,506 *		1,123 *
1990	1,016 *		1,016 *
Means (95% C.I.)			
Historical	875	(731-1,018)	
10 Year	1,174	(885-1,462)	
5 Year	1,248	(677-1,818)	1,122 (671-1,572)

* Science Branch estimates. All other values are from Statistics Branch.

Table 3. Landings of gaspereau for the Gulf Region, 1978 to 1990. Data summarized from purchase slip and Supp. "B" slips collated by Statistics Branch, DFO.

	Nova Scotia Statistical District							Total Landings (metric tons)			
Year	2	3	11	12	13	45	46	NS	NB	PEI	Gulf
1978	1,712.7	4.9	36.3	6.8	32.4	117.9	0.0	1,911.0	3,084.1	104.2	5,099.3
1979	1,776.1	0.2	114.4	9.1	49.4	74.3	0.0	2,023.4	4,408.7	405.3	6,837.4
1980	1,069.3	0.0	909.7	21.2	79.8	75.5	11.8	2,167.4	4,676.0	253.2	7,096.5
1981	1,368.6	0.7	61.2	12.7	77.6	103.1	29.5	1,653.5	2,708.0	258.8	4,620.3
1982	1,445.5	0.0	29.4	18.2	34.4	115.4	20.6	1,663.6	1,993.7	132.9	3,790.2
1983	579.8	0.0	144.1	27.2	16.0	10.2	2.5	779.8	1,900.6	36.4	2,716.9
1984	883.0 *	0.0	77.5	6.8	84.7	0.2	0.1	1,052.4	1,716.9	87.9	2,857.2
1985	1,223.0 *	0.0	0.0	1,854.2	99.6	26.4	0.0	3,203.3	3,569.2	238.4	7,010.9
1986	545.0 *	0.0	161.4	31.8	236.2	0.0	0.0	974.3	2,261.3	463.6	3,699.3
1987	1,259.0 *	0.0	847.5	59.1	127.6	121.6	143.7	2,558.6	4,419.2	364.2	7,342.0
1988	1,911.8	-	570.2	120.0	224.5	-	8.4	2,835.0	3,713.7	233.2	6,782.1
1989	1506.0	-	244.8	148.3	129.9	74.7	11.8	2115.5	3681.4	132.5	5929.4
Mean	1,273.3	0.5	266.4	193.0	99.3	59.9	19.0	1,910.5	3,177.7	225.9	5,314.1

* District 2 1984-1987 landings as per DFO Science Branch estimate (see Table 2).

Table 4. Catch, effort and dates of maximum and cumulative landings for the gaspereau fishery of the Southwest Margaree River, 1983 to 1990.

		1983	1984	1985	1986	1987	1988	1989	1990
Logbook catch (mt)		112.65	637.07	506.37	212.69	882.27	1375.08	972.70	780.13
Estimated Landings (mt)		579.8	883.4	1,222.7	545.2	1,258.8	1,665.7	1,123.0	1,016.2
Expansion Factor		5.1471	1.3867	2.4146	2.5634	1.4268	1.2113	1.1545	1.3026
Landings									
Date of:	Maximum catch	May 17	May 17	May 30	May 17	May 13	May 22	May 18	June 4
	Cumulative 10%	10	16	21	9	12	17	14	13
	50%	17	21	28	17	16	23	19	29
	90%	24	28	June 2	26	26	29	23	June 4
Total days for 10% to 90%		15	12	12	17	15	13	10	22

Catch timing values for 1983 to 1988 were corrected from those presented by Chaput and LeBlanc (1989) who reported the 5% to 95% cumulative catch period.

Table 5. Catch at age (numbers) of blueback herring in the Southwest Margaree River gaspereau fishery, 1983 to 1990. AGE.FSP refers to total age followed by age of recruitment.

AGE.FSP	1983	1984	1985	1986	1987	1988	1989	1990
1.1	0	42	0	0	0	0	0	0
2.2	0	0	0	0	0	0	0	0
3.2	0	1,093	1,419	0	0	0	0	0
4.2	0	716	2,943	0	0	0	0	0
5.2	0	666	72	0	0	0	0	0
3.3	0	51	138	169	675	2,152	0	13264
4.3	0	4,229	10,919	87	0	5,475	341	0
5.3	0	3,012	3,619	237	0	0	597	1099
6.3	6,290	1,501	0	614	52	0	0	0
7.3	0	0	0	105	597	0	0	0
8.3	0	0	1,353	0	0	0	0	0
9.3	0	0	0	0	0	0	0	0
4.4	0	0	7,115	668	1,946	24,956	5,176	0
5.4	0	16	1,775	1,499	77	1,765	35,141	45520
6.4	6,290	28	7,165	699	1,814	0	1,244	3786
7.4	0	0	0	248	103	0	114	535
8.4	0	0	0	0	597	0	0	0
9.4	164	446	0	0	0	0	0	0
10.4	164	0	0	0	0	0	0	0
5.5	0	0	0	0	0	0	14201	793
6.5	0	0	0	0	0	0	654	1673
7.5	0	0	0	0	0	0	28	0
Total Catch	12,908	11,800	36,518	4,326	5,861	34,348	57,496	66,670

Table 6. Estimated numbers of alewife by total age and age of recruitment in the gaspereau fishery, Southwest Margaree River, 1983 to 1990. %FSP refers to percent new recruitment.

Numbers of alewife

Total Age	Year 1983	1984	1985	1986	1987	1988	1989	1990	C.V. % for 1990
Recruited at age 2									
2	0	0	24,806	2,104	0	0	657	0	
3	1,759	0	106,971	15,683	0	0	0	0	
4	0	0	0	0	9,936	0	0	0	
5	0	0	0	0	0	0	0	0	
Recruited at age 3									
3	713,210	2,600,587	446,784	1,262,253	4,400,237	2,479,427	120,091	2,806,413	1.2
4	397,393	258,404	920,280	158,545	429,356	2,354,640	1,235,744	54,329	14.8
5	334,105	185,480	40,614	129,007	18,600	160,274	181,065	243,656	5.6
6	52,414	4,211	27,024	5,818	4,607	6,993	6,235	55,072	15.6
7	17,976	1,090	2,937	0	0	0	0	2,713	47.5
8	2,733	644	0	0	0	0	0	0	
9	5,248	0	0	0	0	0	0	0	
10	0	0	0	0	0	0	0	0	
Recruited at age 4									
4	370,661	428,329	3,069,913	235,293	433,678	1,431,033	2,444,088	281,029	8.3
5	156,504	35,124	204,850	371,931	130,546	267,326	185,607	628,352	3.8
6	45,417	20,213	6,467	10,649	181,210	69	11,078	22,619	14.4
7	0	4,112	0	3,888	0	0	38	3,938	57.2
8	2,733	4,409	1,343	0	0	0	0	0	
9	0	43,447	0	0	0	0	0	0	
10	0	248	0	0	0	0	0	0	
11	0	0	0	0	0	0	0	0	
Recruited at age 5									
5	0	0	0	0	0	0	1,434	35,611	35.1
6	5,248	1,239	875	6,529	0	0	0	1,230	53.3
7	0	0	0	0	0	0	0	250	95.8
Total	2,105,400	3,587,536	4,852,865	2,201,700	5,608,169	6,699,762	4,186,037	4,135,212	
% FSP	51.5	84.4	73.0	68.1	86.2	58.4	61.3	75.5	
Dominant Year-class	1979	1981	1981	1983	1984	1984	1985	1987	
% of total	36.5	72.5	82.2	58.0	78.5	56.5	87.9	67.9	

Table 7. Mean weight (g) at age for alewife in the Southwest Margaree gaspereau fishery.

	1983	1984	1985	1986	1987	1988	1989	1990
2	-	-	164	152	-	-	137	-
3	220	210	210	215	211	214	188	220
4	289	288	250	264	252	261	265	258
5	308	349	321	303	294	303	310	296
6	322	376	348	358	347	339	357	313
7	352	407	405	412	-	411	406	362
8	375	403	397	-	-	-	-	-
9	356	446	455	-	-	-	-	-
10	-	478	-	-	-	-	-	-
6+	340	381	381	363	346	353	362	313
7+	357	389	415	412	-	411	406	362

Table 8. Results of multiplicative model using natural log of catch (kg) per day fished per trap in lower and upper zones, 1984 to 1990. This model uses all logbook reports during the 10-90% catch interval for each season.

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YY	7	84 85 86 87 88 89 90
LOCAT	2	LOWER UPPER

Number of observations in data set = 164

Dependent Variable: KGDAY

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	7	58.59290	8.37041	18.487	0.0001
Error	156	70.63240	0.45277		
C Total	163	129.22531			

Root MSE	0.67288	R-square	0.4534
Dep Mean	7.49793	Adj R-sq	0.4289
C.V.	8.97425		

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YY	6	41.95273301	6.99212217	15.44	0.0001
ZONE	1	18.78786530	18.78786530	41.50	0.0001

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	8.171622	0.13702849	59.634	0.0001
YY84	1	-0.531821	0.17106163	-3.109	0.0022
YY85	1	0.494927	0.26598045	1.861	0.0647
YY86	1	-0.504815	0.25442802	-1.984	0.0490
YY87	1	0.116176	0.19182053	0.606	0.5456
YY88	1	0.210068	0.16467986	1.276	0.2040
YY90	1	-1.116973	0.17154189	-6.511	0.0001
ZONE	1	-0.701134	0.10884338	-6.442	0.0001

Table 9. Parameter estimates, correlations and log residuals from ADAPT formulation for Margaree River gaspereau.

CALIBRATION OF AGE 3 RECRUIT MATRIX

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.010676
MEAN SQUARE RESIDUALS..... 0.147625

PARAMETER No.	AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STAT.
1	3	ABUNDANCE	5.12026E 6	2.21392E 6	2.313
2	4	ABUNDANCE	5.43418E 4	2.18103E 4	2.492
3	5	ABUNDANCE	2.94387E 5	1.15516E 5	2.548
4	3	SLOPE	1.49819E-3	2.97120E-4	5.042
5	4	SLOPE	1.87908E-3	3.64083E-4	5.161
6	5	SLOPE	1.96092E-3	3.70422E-4	5.294

PARAMETER CORRELATION MATRIX

	1	2	3	4	5	6
1	1.00	0.10	0.06	-0.46	-0.05	-0.03
2		1.00	0.11	-0.22	-0.43	-0.05
3			1.00	-0.14	-0.21	-0.42
4				1.00	0.11	-0.06
5					1.00	0.09
6						1.00

LOG RESIDUALS FOR AGE DISAGGREGATED INDEX

	1984	1985	1986	1987	1988	1989	1990
3	0.077	0.723	0.436	0.165	-0.031	0.435	-0.596
4	-0.014	0.649	0.480	-0.092	0.246	0.229	-0.270
5	0.183	0.686	0.756	-0.066	0.443	0.102	-0.557

SUM OF RESIDUALS..... 3.983012
MEAN RESIDUAL..... 0.189667

Table 9 (cont'd).

CALIBRATION OF AGE 4 RECRUIT MATRIX

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.008915
MEAN SQUARE RESIDUALS..... 0.447521

PARAMETER No.	AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STAT.
1	4	ABUNDANCE	4.43713E 5	3.33427E 5	1.331
2	5	ABUNDANCE	1.09041E 6	7.59778E 5	1.435
3	6	ABUNDANCE	2.26271E 4	1.63977E 4	1.380
4	4	SLOPE	1.74882E-3	5.98583E-4	2.922
5	5	SLOPE	1.87370E-3	6.24252E-4	3.002
6	6	SLOPE	1.85633E-3	6.17105E-4	3.008

PARAMETER CORRELATION MATRIX

	1	2	3	4	5	6
1	1.00	0.01	0.02	-0.46	-0.04	-0.01
2		1.00	0.06	-0.21	-0.43	-0.03
3			1.00	-0.04	-0.14	-0.44
4				1.00	0.09	-0.02
5					1.00	0.06
6						1.00

LOG RESIDUALS FOR AGE DISAGGREGATED INDEX

	1984	1985	1986	1087	1988	1989	1990
3	0.205	1.030	0.631	0.185	0.606	0.493	-0.447
4	-0.216	1.129	0.276	0.843	0.534	0.646	-0.680
5	0.518	0.165	1.074	0.884	-0.230	0.220	-0.258

SUM OF RESIDUALS..... 7.608306
MEAN RESIDUAL..... 0.362300

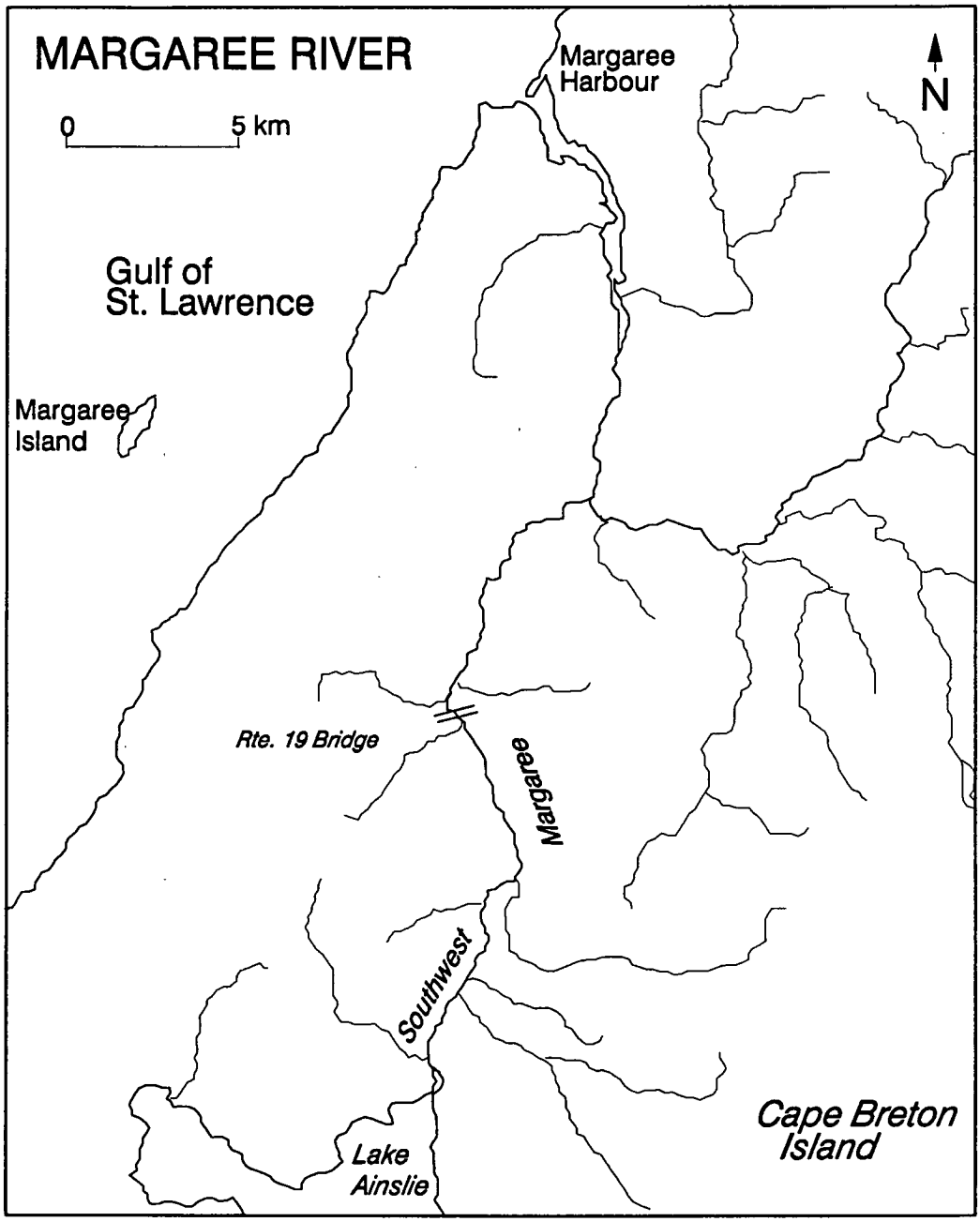

Figure 1. Margaree River, NS showing highway 19 bridge.

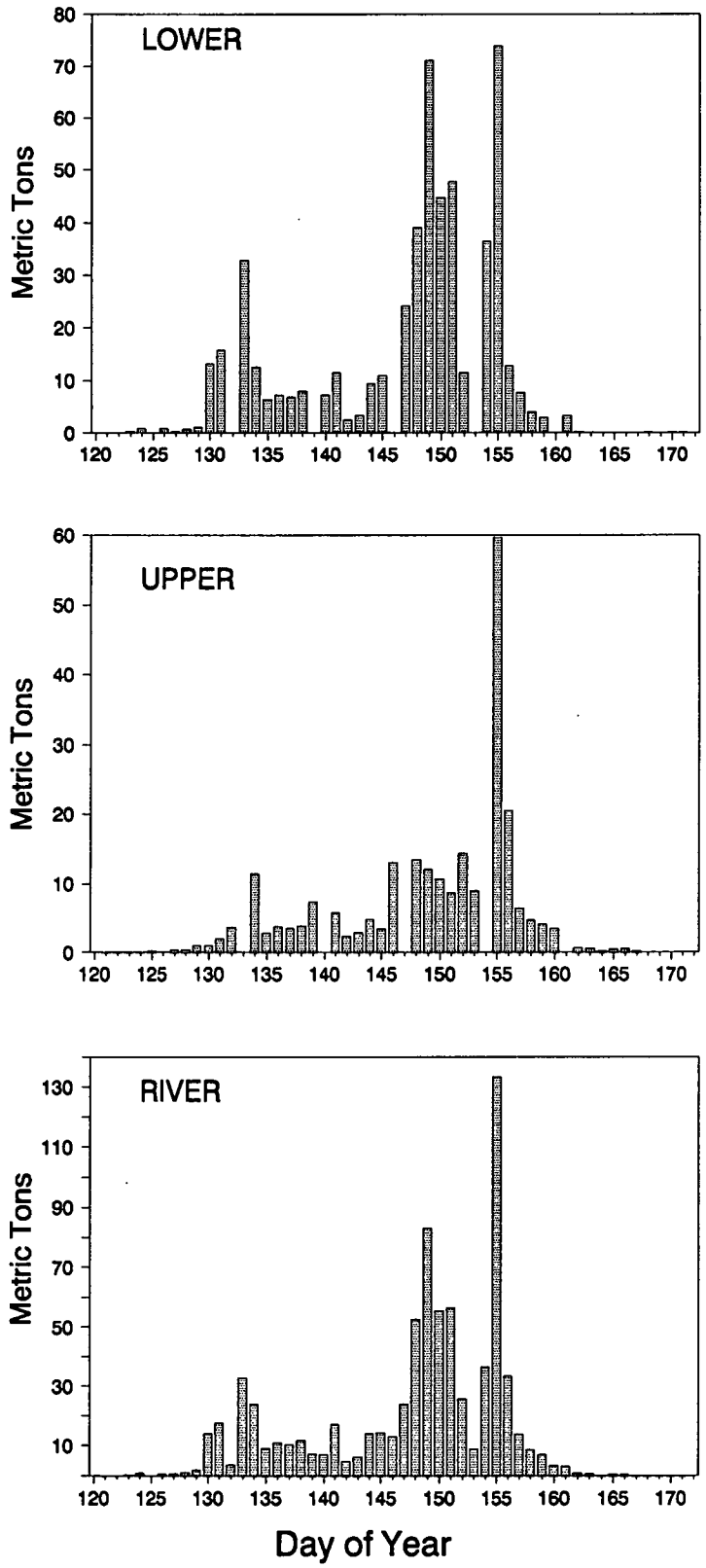

Figure 2. Timing of catch of gaspereau, Margaree River 1990 based on logbook catch and effort reports.

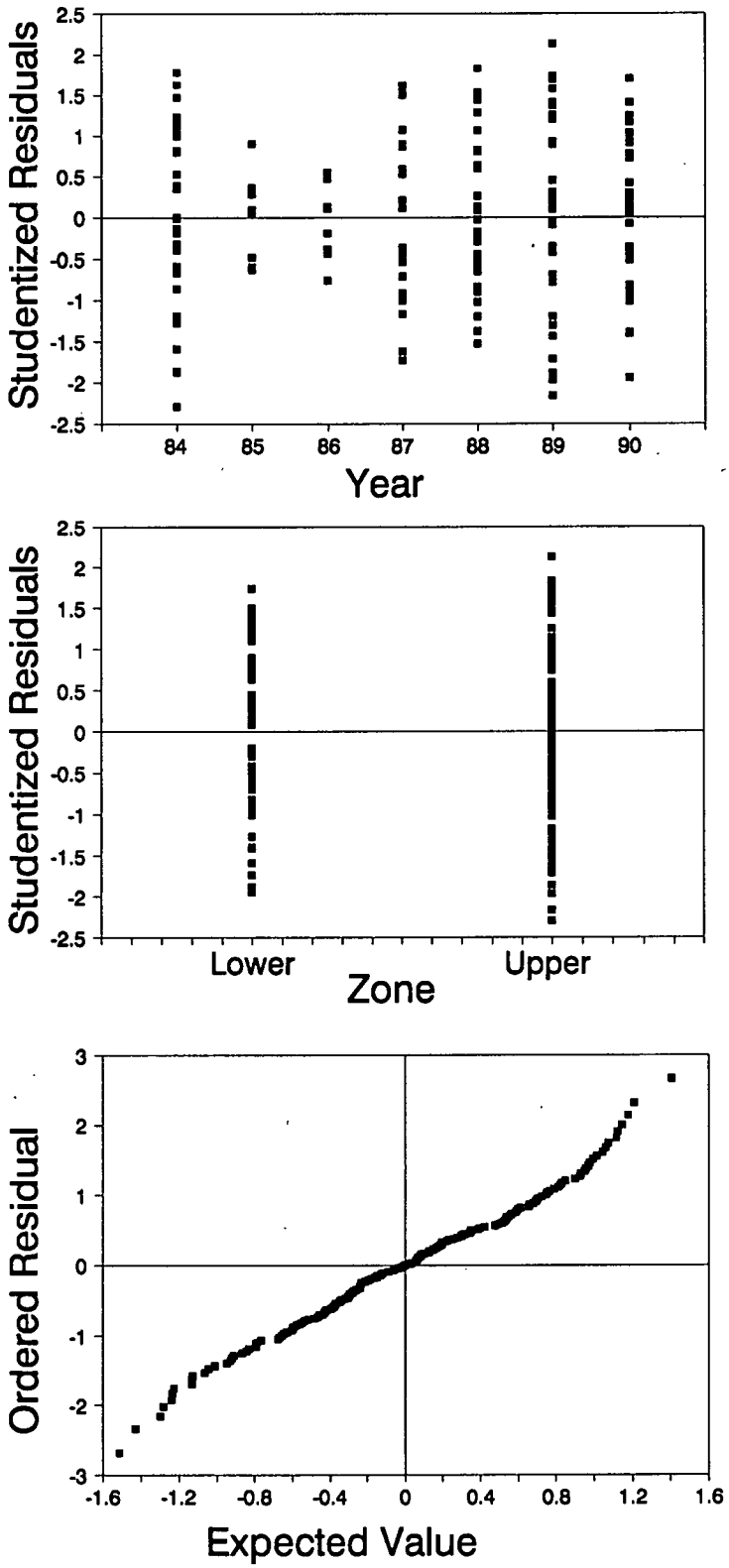

Figure 3. Residual plots for the logbook catch rate multiplicative model for the Margaree River gaspereau fishery, 1990.

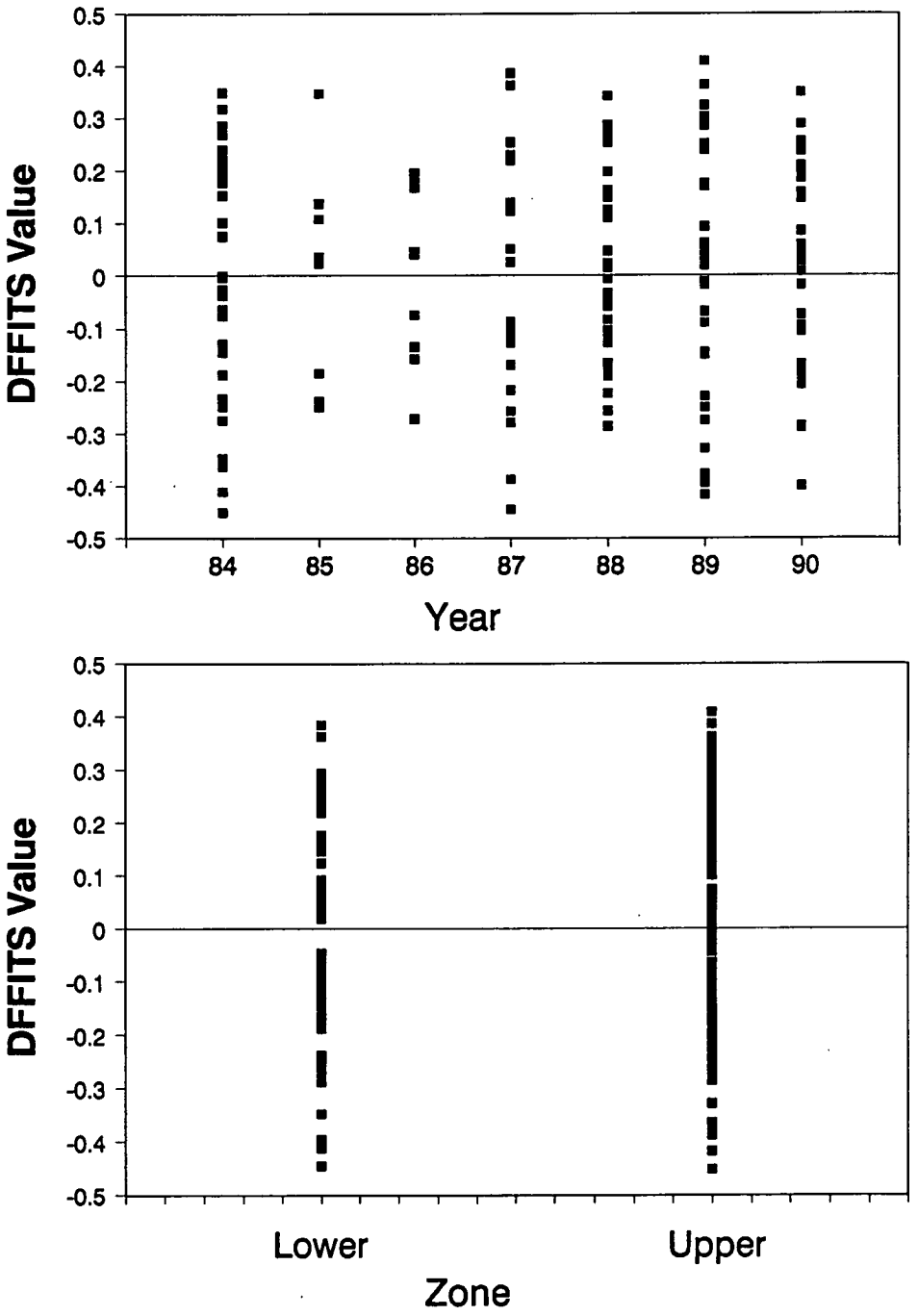

Figure 4. Influence diagnostics (DFFITS) for the multiplicative catch rate model of the Margaree River gaspereau fishery, 1990.

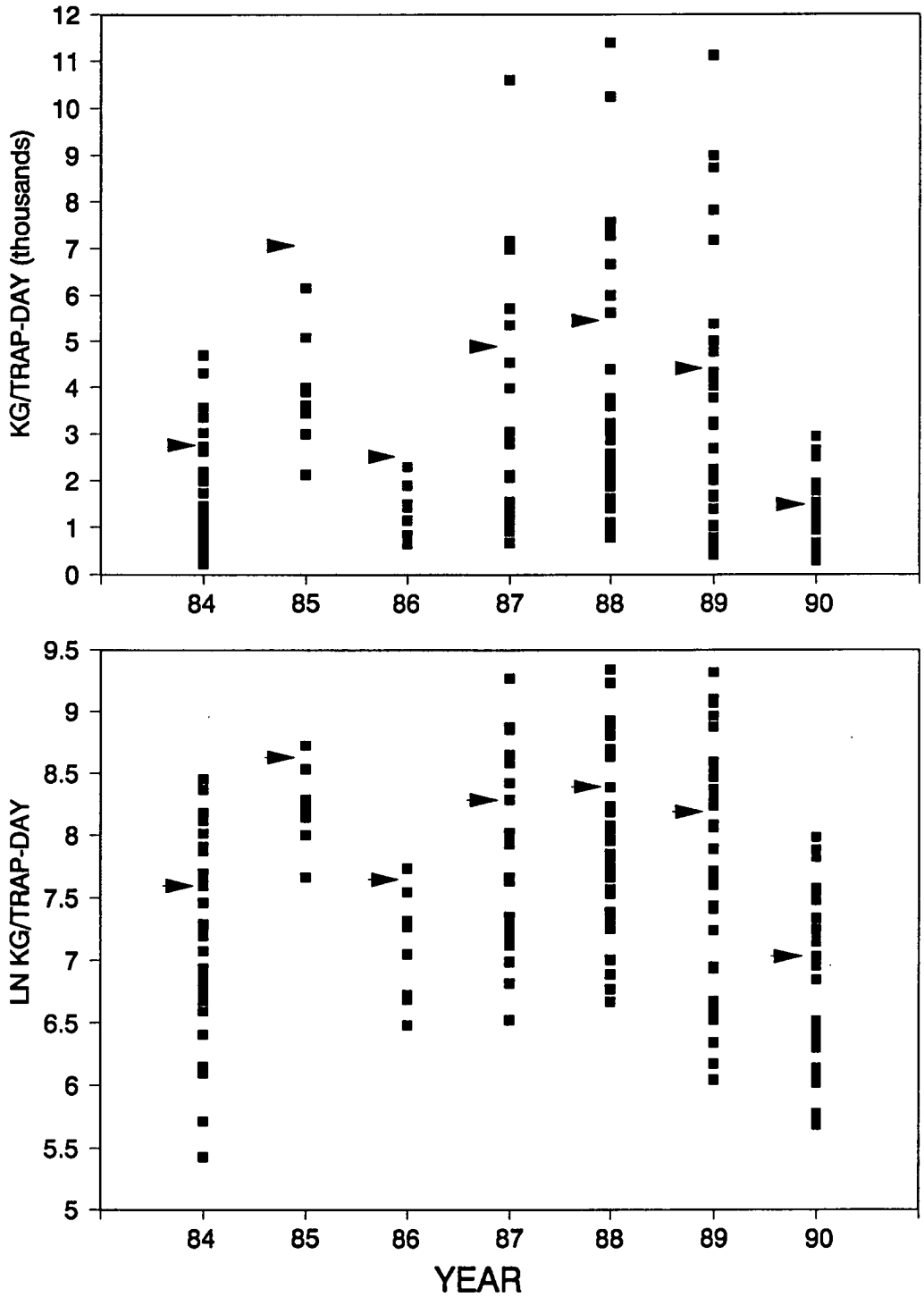

Figure 5. Catch per unit effort (as kg/trap day and ln kg/trap day) based on logbook reports from the Margaree River gaspereau fishery, 1990. Arrows indicate estimated value for the year based on lower zone reference.