Fisheries and Oceans Canada | Pêches et Océans Canada

Canadian Stock Assessment Secretariat
Research Document 98/47

Secrétariat canadien pour l'évaluation des stocks
Document de recherche 98/47

Assessment of the NAFO Divison 4T southern Gulf of St. Lawrence herring stock, 1997

by R. Claytor, C. LeBlanc, C. MacDougall, G. Poirier

Department of Fisheries and Oceans
P.O. Box 5030
Moncton, New Brunswick E1C 9B6

ISSN 1480-4883
Ottawa, 1998
Canada

Abstract

The updated fall spawner $F_{0.1}$ fishing level for 1998 based on this assessment is 66,000t. This level is an increase over the projected amount of 45,000t for 1998 based on the assessment of the 1996 fishery. The 4+ biomass for fall spawners is estimated to be 350,000t compared to 250,000t in 1996. Fishing mortality on the fully recruited ages (5-11+ years-old) was 0.28 compared to the target of 0.30. Three of the four most recent year-classes are now average or above compared to two of the four being above average last year. The 1993 year-class comprises 38% of the 66,000 $F_{0.1}$ 1998 fishing level. Given the present age structure and the uncertainty of the size of the 1993 year-class, fishing below $F_{0.1}$ was identified as a prudent approach.

The updated spring spawner $F_{0.1}$ fishing level for 1998 based on this assessment is 16,500t. This level is an increase over the projected amount of 15,000t for 1998 based on the assessment of the 1996 fishery. The 4+ biomass for spring spawners is estimated to be 71,000t compared to 82,000t in 1996. Fishing mortality on the fully recruited age (7 year-olds) was 0.40 slightly below the target of 0.44. One very large year-class and one very small year-class are present in the fishery at this time.

Résumé

Les captures, mises à jour et basées sur la présente évaluation, de géniteurs d'automne au niveau de pêche $F_{0.1}$ en 1998 s'élèvent à 66 000 t. Cette valeur constitue une augmentation par rapport à la valeur de 45 000 t prévue pour 1998, fondée sur l'évaluation de la pêche de 1996. La biomasse des géniteurs d'automne 4+ est estimée à 350 000 t, comparativement à 250 000 t en 1996. La mortalité par pêche des âges pleinement recrutés (5-11+) était de 0,28 comparativement à la valeur cible de 0,30. Trois des quatre classes d'âge les plus récentes sont maintenant d'importance moyenne ou supérieure à la moyenne comparativement à l'an dernier où l'importance de deux des quatre était supérieure à la moyenne. La classe de 1993 représente 38 % du niveau de pêche $F_{0.1}$ de 66 000 t pour 1998. Étant donné la structure actuelle des âges et le caractère incertain de l'effectif de la classe de 1993, une pêche inférieure au niveau $F_{0.1}$ a été jugée prudente.

Les captures, mises à jour et basées sur la présente évaluation, de géniteurs de printemps au niveau de pêche $F_{0.1}$ en 1998 s'élèvent à 16 500 t. Cette valeur constitue une augmentation par rapport à la valeur prévue de 15 000 t pour 1998, fondée sur l'évaluation de la pêche de 1996. La biomasse des géniteurs de printemps 4+ est estimée à 71 000 t, comparativement à 82 000 t en 1996. La mortalité par pêche de la classe d'âge pleinement recrutée (7 ans) était de 0,40, soit légèrement inférieure à la cible de 0,44. Une classe d'âge très importante et une classe d'âge très faible sont toujours présentes dans la pêche

1. Introduction

This document provides an assessment of population biomass and fishing mortality for spring and fall spawning herring in 4T based on the 1997 fishery data and research projects.

An ADAPT-VPA is used to estimate population biomass of both spawning groups. The calibration indices are based on fishery catch rates.

There are three new analyses. The first, splits the fall fishery catch rate series into two time components. The first component was from 1978-1991 when 2 5/8" mesh accounted for between 80% to 93% of the mesh size used in the fall fishery. The second time component was from 1992-1997 when a change to larger mesh-sizes, primarily 2 3/4", in areas outside of Chaleur Bay, reduced the percentage of 2 5/8" mesh to between 50% and 65%.

The second, utilized a new abundance index for the spring ADAPT-VPA formulation. The previous index, using index gillnetter catch rates, could not be used in 1997 because of the low number of participants. Instead, catch rates based on the New Brunswick market co-ordinator data and the 1997 catch monitoring program were used to calibrate the VPA.

The third, examined the acoustic research survey biomass indices for spring and fall spawners as abundance indices in an ADAPT formulation.

2. The Fishery

2.1 Description

Southern Gulf of St. Lawrence (Fig. 1) herring are harvested by an inshore, primarily gillnet fleet, fishing in 4T and a purse seine fleet of six vessels (>65') in 4T and 4Vn. Five small seiners (<65') also participate in the inshore fishery. Unless specifically stated as small seiners, the terms purse seiners or seiners refer to the purse seine fleet with vessels > 65'. Two stocks of herring are harvested in these fisheries. The spring spawning stock spawns before July 1 and the fall spawning stock after July 1. During the spring and fall fishing seasons seiners are prohibited from fishing in several areas set aside for exclusive fishing by the inshore fleet (Claytor et al 1997).

Prior to 1967, southern Gulf of St. Lawrence herring were exploited mainly by gillnets and average landings from 1935 to 1966 were 34,000 tonnes. In the mid 60s, a purse seine fishery was introduced and average landings were 166,000 tonnes from 1967 to 1972. Quotas were introduced in 1972 at 166,000 tonnes and reduced to 40,000 tonnes in 1973 (Fig. 2). Catches of spring and fall spawners combined have been below the TAC since 1988 (Fig. 2).

The spring spawner TAC was exceeded from 1994 to 1996 and was nearly caught in 1997 (Table 1). The fall spawner TAC has not been exceeded since 1986 (Table 1). Since 1981, the inshore fixed gear component has had the majority of the catch of spring and fall spawners (Table 1).

Most of the spring spawner inshore catches occur during the spring season in areas 16C and E (Table 2, Fig. 1). Most of the fall spawner inshore catches come from 16B during the fall fishing season (Table 2, Fig. 1).

Spring inshore allocations were nearly caught in 1997 but fall inshore catches were about 2700 t below the allocation and seiner catches were about 4400 t below their spring and fall allocation (Table 3).

The bait fishery appears to be increasing in importance in the southern Gulf of St. Lawrence. The number of bait licenses recorded increased in every province from 1996 to 1997 (Fig. 3).

Price in the spring and fall inshore gillnet markets dropped considerably from 1996 to 1997 (Table 4). Prices for the seiner market were similar to 1996 in 1997 (Table 4).

Industry input for the assessment was acquired during workshops held in November, during a phone survey after the fall season from December to January, and through area projects.

During workshops in 1997, the view of industry was that the assessment was under-estimating the size of spring and fall spawning groups. The exception was in Chaleur Bay where opinion was divided within the inshore group.

The phone survey collects information on the fishery and opinions on abundance trends. The southern Gulf is divided into 8 areas corresponding to the major fisheries (Fig. 4). A subset of active commercial license holders are phoned and asked a series of questions concerning number and size of nets used, frequency of fishing and how the abundance in the current year compares to the previous year and the long term trend (LeBlanc and LeBlanc 1996).

In 1997, 157 spring gillnetters and 187 fall gillnetters responded out of a total of 2400 active licenses in spring and fall (Tables 5, 6, Fig. 3).

Concerning abundance trends, spring gillnetters in the areas with the most landings, Escuminac and Southeast New Brunswick felt abundance has been increasing in the last two or three years (Fig. 5). The Magdelen Islands indicates a steady but small increase over time (Fig. 5). In the fall, except for the Acadian Peninsula, survey respondents indicated that abundance was either the same or less in 1997 compared to 1996 (Fig. 6).

The fall and spring gillnet fisheries differ in the type of fishing and size of nets. For example, most spring gillnets are either 2 1/4" to 2 1/2" (Fig. 7). Most spring nets are 13 to 18 fathoms long (Table 7). At one time, 2 5/8" was the most commonly used mesh size throughout the southern Gulf fall inshore fishery. Recently, in Escuminac, Nova Scotia, and West PEI there has been an increasing number of individuals using 2 3/4" or 2 7/8" mesh (Fig. 8). Most nets are 13 to 18 fathoms long with one area using 24 fathom length nets (Table 7).

Type of fishing differs between the two seasons. For example, in the spring almost all nets are fished by anchoring overnight and fishing the next morning. In the fall, spawning schools are searched for, and nets are set when a school of sufficient size is found. In northern areas, Quebec, Magdalen Islands, and Acadian Peninsula nets are fished with one end tied to the boat and the other anchored. In other areas, nets are anchored at both ends and two or more strings may be set (Table 8).

The number of nets used in the spring and fall fisheries, estimated by the phone survey, is an important part of the effort measurement used to formulate abundance indices for ADAPT-VPA models.

Numbers of nets have been estimated for the entire southern Gulf since 1978. In the late 1970s and early 1980s, about twice as many nets were used in the fall fishery than in recent years (Table 9). Since 1986, the number of nets has been estimated by statistical districts accounting for most of the landings. These estimates indicate that fewer nets are used in the Acadian Peninsula (Sds 65-67, Fig. 4) than other areas in the fall (Table 10).

Numbers of nets used in the spring fishery have also been estimated for the entire southern Gulf since 1978. These results also indicate a decline in numbers of nets currently used compared to those in use during the late 1970s and early 1980s (Table 9). Numbers of nets in the spring have been estimated by area since 1986 and indicate that for the two major fishing areas, that fewer nets are used in Escuminac than southeast New Brunswick (Table 11). Although, at workshops, it was reported that the depth of nets in Escuminac is greater than in southeast New Brunswick.

2.2 Catch and Weight-at-age matrices

Separate spring and fall spawner catch and weight-at-age matrices were developed for all 4T herring including those caught by purse seiners in 4Vn. These were derived using age-length keys and length-weight relationships for each principal fishing area and season. In some cases, fishing activity within an area differed through the season and separate keys and relationships were developed for those cases. For example, the bait fishery in 4Tmn during July had a higher proportion of spring spawners than the roe fishery during August and September and required a separate key. The keys, samples, spawning group assignment, and numbers of fish examined in detail in each of these is described in Table 12. When the number of fish sampled for detailed analysis was < 30, the overall length-weight relationship and age-length key nearest in gear, geography, and time that contained sufficient samples was used to estimate the catch-at-age. Spawning group assignment was done as in previous assessments using a gonad-somatic index (GSI) (McQuinn 1989) to assign maturity stage and a monthly key that linked maturity stage and month to spawning group (Cleary et al. 1982).

The distribution of sampling relative to daily catches for each key and relationship is in Tables 13-25.

Catches of fall spawners were dominated by the 1992 (age 5) year-class for inshore and seiner fleets in 1997. The 1993 (age 4) and 1990 (age 7) year-classes were the second most important part of the catch in both fleets for 1997. Low numbers of the 1989 (age 8) and the 1991 (age 6) year-classes continued to indicate the below average size of these year-classes. The once dominant 1987 (age 10) and 1988 (age 9) year-classes no longer contribute appreciably to the fishery (Fig. 9, Tables 26-28).

Catches of spring spawners were dominated by a single year-class (1991, age 6) in 1997 as they were in 1996. Low numbers of the 1990 (age 7) and the 1992 (age 5) year-classes continued to indicate that these year-classes are below average. The very large 1988 (age 9) year-class no longer contributes appreciably to the fishery (Fig. 10, Tables 29-31).

2.3 Aging Consistency Test

A reference collection was selected from herring otolith samples from 1990 to 1996. This collection was selected so that there was approximately equal representation from all times, areas, gears, and survey types sampled during the year. There was no effort to ensure that otoliths were of a particular clarity; but otoliths that had not been aged samples because of problems in their storage media were excluded. The reference collection contained approximately 3800 otolith pairs.

In order to ensure that all ages were represented in this test, the ages were divided into four groups: 0 to 2, 3 to 5, 6 to 8, and 9 to 11+ with 11+ being composed of all ages ≥ 11.

A random selection of 50 fish from each age group was used for the aging test. One otolith pair was removed from the test set because it could not be found leaving only 199 pairs. The rings on each otolith were counted.

The average cv for this data set was 2.9%. (Table 32). The percent agreement overall was 77% and for the groups were:

Ages	Percent Agreement
0 to 2	94
3 to 5	84
6 to 8	74
9 to 11+	64

There was no bias in the test data (Fig. 11).

2.4 Mean weights

Mean weights for fall spawners at age have been generally less since 1990 than they were during the late 1980s and early 1990s (Fig. 12). For fall spawners, herring caught by the purse seiners are smaller at age than those caught by inshore gear (Fig. 12). Most fall spawners caught by the inshore are on spawning beds during spawning.

Mean weights for spring spawners at age are generally less in recent years than they were during the late 1980s and early 1990s (Fig. 13). Spring spawning herring caught by purse seiners are larger than the inshore because most spring spawners are caught by the purse seiners during the fall, after a season of growth. Most inshore spring spawner landings occur during the spring spawning season.

The declines observed in recent years seem to have stabilized or slightly reversed for both spawning groups (Figs. 12, 13).

3. Fall Spawner Abundance Indices

3.1 Commercial Fishery CUE Index

The principal fall spawner abundance index is the catch per unit effort (CUE) from the fall season gillnet fishery. The CUE is defined as catch (kg) / nets/trip/day. The catch information comes from purchase slips and dockside monitoring. Effort information describing trips comes from purchase slips and dockside monitoring where a purchase slip or dockside monitor record equals one trip. The number of nets per trip in each area is estimated from a phone survey of active gillnetters. The number of nets per trip used in the principal landing areas has been estimated by statistical district since 1986 (Table 10) and was used to derive the index for those years. Prior to 1986, the average number of nets for the combined areas of the Southern Gulf of St. Lawrence was used (Table 9). Methods for estimating these indices are described in LeBlanc and LeBlanc (1996).

A multiplicative model with year, district, and 10 day periods was used to estimate an abundance index for each fall since 1978. This model was identical to those used in past assessments. The model was statistically significant ($p<0.0001$, $r2 = 0.60$) (Table 33). Residual and DFFITS plots indicated there were no trends or data points violating the model assumptions (Fig. 14).

The results indicate that catch rates in 1997 were above 1995 and 1996 but slightly below 1989 to 1994 rates (Fig. 15), although confidence intervals among these years overlap. Effort levels were similar to those in the early 1980s and below high levels in 1987 and 1990 (Fig. 15). Analyses completed in the assessment of the 1996 fishery indicated that catch rates were independent of effort (Claytor et al. 1997).

An abundance index for ages 4-10 and years 1978 to 1997 in units of numbers/net/trip/day was derived as follows:

Effort = Catch biomass from inshore gear/ CUE fixed gear

Abundance index = Catch numbers inshore gear/ Effort.

This index (Table 34, Fig. 16) calibrated or tuned the ADAPT-VPA population model used to estimate biomass.

The 1980, 1983, 1987, and 1988 year-classes were consistently strong in the fall spawner abundance index. Year-classes from the early 1970s and two recent year-classes (1989 and 1991) were consistently weak. The fall abundance index for the 1992 (age 5 in 1997) year-class, which was dominant in the fishery in 1997, was relatively greater in 1997 than it was as four year-olds in 1996 (Fig. 16).

3.2 Acoustic Survey Index

The annual acoustic survey provides a second abundance index that is included as an illustrative ADAPT-VPA formulation for the first time this year for the years 1990-1997. The major reason for presenting these results at this time is to determine the direction the research and the survey should take in order to include this index as a regular part of future assessments.

Methods and detailed results from these surveys are provided in (Leblanc et al. 1993; LeBlanc and Dale 1994; LeBlanc et al. 1995; LeBlanc and Dale 1996; Claytor et al. 1997) for 1990 to 1996 and in the Appendix for 1997.

In 1997, this survey covered three major areas of the 4T stock, Chaleur - Miscou (Fig. 17), North PEI and Iles de la Madeleine (Fig. 18), and Cape Breton (Fig. 19). Sampling to determine biological characteristics and to estimate target strength were carried out wherever major concentrations were observed (Fig. 20).

The acoustic survey catch-at-age (Table 35) was estimated using samples collected from each strata. If a sample was not collected from a strata then the sample from its nearest strata was used. The catch-at-age for the survey was weighted by the signal strength in each strata.

The Chaleur - Miscou area has been surveyed each year since 1990. The Cape Breton area has been surveyed in each year except 1994 (Table 36). Tracadie strata were added in 1995, Nova Scotia and East PEI strata were only surveyed in 1995 and 1996. North PEI strata were added in 1996 and the Iles de la Madeleine strata were added in 1997. Milne Bank, a major juvenile area, off the northeast coast of PEI has been done in most, but not all years (Table 36).

There have also been changes in the timing of the survey. The survey was done in late October and early November in 1990, and during October from 1991 to 1994. In 1995, the timing of the survey was moved to begin in late September and end in mid October (Table 36). The changes to earlier dates were made for several reasons. First, in order to provide an assessment of the biomass in the major areas immediately after the gillnet fishing seasons closed. For example, the survey begins in Chaleur Bay immediately after the roe fishery ends and moves south easterly through the Gulf. Fisheries generally end later in the more southerly and easterly fisheries of the Gulf. The survey tends to arrive in 4Vn just as the 4T migration is beginning. Thus, most of the 4T herring are surveyed in 4T. This timing helped to alleviate some of the weather and migration difficulties with conducting a survey in 4Vn late in the year.

Another change made in the survey, beginning in 1994, was to cover 100% of the strata at night. Prior to this time the split between day and night was about 50% (Table 36).

For 1990 to 1993, the same towed body, transducer, and cable were used. Because of equipment and logistical problems ball calibrations in 1990 and 1991 were not useable and the calibration results from 1992 were used in those years (Table 36).

The combined spring and fall biomass index for the Chaleur - Miscou strata shows a decline from 1996 to 1997 with overlapping confidence intervals between the two years (Fig. 21). The Cape Breton strata showed little change from 1996 to 1997 (Fig. 21). The combined spring and fall biomass index for Chaleur - Miscou using the same strata from 1994 to 1997 showed little change from 1996 to 1997 (Fig. 22).

The percentage of fall spawners observed in the Cape Breton portion of the acoustic surveys varied from 10 to 30% from 1990 to 1997 (Table 37). Spring spawners account for 0 to 4% of the herring observed in Cape Breton (Table 37). Including both spawning groups, most of the biomass has been observed in the Chaleur - Miscou strata regardless of additional areas included in the survey between 1990 and 1997 (Table 38).

The Chaleur - Miscou and Cape Breton strata are the most important stock areas for spring and fall spawners at the time of year that the survey is conducted. The Chaleur - Miscou area represents the major spawning area and the major spring spawner feeding area during the fall. Including 4Vn would account for stocks outside Chaleur - Miscou area because all 4T adults overwinter in 4Vn. As a result, survey results from Chaleur - Miscou and 4Vn strata from 1990 to 1997 are included in the abundance index for the initial ADAPT-VPA (Table 34) calibration using the acoustic survey. The index was derived by adding the catch-at-age matrices for Chaleur-Miscou and 4Vn strata (Table 35). Catch-at-age for 4Vn in 1995 and 1996 have not yet been included. The estimation procedure for those years, which relied on the bottom trawl survey and seiner catches for samples has not been thoroughly investigated. The units of the index are numbers of herring at age as estimated in the survey. For the purposes of this initial trial there has been no attempt to standardize the index for changes in areas surveyed, varying day and night coverage, or other survey differences among the years.

3.3 Bottom Trawl Survey

The annual bottom trawl survey provides a third abundance index of 4T herring throughout the southern Gulf of St. Lawrence. During the 1990s herring have been found primarily along the north coast of Prince Edward Island and through the Northumberland Strait (Fig. 23). The survey has occurred consistently during the month of September from 1971 to 1997. The abundance index from this survey indicates the same general low to high shift in population level as the CUE index (compare Figs. 15, 24). Detailed herring samples to construct a catch-at-age by spawning group have been collected since 1994. Catch-at-age matrices from this survey have not as yet been developed. Results are for spring and fall spawners combined.

3.4 Phone survey

The phone survey provides a fourth index of abundance for fall spawners in the southern Gulf of St. Lawrence. During the survey gillnetters are asked to compare abundance in the current year to last year and overall. In the fall, survey respondents indicated that abundance was either the same or less in 1997 compared to 1996 (Fig. 6).

4. Fall Spawner Assessment

4.1 Estimation of Stock Parameters

Two analyses were completed for fall spawners to estimate population abundance. The first, was identical to past assessments (Claytor et al. 1997). There was a tendency in this analysis to estimate new year-classes, observed for the first time as 4 year-olds, lower in the current year than in subsequent years. The time period at which this tendency began was coincident with a trend for some areas of the southern Gulf gillnet fishery to use larger mesh sizes. The second analysis incorporated this change in mesh size in the abundance index used to calibrate the model. In addition, the results of these analyses are compared to illustrative analyses incorporating the acoustic abundance indices as an additional index. Only the results from the second analysis, incorporating changes in mesh size were used to calculate $F_{0.1}$ levels for 1998. We report first on the method used in previous assessments. This analysis is identifed as the split mesh size CUE model throughout the document.

4.2 Previous assessment model - Single CUE Index: The formulation used in past assessments was to calibrate on ages 4-10 for all years of available data starting from 1978 to the current year (Claytor et al. 1997, Table 39). This method uses the CUE index from the commercial catch, as one complete index (Table 34).

Parameter estimates from the formulation using the commercial catch rate index were significant (t>2.0), correlations were low, all < 0.20 with most < 0.10. Bias percentages were <11.5% (Table 40).

Residuals were generally well distributed and close to observed values except for age 4 and 6 (Fig. 25). These patterns are similar to those observed in past years (Claytor et al. 1997). This year, however, was the fifth year in a row that residuals (ln (observed/predicted)) were negative for age 4 and positive for age 6 (Fig. 25). These negative residuals indicate that the model is consistently predicting abundance below what would be expected from the observations. These consistent negative residuals lead to the additional analyses described below in the mesh size CUE index, in an attempt to find an explanation and correction for this trend.

Retrospective analysis, for the single CUE index model, consisted first of examining the 1997 results and comparing those to the ones derived from last year's assessment including the projection to 1997. This analysis indicated that, except for 1996 and 1997, annual biomass estimates made this year were lower than those in last year's assessment (Fig. 26). The 1997 4+ estimate from this assessment indicates that the biomass decline expected from last year's analysis did not occur. The 7+ biomass estimate is lower than that projected in 1996 but a declining trend is not indicated. These differences are primarily because the 1992 year-class (age 5) is stronger than expected (Table 41).

The second retrospective analysis was to delete one year from the current years model for the last six years. This analysis indicated that there is, in general, no consistent trend in over or under-estimation(Fig. 27). Differences between estimates made in the current year and the next year tend to be within 20% and the current year has generally tended to produce an estimate that is lower than the next year (Table. 42A). In contrast, 1997 estimates were lower than those made in the year of the assessment (Table 42B).

Age by age retrospective plots from the second analysis, do not indicate a systematic bias, except for age 4, which seem to be estimated lower in the current year, compared to subsequent years (Fig. 28).

A plot of fishing mortality against effort indicates a significantly linear relationship consistent with model assumptions (Fig. 29). Residuals for 1994-1997 were all positive (Fig. 29).

4.3 New Assessment Model - Mesh Size CUE Index: As noted above, the negative residuals for the single CUE model for age 4 started in 1992. The percentage of 2 5/8" mesh used in the fishery over time was estimated to determine if the change in mesh size in the more southerly portions of the fishery could be an explanation for these residuals.

The percentage of nets for the overall fishery was estimated by calculating a weighted mean percentage of 2 5/'8" mesh. This calculation was done by multiplying the percentage of 2 5/8" mesh in each area from the phone survey (Table 43) by the catch for each area (Table 44) and dividing by the total catch for the year. The results indicated a break in the percentage of 2 5/8" mesh used in the overall fishery from above 70% between 1986 and 1991 to below 70% from 1992 to 1997 (Table 45).

As a result, the CUE abundance index was divided into two sections. One from 1978 to 1991 and a second from 1992 to 1997 (Table 46). Parameter estimates from this formulation were significant for all ages (t >2.0), correlations were low, but slightly higher than the single CUE analysis all <0.40. Bias percentages were similar to the single CUE analysis (11.5% compared to 11.6%; Tables 40, 47). Catchability estimates for the two years, second and third sets of parameter estimates in Table 47, were less for age 4 herring and greater for older ages between 1992-1997. This result is consistent with the expected lower catchability of 4 year-olds by using a larger mesh. These catchabilities are summarized in the text table below:

Catchability Estimates from two indices:

Age	78-91	92-97
4	0.0056	0.0016
5	0.0075	0.0089
6	0.0081	0.0128
7	0.0103	0.0144
8	0.0120	0.0139
9	0.0109	0.0156
10	0.0123	0.0162

Overall, residuals by age for the split CUE index model were well distributed (Fig. 30). In addition, there was considerable improvement in the patterns for the problem ages (4 and 6) in the single CUE analysis (Fig. 31).

The retrospective pattern for the split CUE analysis showed a greater difference between annual updated estimates than for the single CUE analysis (Fig. 32). A comparison of the retrospective analyses for the single CUE index and the split mesh size CUE indices model from 1994 to 1996 indicates that the split CUE model has consistently provided a higher estimate of biomass than the single CUE model (Fig. 33). These differences were, however, less than 10% for each of the three years. Age by age, retrospective analyses, indicate that the tendency to consistently under-estimate age 4s in the year of estimate, compared to later years has been reduced with the split mesh size CUE analysis (Fig. 34). The retrospective differences for the years when the large 1987 and 1988 year-classes were being estimated were greater for the split CUE analysis than for the single CUE analysis, for ages 4 to 7 (Fig. 34). Age by age retrospectives for ages 8-11 were similar with both models (Fig. 35).

4.4 Fall - Assessment Results

Fall spawner 4+ biomass, using the single CUE model, is about 260,000t and 7+ biomass is about 100,000t (Table 48). The estimate of 4+ biomass using the split mesh size CUE indices was considerably higher for 1997, about 350,000t, while the 7+ biomass was less, about 80,000t (Table 49).

A retrospective comparison among the single CUE model, split CUE model, and last year's assessment results indicates that up to 1997, there was little difference in the results of the single and split CUE models. Both of these models, produced results that were in general lower than the 1996 assessment model. Population trends up to 1995 were similar for all models (Fig. 36).

Results using the single CUE ADAPT model indicate that weighted 4+ fishing mortalities have been below the 0.25 target or 22% exploitation rate each year since 1981, except for 1990 and 1995 using both models (Tables 50, 51; Fig. 37). The main difference between the two models was in the lower fishing mortality estimated for 1997 using the split mesh size CUE indices (Fig. 37). Target fishing mortalities on fully recruited ages are 0.30 or 26%. This target was estimated to have been exceeded in 7 of the 17 years from 1981 to 1997 by both models (Tables 50, 51).

Indications are that three of the last four year-classes in the fishery (1990 to 1993) are average or above using either ADAPT-VPA model (Figs. 38, 39). This situation is quite different from last year when 2 of the last four were average or above and the two that were below average were among the lowest since 1978 (Figs. 38, 39).

The main difference between the two models is in the size of the 1993 year-class observed as 4 year-olds in 1997, and to a lesser extent the size of the 1992 year-class observed first as 4 year-olds in 1992 (Figs. 38, 39). In the single CUE model the 1993 year-class appears to be average and in the split mesh size CUE model the 1993 year-class is the largest since 1978. The 1992 year-class, which was estimated to be above average using the single CUE model, is estimated to be in the same level of magnitude as the 1993 and 1987 year-classes using the split mesh size CUE model (Figs. 38, 39).

The age structure of the split mesh size CUE indices model was consistent with that expected from the acoustic survey from 1994 - 1997. For ages 5 and older it was consistent with ages in the catch (Fig. 40). Age 4s in the population and the acoustic survey were always a greater proportion of the population than in the catch (Fig. 40). This difference is consistent with the lower partial recruitment estimated for age 4s, with the split mesh size CUE indices. The large seiner catch in Chaleur Bay and 4Vn in 1997 had a smaller proportion of 4 year-olds than expected from the population estimate (Fig. 41). A comparison of the lengths of 4 year-olds in the acoustic survey in Chaleur Bay and the seiner catch of 4 year-olds in Chaleur Bay and 4Vn indicate that there was some selectivity by the seiners for the larger 4 year-olds in the population (Fig. 42). The regulation requiring that the catch of fish ≤ 24.5 cm fork-length not exceed 10% by number, and which approximately corresponds to a total length of 27 to 27.5 cm is coincident with the point at which selectivity seems to occur in the seiner fishery (Fig. 42). This selectivity provides an explanation for the difference in the proportion of the 4 year-olds in the seiner catch compared to the population. Estimates of numbers of 3 to 5 year-olds in the experimental meshes (2", 2 1/4", and 2 1/2") fished in Pictou in 1997 are consistent with the conclusion that 4 year-olds are relatively abundant in the fall spawner population (Fig. 43). For example, an observation that more 5 and 3 year-olds, than 4 year-olds, in the 2" mesh would have been inconsistent with the conclusions of the assessment that 4 year-olds from the 1993 year-class were the largest since 1978.

4.5 Fall - Future Prospects

Projections for 1998 and 1999 were made by taking the beginning of the year biomass by age and subtracting losses from natural mortality and fishing to determine expected beginning of the year numbers for each of these years as in previous assessments (Claytor et al. 1997). The target fishing mortality of $F_{0.1}$=0.30 (fully recruited) was applied to these numbers to determine the $F_{0.1}$ fishing level.

Input parameters were partial recruitment by age, average weights-at-age, and recruitments at ages 2 and 3. Partial recruitment values were derived from average fishing mortalities from 1995 to 1997. Age 2 and age 3 recruitment were the geometric mean for 1978 to 1994 for age 2 and to 1995 for age 3. The extremely large 1987 year-class was omitted to remove the effects of this recruitment outlier on average year-class strength.

The $F_{0.1}$ fishing level for 1998 is 55,000t and for 1999 is 48,000t using the single CUE model and 66,000t for 1998 and 61,000t for 1999 using the split mesh size CUE indices model (Tables 52, 53). Each model indicates a decline from 1998 to 1999.

A risk analysis indicates that The TAC at which biomass can be expected to remain stable from 1998 to 1999 is about 20,000t. At a TAC of 66,000t the biomass has a greater than 80% probability of declining from 1998 to 1999. The probability that fishing mortality will be below the target for fully recruited ages declines sharply at TACs over 40,000t (Fig. 44).

A comparison of the $F_{0.1}$ fishing levels using each of these models, indicates that except for 1998, the $F_{0.1}$ level was higher using the single CUE model than the split mesh size CUE model (Table 54). This comparison was made using the annual estimates from the results obtained in this assessment and not from a retrospective analysis. The retrospective analysis was not used, because as years are eliminated from the data set the fit for the split mesh size CUE model becomes unacceptable. The target $F_{0.1}$ = 0.3 for fully recruited ages was used for both models. This target is the one currently used, while it may be different for the split mesh CUE model, because of the change in partial recruitment, this change has not been evaluated and so the same target was used for both analyses.

4.6 Fall estimation combining Acoustic and CUE Index

An illustrative ADAPT-VPA was run using the acoustic index, total numbers estimated in Chaleur - Miscou and Cape Breton strata from 1990 to 1997 (Table 34 and Fig. 45) and the single CUE index as above (Table 34 and Fig. 16). For this illustration, only the single CUE index has been used. This analysis was prepared and presented at the RAP meeting and its purpose was only to illustrate the technique and identify potential areas for research for inclusion of the acoustic index in subsequent assessments. As a result, there were two indices calibrating the model, the CUE index from 1978 to 1997, ages 4-10; and the acoustic index, 1990-1997, ages 3-9 (Table 55). Numbers from the acoustic index were divided by 100 to put them on a similar scale as the CUE index.

The model was significant (t>2) for all ages except age 3. Bias was 21% for age three, but < 10% for ages 4-10 (Table 56). Parameter correlations were all < 0.40 and most were < 0.2 (Table 56).

Annual residual patterns for the CUE index were similar to the previous analysis (Tables 40, 56). Residuals for 1990 were positive and for 1991 were negative using the Acoustic Index (Table 56). Age by age residual patterns for the acoustic index were generally well distributed (Fig. 46).

A comparison of the ADAPT-VPA using the single CUE index alone and combined with the acoustic index indicates close agreement for all years except for 1997 (Fig. 47). In 1997, the biomass estimate is highest using the split mesh size CUE model, followed by the combined acoustic and single CUE model, and the single CUE model was least with respect to 4+ biomass (Fig. 47). For 7+ biomass, the acoustic model provided the largest biomass estimate, followed by the single CUE model, and the split mesh size CUE index was lowest (Fig. 47).

Retrospective analysis indicates similar results to those using the single CUE index (compare Figs. 32 and 48). Age by age plots for the combined acoustic - single CUE model are similar to the single CUE model and indicate a tendency to estimate age 4s higher in subsequent assessments (compare Figs. 34, 35, and 49).

The relationship between fishing mortality and effort is significant (Fig. 50). As for the commercial CUE, the 1994 to 1997 points are positive (Fig. 50).

The 4+ biomass estimate using the acoustic index is about 300,000 t (Table 57). These results indicate that the acoustic survey shows promise as a fishery independent index of stock trends.

Before its use can expand in the assessment, a standardized index needs to be developed.

5. Spring Spawner Abundance Indices

5.1 Commercial Fishery CUE Index

Spring spawner abundance indices were derived by combining two data sets. The first consisted of dockside monitoring done in Escuminac and Southeast New Brunswick by the Province of New Brunswick from 1990 to 1996. The second consisted of the dockside monitoring that was conducted throughout the 4T spring fishery in 1997 as directed by the Herring Management Plan. Only the data collected from Escuminac and Southeast New Brunswick was used for reasons described below.

The New Brunswick provincial government had a system in place to record catch and effort in Escuminac (Statistical Districts 73-75, 16C) and Southeast New Brunswick (Statistical Districts 76-80, 16E) (Fig. 1) during the spring season. From 1990 to 1996 daily catches and numbers of people fishing were recorded by a person placed at dockside and checking the processing plants. Only boats landing at ports within these districts were recorded under this program. This program was discontinued in 1997 when dockside monitoring programs as directed by the Herring Management Plan were introduced.

The 1997 dockside monitoring program consisted of a system of hails and random checks to verify the accuracy of the hails. The overall difference between the hails and the observed catches in Escuminac was that the observed catches were about 3% higher than the hails, though individual daily differences ranged from 0 to 71% (Table 58). A similar overall value was observed for southeast New Brunswick, with values ranging from 0 to 57% (Table 59).

Based on these results, all dockside monitoring data including hails were used to form the catch rate index in 1997. Where observed values were available, they were used, otherwise hails were used. Only boats landing in New Brunswick were included to make the data consistent with the previously collected provincial data.

Effort was estimated as the number of fishers each day times the average number of nets as estimated from the phone survey for each area (Table 11). Catch rates forming the index are kg/fisher/net/day.

Last year the abundance index used for spring spawners was derived from the index glitter data set from 1988 to 1996 (Claytor et al. 1997). Index gillnetters were participants in the fishery that voluntarily kept daily records of numbers of nets used, total catch, amounts dumped, kept for private use, local sale, or transfers to other boats. Catch rates using this index were kg/net/trip. This index was correlated with the NB provincial dockside monitoring index (Claytor et al. 1997). In 1997, participation in this program was not sufficient to use it as a calibration index.

A multiplicative model with 10 day, area (Escuminac, Southeast New Brunswick), and year effects was used to estimate an annual abundance index using the dockside monitoring data from 1990 to 1997. The model was significant ($r2 = 0.32$, $p = 0.0001$). Residual and DFFITS plots indicate that there were no points unduly influencing the model or indicating that model assumptions were violated (Fig. 51).

The index developed from the dockside monitoring program shows similar trends to the index developed from the volunteer gillnetter logbook program used last year. These two indices were significantly correlated for 1990 to 1996 (Fig. 52).

The abundance index by age was derived in a manner identical to that for the fall spawners (Fig. 53, Table 61). This index indicates that the 1988 year-class was consistently strong in all years and that the 1991 year-class has been dominant for the last two years (Fig. 53).

5.2 Acoustic Survey

An abundance index from the acoustic survey (Table 62) was derived to include the Chaleur - Miscou and Cape Breton strata as for the fall spawners (Table 63). These indices indicate that the 1991 year-class has been important in recent years (Fig. 54, Table 63).

5.3 Bottom Trawl Survey

Bottom trawl survey results have not been divided into spring and fall spawners and trends are reported for both groups combined (Fig. 23, 24).

5.4 Phone Survey

Responses to the phone survey indicate that in Escuminac and Southeast New Brunswick, abundance was felt to be greater in 1997 than 1996, and was the most abundant since 1990 (Fig. 5). These are the two areas used to formulate the catch rate abundance index described above. In West PEI, the other major spring area, abundance was thought to have increased from 1995 to 1996, but that 1997 was similar to 1996 (Fig. 5).

6. Spring Spawner Assessment

6.1 Estimation of Stock Parameters

Spring biomass was estimated using a similar ADAPT formulation as last year and one that is similar to the fall spawner formulation (Table 64). The dockside monitoring abundance index was used and ages 4-10 were used to calibrate the model for years 1990-1997 (Table 64).

Parameter estimates from the formulation using the dockside monitoring index were significant (t>2.0), correlations were all < 0.40 and most were < 0.20 (Table 65). Bias was about 13% (Table 65). Annual residuals were mostly negative for 1990 and 1996, and mostly positive for 1991, 1993, 1994, and 1997 (Table 65). Residual plots by age generally indicate a well distributed pattern about zero, except for ages 4 and 7 (Fig. 55).

A retrospective comparison of the results from 1997 using the dockside monitoring index compared to the 1996 results using the volunteer index gillnet program indicates very little change from 4+ biomass levels estimated in 1996 or 4+ projections. Estimates of 7+ are lower than those derived last year (Fig. 56). Trends were the same for both analyses (Fig. 56). A comparison of the 1996 and 1997 analyses by age indicates that the younger age-classes were estimated higher using the dockside monitoring 1997 analysis than using the 1996 volunteer gillnetter analysis, while the opposite was true for the older ages (Fig. 57).

A retrospective analysis of the 1997 model indicated a trend to estimate stock size higher in the current year than in subsequent years, although 1995 and 1996 values were similar in each case (Fig. 58). Age by age retrospective analysis indicates that the tendency to over-estimate in the current year was due to patterns in ages 9 and older (Fig. 59). There was no retrospective trend for age 4 spring spawners, as there was for age 4 fall spawners (compare Figs. 34, 59).

Correlations between fishing mortality and effort were not significant (Fig. 60).

To determine if a change to a larger mesh-size could explain the residuals observed for 4 year-olds in the spring as it did for the fall; the percentage of 2 1/4" mesh gillnets used in the fishery since 1988 was examined. The results are summarized in the table below and indicate that in Escuminac the percentage of 2 1/4" mesh has increased, while in southeast New Brunswick it has decreased. The average mesh size used in Escuminac has varied from 2.17" to 2.30" and in southeast New Brunswick from 2.23" to 2.30" since 1988. The consistency of mesh size in this fishery and the short time series for the abundance index, do not warrant trying to incorporate mesh size into the ADAPT model as was done for the fall, at this time.

	% 2 1/4" mesh		Average mesh size (in.)	
Year	Escuminac	SE N.B.	Escuminac	SE N.B.
88	79.1	96.7	2.17	2.26
89	79.6	84.1	2.29	2.23
90	71.8	88.5	2.27	2.27
91	85.0	93.2	2.28	2.26
92	80.4	84.8	2.27	2.25
93	89.7	94.3	2.28	2.26
94	77.9	79.0	2.30	2.26
95	86.3	72.8	2.30	2.30
96	91.3	55.4	2.27	2.25
97	95.4	76.9	2.26	2.28

6.2 Spring Spawner - Assessment Results

Spring spawner 4+ biomass was estimated at about 71,000 tonnes and 7+ biomass at about 21,000 tonnes (Table 66).

Results using the CUE index indicate that weighted 4+ fishing mortality has been very close to the target 26% in recent years (Fig. 61). Target fishing mortality on the fully recruited ages (5-6) (0.44) was close to the target from 1993 to 1997 (Table 66).

Indications are that the incoming 1993 year-class (age 5, in 1998) is close to average, that the 1992 year-class (age 6 in 1998) is well below average, and that the 1991 year-class (age 7 in 1998 is well above average (Fig. 62).

A comparison of the age structure estimated using the population model based on the fishery index to the age structure derived independently from the acoustic survey indicates general agreement between these two estimates (Fig. 63). In addition, sampling from a trapnet designed to capture spawners for a roe on kelp project in Escuminac, shows a similar age structure to the acoustic and population estimates for its two years of operation in June 1996 and 1997 (Fig. 64). Each of these analyses indicates that the 1992 year-class is very poor.

6.3 Spring Spawner - Future Prospects

Projections for 1998 and 1999 were made by taking the beginning of the year biomass by age and subtracting losses from natural mortality and fishing to determine expected beginning of the year numbers for each of these years as in previous assessments (Claytor et al. 1997). The target fishing mortality of $F_{0.1}$=0.44 (fully recruited age) was applied to these numbers to determine the $F_{0.1}$ fishing level.

Input parameters were partial recruitment by age, average weights-at-age, and recruitment at ages 2 and 3. Partial recruitment values were derived from average fishing mortalities from 1995 to 1997. Age 2 and age 3 recruitment were the geometric mean from 1978 to 1994 for age 2 and to 1995 for age 3. The extremely large 1988 year-class was omitted to remove the effects of this recruitment outlier on average year-class strength.

The F0.1 fishing level for 1998 is 16,500t and for 1999 13,000t (Table 67).

A risk analysis indicates that the TAC at which biomass can be expected to remain stable from 1998 to 1999 is about 8,000t. Regardless of TAC, the probability that the spring biomass will decline is $\geq$ 0.40. The probability that fishing mortality will be below the target for fully recruited ages declines at TACs over 12,000t (Fig. 65).

6.4 Spring spawner estimation using Acoustic and DMP index

An illustrative ADAPT-VPA (Table 68) was run using two indices to calibrate the model, the acoustic index, total numbers estimated in Chaleur-Miscou and Cape Breton strata from 1990 to 1997 (Table 62) and the dockside monitoring index as above (Table 61). Calibration ages were 4-10 from the CUE index and 2 -6 from the acoustic index. Numbers from the acoustic index were divided by 100 to make them on a similar scale to the dockside monitoring index.

The model was significant (t>2) only for age 4-6 population numbers, although all calibration constants were significant. Parameter correlations were all < 0.4 and most were < 0.3 (Table 69). Residuals for the acoustic index were negative for 1990 and positive for 1991 (Table 69) but age by age residual patterns for the acoustic index were generally well distributed (Fig. 66).

The acoustic - dockside model provides a higher estimate of 4+ biomass than the 1996 assessment and the CUE model by itself. The acoustic - CUE model and the CUE model alone provide similar 7+ biomass estimates and they are lower than the 1996 assessment model (Fig. 67).

A retrospective analysis of the combined acoustic and CUE indices model, leaving one year off, indicated a close agreement between 1995 and 1996 estimates but earlier biomass estimates were estimated higher in the assessment year, than in subsequent years (Fig. 68).

Age by age retrospective plots indicated that initial estimates of all ages were higher in the first year than in subsequent years (Fig. 69).

The relationship between fishing mortality and effort was not significant (Fig. 70).

These results indicate a 4+ biomass for spring spawners of about 100,000 tonnes and 22,000 tonnes for 7+ (Table 70) compared to 71,000t for spring spawners using the CUE model (Table 66).

These analyses indicate that target fishing mortalities have generally been below targets in recent years (Fig. 71, Table 70).

Dominant year-classes are similar for each analysis, but the CUE index model indicates that the 1988 year-class is the largest since 1978, while the combined acoustic and CUE indices model indicates that the 1991 year-class is the largest since 1978 (Compare Figs. 62, 72).

7. Discussion

The 4+ biomass estimate for fall spawners is similar to the highest levels previously estimated in 1991 and 1992 when the very large 1987 and 1988 year-classes were supporting the fishery. This year is the first time that the analysis accounting for increasing mesh size has been used in the assessment. It is also the first time that the 1993 year-class, which represents 40% of the estimated age 4+ biomass has been observed. As a result, a major source of uncertainty in the assessment is that the 1993 year-class is the largest since 1978 and that it is being observed for the first time. Given the present age structure and the uncertainty regarding this year-class, fishing below $F_{0.1}$ in 1998 would be prudent.

Spring spawners have declined from high levels of 100,000 t for 4+ biomass estimated in the early 1990's when the very large 1988 year-class was supporting the population. Current levels are similar to those estimated during the late 1980's when the stock had recovered from low levels estimated in the late 1970's and early 1980's. In addition, the spring stock is supported almost entirely now by the 1991 year-class with no signs of above average recruitment. As this year-class passes through the population with below average recruitment the $F_{0.1}$ level will continue to decline.

This year was the first year that an abundance index from the acoustic survey was examined as a calibration index for the analysis that estimates population biomass. It looks promising, but this year's attempt did not take into account the different areas which have been surveyed each year. Subsequent assessments will develop a standardized acoustic abundance index that can be used in the estimate of population biomass.

8. Acknowledgments

We would like to thank Clarence Bourque for processing herring samples in the laboratory in Moncton, during the acoustic survey at sea and in Moncton, and for maintenance of detailed data files. Thanks also to Doris Daigle, Yves Richard, Jim Dale, Robert LeBlanc, and Karen Hendsbee for port sampling.

9. References

Claytor, R. C. LeBlanc, A. Sinclair, G. Poirier, and L. Paulin. 1997. Assessment of the NAFO division 4T southern Gulf of St. Lawrence herring stock, 1996. DFO Canadian Stock Assessment Secretariat Res. Doc. 97/30.

Cleary, L., J.J. Hunt, J. Moores, and D. Tremblay. 1982. Herring aging workshop St. John's, Newfoundland March - 1982. Canadian Atlantic Fisheries Scientific Advisory Committee Res. Doc. 82/41.

LeBlanc, C and J. Dale. 1996. Distribution and acoustic backscatter of herring in NAFO divisions 4T and 4Vn, Sept. 23 - Oct. 08, 1995. DFO Canadian Stock Assessment Secretariat Res. Doc. 96/125.

LeBlanc, C. and L. LeBlanc. 1996. The 1995 NAFO Division 4T herring gillnet telephone survey. DFO Altantic Research Document 96/69.

LeBlanc, C. J. Dale, L. Mello. 1995. Distribution and acoustic backscatter of herrring in NAFO division 4T, October 1994. DFO Atlantic Fisheries Res. Doc. 95/128.

LeBlanc, C., and J. Dale. 1994. Distribution and acoustic backscatter of herring in NAFO divisions 4T and 4Vn, October 1993. DFO Atlantic Fisheries Res. Doc. 94/44.

LeBlanc, C, A. St.-Hilaire, and J. Dale. 1993. Distribution and acoustic backscatter of herring in NAFO divisions 4T and 4Vn, fall 1990 - 1992. DFO Atlantic Fisheries Res. Doc. 93/55.

McQuinn, I. H. 1989. Identification of spring- and autumn spawning herring (*Clupea harengus*) using maturity stages assigned from a gonadosomatic index model. Can. J. Fish. Aquat. Sci. 46:969-980.

Table 1. Catch (t) of 4T herring caught in spring and fall, by gear (fixed and mobile) and spawning group (as calculated by the GSI method). Catch (t) in 4Vn from the purse seine fishery (Nov-Mar) is assigned to a spawning group according to otolith characteristics up to 1991 inclusive.

YEAR	SPAWNING GROUP a	4T SPRING		4T FALL		4T CATCH	4T TAC	4Vn CATCH	4Vn TAC	BIOMASS	
		Fixed	Mobile	Fixed	Mobile					Fall 4+	Spring 4+
1978	P	8.098	6.277	109	8.047	22.531		1.168			
	A	449	1,770	5,032	23,708	30,959		1,681			
	Total	**8,547**	**8,047**	**5,141**	**31,755**	**53,490**	**55,000**	**2,849**	**8,000**	73,142	44,975
1979	P	7,089	6,951	282	5,821	20,143		1,426			
	A	535	6,951	5,793	14,798	28,077		1,484			
	Total	**7,624**	**13,902**	**6,075**	**20,619**	**48,220**	**55,000**	**2,910**	**3,000**	57,543	30,761
1980	P	7,216	6,123	306	4,519	18,164		1,348			
	A	56	7,794	6,239	10,293	24,382		2,503			
	Total	**7,272**	**13,917**	**6,545**	**14,812**	**42,546**	**55,000**	**3,851**	**4,500**	41,616	19,932
1981	P	7,028	10	665	938	8,641		1,374			
	A	473	11	10,560	2,250	13,294		2,060			
	Total	**7,501**	**21**	**11,225**	**3,188**	**21,935**	**16,000**	**3,434**	**3,000**	63,131	10,322
1982	P	5,872	29	332	335	6,568		1,549			
	A	51	33	12,650	2,243	14,977		1,971			
	Total	**5,923**	**62**	**12,982**	**2,578**	**21,545**	**15,000**	**3,520**	**3,000**	101,977	8,307
1983	P	8,211	9	425	1,047	9,692		1,154			
	A	312	10	13,415	2,442	16,179		2,826			
	Total	**8,523**	**19**	**13,840**	**3,489**	**25,871**	**20,000**	**3,980**	**5,000**	153,450	23,025
1984	P	5,001	2	481	387	5,871		1,138			
	A	281	2	15,493	1,891	17,667		2,787			
	Total	**5,282**	**4**	**15,974**	**2,278**	**23,538**	**19,000**	**3,925**	**3,500**	234,872	40,211
1985	P	6,535	0	4,018	2,036	12,589	6,000	1,006			
	A	682	0	19,689	4,986	25,357	26,500	2,464			
	Total	**7,217**	**0**	**23,707**	**7,022**	**37,946**	**32,500**	**3,470**	**3,500**	276,266	63,899
1986	P	8,015	0	3,249	4,026	15,290	7,200	1,262			
	A	535	0	36,642	6,889	44,066	36,200	3,090			
	Total	**8,550**	**0**	**39,891**	**10,915**	**59,356**	**43,400**	**4,352**	**4,200**	301,224	86,141
1987	P	10,789	0	2,417	4,393	17,599	8,200	332			
	A	970	0	49,711	9,341	60,022	64,600	2,040			
	Total	**11,759**	**0**	**52,128**	**13,734**	**77,621**	**72,800**	**2,372**	**4,200**	320,974	80,394

a P: Spring/Printemps; A: Fall/Automne

Table 1 (cont'd). Catch (t) of 4T herring caught in spring and fall, by gear and spawning group.

Year	Spawning Group	4T Spring Fixed	Mobile	4T Fall Fixed	Mobile	4T Catch	4T TAC	4Vn Catch	4Vn TAC	Fall 4+ Biomass	Spring 4+ Bioimass
1988	P	11,541	0	3,278	6,644	21,463	12,800	257			
	A	1,346	1	37,933	10,887	50,167	66,100	2,315			
	Total	**12,887**	**1**	**41,211**	**17,531**	**71,630**	**78,900**	**2,572**	**4,200**	320,830	71,435
1989	P	10,441	0	1,564	4,138	16,143	16,800	212			
	A	652	0	32,285	10,131	43,068	70,100	1,905			
	Total	**11,093**	**0**	**33,849**	**14,269**	**59,211**	**86,900**	**2,117**	**4,200**	286,141	63,965
1990	P	8,520	1	1,331	3,815	13,667	21,000	706			
	A	540	0	55,790	6,494	62,824	65,900	4,005			
	Total	**9,060**	**1**	**57,121**	**10,309**	**76,491**	**86,900**	**4,711**	**4,200**	262,311	63,545
1991	P	12,586	17	178	2,095	14,876	21,000	957			
	A	306	1	26,966	5,964	33,237	65,900	3,832			
	Total	**12,892**	**18**	**27,144**	**8,059**	**48,113**	**86,900**	**4,789**	**4,200**	332,914	69,804
1992	P	12,438	952	239	1,850	15,479	21,000	296			
	A	37	168	32,840	5,265	38,310	65,900	3,932			
	Total	**12,475**	**1,121**	**33,079**	**7,115**	**53,790**	**86,900**	**4,228**	**4,200**	345,988	105,484
1993	P	14,584	2,175	917	1,388	19,064	21,000	219			
	A	598	541	22,181	4,840	28,160	80,800	3,736			
	Total	**15,182**	**2,716**	**23,098**	**6,228**	**47,224**	**101,800**	**3,955**	**4,200**	291,361	107,130
1994	P	18,754	2,910	1,422	1,879	24,965	21,000	324			
	A	260	1,023	52,390	5,081	58,754	80,800	2,920			
	Total	**19,014**	**3,933**	**53,812**	**6,960**	**83,719**	**101,800**	**3,244**	**4,200**	295,606	91,701
1995	P	13,970	1,406	1,798	5,775	22,950	21,000	153			
	A	31	436	52,937	9,567	62,982	80,800	3,990			
	Total	**14,001**	**1,842**	**54,735**	**15,342**	**85,932**	**101,800**	**4,143**	**4,200**	237,288	110,054
1996	P	15,536	1,280	1,061	3,500	21,378	17,000	734			
	A	548	627	44,733	4,406	50,313	51,140	3,551			
	Total	**16,084**	**1,907**	**45,794**	**7,906**	**71,690**	**68,140**	**4,285**	**6,423**	265,021	81,720
1997	P	13,164	1,252	147	1,651	16,213	16,500	150			
	A	16	226	34,937	4,156	39,336	50,000	3,381			
	Total	**13,180**	**1,478**	**25,085**	**5,806**	**55,549**	**66,500**	**3,531**	**4200**	352,612	70,981

a P: Spring/Printemps; A: Fall/Automne

Table 2. Catch (tonnes) by season in fixed gear for 4T Southern Gulf of St. Lawrence herring. Catches compiled using ZIFF raw data files for 1986, and 1988-1996. For 1987, purchase slip files were used.

SPRING SEASON - FIXED GEAR

	Area							
Year	16A	16B	16C	16D	16E	16F	16G	Total
86	234	1439	2282	328	3731	66	266	8347
87	206	4089	3082	106	3841	134	38	11496
88	78	6616	3560	108	2041	158	122	12682
89	88	3827	1556	74	5080	134	62	10822
90	62	1715	2232	167	4285	141	17	8618
91	26	2139	5159	193	5018	127	16	12678
92	26	2856	4348	243	4699	146	54	12372
93	34	2377	4533	885	6893	200	124	15047
94	129	1550	6187	218	10499	154	71	18809
95	13	1029	4799	1039	6993	95	27	13995
96	123	460	5380	1628	8428	37	40	16096
97	23	274	3072	619	9221	18	2	13229
Mean 92-96	58	1424	4707	772	7788	108	53	14911

FALL SEASON - FIXED GEAR

	Area							
Year	16A	16B	16C	16D	16E	16F	16G	Total
86	124	25959	93	0	1570	5816	6638	40199
87	208	31653	902	1	1090	9495	8660	52009
88	68	22111	1254	9	2591	9141	6102	41276
89	95	26431	1015	0	517	3160	2905	34123
90	110	31926	753	2	2405	10343	10957	56496
91	34	17181	1559	1	3242	1906	3122	27044
92	35	23559	1789	18	2540	1919	3160	33019
93	87	14597	3062	618	1977	935	1786	23062
94	74	34473	4086	1460	2118	8095	3483	53789
95	77	29448	5164	1901	4216	10113	3816	54735
96	86	21381	2817	1448	4688	7754	7608	45782
97	17	16540	2008	163	3969	6218	6132	35047
Mean 92-96	68	23288	3427	1118	3394	6623	4565	42483

Table 3. Catch (tonnes) by season in fixed gear for 4T Southern Gulf of St. Lawrence herring. Catches are from ZIFF files except for fall bait, small seiner catches, and seiner (>65') catches outside Chaleur Bay which are from quota monitoring.

SOUTHERN GULF OF ST. LAWRENCE TACs and QUOTA ALLOCATIONS

Fishing Area	TAC (t)	Sharing TAC		Inshore		Seiners (>65')	
		Inshore	Seiners	Allocation	Catch	Allocation	Catch
Spring 4T	16,500	86%	14%	13,508	13,229	2,992	1,478
Fall 4T	50,000	84%	16%	37,732	35,047	8,068	5,803
Winter 4Vn	4,200		100%			4,200	3,531
Total Fall	54,200	75%	25%	37,732	35,047	12,268	9,334
Total (Spring + Fall)	70,700	77%	23%	51,240	48,376	15,260	10,812

SPRING FISHERY

Area/Zone	Season/Saison	TAC (t)	Catch (t)/ Prises (t)
INSHORE			
Escuminac 16C	Jan 1-May 31	4,326	2,797
Remainder of 4T	Jan 1-May 31	7,549	8,826
Bait and Roe Fisheries all 4T	June 1-June 30	1,300	1,606
Quebec Small Seiners	Jan. 1 - June 30	200	0
4Vn		133	0
Total Inshore		13,508	13,229
SEINERS (>65')			
All 4T	Ap 1 - June 30	2,992	1,478
Grand Total		16,500	14,707

FALL FISHERY

Area/Zone	Season/Saison	Consistent Weekend Closure	Vessel Limit/ Limite par bateau (lb)	TAC (t)	Catch (t)/ Prises (t)
INSHORE					
Isle Verte 16A	July 1-Dec 31	none	20,000	172	17
Baie des Chaleurs 16B	Aug 1-Dec 31	2 days	20,000	16,727	16,242
Baie des Chaleurs 16B	Jul 1-Dec 31 Bait Fishery			800	192
Escuminac 16C & West PEI 16E	Aug 1-Dec 31	2 day	20,000	5,936	5,977
Magdalen 16D	Aug 1-Dec 31	2 day	20,000	1,018	163
Pictou 16F	Jul 1-Dec 31	2 days	15,000	6,200	6,218
Fisherman's Bank 16G	Aug 1-Dec 31	2 days	15,000	6,160	6,132
Quebec Small Seiners	Aug 1-Dec 31			550	106
4Vn				169	0
Total Inshore				37,732	35,047
SEINERS (>65')					
Within Chaleur Bay	Sept - Dec			5,734	5,669
Outside Chaleur Bay	Sept - Dec			2,334	134
All 4T				8,068	5,803
4Vn	Nov - Mar			4,200	3,531
Total Seiners				12,268	9,334
Grand Total				50,000	44,381

Table 4. Average price paid per pound to purse seiners and gillnetters in the Gulf Region, spring and fall fisheries combined.. na = not available.

Year	Purse Seine (cents/lb)	Spring and Fall Gillnets (cents/lb)	Fall Gillnets	Spring Gillnets
83	9.44	na/nd		
84	8.08	na/nd		
85	9.10	na/nd		
86	8.07	na/nd		
87	9.04	12.00		
88	7.15	8.00		
89	5.00	3.00-4.00		
90	6.21	5.00-6.00		
91	5.65	3.00-4.00		
92	5.60	3.00-4.00		
93	5.00	3.00-4.00		
94	5.50	6.00-8.00		
95	6.50	10.00-12.00		
96	7.60	14.20		
97	7.90		7.60	6.90

Table. 5. Number of respondents fishing in Spring 1997 by fishing area.

Area	Mag Is.	Quebec	Ac. Pen	Esc	Se N.B.	NS	EPEI	W.P.E.I.	Total
Mag Is.	25	.	.	.	.	.	.	.	25
Quebec	.	4	.	.	.	.	.	.	4
Ac Pen.	.	.	19	.	.	.	.	.	19
Escuminac	.	.	.	13	8	.	.	.	21
Se N.B.	.	.	.	2	31	.	.	.	33
NS\NE	1	.	.	.	2	7	.	.	10
E P.E.I.	.	.	.	.	.	.	7	.	7
W P.E.I	.	.	.	2	3	.	1	32	38
Total	**26**	**4**	**19**	**17**	**44**	**7**	**8**	**32**	**157**

Table. 6. Number of respondents fishing in Fall 1997 by fishing area.

Area	Mag Is.	Quebec	Ac. Pen	Esc	Se N.B.	NS	E.P.E.I	W.P.E.I	Total
Mag Is.	5	.	.	.	.	.	.	.	5
Quebec	.	3	.	.	.	.	.	.	3
Ac. Pen	.	16	69	6	.	.	.	1	92
Escuminac	.	.	.	9	.	.	.	1	10
Se N.B.	.	.	.	.	.	.	.	.	0
NS\NE	.	.	.	.	.	28	.	.	28
E P.E.I	.	.	.	.	.	1	25	.	26
W P.E.I.	.	.	1	.	.	.	1	21	23
Total	**5**	**19**	**70**	**15**	**0**	**29**	**26**	**23**	**187**

Table 7. Average length of gillnets (fathoms) used in the 1997 herring fishery.

Area	Spring	Fall
Mag Is.	15.4	16.6
Quebec	18.0	17.6
Ac Pen.	14.8	14.7
Escuminac	13.2	14.0
SE NB	14.3	-
NS\NE	18.2	23.8
EPEI	14.9	16.4
WPEI	14.5	13.8

Table 8. Percent distribution of gillnet types used in the 1997 herring fishery.

	Spring %		Fall %	
Area	Set	Modified	Set	Modified
Mag Is	91%	9%	12%	88%
Quebec	94%	6%	23%	77%
Ac Pen.	100%	0%	2%	98%
Escuminac	100%	0%	89%	11%
SE NB	100%	0%	-	-
NS\NE	93%	7%	91%	9%
EPEI	94%	6%	93%	7%
WPEI	95%	5%	95%	5%

Table 9. Average number of nets used in 4T during fall and spring gillnet fisheries.

Year	Fall	Spring
78	11.4	29.4
79	11.9	34.4
80	10.4	20.2
81	9.6	18.6
82	9.0	20.4
83	7.3	22.5
84	5.3	26.5
85	5.2	37.2
86	5.2	26.6
87	4.7	23.9
88	5.0	19.9
89	5.3	26.6
90	5.2	29.4
91	5.0	27.6
92	5.0	22.7
93	5.4	24.0
94	5.4	22.9
95	5.5	21.7
96	4.8	20.7
97	5.2	20.2

Table 10. Average number of nets used during the fall inshore fishery in statistical districts accounting for most of the fall inshore catch.

	Statistical District						
Year	11	13	65	66	67	87	92
86	10	12	9	5	8	10	10
87	10	9	5	5	6	8	8
88	9	8	9	6	7	10	10
89	6	7	6	6	7	8	11
90	7	8	6	6	6	10	7
91	10	5	5	5	6	12	7
92	9	4	7	5	7	7	9
93	5	8	7	6	6	7	9
94	6	6	10	5	5	7	12
95	7	6	7	5	5	8	8
96	6	6	5	5	5	8	8
97	5	5	6	5	5	7	7

Table 11. Average number of nets used during the spring fishery in Escuminac, NB (16C) and Southeast New Brunswick (16E).

Year / Année	Escuminac	Southeast New Brunswick
86	25	28
87	21	40
88	19	33
89	20	31
90	20	35
91	16	37
92	15	30
93	18	31
94	15	31
95	22	34
96	18	29
97	19	27

Table 12. Age-length keys and length-weight relationships used to derive catch and weight-at-age matrices for 4T herring. Individual keys are compiled by North, Middle, Southern, and 4Vn regions to make total 4tvn matrices.

						Intercept	Transformed Intercept	Slope	Number of Fish			
Season	Gear	Region	Fishery	Area	Sp Grp	a	a	b	Automne	Printemps	No. Samples	Landings(t)
Fall	Fixed	North	Gaspe (16A)	4Topq	Printemps	-5.48	0.000003331	3.239	0	47	1	40
		North	Chaleur (16B) - Bait	4Tmn	Automne	-5.91	0.000001240	3.545	212	34	7	24
		North	Chaleur (16B) - Bait	4Tmn	Printemps	-6.06	0.000000867	3.650				
		North	Chaleur (16B) - Roe	4Tmn	Automne	-5.21	0.000006145	3.097	534	1	16	16516
		North	Chaleur (16B) - Roe	4Tmn	Printemps	insuf data						
		Middle	Esc - WPEI (16CE)	4TL	Automne	-4.79	0.000016231	2.813	361	1	10	5977
		Middle	Esc - WPEI (16CE)	4TL	Printemps	insuf data						
		South	Iles de la M (16D)	4Tf	Automne	-5.09	0.000008208	3.010	73	0	2	163
		South	FB (16G)	4Tg	Automne	-5.26	0.000005436	3.130	273	0	7	6132
		South	Pict (16F)	4Th	Automne	-4.96	0.000010936	2.923	507	0	16	6219
		4Vn	Aspy Bay	4Vn	Automne	-5.82	0.000001512	3.503	18	40	1	
			Aspy Bay	4Vn	Printemps	-5.65	0.000002243	3.371				
	Mobile	North	Purse Seine	4Tmno	Automne	-6.11	0.000000770	3.690	299	121	10	5669
		North	Purse Seine	4Tmno	Printemps	-6.03	0.000000942	3.639				
		4Vn	Purse Seine	4Vn	Automne	-5.24	0.000005775	3.061	621	37	12	3605
		4Vn	Purse Seine	4Vn	Printemps	-5.65	0.000002248	3.378				
		4Vn	Purse Seine - Surv	4Vn	Automne	-5.16	0.000006853	3.010	95	11	2	59
		4Vn	Purse Seine - Surv	4Vn	Printemps	insuf data						
Spring	Fixed	North	Inshore	4Topq	Automne	insuf data			5	35	1	23
			Inshore	4Topq	Printemps	-5.39	0.000004033	3.140				
		North	Inshore	4Tmn	Automne	insuf data			3	246	8	274
			Inshore		Printemps	-5.68	0.000002078	3.360				
		Mid	Inshore	4TL	Automne	insuf data			1	438	14	7360
			Inshore		Printemps	-5.65	0.000002232	3.356				
		South	Inshore	4Tf	Automne	insuf data			4	211	8	619
			Inshore	4Tf	Printemps	-5.07	0.000008506	2.962				
			Inshore	4Tjkgh	Automne	insuf data			1	191	6	4953
			Inshore	4Tjkgh	Printemps	-5.73	0.000001849	3.404				
		4Vn	Aspy Bay	4Vn	Automne	-5.86	0.000001382	3.521	12	40	1	
			Aspy Bay	4Vn	Printemps	-5.70	0.000001978	3.409				
	Mobile	South	Purse Seine	4Tfg	Automne	insuf data			6	52	2	1502
			Purse Seine	4Tfg	Printemps	-5.77	0.000001716	3.413				
	Overall				Automne	-5.51	0.000003078	3.278				59136
					Printemps	-5.51	0.000003056	3.262				

Table 13. Daily 1997 landings(t) in Chaleur fall fixed fisheries in New Brunswick (NB) and Quebec (PQ). The bait fishery occurred before August 18. PS refers to purchase slip data, Supp - B are landings estimated by fishery officers that do not appear on purchase slips, for example private sale or use, bait fisheries. Effort is number of trips per day.

	Catch (t)					Effort					Cumulative			
Date m/dd	NB PS - Daily	Supp - B	Total	PQ PS	NB+PQ Total	NB PS - Daily	Supp - B	Total	PQ PS	NB+PQ Total	Catch	Effort	No. Fish Fall Spawners	No. Fish Spring Spawners
701	0	0	0	0	0	0	0	0	3	3	0	3		
702	0	0	0	0	0	0	0	0	3	3	0	6		
703	0	0	0	0	0	0	0	0	4	4	0	10		
707	0	0	0	1	1	1	0	1	4	5	1	15		
708	0	0	0	0	0	0	0	0	7	7	1	22	33	0
709	0	0	0	0	0	1	0	1	3	4	1	26	13	17
710	0	0	0	0	0	0	0	0	1	1	1	27		
711	0	0	0	0	0	1	0	1	5	6	1	33	34	1
712	0	0	0	1	1	0	0	0	7	7	2	40		
713	0	0	0	0	0	0	0	0	3	3	2	43		
714	0	0	0	0	0	0	0	0	5	5	2	48		
715	0	0	0	10	10	0	0	0	10	10	12	58		
716	0	0	0	0	0	0	0	0	2	2	12	60		
717	0	0	0	0	0	0	0	0	1	1	12	61		
718	0	0	0	0	0	1	0	1	1	2	12	63		
721	0	0	0	0	0	0	0	0	2	2	12	65		
722	0	0	0	5	5	0	0	0	3	3	17	68		
723	0	0	0	1	1	0	0	0	3	3	18	71	40	3
724	0	0	0	1	1	3	0	3	3	6	19	77		
725	3	0	3	1	4	5	0	5	3	8	23	85		
727	0	0	0	0	0	1	0	1	2	3	23	88		
728	0	0	0	0	0	1	0	1	3	4	23	92		
729	0	0	0	1	1	0	0	0	6	6	24	98		
730	0	0	0	0	0	0	0	0	6	6	24	104		
731	0	0	0	0	0	1	0	1	3	4	24	108		
801	0	0	0	0	0	1	0	1	1	2	24	110	20	11
802	0	0	0	0	0	0	0	0	1	1	24	111		
804	0	0	0	0	0	1	0	1	0	1	24	112		
805	0	0	0	0	0	1	0	1	1	2	24	114		
806	0	0	0	0	0	1	0	1	0	1	24	115		
808	0	0	0	0	0	1	0	1	0	1	24	116	34	1
812	0	0	0	0	0	0	0	0	1	1	24	117	38	1
813	0	0	0	0	0	0	0	0	1	1	24	118		
816	0	0	0	0	0	0	0	0	2	2	24	120		
818	0	0	0	61	61	0	0	0	30	30	85	150	60	0
819	0	0	0	76	76	0	0	0	42	42	161	192	32	0
820	49	0	49	26	75	17	0	17	30	47	236	239		
821	0	0	0	62	62	2	0	2	36	38	298	277		
822	3	0	3	0	3	2	0	2	0	2	301	279		
823	0	2	2	0	2	0	1	1	0	1	303	280		
824	0	0	0	2	2	0	0	0	1	1	305	281		
825	1037	0	1037	37	1074	120	0	120	13	133	1379	414	39	0
826	1227	0	1227	79	1306	183	0	183	30	213	2685	627		
827	812	0	812	52	864	169	0	169	29	198	3549	825	35	0
828	836	0	836	28	864	172	0	172	22	194	4413	1019	96	0
829	503	0	503	14	517	118	0	118	11	129	4930	1148	38	0
830	0	0	0	0	0	0	0	0	1	1	4930	1149		
901	44	0	44	13	57	27	0	27	15	42	4987	1191		
902	180	0	180	57	237	64	0	64	24	88	5224	1279		
903	137	0	137	45	182	60	0	60	32	92	5406	1371	31	0
904	690	0	690	88	778	113	0	113	43	156	6184	1527	32	0
905	1190	0	1190	44	1234	158	0	158	21	179	7418	1706	33	0
906	0	0	0	0	0	1	0	1	0	1	7418	1707		
907	1	0	1	2	3	1	0	1	1	2	7421	1709		
908	2139	0	2139	55	2194	259	0	259	24	283	9615	1992	36	1
909	1964	0	1964	74	2038	240	0	240	28	268	11653	2260	35	0
910	325	0	325	41	366	76	0	76	25	101	12019	2361	30	0
911	501	0	501	18	519	139	0	139	14	153	12538	2514		
912	858	0	858	22	880	223	0	223	15	238	13418	2752		
913	0	0	0	0	0	1	0	1	1	2	13418	2754		
914	13	0	13	0	13	1	0	1	0	1	13431	2755		
915	1982	0	1982	52	2034	223	0	223	18	241	15465	2996		
916	672	0	672	20	692	158	0	158	11	169	16157	3165	37	0
918	1	0	1	0	1	1	0	1	1	2	16158	3167		
919	11	0	11	0	11	1	0	1	0	1	16169	3168		
923	2	0	2	0	2	1	0	1	0	1	16171	3169		
926	8	0	8	0	8	1	0	1	0	1	16179	3170		
927	1	0	1	0	1	1	0	1	0	1	16180	3171		
928	31	0	31	0	31	3	0	3	0	3	16211	3174		
929	87	0	87	4	91	22	0	22	3	25	16302	3199		
930	1	0	1	0	1	2	0	2	0	2	16303	3201		
1001	64	0	64	23	87	9	0	9	6	15	16390	3216		
1002	58	0	58	16	74	17	0	17	8	25	16464	3241		
1003	26	0	26	1	27	1	0	1	2	3	16491	3244		
1006	23	0	23	0	23	1	0	1	0	1	16514	3245		
1010	10	0	10	0	10	1	0	1	0	1	16524	3246		
1012	16	0	16	0	16	1	0	1	0	1	16540	3247		
Grand Total	15505	2	15507	1033	16540	2609	1	2610	637	3247			746	35

Table 14. Daily 1997 catch(t) in 16CE fall fixed fisheries.. PS refers to purchase slip data, Supp - B are landings estimated by fishery officers that do not appear on purchase slips, for example private sale or use, bait fisheries. Effort is number of trips per day. Date is month/day.

	16C					16E									16CE			
	PS - Day		Cumu		Samples						Cumulative		Spawning Group Samples		PS - Day		Cumulative	
	Catch	Effort	Catch	Effort	Fall Sp.	Catch				Effort	Catch	Effort	Fall	Spring	Catch	Effort	Catch	Effort
Date						PS- Day	PS -Week	Supp -B	Total									
701	0	0	0	0		2	0	0	2	3	2	3			2	3	2	3
705	0	0	0	0		5	0	38	43	7	45	10			43	7	45	10
706	0	0	0	0		1	0	0	1	1	46	11			1	1	46	11
707	0	0	0	0		12	0	0	12	7	58	18			12	7	58	18
708	0	0	0	0		12	0	0	12	8	70	26			12	8	70	26
709	0	0	0	0		1	0	0	1	2	71	28			1	2	71	28
710	0	0	0	0		1	0	0	1	2	72	30			1	2	72	30
711	0	0	0	0		9	0	0	9	2	81	32			9	2	81	32
712	0	0	0	0		0	0	8	8	5	89	37			8	5	89	37
714	0	0	0	0		0	0	0	0	1	89	38			0	1	89	38
716	0	0	0	0		2	0	0	2	1	91	39			2	1	91	39
722	0	0	0	0		4	0	0	4	1	95	40			4	1	95	40
723	0	0	0	0		3	0	0	3	1	98	41			3	1	98	41
724	0	0	0	0		5	0	0	5	2	103	43			5	2	103	43
725	0	0	0	0		5	0	0	5	2	108	45			5	2	108	45
731	0	0	0	0		0	2	0	2	2	110	47			2	2	110	47
805	0	0	0	0		3	0	0	3	3	113	50			3	3	113	50
808	0	0	0	0		0	0	0	0	2	113	52			0	2	113	52
815	0	0	0	0		0	0	0	0	1	113	53			0	1	113	53
816	0	0	0	0		0	0	0	0	1	113	54			0	1	113	54
817	0	0	0	0		0	0	0	0	1	113	55			0	1	113	55
820	0	0	0	0		0	0	0	0	1	113	56			0	1	113	56
821	0	0	0	0		0	0	0	0	1	113	57			0	1	113	57
822	0	1	0	1		0	0	0	0	1	113	58			0	2	113	59
826	58	6	58	7		296	0	0	296	37	409	95			354	43	467	102
827	0	0	58	7		148	0	0	148	30	557	125			148	30	615	132
828	21	5	79	12		91	0	0	91	29	648	154			112	34	727	166
829	28	7	107	19		55	0	0	55	24	703	178			83	31	810	197
901	0	0	107	19		0	0	0	0	8	703	186			0	8	810	205
902	0	0	107	19		0	0	0	0	1	703	187			0	1	810	206
903	0	0	107	19		0	0	0	0	1	703	188			0	1	810	207
904	8	7	115	26		206	0	0	206	26	909	214			214	33	1024	240
905	143	35	258	61		23	0	0	23	12	932	226	73		166	47	1190	287
907	0	0	258	61		9	0	0	9	2	941	228			9	2	1199	289
908	149	46	407	107	35	508	0	0	508	61	1449	289			657	107	1856	396
909	66	15	473	122		121	0	0	121	33	1570	322	83	1	187	48	2043	444
910	0	0	473	122		3	0	0	3	2	1573	324			3	2	2046	446
911	0	0	473	122		2	0	0	2	2	1575	326			2	2	2048	448
912	69	39	542	161	31	523	0	0	523	65	2098	391	74		592	104	2640	552
915	151	35	693	196		478	0	0	478	64	2576	455			629	99	3269	651
916	0	0	693	196		120	0	0	120	49	2696	504			120	49	3389	700
917	0	0	693	196		3	0	0	3	2	2699	506			3	2	3392	702
918	244	38	937	234	29	209	0	0	209	58	2908	564			453	96	3845	798
919	252	41	1189	275	36	515	0	0	515	59	3423	623			767	100	4612	898
922	53	7	1242	282		0	0	0	0	0	3423	623			53	7	4665	905
923	224	31	1466	313		12	0	0	12	3	3435	626			236	34	4901	939
924	127	26	1593	339		0	0	0	0	0	3435	626			127	26	5028	965
925	206	26	1799	365		9	0	0	9	3	3444	629			215	29	5243	994
926	105	13	1904	378		244	0	0	244	30	3688	659			349	43	5592	1037
929	104	22	2008	400		281	0	0	281	38	3969	697			385	60	5977	1097
Total	2008	400				3921	2	46	3969	697					5977	1097		

Table 15. Daily 1997 catch(t) in 16G, Fisherman's Bank (FB) and 16F, Pictou fall fixed fisheries. PS refers to purchase slip data, Effort is number of trips per day. Date units are month/day.

	FB					Pictou						
			Cumulative									
	PS - Day		PS - Day		Spawning Group	Catch				Cumulative		Spawning Group
Date	Catch	Effort	Catch	Effort	Fall	PS - Day	PS - Week	Total	Effort	Catch	Effort	Fall.
704	0	0	0	0		1	0	1	2	1	2	
705	0	0	0	0		0	0	0	1	1	3	
707	0	0	0	0		0	0	0	1	1	4	
708	0	0	0	0		0	0	0	1	1	5	
709	0	0	0	0		0	0	0	1	1	6	
710	0	0	0	0		0	0	0	2	1	8	
711	0	0	0	0		0	0	0	1	1	9	
712	0	0	0	0		0	0	0	1	1	10	
731	0	0	0	0		0	0	0	1	1	11	
818	72	21	72	21		0	0	0	0	1	11	
819	6	5	78	26		0	0	0	0	1	11	
820	5	3	83	29		0	0	0	0	1	11	
821	37	19	120	48		0	0	0	0	1	11	
822	24	11	144	59		0	0	0	0	1	11	
823	1	1	145	60		0	0	0	0	1	11	
825	324	80	469	140		0	0	0	0	1	11	
826	118	46	587	186		7	0	7	1	8	12	
827	166	46	753	232		0	0	0	0	8	12	
828	45	17	798	249		0	0	0	0	8	12	
829	3	2	801	251		0	0	0	0	8	12	
831	0	1	801	252		0	0	0	0	8	12	
901	287	71	1088	323		0	0	0	0	8	12	
902	607	113	1695	436	37	0	0	0	0	8	12	
903	107	49	1802	485		0	0	0	0	8	12	
904	270	55	2072	540	42	0	0	0	0	8	12	
905	623	96	2695	636		0	0	0	0	8	12	
907	7	1	2702	637		0	0	0	0	8	12	33
908	687	107	3389	744	36	204	0	204	53	212	65	
909	369	99	3758	843		102	0	102	31	314	96	
910	271	65	4029	908		166	0	166	45	480	141	78
911	484	90	4513	998	39	75	0	75	33	555	174	
912	621	99	5134	1097	41	99	0	99	29	654	203	68
914	0	0	5134	1097	37	3	0	3	1	657	204	69
915	613	96	5747	1193	41	164	0	164	54	821	258	
916	383	81	6130	1274		186	0	186	43	1007	301	
917	0	0	6130	1274		152	0	152	36	1159	337	
918	0	0	6130	1274		516	0	516	99	1675	436	75
919	0	0	6130	1274		72	0	72	25	1747	461	39
922	0	0	6130	1274		88	0	88	14	1835	475	73
923	0	0	6130	1274		876	0	876	158	2711	633	72
924	0	0	6130	1274		269	0	269	55	2980	688	
925	0	0	6130	1274		747	0	747	117	3727	805	
926	0	0	6130	1274		547	0	547	87	4274	892	
927	0	0	6130	1274		7	0	7	1	4281	893	
928	0	0	6130	1274		176	0	176	27	4457	920	
929	0	0	6130	1274		693	0	693	108	5150	1028	
930	0	0	6130	1274		458	1	459	80	5609	1108	
1001	0	2	6130	1276		610	0	610	94	6219	1202	
1002	2	3	6132	1279		0	0	0	0	6219	1202	
1003	0	2	6132	1281		0	0	0	0	6219	1202	
1004	0	1	6132	1282		0	0	0	0	6219	1202	
1006	0	2	6132	1284		0	0	0	0	6219	1202	
1010	0	2	6132	1286		0	0	0	0	6219	1202	
Total	6132	1286			273	6218	1	6219	1202			507

Table 16. Daily 1997 catch(t) in 16D, Ile de la Madeleine fall fixed fisheries. Effort is number of trips per day. Numbers of fish in detailed sample by spawning group. Date is month/day.

	Day		Cumulative		Spawning Group
Date	Catch	Effort	Catch	Effort	Fall
701	0	1	0	1	
908	32	8	32	9	35
909	58	17	91	26	38
910	20	6	110	32	
911	38	10	149	42	
912	15	4	163	46	

Table 17. Daily 1997 catch(t) in 16A, 4Topq fall fixed fisheries. Effort is number of trips per day. Number of fish in detailed sample by spawning group. Date is month/day.

	Catch			Effort			Cumulative		Spawning Group
Date	4TO	4TPQ	Total	4TO	4TPQ	Total	Catch	Effort	Spring
702	0	1	1	0	1	1	1	1	
708	0	0	0	1	0	1	1	2	
715	0	0	0	1	0	1	1	3	
716	0	0	0	1	0	1	1	4	
717	0	0	0	1	0	1	1	5	
718	0	0	0	1	0	1	1	6	
722	1	0	1	2	0	2	2	8	
723	0	0	0	1	0	1	2	9	
729	0	0	0	1	0	1	2	10	
731	0	0	0	1	0	1	2	11	
802	3	0	3	5	0	5	5	16	
806	0	0	0	1	0	1	5	17	
808	1	0	1	1	0	1	6	18	
809	2	0	2	2	0	2	8	20	
813	1	0	1	3	0	3	9	23	47
820	1	0	1	1	0	1	10	24	
821	0	0	0	2	0	2	10	26	
827	3	0	3	2	0	2	13	28	
829	0	0	0	1	0	1	13	29	
903	0	0	0	1	0	1	13	30	
904	1	0	1	1	0	1	14	31	
906	0	0	0	1	0	1	14	32	
908	0	0	0	2	0	2	14	34	
910	1	0	1	1	0	1	15	35	
912	1	0	1	1	0	1	16	36	
919	0	0	0	1	0	1	16	37	
926	1	0	1	1	0	1	17	38	
927	0	0	0	1	0	1	17	39	
930	0	0	0	0	1	1	17	40	
Total	16	1	17	38	2	40			

Table 18. Daily 1997 catch(t) in fall 4T purse seine fishery. Number of fish in detailed sample by spawning group is provided. Date is month/day.

	Daily		Cumulative		Spawning Group	
Date	Catch	Boats	Catch	Boats	Fall	Spring
803	5	1	5	1		
805	1	1	6	2		
807	3	1	9	3		
808	2	1	11	4		
809	5	2	16	6		
813	2	1	18	7		
816	5	2	23	9		
818	4	2	27	11		
825	145	2	172	13		
826	163	3	335	16		
827	74	2	409	18	36	6
828	179	3	588	21	38	1
Aug Total	588	21				
902	60	1	60	1		
911	71	1	131	2		
912	249	2	380	4		
915	4	1	384	5		
918	121	2	505	7		
919	205	3	710	10		
923	165	6	875	16		
928	380	5	1255	21	27	16
929	305	5	1560	26	18	13
1001	232	5	1792	31	54	17
1002	705	8	2497	39		
1003	45	1	2542	40	32	10
1004	314	6	2856	46		
1005	115	6	2971	52	30	13
1006	118	4	3089	56	25	19
1007	32	2	3121	58		
1009	585	8	3706	66	22	13
1010	580	7	4286	73	27	13
1011	253	5	4539	78		
1013	539	9	5078	87		
1014	3	1	5081	88		
After Sep 1	5081	88				
Total	5669	109			309	121

Table 19. Daily 1997 catch(t) in fall 4T overwinter purse seine fishery in 4Vn. Number of fish in detailed sample by spawning group is provided. Date is month/day.

	Daily		Cumulative		Spawning Group		
Date	Catch	Boats	Catch	Boats	Fall	Spring	Samp No.
1101	141	4	141	4	42	2	1
1104	179	4	320	8	129	5	3
1107	330	6	650	14	47	2	1
1108	185	5	835	19			
1112	744	6	1579	25	46	1	1
1115	120	5	1699	30	49	0	1
1117	496	5	2195	35	125	14	3
1119	627	6	2822	41	83	7	2
1120	650	5	3472	46			
1122	134	2	3606	48	37	3	1
Sub- Total	3606	48			558	34	13
4Vn Survey							
1122	59	1	3531	47	95	11	2
Total 4Vn	3665	49			653	45	15

Table 20. Spring catch(t) and effort (trips per day) with timing of port sampling in 16E, western Prince Edward Island and southeast New Brunswick.. Numbers of fish examined in detail for spawning group, length, and age is indicated for date of sampling. Number of fish in detailed sample by spawning group is provided. Date is month/day.

SENB												WPEI							
	Catch			Effort			Cumuloative		Spawning Group				PS -Day		Cumulative		Spawning Group		
Date	PS -Day	Supp - B	Total	PS -Day	Supp - B	Total	Catch	Effort	Fall	Spring	Samples	Date	Catch	Effort	Catch	Effort	Fall	Spring	Samples
424	1		1	1		1	1	1				424			0	0			
425	2		2	3		3	3	4				425			0	0			
426			0	1		1	3	5				426			0	0			
427	5		5	5		5	8	10				427	1	2	1	2			
428	19		19	13		13	27	23				428	1	3	2	5			
429	5		5	5		5	32	28				429	1	2	3	7			
430	22		22	14		14	54	42				430	1	2	4	9			
501	107		107	31		31	161	73	0	24	1	501	37	23	41	32			
502	236		236	45		45	397	118				502	39	28	80	60			
503	566	367	933	89	27	116	1330	234				503	188	64	268	124			
504	291	9	300	61	1	62	1630	296				504	232	88	500	212			
505	295		295	71		71	1925	367				505	163	80	663	292			
506	305	324	629	72	30	102	2554	469	0	25	1	506	587	126	1250	418	0	77	3
507	330	45	375	70	2	72	2929	541	0	54	2	507	254	93	1504	511	0	24	1
508	88		88	21		21	3017	562				508			1504	511			
509	242	10	252	27	1	28	3269	590				509	20	6	1524	517			
510	338	740	1078	48	40	88	4347	678				510	211	43	1735	560			
511	38		38	11		11	4385	689				511	10	3	1745	563			
512	91		91	23		23	4476	712				512	28	12	1773	575			
513	41	80	121	14	5	19	4597	731				513	45	13	1818	588			
514	46		46	12		12	4643	743				514			1818	588			
515	13		13	4		4	4656	747				515	54	15	1872	603			
516	89		89	40		40	4745	787				516	170	43	2042	646	0	25	1
517	157	6	163	31	2	33	4908	820				517	27	13	2069	659			
518	5		5	3		3	4913	823				518	2	1	2071	660			
519	98		98	34		34	5011	857				519	118	65	2189	725			
520	64	5	69	31	1	32	5080	889				520	162	75	2351	800			
521	38	76	114	20	9	29	5194	918				521	134	67	2485	867	0	26	1
522	34	21	55	12	2	14	5249	932				522	72	57	2557	924			
523	12		12	6		6	5261	938				523	38	36	2595	960			
524	32	70	102	11	7	18	5363	956				524	13	11	2608	971			
525			0				5363	956				525			2608	971			
526			0				5363	956				526			2608	971			
527	1		1	1		1	5364	957				527			2608	971			
528	1		1	1		1	5365	958				528			2608	971			
529	1		1	1		1	5366	959				529			2608	971			
530	1		1	1		1	5367	960				530			2608	971			
531		15	15	1	1	2	5382	962				531	2	2	2610	973			

Table 20. (continued).

SENB												WPEI							
	Catch			Effort			Cumuloative		Spawning Group				PS -Day		Cumulative		Spawning Group		
Date	PS -Day	Supp - B	Total	PS -Day	Supp - B	Total	Catch	Effort	Fall	Spring	Samples	Date	Catch	Effort	Catch	Effort	Fall	Spring	Samples
601	49		49	18		18	5431	980				601	203	78	2813	1051			
602	28		28	17		17	5459	997				602	115	51	2928	1102			
603	1		1	8		8	5460	1005				603	48	30	2976	1132			
604	1		1	4		4	5461	1009				604	50	29	3026	1161			
605	5		5	3		3	5466	1012				605	12	9	3038	1170	0	27	1
606	10		10	3		3	5476	1015				606	13	8	3051	1178			
607	23	32	55	6	11	17	5531	1032				607			3051	1178			
608	11		11	7		7	5542	1039				608	48	13	3099	1191			
609	8		8	7		7	5550	1046	1	55	2	609	18	12	3117	1203			
610	11	4	15	4	1	5	5565	1051				610	22	10	3139	1213			
611	1		1	1		1	5566	1052				611			3139	1213			
612							5566	1052				612		3	3139	1216			
613							5566	1052				613		1	3139	1217			
614	7	15	22	2	7	9	5588	1061				614	1	6	3140	1223			
615							5588	1061				615	1	17	3141	1240			
616	1		1	1		1	5589	1062				616	25	19	3166	1259			
617						0	5589	1062				617	32	17	3198	1276			
618	1		1	1		1	5590	1063				618	35	26	3233	1302			
619	9		9	1	2	3	5599	1066				619	64	55	3297	1357	0	33	1
620	19		19	4		4	5618	1070				620	21	34	3318	1391			
621	8	28	36	2	2	4	5654	1074				621	58	78	3376	1469			
622			0			0	5654	1074				622	13	8	3389	1477			
623	1		1	1		1	5655	1075				623	23	45	3412	1522			
624	1		1	1		1	5656	1076				624	14	26	3426	1548			
625			0				5656	1076				625	31	40	3457	1588			
626		1	1	0	1	1	5657	1077				626	16	36	3473	1624			
627	2		2	1		1	5659	1078				627	16	29	3489	1653			
628	16	31	47	4	4	8	5706	1086				628		2	3489	1655			
629	4		4	2		2	5710	1088				629			3489	1655			
630	22		22	4		4	5732	1092				630		2	3489	1657			
Total	3853	1879	5732	936	156	1092			1	158	6		3489	1657			0	212	8

Table 21. Spring fixed gear catch(t) and effort (trips per day) with timing of port sampling in 16C, Escuminac. Numbers of fish examined in detail for spawning group, length, and age is indicated for date of sampling. Date is month/day.

	Catch			Effort - Trips			Cumululative		Spawning Group		
Date	PS -Day	PS - Supp - B	Total	PS -Day	PS - Supp - B	Total	Catch	Effort	Fall	Spring	Samples
424	3		3	1		1	3	1			
425	3		3	1		1	6	2			
426	8		8	2		2	14	4			
427	6		6	4		4	20	8			
428	7		7	8		8	27	16			
429	11		11	4		4	38	20			
430	29		29	10		10	67	30			
501	32		32	9		9	99	39	0	25	1
502	72		72	16		16	171	55			
503	15		15	6		6	186	61			
504	205		205	39		39	391	100			
505	533		533	60		60	924	160	0	25	1
506	3		3	3		3	927	163			
507	1		1	1		1	928	164			
508	6		6	3		3	934	167			
509	195		195	42		42	1129	209			
510	352		352	59		59	1481	268	1	51	2
511	285		285	56		56	1766	324	0	50	2
512	373		373	58		58	2139	382	0	27	1
513			0			0	2139	382	0	26	1
514			0			0	2139	382			
515			0	2		2	2139	384			
516			0			0	2139	384			
517			0		2	2	2139	386			
518	87	18	105	18		18	2244	404			
519			0	1		1	2244	405			
520	83		83	21		21	2327	426			
521	108	13	121	21	2	23	2448	449			
522	96		96	17		17	2544	466			
523	135		135	26		26	2679	492	0	27	1
524	42		42	18		18	2721	510			
525			0			0	2721	510			
526			0			0	2721	510			
527			0			0	2721	510			
528			0			0	2721	510			
529			0			0	2721	510			
530			0			0	2721	510			
531		76	76		4	4	2797	514			

Table 21. (continued).

	Catch				Effort - Trips				Cumulative		Spawning Group		
Date	PS -Day	PS -	Supp - B	Total	PS -Day	PS -	Supp - B	Total	Catch	Effort	Fall	Spring	Samples
601	90			90	26			26	2887	540			
602	67			67	25			25	2954	565			
603	37			37	24			24	2991	589	0	28	1
604	30			30	19			19	3021	608			
605				0				0	3021	608			
606	1			1	1			1	3022	609			
607				0				0	3022	609			
608	28			28	19			19	3050	628			
609	9			9	6			6	3059	634			
610	3			3	1			1	3062	635			
611				0	1			1	3062	636			
612				0	1			1	3062	637			
613				0	1			1	3062	638			
614				0	2			2	3062	640			
615				0				0	3062	640			
616	2			2	6			6	3064	646			
617	1			1	1			1	3065	647			
618	1			1	1			1	3066	648			
619	1			1	1			1	3067	649			
620	1			1	2			2	3068	651			
621	1			1	1			1	3069	652			
622				0				0	3069	652			
623				0				0	3069	652			
624	2			2	4			4	3071	656			
625				0	1			1	3071	657			
626				0	3			3	3071	660			
627	1			1	2			2	3072	662			
628				0	1			1	3072	663			
629				0				0	3072	663			
630				0				0	3072	663			
Total	2965	76	31	3072	655	4	4	663			1	259	10

Table 22. Spring fixed gear catch(t) and effort (triips per day) with timing of port sampling in 16B, Chaleur. Numbers of fish examined in detail for spawning group, length, and age is indicated for date of sampling. Date is month/day.

	Catch					Effort - Trips							Spawning Group		
Date	NB PS -Day	Supp - B	Total	PQ PS - Day	Total NB+PQ	NB PS -Day	Supp - B	Total	PQ PS - Day	Total NB+PQ	Cumulative Catch	Cumulative Effort	Fall	Spring	Samples
420			0		0			0	1	1	0	1			
421	5		5	1	6	1		1	1	2	6	3			
422			0	1	1			0	2	2	7	5			
423	2		2		2	1		1	1	2	9	7			
424			0	2	2			0	3	3	11	10	0	27	1
425	1		1	1	2	1		1	2	3	13	13			
426			0		0			0		0	13	13			
427			0	11	11			0	15	15	24	28			
428			0	7	7			0	13	13	31	41			
429			0	1	1			0	1	1	32	42			
430	1		1	3	4	3		3	6	9	36	51			
501	1		1		1	4		4		4	37	55			
502			0	2	2	2		2	3	5	39	60			
503			0		0	1		1	5	6	39	66			
504			0		0			0	2	2	39	68			
505			0	1	1			0	3	3	40	71			
506			0	1	1	1		1	2	3	41	74			
507	1		1	1	2	4		4	1	5	43	79			
508	1		1	12	13	5		5	6	11	56	90			
509			0		0			0		0	56	90			
510			0		0			0		0	56	90			
511	11		11		11			0		0	67	90			
512	1		1		1	2		2		2	68	92			
513			0		0	4		4		4	68	96			
514			0		0			0		0	68	96			
515	4		4		4	4		4		4	72	100			
516	12		12	1	13	3		3	3	6	85	106	0	29	1
517	6		6	1	7	4		4	2	6	92	112			
518	2		2	2	4	1		1	2	3	96	115			
519	3		3	4	7	5		5	5	10	103	125	2	28	1
520	7		7	12	19	5		5	8	13	122	138			
521	2		2	9	11	3		3	9	12	133	150	0	65	2
522	1		1	4	5	1		1	8	9	138	159	0	32	1
523	4		4	2	6	4		4	5	9	144	168			
524	14		14	1	15	6		6	5	11	159	179			
525	10		10	1	11	1		1	3	4	170	183			
526			0		0			0		0	170	183			
527			0	1	1			0	3	3	171	186			
528	5		5	1	6	4		4	4	8	177	194	1	32	1
529	1		1		1	3		3	3	6	178	200			
530	5		5		5	3		3	2	5	183	205			
531	8		8	1	9	5		5	3	8	192	213			

Table 22. (continued).

	Catch					Effort - Trips							Spawning Group		
Date	NB PS -Day	Supp - B	Total	PQ PS - Day	Total NB+PQ	NB PS -Day	Supp - B	Total	PQ PS - Day	Total NB+PQ	Cumulative Catch	Cumulative Effort	Fall	Spring	Samples
601	3		3	1	4	1		1	3	4	196	217			
602	7		7		7	4		4		4	203	221			
603	3		3		3	3		3		3	206	224			
604	1		1		1	2		2	2	4	207	228			
605	8		8		8	1		1		1	215	229			
606	1		1	1	2	2		2	1	3	217	232			
607	8		8		8	3		3		3	225	235			
608	5		5		5	1		1		1	230	236			
609	3		3		3	3		3		3	233	239			
610	1		1		1	1		1	2	3	234	242			
611			0		0			0	1	1	234	243			
612	6		6		6	1		1		1	240	244			
613			0		0			0		0	240	244			
614	7		7	1	8	3		3	1	4	248	248			
615			0		0			0		0	248	248			
616			0		0			0	1	1	248	249			
617			0		0	1		1	1	2	248	251			
618	1		1	4	5	1		1	1	2	253	253			
619	1		1	3	4	2		2	3	5	257	258	0	33	1
620	1		1	2	3	1		1	3	4	260	262			
621		5	5	2	7		2	2	7	9	267	271			
622			0		0			0	2	2	267	273			
623			0		0			0	2	2	267	275			
624			0		0			0	1	1	267	276			
625			0		0			0		0	267	276			
626			0		0			0	1	1	267	277			
627			0		0			0	3	3	267	280			
628			0		0			0		0	267	280			
629	7		7		7	3		3		3	274	283			
630			0		0			0	2	2	274	285			
Total	171	5	176	98	274	114	2	116	169	285			3	246	8

Table 23. Spring fixed gear catch(t) and effort (trips per day) with timing of port sampling in 16F and 16G, Pictou and Fisherman's Bank. Numbers of fish examined in detail for spawning group, length, and age is indicated for date of sampling. Date is month/day.

	16G				16F			
Date	PS - Day	Effort Trips	Cumul Catch	Effort	PS - Day	Effort Trips	Cumul Catch	Effort
511			0	0	1	2	1	2
522			0	0		1	1	3
523			0	0	1	1	2	4
524			0	0		1	2	5
525			0	0			2	5
526			0	0			2	5
527			0	0			2	5
528			0	0	1	2	3	7
529			0	0		1	3	8
530			0	0		1	3	9
531			0	0	1	2	4	11
601			0	0	1	1	5	12
602			0	0	2	1	7	13
603			0	0	2	3	9	16
604			0	0	1	4	10	20
605			0	0	1	3	11	23
606			0	0	2	4	13	27
607			0	0	1	2	14	29
608			0	0	1	1	15	30
609			0	0	1	2	16	32
610			0	0		1	16	33
611			0	0		1	16	34
612			0	0			16	34
613			0	0			16	34
614			0	0			16	34
615		1	0	1			16	34
616	2	2	2	3			16	34
617			2	3	1	1	17	35
618			2	3		1	17	36
619			2	3			17	36
620			2	3			17	36
621			2	3			17	36
622			2	3			17	36
623			2	3			17	36
624			2	3			17	36
625			2	3		1	17	37
626			2	3		1	17	38
627			2	3			17	38
628			2	3			17	38
629			2	3			17	38
630			2	3	1	1	18	39
Total	2	3			18	39		

Table 24. Daily 1997 spring fixe gear catch(t) in 16A 4Topq and 16D Ile de la Madeleine. Effort is number of trips per day. Date is month/day.

16A -	Catch			Effort			Cumulative		Spawning Group			16D			Cumulative		Spawning Group		
	4To	4Tpq	Total	4To	4Tpq	Total	Catch	Effort	Fall	Spring	Sample	4Tf	Catch	Effort	Catch	Effort	Fall	Spring	Samples
409	0	0	0	1	0	1	0	1				409	0	0	0	0			
410	0	0	0	1	0	1	0	2				410	0	0	0	0			
411	0	0	0	2	0	2	0	4				411	0	0	0	0			
412	0	0	0	2	0	2	0	6				412	0	0	0	0			
413	0	0	0	1	0	1	0	7				413	0	0	0	0			
414	2	0	2	4	0	4	2	11				414	0	0	0	0			
415	1	0	1	2	0	2	3	13				415	0	1	0	1			
416	1	0	1	2	0	2	4	15				416	0	2	0	3			
417	0	0	0	1	0	1	4	16				417	0	1	0	4			
418	1	0	1	2	0	2	5	18				418	0	2	0	6			
419	1	0	1	2	0	2	6	20				419	0	1	0	7			
420	4	0	4	6	0	6	10	26				420	0	0	0	7			
421	1	0	1	3	0	3	11	29				421	1	3	1	10			
422	1	0	1	4	0	4	12	33				422	1	6	2	16	0	25	1
423	1	0	1	4	0	4	13	37				423	1	4	3	20			
424	1	0	1	4	0	4	14	41				424	4	10	7	30	0	25	1
425	1	0	1	4	0	4	15	45				425	9	10	16	40			
426	0	0	0	2	0	2	15	47				426	17	14	33	54			
427	0	0	0	3	0	3	15	50				427	1	1	34	55			
428	0	0	0	3	0	3	15	53				428	71	60	105	115			
429	0	0	0	2	0	2	15	55				429	18	16	123	131			
430	0	0	0	2	0	2	15	57				430	3	5	126	136			

Table 24. (continued).

16A -	Catch			Effort			Cumulative		Spawning Group			16D			Cumulative		Spawning Group		
	4To	4Tpq	Total	4To	4Tpq	Total	Catch	Effort	Fall	Spring	Sample	4Tf	Catch	Effort	Catch	Effort	Fall	Spring	Samples
501	0	0	0	3	0	3	15	60				501	90	67	216	203			
502	0	0	0	1	0	1	15	61				502	37	33	253	236			
503	0	0	0	0	0	0	15	61				503	145	62	398	298			
504	0	0	0	1	0	1	15	62				504	1	1	399	299			
505	0	0	0	1	0	1	15	63				505	34	26	433	325			
506	1	0	1	3	0	3	16	66				506	138	87	571	412	1	25	1
507	0	0	0	3	0	3	16	69				507	22	28	593	440			
508	0	0	0	1	0	1	16	70				508	0	0	593	440			
509	0	0	0	1	0	1	16	71				509	0	0	593	440			
510	0	0	0	2	0	2	16	73				510	0	0	593	440			
512	0	0	0	1	0	1	16	74				512	0	0	593	440			
513	0	0	0	0	0	0	16	74				513	0	2	593	442			
514	0	0	0	0	0	0	16	74				514	0	2	593	444			
515	0	0	0	0	0	0	16	74	5	35	1	515	1	1	594	445			
516	0	0	0	0	0	0	16	74				516	0	1	594	446			
518	0	0	0	1	0	1	16	75				518	0	0	594	446			
519	0	0	0	0	0	0	16	75				519	4	3	598	449			
520	0	0	0	1	0	1	16	76				520	9	9	607	458			
521	1	0	1	2	0	2	17	78				521	4	9	611	467	0	30	1
522	0	0	0	1	0	1	17	79				522	4	8	615	475			
523	0	0	0	0	0	0	17	79				523	1	8	616	483			
524	1	0	1	4	0	4	18	83				524	0	1	616	484			
527	0	0	0	2	0	2	18	85				527	1	2	617	486			
528	0	0	0	0	0	0	18	85				528	0	2	617	488			
529	1	0	1	3	0	3	19	88				529	0	1	617	489	0	31	1
530	0	0	0	1	0	1	19	89				530	0	0	617	489	0	26	1
531	0	2	2	0	4	4	21	93				531	0	0	617	489			

Table 24. (continued).

16A -	Catch			Effort			Cumulative		Spawning Group			16D			Cumulative		Spawning Group		
	4To	4Tpq	Total	4To	4Tpq	Total	Catch	Effort	Fall	Spring	Sample	4Tf	Catch	Effort	Catch	Effort	Fall	Spring	Samples
601	0	0	0	2	0	2	21	95				601	0	0	617	489			
602	0	0	0	1	0	1	21	96				602	1	1	618	490			
603	1	0	1	2	0	2	22	98				603	0	1	618	491			
604	0	0	0	1	0	1	22	99				604	1	1	619	492	3	26	1
606	0	0	0	1	0	1	22	100				606	0	0	619	492			
607	0	0	0	1	0	1	22	101				607	0	0	619	492			
608	0	0	0	1	0	1	22	102				608	0	1	619	493			
609	0	0	0	1	0	1	22	103				609	0	1	619	494			
610	0	0	0	2	0	2	22	105				610	0	0	619	494			
612	0	0	0	1	0	1	22	106				612	0	0	619	494			
617	0	0	0	1	0	1	22	107				617	0	0	619	494			
618	0	0	0	1	0	1	22	108				618	0	0	619	494			
621	0	0	0	0	1	1	22	109				621	0	0	619	494			
622	0	0	0	0	1	1	22	110				622	0	0	619	494			
624	0	0	0	0	1	1	22	111				624	0	0	619	494			
625	0	0	0	1	0	1	22	112				625	0	0	619	494			
626	1	0	1	1	0	1	23	113				626	0	0	619	494			
630	0	0	0	0	1	1	23	114				630	0	0	619	494			
Grand Total	21	2	23	106	8	114						Grand Total	619	494			4	188	7

Table 25. Daily 1997 catch(t) in the spring purse seine fishery in 4Tfg. Numbers of fish in detailed sample is provided. Date is month/day.

	Daily		Cumulative		Spawning Group		
	Catch	Effort	Catch	Effort	Fall	Spring.	No. Samples
502	60	1	60	1			
504	8	2	68	3			
512	83	2	151	5			
513	6	1	157	6			
516	24	1	181	7	5	30	1
605	255	2	436	9			
606	263	3	699	12			
607	197	2	896	14			
608	242	2	1138	16			
609	310	2	1448	18			
610	54	1	1502	19	6	52	1
Total	1502	19			11	82	2

Table 26. Catch-at-age for 4T herring fall spawners, including those caught by purse seine in 4Vn, 1978-1997. Numbers are in thousands of fish

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	904	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	82	8	64	322	0	0	0	0	253	15	0	0	19	0	52	0	0	0	0	0
3	3592	474	7965	5753	2154	720	963	1117	1627	8010	1165	294	3706	158	325	78	0	53	9	947
4	5548	9986	5224	24124	14985	20231	24882	8816	32871	38205	20432	14113	22572	39459	12879	2440	9158	3483	19846	17675
5	3484	5132	6097	6313	16883	9570	13445	24441	16497	30249	41943	22056	19815	10235	54288	29704	12264	38155	19745	64160
6	816	2924	994	2477	4922	13180	8306	14860	34428	20712	20253	29673	28214	7309	12201	36482	48412	14500	45273	13050
7	745	865	1733	1027	2523	2168	5978	9498	19251	36337	13240	14057	54225	10784	7345	6034	69790	47315	10111	20135
8	3911	1065	373	597	1050	1632	1335	4495	8212	15518	14266	7133	17002	13296	8943	3168	12224	42105	23761	3792
9	117	879	232	258	371	486	456	1212	4666	9382	6953	9021	9163	4840	9347	3661	9658	7986	24446	6895
10	157	278	304	239	117	124	200	727	341	4563	2738	3324	9958	2409	4554	1949	9640	5643	5291	6374
11+	1903	545	96	102	62	160	91	159	692	1878	1623	2593	5404	4538	6705	2785	14115	14055	11126	3725
Total	20355	23060	23082	41212	43067	48271	55656	65325	118838	164869	122613	102264	170079	93028	116639	86301	185262	173295	159607	136753

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	240	140	0	0	0	0	0	5	20	77	0	0	0	0	0	0	0	0	0
2	1464	8555	2970	455	2088	1479	1031	1080	761	863	4283	752	43	0	61	47	15	14	311	222
3	22001	15905	39638	5059	8169	7995	3883	4024	3507	2526	3483	1399	4123	6448	565	2066	310	2977	2670	4539
4	29044	21322	17650	11260	5597	8339	6727	8223	7400	5754	4028	4592	5475	22717	5682	2810	9164	4524	13885	6766
5	24187	16923	12979	1315	3891	4192	5704	8085	8729	4032	6081	6959	7433	6142	15818	6033	3398	26780	5129	10996
6	4902	16786	7906	699	681	1629	2387	5824	8079	9035	5667	7497	3402	1939	4258	10570	7957	8576	11130	2714
7	4947	4734	8118	317	268	400	941	2540	8102	8593	9403	4483	5003	1947	2909	3667	11043	9877	4413	6983
8	10893	3702	6168	297	135	95	163	1826	3828	6883	8227	7390	2404	1964	1753	2738	2485	10657	3108	1204
9	1898	5277	4233	503	149	108	91	731	1352	2326	4500	4737	4434	1788	1724	2002	1433	1924	2091	1970
10	1017	1249	2259	116	38	30	14	449	510	364	1417	2407	3534	995	1708	3571	1389	1415	1083	1218
11+	11937	10464	1389	64	178	57	20	420	217	82	2441	1658	3330	2235	5417	5739	2951	2335	843	1035
Total	112290	105157	103450	20085	21194	24324	20961	33202	42490	40478	49607	41874	39181	46175	39895	39243	40145	69077	44664	37647

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	1144	143	0	0	0	0	0	5	20	77	0	0	0	0	0	0	0	0	0
2	1546	8563	3085	777	2088	1478	1031	1080	1014	879	4283	752	63	0	113	48	15	14	311	222
3	25594	16379	48009	10813	10324	8715	4847	5141	5134	10536	4649	1693	7830	6605	890	2145	309	3030	2679	5486
4	34592	31309	23000	35384	20582	28585	31610	17039	40271	43959	24460	18705	28047	62176	18561	5251	18322	8007	33730	24441
5	27672	22055	19127	7629	20775	13764	19149	32527	25225	34280	48025	29015	27248	16378	70106	35736	15662	64935	24874	75156
6	5718	19709	8926	3175	5603	14811	10693	20685	42507	29747	25921	37170	31616	9248	16459	47052	56369	23076	56404	15763
7	5692	5598	9984	1344	2792	2568	6919	12037	27353	44930	22644	18540	59229	12730	10254	9698	80833	57192	14524	27118
8	14803	4766	6656	894	1186	1727	1498	6321	12040	22400	22494	14523	19406	15260	10696	5906	14710	52762	26869	4997
9	2015	6156	4524	762	520	594	547	1943	6017	11708	11454	13758	13597	6627	11071	5663	11091	9910	26538	8865
10	1174	1527	2595	355	155	154	214	1175	852	4926	4155	5731	13492	3404	6262	5519	11029	7058	6374	7592
11+	13840	10409	1499	167	241	217	111	579	909	1960	4063	4251	8734	6773	12122	8524	17067	16390	11969	4760
Total	132646	127615	127548	61300	64266	72613	76619	98527	161327	205345	172225	144138	209261	139202	156534	125542	225408	242374	204272	174400

Table 27. Weights-at-age (kg) for 4T herring fall spawners, including those caught by purse seines in 4Vn, 1978-1997.

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0000	0.0231	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0787	0.1066	0.2115	0.1288	0.0000	0.0000	0.0000	0.0000	0.1793	0.1328	0.0000	0.0000	0.2675	0.0000	0.0658	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.1344	0.2015	0.2068	0.2048	0.2220	0.1908	0.2362	0.2573	0.1958	0.2347	0.2309	0.2260	0.2102	0.1959	0.1421	0.1596	0.0000	0.1247	0.0000	0.1711
4	0.2371	0.2554	0.2577	0.2468	0.2660	0.2519	0.2484	0.2541	0.2485	0.2470	0.2645	0.2602	0.2499	0.2339	0.2202	0.2127	0.2085	0.2023	0.2208	0.2060
5	0.2822	0.2934	0.3118	0.3101	0.3006	0.2853	0.2863	0.2917	0.2896	0.2789	0.2902	0.2955	0.2855	0.2675	0.2551	0.2349	0.2339	0.2296	0.2455	0.2347
6	0.3074	0.3201	0.3587	0.3679	0.3370	0.3169	0.3219	0.3352	0.3248	0.3164	0.3252	0.3255	0.3248	0.3025	0.2818	0.2599	0.2583	0.2500	0.2574	0.2619
7	0.3191	0.3553	0.3490	0.3950	0.3739	0.3493	0.3480	0.3611	0.3672	0.3434	0.3538	0.3532	0.3478	0.3360	0.3054	0.2822	0.2867	0.2799	0.2828	0.2766
8	0.3687	0.3982	0.3672	0.4200	0.3825	0.3652	0.3974	0.3742	0.3848	0.3673	0.3794	0.3731	0.3684	0.3545	0.3423	0.3300	0.3150	0.2988	0.3055	0.3114
9	0.3711	0.4171	0.4020	0.4585	0.3927	0.3724	0.4128	0.4102	0.4013	0.3818	0.4073	0.3847	0.3878	0.3732	0.3491	0.3520	0.3426	0.3335	0.3255	0.3289
10	0.3479	0.4274	0.4354	0.4717	0.3700	0.4495	0.3794	0.4055	0.4315	0.3855	0.4095	0.4062	0.4038	0.3917	0.3640	0.3497	0.3589	0.3634	0.3628	0.3442
11+	0.4324	0.4366	0.4310	0.5211	0.4674	0.4295	0.4896	0.4969	0.4337	0.4257	0.4381	0.4065	0.4319	0.4114	0.3987	0.3826	0.3837	0.3798	0.3954	0.3962
Ave.	0.2770	0.2847	0.2718	0.2665	0.2963	0.2859	0.2848	0.3157	0.3117	0.3071	0.3196	0.3268	0.3309	0.2920	0.2835	0.2639	0.2878	0.2826	0.2837	0.2557

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0000	0.0692	0.0308	0.0000	0.0000	0.0000	0.0000	0.0000	0.0378	0.0389	0.0690	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1023	0.1107	0.1089	0.0861	0.1154	0.1381	0.1253	0.1116	0.0925	0.0787	0.0959	0.1054	0.1081	0.0000	0.0661	0.0522	0.0912	0.0854	0.0965	0.0818
3	0.1501	0.1554	0.1426	0.1801	0.1802	0.1831	0.1960	0.1948	0.1509	0.1658	0.1636	0.1608	0.1765	0.1509	0.1279	0.1413	0.1372	0.1202	0.1514	0.1436
4	0.2202	0.1865	0.1777	0.2155	0.2248	0.2211	0.2299	0.2299	0.1930	0.2021	0.2205	0.2134	0.2062	0.1898	0.1738	0.1631	0.1624	0.1659	0.1680	0.1693
5	0.2574	0.2209	0.2317	0.2662	0.2594	0.2483	0.2508	0.2607	0.2428	0.2483	0.2489	0.2469	0.2375	0.2199	0.2112	0.1949	0.1793	0.1778	0.1853	0.1950
6	0.2848	0.2517	0.2459	0.3106	0.2883	0.2888	0.2704	0.2854	0.2728	0.2862	0.2862	0.2803	0.2811	0.2503	0.2307	0.2149	0.2131	0.1992	0.2240	0.2224
7	0.3009	0.2648	0.2723	0.3410	0.3454	0.3214	0.3097	0.3169	0.2868	0.3082	0.3304	0.2942	0.2959	0.2715	0.2537	0.2327	0.2295	0.2194	0.2288	0.2381
8	0.3408	0.2965	0.2658	0.3758	0.3568	0.3637	0.3406	0.3375	0.3150	0.3317	0.3236	0.3083	0.3244	0.3015	0.2803	0.2366	0.2416	0.2368	0.2567	0.2498
9	0.3476	0.3440	0.3038	0.3325	0.3356	0.3954	0.3631	0.3761	0.3419	0.3425	0.3764	0.3307	0.3290	0.3041	0.2905	0.2870	0.2800	0.2687	0.2744	0.2721
10	0.3430	0.3343	0.3231	0.2620	0.4223	0.2639	0.3278	0.4055	0.3276	0.3887	0.3975	0.3597	0.3401	0.3188	0.2928	0.2750	0.2889	0.2990	0.2714	0.3018
11+	0.3919	0.3823	0.3857	0.2624	0.4364	0.4322	0.4086	0.4348	0.4110	0.4306	0.4095	0.3774	0.3529	0.3543	0.3326	0.3139	0.3223	0.3350	0.3052	0.3254
Ave.	0.2525	0.2278	0.1979	0.2180	0.2105	0.2163	0.2341	0.2598	0.2495	0.2753	0.2829	0.2808	0.2726	0.2143	0.2361	0.2308	0.2173	0.2026	0.1947	0.2066

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0000	0.0328	0.0308	0.0000	0.0000	0.0000	0.0000	0.0000	0.0378	0.0389	0.0690	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1011	0.1107	0.1110	0.1038	0.1154	0.1381	0.1253	0.1116	0.1142	0.0797	0.0959	0.1054	0.1576	0.0000	0.0661	0.0522	0.0912	0.0854	0.0965	0.0818
3	0.1479	0.1567	0.1536	0.1932	0.1889	0.1837	0.2040	0.2083	0.1651	0.2182	0.1805	0.1719	0.1925	0.1520	0.1385	0.1419	0.1373	0.1202	0.1509	0.1483
4	0.2229	0.2084	0.1962	0.2369	0.2548	0.2429	0.2445	0.2424	0.2383	0.2411	0.2572	0.2484	0.2414	0.2178	0.2077	0.1862	0.1854	0.1817	0.1991	0.1958
5	0.2605	0.2378	0.2574	0.3024	0.2930	0.2740	0.2758	0.2839	0.2734	0.2753	0.2850	0.2837	0.2724	0.2496	0.2455	0.2281	0.2221	0.2083	0.2331	0.2289
6	0.2880	0.2619	0.2586	0.3553	0.3311	0.3138	0.3104	0.3212	0.3149	0.3072	0.3167	0.3162	0.3201	0.2916	0.2689	0.2498	0.2519	0.2311	0.2508	0.2551
7	0.3033	0.2787	0.2855	0.3823	0.3711	0.3449	0.3428	0.3518	0.3433	0.3367	0.3441	0.3388	0.3434	0.3261	0.2908	0.2635	0.2789	0.2694	0.2664	0.2667
8	0.3482	0.3192	0.2712	0.4052	0.3796	0.3651	0.3912	0.3636	0.3626	0.3564	0.3590	0.3399	0.3629	0.3477	0.3321	0.2867	0.3026	0.2863	0.2998	0.2965
9	0.3490	0.3544	0.3082	0.3750	0.3763	0.3766	0.4045	0.3974	0.3880	0.3740	0.3952	0.3659	0.3686	0.3546	0.3400	0.3290	0.3345	0.3209	0.3215	0.3163
10	0.3436	0.3512	0.3356	0.4032	0.3827	0.4137	0.3762	0.4055	0.3693	0.3858	0.4053	0.3865	0.3871	0.3704	0.3446	0.3014	0.3501	0.3505	0.3473	0.3374
11+	0.3976	0.3839	0.3882	0.4208	0.4444	0.4302	0.4747	0.4518	0.4282	0.4259	0.4209	0.3949	0.4018	0.3926	0.3692	0.3364	0.3731	0.3734	0.3890	0.3808
Ave	0.2563	0.2373	0.2114	0.2506	0.2680	0.2625	0.2709	0.2968	0.2953	0.3008	0.3091	0.3132	0.3200	0.2662	0.2724	0.2536	0.2753	0.2598	0.2642	0.2451

Table 28. Catch-at-age and weights-at-age (kg) for 4Vn herring fall spawners, 1978-1997. Numbers are in thousands of fish.

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	0	0	0	0	0	0	0	5	20	12	0	0	0	0	0	0	0	0	0
2	42	5827	628	377	1888	1352	997	827	604	816	441	26	0	0	0	25	15	14	237	166
3	563	2622	2865	541	3147	4652	3551	1987	2533	1613	833	559	697	2105	20	159	280	137	1335	3267
4	1601	656	2602	6800	3103	3651	4271	3920	5162	4138	1103	1408	2264	5406	1096	456	1964	551	7966	2965
5	1092	167	888	693	1428	2114	2790	2982	2394	1413	3328	1130	1524	2547	3273	1814	722	4374	2560	6074
6	842	100	655	591	359	584	775	927	1375	735	2394	2443	413	750	1427	4357	2426	1266	3309	939
7	628	324	663	0	158	218	377	590	1770	1040	575	460	2716	856	1474	1687	3193	3844	1657	1536
8	366	0	636	206	40	50	66	66	967	620	734	684	642	1266	990	1473	984	3294	1176	554
9	449	0	905	236	47	83	58	130	245	165	346	429	857	1309	1379	1594	695	967	887	834
10	280	0	638	0	0	0	0	0	75	75	183	123	1686	539	983	1564	829	909	579	514
11+	156	0	493	0	57	38	19	48	7	22	79	292	3033	1699	4317	2587	1689	1732	589	626
Total	6019	9696	10973	9444	10227	12742	12904	11477	15137	10657	10028	7554	13832	16477	14959	15716	12797	17088	20295	17474

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0380	0.0390	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1930	0.1070	0.1300	0.0800	0.1180	0.1410	0.1260	0.1140	0.0890	0.0750	0.0960	0.1200	0.0000	0.0000	0.0000	0.0280	0.0910	0.0850	0.0850	0.0860
3	0.1830	0.1760	0.1650	0.1900	0.1950	0.1900	0.1990	0.2010	0.1480	0.1450	0.1590	0.1640	0.1730	0.1440	0.1320	0.1180	0.1390	0.1280	0.1220	0.1430
4	0.2470	0.2260	0.2330	0.2090	0.2360	0.2380	0.2410	0.2470	0.1840	0.1860	0.2090	0.2080	0.2030	0.1920	0.1800	0.1530	0.1610	0.1610	0.1460	0.1688
5	0.3040	0.2740	0.3040	0.2810	0.2570	0.2620	0.2660	0.2690	0.2200	0.2110	0.2400	0.2360	0.2240	0.2230	0.2090	0.1780	0.1800	0.1920	0.1650	0.1869
6	0.3320	0.2980	0.3370	0.3150	0.2940	0.2960	0.2930	0.2980	0.2540	0.2540	0.2610	0.2740	0.2650	0.2480	0.2380	0.2040	0.2120	0.2130	0.1860	0.2197
7	0.3560	0.3460	0.3660	0.0000	0.3250	0.3240	0.3190	0.3170	0.2600	0.2610	0.2940	0.2910	0.2920	0.2630	0.2470	0.2270	0.2300	0.2200	0.2060	0.2239
8	0.3740	0.0000	0.3920	0.4280	0.3610	0.3600	0.3540	0.3510	0.2930	0.2970	0.3190	0.3100	0.3150	0.2970	0.2760	0.2460	0.2470	0.2490	0.2280	0.2472
9	0.3880	0.0000	0.4000	0.4140	0.3960	0.4050	0.3590	0.3790	0.3280	0.3300	0.3330	0.3410	0.3360	0.3070	0.2860	0.2690	0.2820	0.2670	0.2380	0.2568
10	0.3990	0.0000	0.4140	0.0000	0.0000	0.0000	0.0000	0.0000	0.3200	0.3180	0.3520	0.3370	0.3420	0.3210	0.2850	0.2830	0.2990	0.2900	0.2630	0.2913
11+	0.4290	0.0000	0.4350	0.0000	0.4210	0.4190	0.4080	0.4210	0.4460	0.3920	0.3700	0.3480	0.3470	0.3540	0.3300	0.3110	0.3240	0.3390	0.3220	0.3464
Total	0.3050	0.1460	0.2720	0.2250	0.2100	0.2200	0.2330	0.2460	0.2050	0.1960	0.2430	0.2590	0.2850	0.2350	0.2640	0.2370	0.2320	0.2340	0.1750	0.1944

Table 29. Catch-at-age for 4T herring spring spawners, including those caught by purse seines in 4Vn, 1978-1997. Numbers are in thousands of fish.

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	425	0	14	10	0	0	0	0	0	59	0	0	0	53	0	0	0	0	0
2	14	198	169	394	162	248	84	330	10	271	501	0	104	65	619	6	0	0	0	1
3	5644	6922	10538	13093	23717	16174	4538	6009	3593	1684	4012	4093	2897	6293	2725	280	1817	331	320	155
4	25469	3140	6746	8353	4509	25937	13994	15844	18110	8051	8626	16434	14297	12101	30568	6477	5278	12469	1511	5456
5	1255	17307	2632	2688	1066	2097	8044	14353	12735	22119	11447	6223	10323	14809	11750	37705	26443	11120	46691	4213
6	1831	641	8501	1818	493	460	376	5198	11482	11213	15722	6114	3415	9180	7680	17143	47296	16846	8154	37461
7	1391	1242	1824	3363	323	102	58	1304	2932	8669	9255	7153	3074	3488	3497	6448	9030	24526	13512	7905
8	259	274	942	486	337	0	49	696	444	3676	7012	4491	4865	3201	1745	2676	4437	4948	9769	5149
9	447	136	851	454	123	0	4	61	32	516	1651	2635	2609	4764	1888	1954	1198	2003	3399	3789
10	1375	302	462	195	91	0	5	0	130	331	89	901	1000	2261	1888	1614	1225	1029	989	1287
11+	1496	1454	699	961	571	0	0	1	205	162	530	283	265	1138	1738	2023	1599	2088	1598	249
Total	39181	32041	33364	31819	31402	45018	27152	43796	49673	56692	58904	48327	42849	57300	64151	76326	98323	75359	85943	65666

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	1479	12367	965	595	1525	302	522	826	167	73	2447	332	38	0	61	17	0	0	0	43
2	15379	14047	10852	4683	3790	4120	1850	1963	2362	409	4987	396	3463	1372	862	741	39	995	272	411
3	5909	16513	13124	3136	2821	5201	1989	2619	5218	1224	1515	1650	3521	4682	2742	597	3085	1235	3273	1516
4	16315	12113	12773	137	715	1519	1480	2090	5536	1966	1005	2100	2574	2481	4719	1968	2269	10147	2018	3505
5	2673	12527	5335	443	372	462	815	998	3132	4683	1362	856	2079	1378	2328	3520	5807	4633	10131	956
6	4929	3627	6435	101	6	1	20	511	2634	3889	4768	2317	1165	771	1754	2620	8184	5268	3908	4739
7	5128	1772	3526	229	4	16	0	58	719	3148	2874	4075	715	674	374	1265	2015	7577	2695	345
8	1303	1672	1783	389	19	36	15	0	495	1225	2411	1768	1925	1355	329	764	1886	1724	1837	891
9	1328	411	1280	1	67	0	0	113	194	0	1617	1413	1034	336	453	1283	641	504	297	713
10	1107	145	295	252	1	0	0	0	0	0	0	428	425	364	342	1360	326	932	562	200
11+	5628	1450	340	3	8	0	0	145	45	37	570	23	176	344	250	1621	811	1237	357	349
Total	61178	76644	56708	9969	9328	11657	6691	9323	20502	16654	23556	15358	17115	13757	14214	15756	25063	34252	25349	13669

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	1479	12792	965	609	1535	302	522	826	167	73	2506	332	38	0	114	17	0	0	0	43
2	15393	14245	11021	5077	3952	4368	1934	2293	2372	680	5488	396	3567	1437	1481	747	39	995	272	411
3	11553	23435	23662	16229	26538	21375	6527	8628	8811	2908	5527	5743	6418	10975	5467	877	4902	1566	3593	1671
4	41784	15253	19519	8490	5224	27456	15474	17934	23646	10017	9631	18534	16871	14582	35287	8445	7547	22616	3529	8961
5	3928	29834	7967	3131	1438	2559	8859	15351	15867	26802	12809	7079	12402	16187	14078	41225	32250	15753	56822	5169
6	6760	4268	14936	1919	499	461	396	5709	14116	15102	20490	8431	4580	9951	9434	19763	55480	22114	12061	42201
7	6519	3014	5350	3592	327	118	58	1362	3651	11817	12129	11228	3789	4162	3871	7713	11045	32102	16207	8250
8	1562	1946	2725	875	356	36	64	696	939	4901	9423	6259	6790	4556	2074	3440	6323	6672	11606	6040
9	1775	547	2131	455	190	0	4	174	226	516	3268	4048	3643	5100	2341	3237	1839	2507	3696	4503
10	2482	447	757	447	92	0	5	0	130	331	89	1329	1425	2625	2230	2974	1551	1960	1551	1488
11+	7124	2904	1039	964	579	0	0	146	250	199	1100	306	441	1482	1988	3644	2410	3325	1955	598
Total	100359	108685	90072	41788	40730	56675	33843	53119	70175	73346	82460	63685	59964	71057	78365	92082	123386	109611	111292	79335

Table 30. Weights-at-age (kg) for 4T herring spring spawners, including those caught by purse seines in 4Vn, 1978-1997.

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0000	0.0195	0.0000	0.1005	0.0366	0.0000	0.0000	0.0000	0.0000	0.0000	0.0379	0.0000	0.0000	0.0000	0.0501	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1418	0.1608	0.1816	0.1397	0.1953	0.1721	0.0933	0.2132	0.1073	0.1513	0.0798	0.0000	0.1495	0.1483	0.1111	0.1240	0.0000	0.0000	0.0000	0.0000
3	0.1478	0.1698	0.1674	0.1834	0.1745	0.1554	0.1764	0.1836	0.1603	0.1880	0.1605	0.1658	0.1599	0.1452	0.1421	0.1405	0.1494	0.1242	0.1374	0.1376
4	0.1888	0.2139	0.1861	0.2358	0.2105	0.2084	0.1957	0.2161	0.1959	0.1959	0.2031	0.2019	0.1957	0.1812	0.1710	0.1667	0.1546	0.1597	0.1728	0.1616
5	0.2109	0.2291	0.2284	0.2848	0.2640	0.2423	0.2137	0.2456	0.2419	0.2175	0.2402	0.2315	0.2242	0.2182	0.2002	0.1864	0.1773	0.1830	0.1730	0.1799
6	0.2562	0.2441	0.2691	0.3269	0.3171	0.2675	0.2683	0.2789	0.2561	0.2520	0.2662	0.2552	0.2584	0.2437	0.2309	0.2069	0.1985	0.2037	0.1892	0.1997
7	0.3221	0.3046	0.3067	0.3362	0.3717	0.3269	0.3029	0.3499	0.3194	0.2705	0.2875	0.2807	0.2640	0.2576	0.2537	0.2395	0.2183	0.2200	0.2096	0.2119
8	0.3076	0.3362	0.3319	0.3393	0.3794	0.0000	0.3843	0.3705	0.3392	0.2781	0.3038	0.2939	0.2885	0.2855	0.2601	0.2505	0.2567	0.2397	0.2330	0.2314
9	0.3114	0.3430	0.3678	0.3787	0.4026	0.0000	0.4429	0.4001	0.3486	0.2959	0.3233	0.3124	0.3060	0.2992	0.2886	0.2747	0.2942	0.2768	0.2360	0.2464
10	0.3308	0.3174	0.3630	0.3986	0.4060	0.0000	0.3713	0.0000	0.3159	0.2964	0.3754	0.3238	0.3072	0.3041	0.3015	0.2864	0.2944	0.2847	0.2818	0.2400
11+	0.3671	0.3529	0.3731	0.4082	0.4460	0.0000	0.0000	0.4913	0.4181	0.3913	0.3367	0.2978	0.3306	0.3208	0.3198	0.2949	0.3212	0.3190	0.3037	0.2902
Ave.	0.2054	0.2227	0.2264	0.2428	0.1957	0.1916	0.1991	0.2354	0.2289	0.2338	0.2531	0.2385	0.2306	0.2247	0.1999	0.2031	0.1983	0.2069	0.1931	0.1934

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0787	0.0967	0.1070	0.1057	0.0995	0.1183	0.0991	0.0886	0.0650	0.0571	0.0810	0.0882	0.0789	0.0000	0.0511	0.0587	0.0000	0.0000	0.0704	0.0604
2	0.1305	0.1520	0.1532	0.1794	0.1607	0.1635	0.1678	0.1632	0.1293	0.1518	0.1132	0.1716	0.1724	0.1417	0.1190	0.1157	0.1456	0.0889	0.1131	0.1551
3	0.1817	0.1483	0.1618	0.2233	0.2186	0.1950	0.2183	0.2166	0.1678	0.1703	0.1740	0.2131	0.1990	0.1767	0.1471	0.1370	0.1513	0.1310	0.1595	0.1490
4	0.2523	0.1774	0.2141	0.2389	0.2512	0.2290	0.2369	0.2415	0.2365	0.2541	0.2367	0.2516	0.2437	0.1969	0.1995	0.1749	0.1776	0.1764	0.1812	0.1921
5	0.2556	0.2486	0.2470	0.3678	0.2885	0.2933	0.2742	0.2971	0.2816	0.2972	0.3044	0.2626	0.2789	0.2335	0.2439	0.1893	0.1955	0.1976	0.2174	0.2090
6	0.2822	0.2513	0.2731	0.4102	0.3241	0.2731	0.3031	0.3112	0.3070	0.3282	0.3226	0.3126	0.2988	0.2528	0.2729	0.2242	0.2218	0.2254	0.2256	0.2431
7	0.3026	0.2820	0.2633	0.3286	0.3796	0.2455	0.0000	0.2824	0.3241	0.3375	0.3588	0.3410	0.3365	0.2889	0.2805	0.2628	0.2640	0.2489	0.2356	0.2401
8	0.3040	0.3122	0.2812	0.2846	0.3337	0.2375	0.3189	0.0000	0.3003	0.3671	0.3889	0.3496	0.3214	0.2909	0.3068	0.3308	0.2570	0.2701	0.2656	0.2780
9	0.3139	0.3525	0.3377	0.3839	0.3221	0.0000	0.0000	0.5884	0.2910	0.0000	0.4024	0.3671	0.3435	0.3392	0.3332	0.3655	0.2988	0.2928	0.3153	0.3145
10	0.3759	0.3115	0.3820	0.3251	0.4328	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3829	0.3927	0.3412	0.3412	0.3082	0.3274	0.3329	0.3086	0.3257
11+	0.3618	0.3917	0.3589	0.4081	0.4472	0.0000	0.0000	0.3466	0.3933	0.5328	0.4281	0.3838	0.3288	0.3509	0.3731	0.3254	0.3330	0.3073	0.3417	0.3641
Ave.	0.2322	0.1792	0.2080	0.2116	0.1822	0.1904	0.2064	0.2203	0.2267	0.2987	0.2581	0.3012	0.2510	0.2162	0.2156	0.2391	0.2159	0.2141	0.2175	0.2234

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0787	0.0941	0.1070	0.1056	0.0991	0.1183	0.0991	0.0886	0.0650	0.0571	0.0800	0.0882	0.0789	0.0000	0.0506	0.0587	0.0000	0.0000	0.0704	0.0604
2	0.1305	0.1521	0.1537	0.1763	0.1621	0.1640	0.1645	0.1704	0.1292	0.1516	0.1102	0.1716	0.1717	0.1420	0.1157	0.1158	0.1456	0.0889	0.1131	0.1548
3	0.1651	0.1546	0.1643	0.1911	0.1792	0.1650	0.1891	0.1936	0.1647	0.1805	0.1642	0.1794	0.1814	0.1586	0.1447	0.1381	0.1506	0.1296	0.1575	0.1479
4	0.2136	0.1849	0.2044	0.2359	0.2160	0.2096	0.1997	0.2190	0.2054	0.2073	0.2066	0.2075	0.2031	0.1839	0.1748	0.1686	0.1615	0.1672	0.1776	0.1735
5	0.2414	0.2373	0.2409	0.2966	0.2703	0.2515	0.2193	0.2490	0.2497	0.2314	0.2470	0.2353	0.2334	0.2195	0.2075	0.1866	0.1805	0.1873	0.1809	0.1853
6	0.2752	0.2502	0.2708	0.3313	0.3172	0.2675	0.2701	0.2818	0.2656	0.2716	0.2793	0.2710	0.2687	0.2444	0.2387	0.2092	0.2020	0.2089	0.2010	0.2046
7	0.3068	0.2913	0.2781	0.3357	0.3718	0.3159	0.3029	0.3470	0.3203	0.2883	0.3044	0.3026	0.2777	0.2627	0.2563	0.2433	0.2267	0.2268	0.2140	0.2130
8	0.3046	0.3156	0.2987	0.3150	0.3770	0.2375	0.3690	0.3705	0.3187	0.3003	0.3256	0.3096	0.2978	0.2871	0.2675	0.2684	0.2568	0.2476	0.2381	0.2382
9	0.3132	0.3501	0.3497	0.3787	0.3742	0.0000	0.4429	0.5224	0.2992	0.2959	0.3624	0.3315	0.3167	0.3019	0.2972	0.3107	0.2958	0.2800	0.2424	0.2572
10	0.3509	0.3155	0.3704	0.3572	0.4063	0.0000	0.3713	0.0000	0.3159	0.2964	0.3754	0.3428	0.3327	0.3093	0.3076	0.2964	0.3013	0.3076	0.2915	0.2516
11+	0.3629	0.3723	0.3685	0.4082	0.4460	0.0000	0.0000	0.3476	0.4136	0.4176	0.3841	0.3043	0.3299	0.3278	0.3265	0.3085	0.3252	0.3146	0.3106	0.3333
Ave.	0.2217	0.1920	0.2148	0.2354	0.1926	0.1914	0.2006	0.2328	0.2282	0.2485	0.2546	0.2536	0.2364	0.2231	0.2027	0.2093	0.2019	0.2091	0.1987	0.1986

Table 31. Weights-at-age (kg) for spring spawners caught by purse seines in 4Vn, 1978-1997. Numbers are in thousands of fish.

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	58	5679	349	595	1525	302	522	615	117	73	0	0	8	0	0	16	0	0	0	20
2	809	5007	2614	2829	3074	3383	1759	953	929	226	214	0	218	167	28	43	35	36	72	43
3	978	383	901	1833	1994	1561	1702	1129	4064	827	132	105	552	108	11	27	474	13	551	88
4	358	0	143	0	667	526	636	636	1466	441	145	180	608	990	74	51	187	289	209	37
5	330	0	117	438	362	289	371	418	0	0	127	99	701	289	182	176	138	104	1442	19
6	455	298	277	0	0	0	0	0	265	64	0	219	333	134	573	265	208	113	932	156
7	0	0	0	0	0	0	0	0	0	0	59	0	218	381	0	150	183	141	79	10
8	114	0	43	0	0	0	0	0	413	67	29	109	35	1157	0	120	53	27	27	43
9	14	0	17	0	0	0	0	0	0	0	0	0	47	186	0	0	83	4	96	116
10	0	0	0	0	0	0	0	0	0	0	0	0	99	186	0	0	0	8	4	31
11+	32	0	55	0	0	0	0	0	0	0	0	0	0	194	148	0	0	20	64	51
Total	3148	11367	4516	5695	7622	6061	4990	3751	7254	1698	706	712	2819	3792	1016	848	1361	755	3477	613

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.071	0.097	0.110	0.106	0.100	0.118	0.099	0.090	0.056	0.057	0.000	0.000	0.079	0.000	0.000	0.059	0.000	0.000	0.070	0.0695
2	0.174	0.154	0.156	0.182	0.166	0.168	0.169	0.168	0.121	0.121	0.123	0.000	0.157	0.094	0.140	0.099	0.151	0.108	0.103	0.0957
3	0.228	0.181	0.215	0.230	0.221	0.220	0.224	0.234	0.156	0.158	0.181	0.145	0.217	0.113	0.179	0.163	0.149	0.126	0.136	0.1401
4	0.290	0.000	0.275	0.000	0.252	0.254	0.257	0.263	0.192	0.188	0.198	0.177	0.242	0.181	0.207	0.222	0.195	0.177	0.183	0.1911
5	0.323	0.000	0.314	0.369	0.289	0.301	0.300	0.313	0.000	0.000	0.242	0.213	0.279	0.228	0.243	0.233	0.187	0.199	0.221	0.1958
6	0.370	0.364	0.383	0.000	0.000	0.000	0.000	0.000	0.228	0.228	0.000	0.274	0.280	0.245	0.294	0.269	0.220	0.218	0.228	0.2447
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.287	0.000	0.319	0.265	0.000	0.296	0.296	0.241	0.265	0.2771
8	0.363	0.000	0.387	0.000	0.000	0.000	0.000	0.000	0.293	0.294	0.390	0.279	0.279	0.282	0.000	0.342	0.254	0.239	0.324	0.2859
9	0.480	0.000	0.483	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.360	0.335	0.000	0.000	0.296	0.321	0.310	0.3151
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.341	0.335	0.000	0.000	0.000	0.317	0.314	0.3129
11+	0.433	0.000	0.441	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.329	0.392	0.000	0.000	0.314	0.318	0.3621
Ave.	0.257	0.132	0.193	0.204	0.180	0.193	0.201	0.207	0.167	0.165	0.195	0.223	0.256	0.243	0.287	0.258	0.203	0.202	0.211	0.2479

Table 32. Comparison of original and test ring counts.

	Test Ring Count												
Original	0	1	2	3	4	5	6	7	8	9	10	11	
0	20	0	0	0	0	0	0	0	0	0	0	0	20
1	0	18	0	0	0	0	0	0	0	0	0	0	18
2	0	3	8	0	0	0	0	0	0	0	0	0	11
3	0	0	1	12	1	0	0	0	0	0	0	0	14
4	0	0	0	1	18	0	0	0	0	0	0	0	19
5	0	0	0	0	0	12	5	0	0	0	0	0	17
6	0	0	0	0	0	3	24	3	0	0	0	0	30
7	0	0	0	0	0	1	0	10	2	0	0	0	13
8	0	0	0	0	0	0	0	1	3	4	0	0	8
9	0	0	0	0	0	0	0	0	1	8	4	0	13
10	0	0	0	0	0	0	0	0	2	2	7	4	15
11	0	0	0	0	0	0	0	0	0	1	3	17	21
Total	20	21	9	13	19	16	29	14	8	15	14	21	199

Table 33. Analysis of variance for multiplicative model for 4T herring fall fixed gear catch rates.

Model: MODEL1
Dependent Variable: CPUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	30	3611.77683	120.39256	150.012	0.0001
Error	3063	2458.21801	0.80255		
C Total	3093	6069.99484			

Root MSE	0.89585	R-square	0.5950
Dep Mean	5.87048	Adj R-sq	0.5911
C.V.	15.26031		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	7.218947	0.08341984	86.538	0.0001
YY78	1	-1.118201	0.14380093	-7.776	0.0001
YY79	1	-1.875549	0.11220742	-16.715	0.0001
YY80	1	-1.970246	0.11018135	-17.882	0.0001
YY81	1	-1.312033	0.09236666	-14.205	0.0001
YY82	1	-1.313046	0.09411640	-13.951	0.0001
YY83	1	-0.932661	0.09369770	-9.954	0.0001
YY84	1	-0.404390	0.09798187	-4.127	0.0001
YY85	1	0.208647	0.10144287	2.057	0.0398
YY86	1	-0.162333	0.10296877	-1.577	0.1150
YY88	1	-0.158891	0.10329863	-1.538	0.1241
YY89	1	0.247045	0.10824480	2.282	0.0225
YY90	1	0.245640	0.09843633	2.495	0.0126
YY91	1	0.362089	0.10590075	3.419	0.0006
YY92	1	0.321096	0.10101498	3.179	0.0015
YY93	1	0.224311	0.10387470	2.159	0.0309
YY94	1	0.279594	0.09149613	3.056	0.0023
YY95	1	0.051326	0.09310912	0.551	0.5815
YY96	1	-0.060071	0.10624007	-0.565	0.5718
YY97	1	0.188729	0.11166556	1.690	0.0911
D11	1	-0.859475	0.05652090	-15.206	0.0001
D13	1	-1.174871	0.08826531	-13.311	0.0001
D65	1	-1.089800	0.05151799	-21.154	0.0001
D67	1	-0.205840	0.05760384	-3.573	0.0004
D87	1	-0.494157	0.05711591	-8.652	0.0001
D92	1	-1.098594	0.06307337	-17.418	0.0001
W1	1	-1.198991	0.05463863	-21.944	0.0001
W2	1	-0.294100	0.05479004	-5.368	0.0001
W3	1	-0.123517	0.05064629	-2.439	0.0148
W5	1	-0.053686	0.05579684	-0.962	0.3360
W6	1	-0.519900	0.07454124	-6.975	0.0001

Table 34. Commercial catch rate abundance index by age (top) from 1978-1997. Acoustic survey abundance index by age (bottom) from 1990-1997.

Commercial

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
1	0	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	10	0	3	16	0	0	0	0	12	1	0	0	1	0	4	0	0	0	0	0
3	421	22	359	287	92	42	82	136	76	322	52	23	171	17	28	9	0	2	0	66
4	650	473	236	1202	642	1172	2129	1070	1532	1534	903	1098	1042	4238	1091	272	462	152	838	1239
5	408	243	275	315	723	555	1150	2966	769	1214	1855	1716	915	1099	4598	3316	619	1667	834	4498
6	96	139	45	123	211	764	711	1803	1605	831	896	2308	1302	785	1033	4072	2442	634	1912	915
7	87	41	78	51	108	126	511	1153	897	1459	585	1094	2503	1158	622	674	3520	2068	427	1411
8	458	50	17	30	45	95	114	545	383	623	631	555	785	1428	758	354	616	1840	1003	266
9	14	42	10	13	16	28	39	147	218	377	307	702	423	520	792	409	487	349	1032	483
10	18	13	14	12	5	7	17	88	16	183	121	259	460	259	386	218	486	247	223	447
11	223	26	4	5	3	9	8	19	32	75	72	202	249	487	568	311	712	614	470	261

Acoustic

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
1													428444	943	0	0	4023	59	39652	0
2													1484657	5489	31959	9162	2995	16977	139377	157318
3													656553	46722	22854	114034	9135	22111	150902	240874
4													254265	68183	155166	57580	338873	12927	285210	182160
5													65477	15967	266018	68311	106755	91421	48022	96992
6													74906	6858	61443	190966	103504	17178	152074	22478
7													63303	4466	24931	40602	106099	36164	30827	53195
8													31359	7814	34328	1743	13468	35111	11768	24421
9													17351	3858	21411	3811	7204	4557	19168	23068
10													29416	1605	23436	1430	0	956	10565	12927
11													66849	5610	55134	2168	4534	487	0	7206

Table 35. Acoustic survey catch-at-age for herring fall spawners, in Chaleur - Miscou, PEI-Magdalen Is. and Cape Breton strata, 1990-1997. Values are in numbers at age (x 1000) weighted by acoustic biomass estimate. Where samples during the acoustic survey were not available the following substitutions were made: Cape Breton strata for 1995 used the bottom trawl survey samples from eastern 4T in September to derive the catch-at-age, Cape Breton for 1996 used the seiner samples within one week of the survey, 1996 North PEI used 1996 bottom trawl survey samples for September.

Chaleur - Miscou (excludes Tracadie and Gaspé)

AGE	1990	1991	1992	1993	1994	1995	1996	1997
0	0	0	0	0	0	0	0	0
1	428444	943	0	0	4023	59	39652	0
2	1484657	5478	29832	8461	2995	16977	139377	156915
3	633917	46376	19596	108416	9135	22111	150902	234337
4	166696	64120	138894	52489	338873	12927	285210	177599
5	0	14433	242378	44657	106755	91421	48022	76258
6	0	4793	48766	181170	103504	17178	152074	15543
7	0	3128	16274	35855	106099	36164	30827	40955
8	0	4705	15498	0	13468	35111	11768	18523
9	0	2707	5866	2050	7204	4557	19168	13605
10	0	1078	10754	0	0	956	10565	7241
11+	0	3572	11918	0	4534	487	0	3460
Total	2713713	151335	539775	433099	696590	237949	887566	744436
4+	166696	98536	490348	316221	680437	198802	557634	353185

PEI (includes Milne)

AGE	1990	1991	1992	1993	1994	1995	1996	1997
0							0	0
1							52257	232
2							51817	166894
3							12666	39603
4							6344	10894
5							1535	10857
6							32967	906
7							24577	1266
8							33066	906
9							12276	0
10							4529	0
11+							17358	0
Total							249392	231559
4+							132652	24830

4Vn

AGE	1990	1991	1992	1993	1994	1995	1996	1997
0	0	0	0	0		0	0	0
1	0	0	0	0		0	0	0
2	0	11	2127	701		63	1539	403
3	22636	346	3258	5617		2392	4619	6537
4	87570	4064	16272	5091		1393	37516	4560
5	65477	1534	23641	23654		4665	8603	20734
6	74906	2066	12677	9796		2685	25187	6935
7	63303	1338	8657	4747		4306	8272	12240
8	31359	3109	18830	1743		5168	6221	5898
9	17351	1151	15545	1761		2318	5628	9463
10	29416	527	12682	1430		2004	3863	5686
11+	66849	2039	43215	2168		3205	2890	3746
Total	458867	16182	156904	56708		28198	104338	76202
4+	436231	15826	151518	50389		25743	98180	69262

Total 4TVn

AGE	1990	1991	1992	1993	1994	1995	1996	1997
0	0	0	0	0	0	0	0	0
1	428444	943	0	0	4023	59	91910	232
2	1484657	5489	31959	9162	2995	17040	192733	324211
3	656553	46722	22854	114034	9135	24503	168187	280476
4	254265	68183	155166	57580	338873	14320	329070	193054
5	65477	15967	266018	68311	106755	96086	58160	107849
6	74906	6858	61443	190966	103504	19863	210228	23384
7	63303	4466	24931	40602	106099	40470	63676	54461
8	31359	7814	34328	1743	13468	40279	51055	25327
9	17351	3858	21411	3811	7204	6874	37072	23068
10	29416	1605	23436	1430	0	2960	18958	12927
11+	66849	5610	55134	2168	4534	3693	20248	7206
Total	3172580	167517	696679	489806	696590	266147	1241296	1052197
4+	602927	114362	641867	366610	680437	224545	788466	447277

Table 36. Acoustic survey dates and proportion of transects covered during night (PCTN) (1900-0700 hours) by area.

Area / Région	1990 Date	1990 P.T.C.N.	1991 Date	1991 P.T.C.N.	1992 Date	1992 P.T.C.N.	1993 Date	1993 P.T.C.N.	1994 Date	1995 Date	1996 Date	1997 Date	1994-97 P.T.C.N.
Chaleur-Miscou	Oct 26 - Nov 3	0.54	Oct. 10 - 19	0.53	Oct. 1 - 15	0.54	Oct. 2 - 14	0.56	Oct. 16 - 28	Sept 30-Oct 8	Sept 24-Oct 5	Sept 21 - 28	1.00
Tracadie	----------	----------	----------	----------	----------	----------	----------	----------	----------	Sept 28 - 29	Oct. 6 - 7	Sept 28 - 29	1.00
North P.E.I.	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	Oct. 8 - 10	Oct. 2 - 4	1.00
Milne Bank	----------	----------	----------	----------	Oct. 16	0.63	Oct. 15	0.40	----------	Sept. 23	Oct. 10	Oct. 4	1.00
N.S. & East P.E.I.	----------	----------	----------	----------	----------	----------	----------	----------	----------	Sept. 23 - 24 (N. S. only)	Oct. 10 - 13	----------	1.00
Magdelen Islands	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	Oct. 5 - 7	1.00
Cape Breton	Nov 4 - 8	0.40	Oct. 22 - 24	0.61	Oct. 16 - 22	0.46	Oct. 15 - 20	0.53	----------	Sept. 25 - 27 (Northwest not surveyed)	Oct. 14 - 16 (Northwest not surveyed)	Oct. 9 - 11	1.00
Vessels	A. Needler		A. Needler		E.E. Prince		A. Needler		F. Creed and J.L. Hart	F. Creed and Calanus II	F. Creed and Calanus II	F. Creed and Calanus II	
Transceiver	Simrad EY200		Simrad EY200		Simrad EY200		Simrad EY200		Simrad EY200	Simrad EY200	Simrad EY200	Simrad EY200	
Transducer mount	Towed body and cable		Towed body and cable		Towed body and cable		Towed body and cable		Torpedo between hulls	hull	hull	hull	
Ball calibration	Used 1992 constants		Used 1992 constants		Yes		Yes		Yes	Yes	Yes	Yes	
Problems	Towed body cable spliced and repaired		Towed body cable caught in bouy, spliced and repaired Motherboard in EY200 replaced		Prior to survey, motherboard in EY200 replaced		Replacement of faulty power supply in EY200		---------- ---------- ---------- ----------	---------- ---------- ---------- ----------	---------- ---------- ---------- ----------	---------- ---------- ---------- ----------	

Table 37. Acoustic survey biomass (t) by spawning group and area from catch-at-age analysis, 1990-1997. Percentage of total catch-at-age biomass is provided. Chaleur-Miscou excludes Gaspé and Tracadie, North PEI includes Milne. Where samples during the acoustic survey were not available the following substitutions were made: Cape Breton strata for 1995 used the bottom trawl survey samples from eastern 4T in September to derive the catch-at-age, Cape Breton for 1996 used the seiner samples within one week of the survey, 1996 North PEI used 1996 bottom trawl survey samples for September.

Fall Spawners

	Biomass								% of Total							
Area	1990	1991	1992	1993	1994	1995	1996	1997	1990	1991	1992	1993	1994	1995	1996	1997
Chaleur-Miscou	302765	27158	102836	74552	122008	43300	134003	107458	70.9	86.1	70.5	86.6		87.4	70.4	65.7
North P.E.I							35115	38912							18.5	23.8
Cape Breton	124429	4374	43051	11511		6254	21093	17114	29.1	13.9	29.5	13.4		12.6	11.1	10.5
Total	427194	31532	145888	86063	122008	49554	190211	163484								

Spring Spawners

Chaleur-Miscou	643376	12780	42004	43784	57415	20376	89332	66596	98.3	99.7	95.9	97.8		95.7	88.7	79.8
North P.E.I.							10562	16518							10.5	19.8
Cape Breton	10820	44	1794	1001		913	777	349	1.7	0.3	4.1	2.2		4.3	0.8	0.4
Total	654196	12824	43797	44785	57415	21289	100671	83463								

Table 38. Acoustic survey biomass, spring and fall spawners combined, by converting acoustic backscatter to biomass based on length-weight and target strength relationships for all areas surveyed. Bold indicates areas where no samples were obtained and could not be included in the catch-at-age.

	Biomass								% of Total							
Area / Year	1990	1991	1992	1993	1994	1995	1996	1997	1990	1991	1992	1993	1994	1995	1996	1997
Rivière-au-Renard				3655			**4401**	**10350**				2.8			1.3	3.7
Gaspé	**47772**	233	3766	330	0	0	**579**	**1307**	4.2	0.5	1.9	0.3		0.0	0.2	0.5
Chaleur-Miscou	945262	39705	153269	114351	179423	63676	224143	173880	83.8	89.5	75.5	87.4		71.4	65.6	61.8
Tracadie						**7709**	27960	**8119**						8.6	8.2	2.9
North P.E.I.							**42062**	48642							12.3	17.3
Milne Bank			*1021*	*60*		*9134*	11310	6788			0.5	0.0		10.2	3.3	2.4
N.S. & East P.E.I.							9474							1.6	2.8	
Magdelen Islands								14943								5.3
Cape Breton	135249	4418	44845	12512		7295	21869	17463	12.0	10.0	22.1	9.6		8.2	6.4	6.2
Total	1128283	44356	202901	130908	179423	89241	341798	281492								

Table 39. ADAPT input summary for fall herring Division 4T, 1997.

Parameters:
- year-class estimates: N_i i=4-10
- calibration contants: K_i i=4-10

Strucuture:
- F for oldest age group (11+) assumed equal to F at age 10 (CALC-F-OLD)
- model did not include an intercept term (tested and found to be non-significant)

Input:
- $catch_{i,t}$ and $weight_{i,t}$ i=2-11+, t=1978-1997
- log $CPUE_{i,t}$ (kg/net-trip) i=2-11+, t=1978-1997
- natural mortality=0.2

Objective function:
- minimize $\sum\sum(\text{observed} \log CPUE_{i,t}) - (\text{predicted} \log CPUE_{i,t})$

Summary:
- number of parameters: 14
- number of observations: 140

Table 40. Diagnostics for ADAPT-VPA , fall spawners.

orthogonality offset 0.00066

mean square residuals 0.20803

	par est	std err	cv	t-stat	% bias
4	285251.344	135937.989	0.476555	2.098393	11.467990
5	271674.558	102921.693	0.378842	2.639624	6.650905
6	48451.0553	17026.9696	0.351426	2.845548	5.281394
7	80669.5485	27758.6345	0.344103	2.906107	4.773728
8	18291.3783	6133.48052	0.335321	2.982218	4.429874
9	48093.0535	14871.9732	0.309233	3.233804	3.744114
10	52088.1035	15517.1472	0.297902	3.356809	3.445710
4	0.004067	0.000436	0.107300	9.319647	0.323954
5	0.007968	0.000841	0.105530	9.475963	0.392197
6	0.009186	0.000965	0.105025	9.521578	0.460213
7	0.011151	0.001169	0.104872	9.535456	0.530382
8	0.012278	0.001284	0.104562	9.563741	0.581882
9	0.011845	0.001231	0.103894	9.625196	0.597714
10	0.013138	0.001353	0.103011	9.707672	0.575818

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	0.04	0.03	0.02	0.02	0.01	0.01	-0.23	-0.01	-0.01	-0.01	-0.00	-0.00	-0.00
2	0.04	1.00	0.04	0.03	0.02	0.02	0.02	-0.16	-0.18	-0.01	-0.01	-0.01	-0.00	-0.00
3	0.03	0.04	1.00	0.04	0.03	0.03	0.02	-0.11	-0.14	-0.17	-0.01	-0.01	-0.01	-0.00
4	0.02	0.03	0.04	1.00	0.04	0.03	0.03	-0.09	-0.10	-0.13	-0.16	-0.01	-0.01	-0.00
5	0.02	0.02	0.03	0.04	1.00	0.04	0.03	-0.07	-0.07	-0.09	-0.13	-0.16	-0.01	-0.00
6	0.01	0.02	0.03	0.03	0.04	1.00	0.04	-0.06	-0.06	-0.07	-0.10	-0.13	-0.15	-0.01
7	0.01	0.02	0.02	0.03	0.03	0.04	1.00	-0.05	-0.05	-0.06	-0.07	-0.10	-0.13	-0.14
8	-0.23	-0.16	-0.11	-0.09	-0.07	-0.06	-0.05	1.00	0.06	0.04	0.03	0.02	0.01	0.01
9	-0.01	-0.18	-0.14	-0.10	-0.07	-0.06	-0.05	0.06	1.00	0.05	0.03	0.02	0.02	0.01
10	-0.01	-0.01	-0.17	-0.13	-0.09	-0.07	-0.06	0.04	0.05	1.00	0.04	0.03	0.02	0.01
11	-0.01	-0.01	-0.01	-0.16	-0.13	-0.10	-0.07	0.03	0.03	0.04	1.00	0.04	0.02	0.01
12	-0.00	-0.01	-0.01	-0.01	-0.16	-0.13	-0.10	0.02	0.02	0.03	0.04	1.00	0.03	0.01
13	-0.00	-0.00	-0.01	-0.01	-0.01	-0.15	-0.13	0.01	0.02	0.02	0.02	0.03	1.00	0.02
14	-0.00	-0.00	-0.00	-0.00	-0.00	-0.01	-0.14	0.01	0.01	0.01	0.01	0.01	0.02	1.00

Table 41. Comparison of numbers at-age projected for 1997 using last year's assessment results, compared to numbers for 1997 estimated for this assessment (Current) using ADAPT-VPA with single CUE index.

Age	Projected	Current	% Diff
4	267094	334443	20
5	169269	390401	57
6	46613	72971	36
7	105489	123128	14
8	28770	26726	-8
9	89108	66021	-35
10	111105	71744	-55
11	54772	44787	-22
4+	872220	1130221	

Table 42. Comparison of 4+ biomass estimated in assessment year compared to 4+ biomass estimated the next year (A). Comparison of 4+ biomass estimate made in assessment year to 4+ biomass estimate made in 1997 (B) using CUE single index.

A.	4+ Biomass		
Assessment Year	Estimate in next Assessment	Estimate in Assessment Year	% diff
91	463478	404979	13
92	398302	422395	-6
93	393441	330359	16
94	362869	329470	9
95	287439	267219	7
96	250679	232677	7

B.	4+ Biomass		
Assessment Year	97	Assessment Year	% Diff
91	346728	404979	-17
92	363786	422395	-16
93	308459	330359	-7
94	313033	329470	-5
95	251948	267219	-6
96	250679	232677	7

Table 43. Percentage of 2 5/8" mesh nets used in the fall 4T herring gillnet fishery from 1986 to 1997.

Area/ Région	86	87	88	89	90	91	92	93	94	95	96	97
Mag Is			50.0			0.0	11.1	52.6	100.0	83.3	30.8	100
Quebec	70.1	84.1	51.9	76.2	77.6	81.0	57.7	56.5	76.5	69.4	94.4	61
Acad Pen	72.4	94.5	93.2	92.7	88.1	86.0	75.3	65.9	68.6	65.5	70.5	72.5
Escuminac	87.2	91.7	97.3	70.9	89.2	67.0	27.8	48.2	29.0	35.6	47.4	47.2
SE NB			100.0	100.0		83.0	100.0	62.5			86.2	
Nova Scotia	83.4	84.2	87.7	74.2	69.1	53.0	69.7	20.0	45.3	33.9	35.5	25.2
E PEI	85.6	96.9	100.0	91.7	88.5	91.0	80.0	78.2	51.8	74.8	61.4	72.9
W PEI	38.5	85.6	98.8	38.5	64.0	49.0	15.1	58.6	14.1	16.9	22.3	30.2

Table 44. Catches for areas used to estimate overall mesh size in the 4T herring fall gillnet fishery.

Area/ Région	86	87	88	89	90	91	92	93	94	95	96	97
Mag Is	0	1	9	0	2	1	618	1459	1901	1447	359	359
Quebec	2087	3176	2506	1239	4091	1575	1222	1348	2114	2753	2316	2316
Acad Pen	23872	28477	19605	25192	27835	15606	22337	13249	32359	26695	19065	14224
Escuminac	93	902	1254	1015	753	1559	1789	3062	4086	5164	2817	2008
SE NB	58	39	21	259	1247	187	14	111	40	46	203	107
Nova Scotia	5816	9495	9141	3160	10343	1906	1919	935	8095	10113	7754	6218
E PEI	6638	8660	6102	2905	10957	3122	3160	1786	3483	3816	7608	6132
W PEI	1512	1051	2570	258	1158	3055	2526	1866	2078	4170	4485	3862
Total	40076	51801	41208	34028	56386	27011	33585	23816	54156	54204	44607	35226

Table 45. Percentage of 2 5'8" mesh used in fall 4T herring gillnet fishery.

Year / Année	Percentage / Pourcentage
86	74.7
87	92.1
88	90.9
89	89.3
90	81.5
91	78.7
92	66.6
93	60.8
94	60.3
95	54.3
96	57.6
97	57.4

Table 46. ADAPT input summary for fall herring Division 4T, 1997 using new model with split in CUE index for mesh size.

Parameters:
- year-class estimates: N_i i=4-10
- calibration contants: K_i I=4-10 (1978-1991)
- calibration constants: K_i i=4-10 (1992-1997)

Strucuture:
- F for oldest age group (11+) assumed equal to F at age 10 (CALC-F-OLD)
- model did not include an intercept term (tested and found to be non-significant)

Input:
- $catch_{i,t}$ and $weight_{i,t}$ i=2-11+, t=1978-1997
- log $CPUE_{i,x}$ (kg/net-trip) i=2-11+, x=1978-1991
- log $CPUE_{i,y}$ (kg/net-trip) I=2-11+, y=1992-1997
- natural mortality=0.2

Objective function:
- minimize $\sum\sum$ ((obs log CPUEi,x)-(pred log CPUEi,x)+(obs log CPUEi,y)-(log pred CPUEi,y))

Summary:
- number of parameters: 21
- number of observations 140

Table 47. Diagnostics for new model 4T fall herring ADAPT-VPA with index split for mesh size changes.

approximate statistics assuming linearity near solution

orthogonality offset 0.00371

mean square residuals 0.15881

	par est	std err	cv	t-stat	% bias
4	715591.594	325033.483	0.454216	2.201593	11.567995
5	400498.554	143243.202	0.357662	2.795934	7.126403
6	52419.2509	17967.4066	0.342764	2.917463	6.062966
7	74959.8729	26022.6382	0.347154	2.880564	5.733233
8	16374.3757	5581.12893	0.340845	2.933882	5.263646
9	39525.5557	12603.2503	0.318863	3.136140	4.463841
10	35427.2973	11099.2655	0.313297	3.191860	4.008274
4	0.005571	0.000597	0.107130	9.334454	0.535782
5	0.007496	0.000802	0.107039	9.342365	0.577580
6	0.008104	0.000867	0.107039	9.342365	0.577580
7	0.010298	0.001102	0.107039	9.342365	0.577580
8	0.012041	0.001289	0.107039	9.342365	0.577580
9	0.010897	0.001166	0.107039	9.342365	0.577580
10	0.012329	0.001320	0.107039	9.342365	0.577580
4	0.001633	0.000339	0.207474	4.819872	0.939174
5	0.008895	0.001729	0.194330	5.145886	0.898789
6	0.012764	0.002422	0.189773	5.269465	1.122449
7	0.014380	0.002703	0.187979	5.319745	1.397864
8	0.013914	0.002565	0.184307	5.425735	1.592560
9	0.015636	0.002787	0.178226	5.610862	1.665956
10	0.016214	0.002773	0.171051	5.846205	1.599220

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	1.00	0.18	0.15	0.12	0.11	0.09	0.04	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.46	-0.12	
2	0.18	1.00	0.21	0.17	0.15	0.13	0.08	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.38	-0.40	
3	0.15	0.21	1.00	0.22	0.18	0.16	0.10	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.32	-0.35	
4	0.12	0.17	0.22	1.00	0.22	0.19	0.13	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.27	-0.30	
5	0.11	0.15	0.18	0.22	1.00	0.22	0.16	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.23	-0.25	
6	0.09	0.13	0.16	0.19	0.22	1.00	0.19	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.20	-0.22	
7	0.04	0.08	0.10	0.13	0.16	0.19	1.00	-0.04	0.00	0.00	0.00	0.00	0.00	0.00	-0.09	-0.16	
8	-0.00	-0.00	-0.00	-0.01	-0.01	-0.01	-0.04	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	
15	-0.46	-0.38	-0.32	-0.27	-0.23	-0.20	-0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.27	
16	-0.12	-0.40	-0.35	-0.30	-0.25	-0.22	-0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.27	1.00	
17	-0.10	-0.14	-0.38	-0.34	-0.28	-0.23	-0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.23	
18	-0.08	-0.11	-0.14	-0.38	-0.33	-0.27	-0.20	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.19	
19	-0.06	-0.08	-0.10	-0.13	-0.37	-0.32	-0.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.14	
20	-0.04	-0.05	-0.07	-0.08	-0.10	-0.33	-0.28	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.10	
21	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.29	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	

Parameter Correlations

	17	18	19	20	21
1	-0.10	-0.08	-0.06	-0.04	-0.01
2	-0.14	-0.11	-0.08	-0.05	-0.02
3	-0.38	-0.14	-0.10	-0.07	-0.03
4	-0.34	-0.38	-0.13	-0.08	-0.04
5	-0.28	-0.33	-0.37	-0.10	-0.05
6	-0.23	-0.27	-0.32	-0.33	-0.06
7	-0.17	-0.20	-0.24	-0.28	-0.29
8	0.01	0.01	0.01	0.01	0.01
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00
15	0.21	0.17	0.13	0.08	0.03
16	0.23	0.19	0.14	0.10	0.05
17	1.00	0.21	0.16	0.11	0.05
18	0.21	1.00	0.19	0.12	0.06
19	0.16	0.19	1.00	0.14	0.07
20	0.11	0.12	0.14	1.00	0.08
21	0.05	0.06	0.07	0.08	1.00

residuals for calibration index 1

	78	79	80	81	82	83	84	85	86	87	88	89	90	91
4	0.68	0.33	-0.18	0.34	-0.35	-0.24	-0.08	-0.27	0.08	-0.30	-0.41	0.16	0.06	0.19
5	0.14	0.22	0.19	0.27	-0.07	-0.49	-0.26	0.24	-0.59	-0.08	-0.06	0.28	0.07	0.14
6	-0.52	-0.09	-0.70	-0.25	0.23	0.29	-0.01	0.43	-0.09	-0.20	-0.07	0.46	0.35	0.17
7	-0.59	-1.03	0.53	-0.32	-0.24	-0.15	-0.01	0.60	-0.08	0.04	-0.35	0.30	0.94	0.36
8	1.01	-0.65	-0.65	0.26	-0.18	-0.15	-0.06	0.26	-0.21	-0.08	-0.51	-0.11	0.33	0.73
9	-0.62	-0.13	-0.79	0.24	0.35	-0.16	-0.64	0.73	-0.14	0.48	-0.18	0.12	0.28	0.46
10	0.14	0.98	0.53	0.06	-0.29	-0.13	-0.47	0.44	-1.21	0.04	-0.24	-0.02	0.08	0.09

sum of residuals 0.00147

mean residual 0.00002

residuals for calibration index 2

	78	79	80	81	82	83
4	0.47	0.28	-0.21	-0.37	-0.17	0.00
5	0.13	0.18	-0.27	-0.23	0.04	0.15
6	-0.10	-0.02	-0.08	-0.09	0.08	0.21
7	-0.28	-0.30	0.22	0.21	0.00	0.15
8	0.01	-0.47	0.12	0.21	0.08	0.05
9	0.34	-0.38	0.26	0.01	0.10	-0.34
10	0.32	-0.47	0.40	0.27	0.25	-0.26

sum of residuals 0.51428

mean residual 0.01224

Table 48. Fall spawner beginning of year number and biomass for single CUE index for ADAPT-VPA.

Numbers

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	141478	384505	328201	513921	771652	467380	498918	710479	468141	320768	348713	1281538	788331	230521	637421	226161	771074	502563		
3	148160	114433	307058	265917	420060	629886	381321	407546	580714	382364	261827	281627	1048554	645374	188735	521774	185121	631289	411451	
4	99195	98145	78870	207957	207930	334575	507821	307813	329019	470803	303520	210159	229045	851399	522411	153718	425251	151285	514114	334443
5	79130	49914	52025	43762	138244	151615	248062	387167	236599	232939	345685	226368	155139	162148	640807	410919	121102	331588	116618	390401
6	28081	39747	20910	25287	28926	94387	111678	185769	287554	170886	159697	239568	159081	102362	117936	461214	304097	84978	212726	72971
7	22674	17817	14709	9043	17831	18613	63876	81759	133378	196967	112994	107294	162509	101637	75439	81665	335036	197969	48694	123128
8	29535	13413	9522	3009	6188	12072	12915	46037	56047	84451	120609	72022	71069	79459	71695	52486	58087	201163	110334	26726
9	4573	10787	6669	1773	1654	3993	8321	9219	31972	34993	48874	78393	45826	40627	51247	49021	37628	34247	116958	66021
10	2514	1921	3262	1367	762	884	2732	6318	5790	20732	18056	29651	51734	25216	27267	31940	35011	20772	19072	71744
11	29638	13093	1884	643	1185	1246	1417	3113	6177	8249	17656	21994	33490	50173	52783	49331	54178	48236	35814	44787
4+	295340	244837	187851	292841	402720	617385	956822	1027195	1086536	1220020	1127091	985449	907893	1413021	1559585	1290294	1370390	1070238	1174330	1130221
5+	196145	146692	108981	84884	194790	282810	449001	719382	757517	749217	823571	775290	678848	561622	1037174	1136576	945139	918953	660216	795778
7+	88934	57031	36046	15835	27620	36808	89261	146446	233364	345392	318189	309354	364628	297112	278431	264443	519940	502387	330872	332406

Biomass

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	14303	42565	36430	53345	89049	64545	62514	79289	53462	25565	33442	135074	124241	19373	42134	11806	70322	42919		
3	19888	14403	40040	38941	58820	91711	64003	65841	78826	60358	31404	36159	149357	99888	23745	50533	15672	66108	46705	
4	17910	17231	13829	39669	46134	71668	107623	68449	73304	93932	71904	44500	46658	174332	92822	24685	68975	23897	79546	57477
5	18607	11492	12049	10660	36422	40061	64205	102005	60909	59663	90615	61148	40355	39802	148177	89441	24627	65155	24000	83367
6	7597	10382	5185	7647	9153	28620	32569	55291	85978	49524	47155	71917	47939	28849	30554	114215	72894	19254	48616	17796
7	6584	5048	4022	2843	6475	6290	20950	27017	44290	64136	36737	35146	53550	32837	21968	21738	88433	51576	12083	31831
8	9118	4173	2618	1023	2357	4444	4744	16253	20018	29540	41932	24631	24920	27457	23594	15155	16402	56841	31361	7514
9	1500	3789	2092	565	646	1547	3198	3635	12009	12886	18342	28412	16221	14574	17620	16204	11653	10672	35482	20335
10	878	673	1125	482	289	323	1017	2331	2218	8021	7030	11588	19470	9317	9532	10225	11882	7112	6367	23611
11	10948	4755	696	242	502	498	566	1283	2498	3271	7115	8799	13198	19559	19519	16796	18168	17441	13225	16287
4+	73142	57543	41616	63131	101977	153450	234872	276266	301224	320974	320830	286141	262311	346728	363786	308459	313033	251948	250679	258218
5+	55232	40312	27787	23462	55843	81782	127249	207816	227920	227042	248927	241641	215652	172396	270964	283774	244058	228051	171133	200741
7+	29029	18438	10552	5156	10268	13101	30475	50520	81033	117855	111157	108576	127358	103745	92233	80117	146538	143643	98517	99578

Table 49. Fall spawner beginning of year numbers and biomass from split mesh size CUE indices from ADAPT-VPA.

Numbers

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	141478	384505	328201	513921	771652	467380	498918	710479	468141	320768	348713	1180895	746135	222547	617000	235255	1034121	1194329	772472	76314
3	148160	114433	307058	265917	420060	629886	381321	407546	580714	382364	261827	281627	966155	610826	182206	505055	192567	846653	977821	632165
4	99195	98145	78870	207957	207930	334575	507821	307813	329019	470803	303520	210159	229045	783936	494126	148373	411563	157381	690440	798148
5	79130	49914	52025	43762	138244	151615	248062	387167	236599	232939	345685	226368	155139	162148	585573	387761	116726	320381	121608	534764
6	28081	39747	20910	25287	28926	94387	111678	185769	287554	170886	159697	239568	159081	102362	117936	415992	285137	81396	203550	77057
7	22674	17817	14709	9043	17831	18613	63876	81759	133378	196967	112994	107294	162509	101637	75439	81665	298011	182446	45761	115616
8	29535	13413	9522	3009	6188	12072	12915	46037	56047	84451	120609	72022	71069	79459	71695	52486	58087	170850	97624	24324
9	4573	10787	6669	1773	1654	3993	8321	9219	31972	34993	48874	78393	45826	40627	51247	49021	37628	34247	92139	55616
10	2514	1921	3262	1367	762	884	2732	6318	5790	20732	18056	29651	51734	25216	27267	31940	35011	20772	19072	51425
11	29638	13093	1884	643	1185	1246	1417	3113	6177	8249	17656	21994	33490	50173	52783	49331	54178	48236	35814	32102
4+	295340	244837	187851	292841	402720	617385	956822	1027195	1086536	1220020	1127091	985449	907893	1345558	1476066	1216569	1296341	1015709	1306008	1689052
5+	196145	146692	108981	84884	194790	282810	449001	719382	757517	749217	823571	775290	678848	561622	981940	1068196	884778	858328	615568	890904
7+	88934	57031	36046	15835	27620	36808	89261	146446	233364	345392	318189	309354	364628	297112	278431	264443	482915	456551	290410	279083

Biomass

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	14303	42565	36430	53345	89049	64545	62514	79289	53462	25565	33442	124466	117591	18703	40784	12280	94312	101996		
3	19888	14403	40040	38941	58820	91711	64003	65841	78826	60358	31404	36159	137620	94540	22924	48914	16302	88660	110996	
4	17910	17231	13829	39669	46134	71668	107623	68449	73304	93932	71904	44500	46658	160518	87797	23827	66755	24859	106828	137170
5	18607	11492	12049	10660	36422	40061	64205	102005	60909	59663	90615	61148	40355	39802	135405	84400	23737	62953	25026	114194
6	7597	10382	5185	7647	9153	28620	32569	55291	85978	49524	47155	71917	47939	28849	30554	103017	68349	18442	46519	18792
7	6584	5048	4022	2843	6475	6290	20950	27017	44290	64136	36737	35146	53550	32837	21968	21738	78660	47532	11355	29889
8	9118	4173	2618	1023	2357	4444	4744	16253	20018	29540	41932	24631	24920	27457	23594	15155	16402	48276	27748	6839
9	1500	3789	2092	565	646	1547	3198	3635	12009	12886	18342	28412	16221	14574	17620	16204	11653	10672	27952	17130
10	878	673	1125	482	289	323	1017	2331	2218	8021	7030	11588	19470	9317	9532	10225	11882	7112	6367	16924
11	10948	4755	696	242	502	498	566	1283	2498	3271	7115	8799	13198	19559	19519	16796	18168	17441	13225	11674
4+	73142	57543	41616	63131	101977	153450	234872	276266	301224	320974	320830	286141	262311	332914	345988	291361	295606	237288	265021	352612
5+	55232	40312	27787	23462	55843	81782	127249	207816	227920	227042	248927	241641	215652	172396	258192	267534	228851	212428	158193	215443
7+	29029	18438	10552	5156	10268	13101	30475	50520	81033	117855	111157	108576	127358	103745	92233	80117	136765	131033	86647	82456

Table 50. Fall spawner fishing mortality from single CUE index ADAPT-VPA. ER = exploitation rate.

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
3	0.21	0.17	0.19	0.05	0.03	0.02	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
4	0.49	0.44	0.39	0.21	0.12	0.10	0.07	0.06	0.15	0.11	0.09	0.10	0.15	0.08	0.04	0.04	0.05	0.06	0.08	0.08
5	0.49	0.67	0.52	0.21	0.18	0.11	0.09	0.10	0.13	0.18	0.17	0.15	0.22	0.12	0.13	0.10	0.15	0.24	0.27	0.24
6	0.26	0.79	0.64	0.15	0.24	0.19	0.11	0.13	0.18	0.21	0.20	0.19	0.25	0.11	0.17	0.12	0.23	0.36	0.35	0.27
7	0.33	0.43	1.39	0.18	0.19	0.17	0.13	0.18	0.26	0.29	0.25	0.21	0.52	0.15	0.16	0.14	0.31	0.39	0.40	0.28
8	0.81	0.50	1.48	0.40	0.24	0.17	0.14	0.17	0.27	0.35	0.23	0.25	0.36	0.24	0.18	0.13	0.33	0.34	0.31	0.23
9	0.67	1.00	1.39	0.64	0.43	0.18	0.08	0.27	0.23	0.46	0.30	0.22	0.40	0.20	0.27	0.14	0.39	0.39	0.29	0.16
10	0.71	1.91	1.91	0.34	0.25	0.21	0.09	0.23	0.18	0.30	0.29	0.24	0.34	0.16	0.29	0.21	0.42	0.47	0.46	0.12
11	0.71	1.91	1.91	0.34	0.25	0.21	0.09	0.23	0.18	0.30	0.29	0.24	0.34	0.16	0.29	0.21	0.42	0.47	0.46	0.12
Ave 5-9 F	**0.51**	**0.68**	**1.08**	**0.32**	**0.26**	**0.16**	**0.11**	**0.17**	**0.21**	**0.30**	**0.23**	**0.20**	**0.35**	**0.16**	**0.18**	**0.13**	**0.28**	**0.34**	**0.32**	**0.23**
Wt 4+ F	**0.49**	**0.59**	**0.65**	**0.21**	**0.15**	**0.12**	**0.09**	**0.10**	**0.17**	**0.20**	**0.17**	**0.17**	**0.29**	**0.11**	**0.11**	**0.11**	**0.20**	**0.28**	**0.21**	**0.18**
Ave 5-9 ER	**40**	**49**	**66**	**27**	**23**	**15**	**10**	**15**	**19**	**26**	**20**	**18**	**29**	**15**	**17**	**12**	**25**	**29**	**28**	**21**
Wt 4+ ER	**39**	**44**	**48**	**19**	**14**	**11**	**8**	**10**	**16**	**18**	**16**	**16**	**25**	**10**	**11**	**10**	**18**	**25**	**19**	**17**

Table 51. Fall spawner fishing mortality from split mesh size CUE indices ADAPT-VPA.

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
3	0.21	0.17	0.19	0.05	0.03	0.02	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01
4	0.49	0.44	0.39	0.21	0.12	0.10	0.07	0.06	0.15	0.11	0.09	0.10	0.15	0.09	0.04	0.04	0.05	0.06	0.06	0.03
5	0.49	0.67	0.52	0.21	0.18	0.11	0.09	0.10	0.13	0.18	0.17	0.15	0.22	0.12	0.14	0.11	0.16	0.25	0.26	0.17
6	0.26	0.79	0.64	0.15	0.24	0.19	0.11	0.13	0.18	0.21	0.20	0.19	0.25	0.11	0.17	0.13	0.25	0.38	0.37	0.25
7	0.33	0.43	1.39	0.18	0.19	0.17	0.13	0.18	0.26	0.29	0.25	0.21	0.52	0.15	0.16	0.14	0.36	0.43	0.43	0.30
8	0.81	0.50	1.48	0.40	0.24	0.17	0.14	0.17	0.27	0.35	0.23	0.25	0.36	0.24	0.18	0.13	0.33	0.42	0.36	0.26
9	0.67	1.00	1.39	0.64	0.43	0.18	0.08	0.27	0.23	0.46	0.30	0.22	0.40	0.20	0.27	0.14	0.39	0.39	0.38	0.19
10	0.71	1.91	1.91	0.34	0.25	0.21	0.09	0.23	0.18	0.30	0.29	0.24	0.34	0.16	0.29	0.21	0.42	0.47	0.46	0.18
11	0.71	1.91	1.91	0.34	0.25	0.21	0.09	0.23	0.18	0.30	0.29	0.24	0.34	0.16	0.29	0.21	0.42	0.47	0.46	0.18
Ave 5-9 F	**0.51**	**0.68**	**1.08**	**0.32**	**0.26**	**0.16**	**0.11**	**0.17**	**0.21**	**0.30**	**0.23**	**0.20**	**0.35**	**0.16**	**0.19**	**0.13**	**0.30**	**0.37**	**0.36**	**0.23**
Wt 4+ F	**0.49**	**0.59**	**0.65**	**0.21**	**0.15**	**0.12**	**0.09**	**0.10**	**0.17**	**0.20**	**0.17**	**0.17**	**0.29**	**0.11**	**0.12**	**0.12**	**0.21**	**0.30**	**0.19**	**0.12**
Ave 5-9 ER	**40**	**49**	**66**	**27**	**23**	**15**	**10**	**15**	**19**	**26**	**20**	**18**	**29**	**15**	**17**	**12**	**26**	**31**	**30**	**21**
Wt 4+ ER	**39**	**44**	**48**	**19**	**14**	**11**	**8**	**10**	**16**	**18**	**16**	**16**	**25**	**11**	**11**	**11**	**19**	**26**	**17**	**11**

Table 52. Fall spawner projection using single CUE index ADAPT-VPA, beginning of year numbers and biomass are used..

	Weight		Average	Numbers			Biomass			Catch (t) $F_{0.1}$	
Age	Begin	Catch	PR	1997	1998	1999	1997	1998	1999	1998	1999
2	0.0557	0.0886	0.02	431512	431512	431512	23428	24050	24050	244	244
3	0.1126	0.1398	0.05	322489	322489	322489	38559	36312	36312	574	574
4	0.1615	0.1922	0.40	334443	261405	260325	57477	42220	42046	5109	5088
5	0.2053	0.2234	1.00	390401	251758	190055	83367	51680	39014	13281	10026
6	0.2330	0.2457	1.00	72971	252188	152699	17796	58759	35578	14629	8858
7	0.2557	0.2674	1.00	123128	45607	152960	31831	11663	39116	2879	9657
8	0.2827	0.2943	1.00	26726	76342	27662	7514	21578	7819	5304	1922
9	0.3077	0.3196	1.00	66021	17386	46304	20335	5349	14246	1312	3494
10	0.3351	0.3449	1.00	71744	46107	10545	23611	15451	3534	3754	859
11	0.3648	0.3811	1.00	44787	84281	79085	16287	30748	28853	7582	7115
2+				1884222	1789074	1673635	320205	297811	270567	54668	47836
4+				1130221	1035073	919634	258218	237449	210205	53850	47018

Table 53. Fall spawner projection using split mesh size CUE indices ADAPT-VPA, beginning of year numbers and biomass are used..

	Weights		Average	Numbers			Biomass			Catch (t) F0.1	
Age	Begin	Catch	PR	1997	1998	1999	1997	1998	1999	1998	1999
2	0.0557	0.0886	0.02	433072	433072	433072	23513	24137	24137	221	221
3	0.1126	0.1398	0.04	335262	335262	335262	40086	37750	37750	537	537
4	0.1615	0.1922	0.14	798148	271758	271016	137170	43893	43773	2007	2002
5	0.2053	0.2234	0.71	534764	631624	213069	114194	129658	43738	24591	8295
6	0.2330	0.2457	1.00	77057	370490	418069	18792	86323	97408	21491	24251
7	0.2557	0.2674	1.00	115616	48938	224713	29889	12515	57465	3090	14188
8	0.2827	0.2943	1.00	24324	70195	29682	6839	19841	8390	4877	2062
9	0.3077	0.3196	1.00	55616	15417	42575	17130	4743	13099	1163	3212
10	0.3351	0.3449	1.00	51425	37580	9351	16924	12594	3134	3060	761
11	0.3648	0.3811	1.00	32102	57293	57543	11674	20902	20994	5154	5177
2+				2457386	2271627	2034352	416211	392355	349888	66192	60707
4+				1689052	1503293	1266018	352612	330468	288001	65433	59949

Table 54. Comparison of F0.1 levels between single CUE and split mesh size CUE models used for fall spawners in 1997. The comparison uses biomass for the relevant years using the estimates made in 1997 and not on retrospective analyses. The target has been assumed to be the same for each model, $F_{0.1}$=0.3 for fully recruited age.

	F0.1 Level (t)	
	Model	
Year / Année	Single CUE	Split Mesh Size CUE
1995	51,000	49,000
1996	41,000	38,000
1997	50,000	43,000
1998	54,500	66,000

Table 55. ADAPT input summary for fall herring Division 4T, 1997 using acoustic index.

Parameters:
- year-class estimates: N_i — I=3 - 10
- calibration constants: K_i — I=3 - 9 (acoustic index, 1990-1997)
- calibration constants: Ki — I=4-10 (CUE index, 1978-1997)

Strucuture:
- F for oldest age group (11+) assumed equal to F at age 10 (CALC-F-OLD)
- model did not include an intercept term (tested and found to be non-significant)

Input:
- $catch_{i,t}$ and $weight_{i,t}$ — i=2-11+, t=1978-1997
- log Numbers $_{i,y}$ — I=2 -11+, y=1990-1997 (acoustic index)
- log CPUE $_{i,x}$ — I=2-11+, x=1978-1997 (CPUE index)
- natural mortality=0.2

Objective function:

```
- minimize ΣΣ ((obs log CPUEi,x)-(pred log CPUEi,x)+(obs log Numbi,y)-(log pred Numbi,y))
```

Summary:
- number of parameters: 22
- number of observations: 196

Table 56. Diagnostics for ADAPT-VPA using acoustic index and single CUE index for fall spawners.

approximate statistics assuming linearity near solution

orthogonality offset 0.00149

mean square residuals 0.34778

	par est	std err	cv	t-stat	% bias
3	1663785.15	1064184.00	0.639616	1.563437	21.371941
4	476648.825	177802.155	0.373025	2.680782	7.422001
5	228430.037	77140.4673	0.337698	2.961222	5.433411
6	39033.9438	12948.4932	0.331724	3.014555	4.793603
7	124304.416	35866.8367	0.288540	3.465720	3.641968
8	31869.6819	8755.49091	0.274728	3.639965	3.205817
9	44050.6619	12928.5505	0.293493	3.407239	3.444975
10	56071.1481	16872.8647	0.300919	3.323155	3.394584
4	0.003933	0.000535	0.136145	7.345109	0.688229
5	0.007902	0.001069	0.135312	7.390352	0.766184
6	0.008990	0.001213	0.134984	7.408266	0.839494
7	0.010697	0.001440	0.134573	7.430905	0.875411
8	0.011968	0.001608	0.134317	7.445094	0.920280
9	0.011859	0.001589	0.134013	7.461985	0.962049
10	0.013091	0.001746	0.133334	7.499977	0.947996
3	0.001398	0.000335	0.239739	4.171210	2.139737
4	0.003862	0.000864	0.223699	4.470292	1.912430
5	0.004005	0.000884	0.220769	4.529616	2.082475
6	0.004233	0.000929	0.219522	4.555342	2.252130
7	0.003825	0.000833	0.217859	4.590134	2.314295
8	0.002759	0.000598	0.216815	4.612225	2.412932
9	0.002828	0.000610	0.215567	4.638926	2.500106

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00	0.09	0.07	0.06	0.05	0.05	0.03	0.03	-0.03	-0.02	-0.02	-0.01	-0.01	-0.01	-0.00	-0.37
2	0.09	1.00	0.10	0.08	0.07	0.06	0.05	0.04	-0.16	-0.03	-0.02	-0.02	-0.01	-0.01	-0.00	-0.25
3	0.07	0.10	1.00	0.10	0.09	0.07	0.06	0.05	-0.13	-0.14	-0.03	-0.02	-0.02	-0.01	-0.01	-0.19
4	0.06	0.08	0.10	1.00	0.10	0.09	0.06	0.06	-0.10	-0.11	-0.13	-0.03	-0.02	-0.01	-0.01	-0.15
5	0.05	0.07	0.09	0.10	1.00	0.10	0.08	0.07	-0.09	-0.10	-0.11	-0.12	-0.02	-0.02	-0.01	-0.14
6	0.05	0.06	0.07	0.09	0.10	1.00	0.10	0.09	-0.08	-0.08	-0.09	-0.11	-0.11	-0.02	-0.01	-0.12
7	0.03	0.05	0.06	0.06	0.08	0.10	1.00	0.10	-0.06	-0.06	-0.07	-0.08	-0.10	-0.12	-0.01	-0.09
8	0.03	0.04	0.05	0.06	0.07	0.09	0.10	1.00	-0.06	-0.06	-0.06	-0.07	-0.09	-0.11	-0.11	-0.09
9	-0.03	-0.16	-0.13	-0.10	-0.09	-0.08	-0.06	-0.06	1.00	0.04	0.03	0.02	0.02	0.01	0.01	0.08
10	-0.02	-0.03	-0.14	-0.11	-0.10	-0.08	-0.06	-0.06	0.04	1.00	0.03	0.02	0.02	0.01	0.01	0.06
11	-0.02	-0.02	-0.03	-0.13	-0.11	-0.09	-0.07	-0.06	0.03	0.03	1.00	0.03	0.02	0.01	0.01	0.05
12	-0.01	-0.02	-0.02	-0.03	-0.12	-0.11	-0.08	-0.07	0.02	0.02	0.03	1.00	0.02	0.02	0.01	0.04
13	-0.01	-0.01	-0.02	-0.02	-0.02	-0.11	-0.10	-0.09	0.02	0.02	0.02	0.02	1.00	0.02	0.01	0.03
14	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.12	-0.11	0.01	0.01	0.01	0.02	0.02	1.00	0.01	0.02
15	-0.00	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.11	0.01	0.01	0.01	0.01	0.01	0.01	1.00	0.01
16	-0.37	-0.25	-0.19	-0.15	-0.14	-0.12	-0.09	-0.09	0.08	0.06	0.05	0.04	0.03	0.02	0.01	1.00
17	-0.05	-0.24	-0.19	-0.15	-0.14	-0.12	-0.09	-0.09	0.08	0.06	0.04	0.03	0.03	0.02	0.01	0.12
18	-0.03	-0.05	-0.22	-0.17	-0.15	-0.13	-0.09	-0.09	0.06	0.06	0.05	0.04	0.03	0.02	0.01	0.09
19	-0.03	-0.04	-0.04	-0.21	-0.17	-0.14	-0.11	-0.10	0.05	0.05	0.06	0.04	0.03	0.02	0.01	0.07
20	-0.02	-0.03	-0.03	-0.04	-0.19	-0.17	-0.13	-0.11	0.04	0.04	0.04	0.05	0.04	0.02	0.01	0.06
21	-0.02	-0.02	-0.03	-0.03	-0.04	-0.18	-0.16	-0.14	0.03	0.03	0.03	0.04	0.04	0.03	0.02	0.04
22	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03	-0.18	-0.17	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.03

Table 56. (cont).

	17	18	19	20	21	22
1	-0.05	-0.03	-0.03	-0.02	-0.02	-0.01
2	-0.24	-0.05	-0.04	-0.03	-0.02	-0.01
3	-0.19	-0.22	-0.04	-0.03	-0.03	-0.02
4	-0.15	-0.17	-0.21	-0.04	-0.03	-0.02
5	-0.14	-0.15	-0.17	-0.19	-0.04	-0.02
6	-0.12	-0.13	-0.14	-0.17	-0.18	-0.03
7	-0.09	-0.09	-0.11	-0.13	-0.16	-0.18
8	-0.09	-0.09	-0.10	-0.11	-0.14	-0.17
9	0.08	0.06	0.05	0.04	0.03	0.02
10	0.06	0.06	0.05	0.04	0.03	0.02
11	0.04	0.05	0.06	0.04	0.03	0.02
12	0.03	0.04	0.04	0.05	0.04	0.02
13	0.03	0.03	0.03	0.04	0.04	0.03
14	0.02	0.02	0.02	0.02	0.03	0.03
15	0.01	0.01	0.01	0.01	0.02	0.02
16	0.12	0.09	0.07	0.06	0.04	0.03
17	1.00	0.09	0.07	0.05	0.04	0.03
18	0.09	1.00	0.08	0.06	0.04	0.03
19	0.07	0.08	1.00	0.07	0.05	0.03
20	0.05	0.06	0.07	1.00	0.06	0.04
21	0.04	0.04	0.05	0.06	1.00	0.05
22	0.03	0.03	0.03	0.04	0.05	1.00

residuals for calibration index 1

	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
4	1.03	0.68	0.17	0.69	-0.01	0.11	0.27	0.07	0.43	0.04	-0.06	0.51	0.40	0.43	-0.44	-0.85	-1.33	-1.08	-0.59	-0.47
5	0.09	0.17	0.14	0.22	-0.13	-0.54	-0.32	0.19	-0.64	-0.13	-0.11	0.22	0.02	0.09	0.13	0.26	-0.43	-0.39	0.37	0.80
6	-0.63	-0.20	-0.80	-0.35	0.12	0.19	-0.11	0.33	-0.19	-0.30	-0.17	0.36	0.24	0.07	0.25	0.20	0.23	-0.11	0.05	0.84
7	-0.63	-1.07	0.49	-0.36	-0.28	-0.18	-0.04	0.56	-0.12	0.00	-0.39	0.26	0.90	0.32	0.01	-0.00	0.33	0.44	-0.22	-0.03
8	1.01	-0.64	-0.64	0.27	-0.17	-0.14	-0.05	0.26	-0.21	-0.07	-0.50	-0.10	0.34	0.74	0.16	-0.32	0.28	0.09	0.15	-0.44
9	-0.70	-0.22	-0.88	0.15	0.27	-0.24	-0.72	0.64	-0.23	0.40	-0.26	0.03	0.20	0.38	0.62	-0.10	0.53	0.29	0.01	-0.17
10	0.08	0.92	0.47	0.00	-0.35	-0.19	-0.53	0.38	-1.27	-0.02	-0.30	-0.08	0.02	0.03	0.45	-0.34	0.53	0.40	0.38	-0.57

sum of residuals -0.0007

mean residual -507E-8

residuals for calibration index 2

	90	91	92	93	94	95	96	97
3	1.65	-0.47	-0.20	0.40	-0.79	-1.14	0.54	0.00
4	1.34	-1.36	-0.05	-0.06	0.70	-1.20	0.67	-0.05
5	0.40	-1.14	0.29	-0.61	0.82	-0.28	0.54	-0.01
6	0.48	-1.59	0.51	0.22	0.16	-0.62	0.61	0.23
7	0.61	-1.87	0.16	0.55	0.20	-0.22	0.52	0.05
8	0.94	-0.67	0.87	-1.84	0.27	-0.05	-0.48	0.97
9	0.87	-0.68	0.87	-0.93	0.19	-0.18	-0.12	0.64

sum of residuals 0.66996

mean residual 0.01196

Table 57. Fall spawner numbers, biomass, and fishing mortality for acoustic and single CUE ADAPT-VPA. ER=exploitation rate.

Numbers

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	141478	384505	328201	513921	771652	467380	498918	710479	468141	320768	348713	1154338	728474	341328	932739	173519	568378	922941		
3	148160	114433	307058	265917	420060	629886	381321	407546	580714	382364	261827	281627	944411	596367	279455	763559	142022	465335	755627	
4	99195	98145	78870	207957	207930	334575	507821	307813	329019	470803	303520	210159	229045	766134	482288	227993	623209	115998	378243	616231
5	79130	49914	52025	43762	138244	151615	248062	387167	236599	232939	345685	226368	155139	162148	570998	378069	181914	493662	87727	279159
6	28081	39747	20910	25287	28926	94387	111678	185769	287554	170886	159697	239568	159081	102362	117936	404059	277202	134767	345420	49318
7	22674	17817	14709	9043	17831	18613	63876	81759	133378	196967	112994	107294	162509	101637	75439	81665	288241	175949	89458	231770
8	29535	13413	9522	3009	6188	12072	12915	46037	56047	84451	120609	72022	71069	79459	71695	52486	58087	162851	92305	60100
9	4573	10787	6669	1773	1654	3993	8321	9219	31972	34993	48874	78393	45826	40627	51247	49021	37628	34247	85590	51261
10	2514	1921	3262	1367	762	884	2732	6318	5790	20732	18056	29651	51734	25216	27267	31940	35011	20772	19072	46063
11	29638	13093	1884	643	1185	1246	1417	3113	6177	8249	17656	21994	33490	50173	52783	49331	54178	48236	35814	28755
4+	295340	244837	187851	292841	402720	617385	956822	1027195	1086536	1220020	1127091	985449	907893	1327756	1449653	1274564	1555470	1186482	1133629	1362657
5+	196145	146692	108981	84884	194790	282810	449001	719382	757517	749217	823571	775290	678848	561622	967365	1046571	932261	1070484	755386	746426
7+	88934	57031	36046	15835	27620	36808	89261	146446	233364	345392	318189	309354	364628	297112	278431	264443	473145	442055	322239	417949

Biomass

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	14303	42565	36430	53345	89049	64545	62514	79289	53462	25565	33442	121667	114808	28686	61654	9058	51836	78819		
3	19888	14403	40040	38941	58820	91711	64003	65841	78826	60358	31404	36159	134523	92303	35159	73949	12023	48729	85774	
4	17910	17231	13829	39669	46134	71668	107623	68449	73304	93932	71904	44500	46658	156873	85693	36613	101083	18323	58523	105905
5	18607	11492	12049	10660	36422	40061	64205	102005	60909	59663	90615	61148	40355	39802	132035	82291	36994	97001	18054	59612
6	7597	10382	5185	7647	9153	28620	32569	55291	85978	49524	47155	71917	47939	28849	30554	100061	66447	30534	78942	12028
7	6584	5048	4022	2843	6475	6290	20950	27017	44290	64136	36737	35146	53550	32837	21968	21738	76081	45839	22198	59917
8	9118	4173	2618	1023	2357	4444	4744	16253	20018	29540	41932	24631	24920	27457	23594	15155	16402	46016	26236	16898
9	1500	3789	2092	565	646	1547	3198	3635	12009	12886	18342	28412	16221	14574	17620	16204	11653	10672	25965	15789
10	878	673	1125	482	289	323	1017	2331	2218	8021	7030	11588	19470	9317	9532	10225	11882	7112	6367	15159
11	10948	4755	696	242	502	498	566	1283	2498	3271	7115	8799	13198	19559	19519	16796	18168	17441	13225	10457
4+	73142	57543	41616	63131	101977	153450	234872	276266	301224	320974	320830	286141	262311	329269	340515	299083	338710	272939	249511	295765
5+	55232	40312	27787	23462	55843	81782	127249	207816	227920	227042	248927	241641	215652	172396	254821	262470	237627	254616	190988	189859
7+	29029	18438	10552	5156	10268	13101	30475	50520	81033	117855	111157	108576	127358	103745	92233	80117	134186	127080	93991	118220

Fishing Mortality

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
3	0.21	0.17	0.19	0.05	0.03	0.02	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01
4	0.49	0.44	0.39	0.21	0.12	0.10	0.07	0.06	0.15	0.11	0.09	0.10	0.15	0.09	0.04	0.03	0.03	0.08	0.10	0.05
5	0.49	0.67	0.52	0.21	0.18	0.11	0.09	0.10	0.13	0.18	0.17	0.15	0.22	0.12	0.15	0.11	0.10	0.16	0.38	0.35
6	0.26	0.79	0.64	0.15	0.24	0.19	0.11	0.13	0.18	0.21	0.20	0.19	0.25	0.11	0.17	0.14	0.26	0.21	0.20	0.43
7	0.33	0.43	1.39	0.18	0.19	0.17	0.13	0.18	0.26	0.29	0.25	0.21	0.52	0.15	0.16	0.14	0.37	0.45	0.20	0.14
8	0.81	0.50	1.48	0.40	0.24	0.17	0.14	0.17	0.27	0.35	0.23	0.25	0.36	0.24	0.18	0.13	0.33	0.44	0.39	0.10
9	0.67	1.00	1.39	0.64	0.43	0.18	0.08	0.27	0.23	0.46	0.30	0.22	0.40	0.20	0.27	0.14	0.39	0.39	0.42	0.21
10	0.71	1.91	1.91	0.34	0.25	0.21	0.09	0.23	0.18	0.30	0.29	0.24	0.34	0.16	0.29	0.21	0.42	0.47	0.46	0.20
11	0.71	1.91	1.91	0.34	0.25	0.21	0.09	0.23	0.18	0.30	0.29	0.24	0.34	0.16	0.29	0.21	0.42	0.47	0.46	0.20
Ave 5-9 F	0.51	0.68	1.08	0.32	0.26	0.16	0.11	0.17	0.21	0.30	0.23	0.20	0.35	0.16	0.19	0.13	0.29	0.33	0.32	0.24
Wt 4+ F	0.49	0.59	0.65	0.21	0.15	0.12	0.09	0.10	0.17	0.20	0.17	0.17	0.29	0.12	0.12	0.11	0.18	0.25	0.22	0.15
Ave 5-9 ER	40	49	66	27	23	15	10	15	19	26	20	18	29	15	17	12	25	28	27	22
Wt 4+ ER	39	44	48	19	14	11	8	10	16	18	16	16	25	11	12	10	16	22	20	14

Table 58. Comparison of landings recorded by hails and landings recorded by dockside monitors in spring 1997 fishery in 16C. Numbers in total row for % observed and % difference are averages.

Month / mois	Day / jour	No. fishers hailed / Nom. pêcheurs "hailé"	No. fishers observed / Nom. pêcheurs observes	% Observed(é)	Landings Observed/ Débarquements observé	Amount hailed by those observed / Montant hailé par ceux observés	% Diff.	Observed no. hail/ Observé aucun hail	
								No. Fishers / Nom. pêcheurs	Landings / Débarq.
April / avril	24	9	2	22	500	500	0	0	0
	25	1	0	0	0	0	0	0	0
	26	3	2	67	5625	3375	67	1	3375
	27	2	1	50	1000	1000	0	4	14250
	28	13	7	54	25500	32800	-22	11	23921
	29	1	0	0	0	0	0	0	0
	30	1	0	0	0	0	0	0	0
May / mai	1	9	2	22	23125	22750	2	11	68500
	2	24	0	0	0	0	0	0	0
	3	37	7	19	86750	88750	-2	0	0
	4	20	3	15	26000	26000	0	0	0
	4	47	13	28	187250	186000	1	8	120000
	6	68	44	65	583500	589250	-1	22	334250
	7	15	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0
	9	12	0	0	0	0	0	2	62625
	10	84	38	45	758375	739125	3	11	180975
	11	41	28	68	449500	499125	-10	17	259800
	12	61	28	46	329250	258875	27	11	127375
	13	78	31	40	460000	427000	8	15	219125
	17	1	0	0	0	0	0	0	0
	18	14	14	100	174250	163250	7	1	10375
	19	3	0	0	0	0	0	0	0
	20	14	9	64	75125	75625	-1	3	27625
	21	25	13	52	288250	258750	11	1	12125
	22	20	14	70	128500	118125	9	4	50750
	23	7	7	100	41375	43250	-4	5	29750
	24	6	3	50	12975	12975	0	4	14250
June / juin	1	9	8	89	74000	71875	3	7	50375
	2	22	8	36	38500	50250	-23	0	31750
	3	24	11	46	46250	27000	71	0	0
	4	11	8	73	24625	25750	-4	3	19250
	7	1	0	0	0	0	0	0	0
	8	8	8	100	33250	29750	12	6	14325
	9	4	4	100	13500	14625	-8	1	1125
	10	1	0	0	0	0	0	0	0
Total		696	313	45	3886975	3765775	3	148	1675896

Table 59. Comparison of landings recorded by hails and landings recorded by dockside monitors in spring 1997 fishery in the southeast New Brunswick portion of 16E. Numbers in total row for % observed and % difference are averages.

Month	Day / jour	No. fishers hailed	No. fishers observed	% Observed(é)	Landings Observed	Amount hailed by those observed	% Diff.	Observed no. hail/ Observé aucun hail	
								No. Fishers	Landings.
April	24	3	0	0	0	0	0	0	0
	26	4	0	0	0	0	0	0	0
	27	14	0	0	0	0	0	0	0
	28	19	0	0	0	0	0	0	0
	30	17	0	0	0	0	0	0	0
May	1	54	9	17	88875	88750	0	0	0
	2	92	23	25	247012	245500	1	17	199500
	3	116	19	16	191575	184750	4	0	0
	4	81	0	0	0	0	0	0	0
	5	85	0	0	0	0	0	4	23750
	6	101	0	0	0	0	0	0	0
	7	64	0	0	0	0	0	0	0
	8	3	0	0	0	0	0	0	0
	10	10	0	0	0	0	0	0	0
	11	3	0	0	0	0	0	0	0
	12	1	0	0	0	0	0	0	0
	13	1	0	0	0	0	0	0	0
	16	27	0	0	0	0	0	4	5625
	17	23	0	0	0	0	0	0	0
	19	44	23	52	189250	183313	3	8	62500
	20	38	5	13	14250	12000	19	0	0
	21	3	3	100	9625	8000	20	14	22375
	22	7	5	71	23750	23250	2	1	7600
	23	2	1	50	2000	2000	0	0	0
	24	1	0	0	0	0	0	0	0
June	1	6	0	0	0	0	0	0	0
	2	28	3	11	14750	9375	57	2	9500
	3	11	0	0	0	0	0	0	0
	4	9	0	0	0	0	0	0	0
	5	5	0	0	0	0	0	0	0
	6	5	2	40	600	563	7	2	450
	8	11	10	91	41890	42039	0	6	23290
	9	10	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	2	3375
	18	4	0	0	0	0	0	0	0
	28	4	0	0	0	0	0	0	0
	29	2	0	0	0	0	0	0	0
Total		908	103	11	823577	799540	3	60	357865

Table 60. Diagnostics for spring catch rate index using combined NB Provincial dockside monitoring (1990-1996) and 1997 dockside monitoring.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	13	213.16165	16.39705	15.708	0.0001
Error	395	412.32006	1.04385		
C Total	408	625.48171			

Root MSE	1.02169	R-square	0.3408
Dep Mean	4.56483	Adj R-sq	0.3191
C.V.	22.38176		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	5.707813	0.15926706	35.838	0.0001
YY90	1	-1.072102	0.25243466	-4.247	0.0001
YY91	1	-0.481025	0.19938149	-2.413	0.0163
YY92	1	-0.308090	0.19295859	-1.597	0.1111
YY93	1	-0.192677	0.18497590	-1.042	0.2982
YY95	1	-0.529855	0.19444032	-2.725	0.0067
YY96	1	-0.674019	0.20088785	-3.355	0.0009
YY97	1	-0.172320	0.17069041	-1.010	0.3133
A2	1	-1.235135	0.10488845	-11.776	0.0001
W2	1	-0.850571	0.24536823	-3.467	0.0006
W3	1	-0.376285	0.14781193	-2.546	0.0113
W5	1	-0.285716	0.14031248	-2.036	0.0424
W6	1	-0.293745	0.16944583	-1.734	0.0838
W7	1	0.509468	0.36145073	1.410	0.1595

Table 61. Spring abundance index derived from 16C and southeast New Brunswick sections of the spring gillnet fishery. Units are kg/fisher/net/trip.

	Year / Année							
Age	90	91	92	93	94	95	96	97
1	0	0	2	0	0	0	0	0
2	2	2	18	0	0	0	0	0
3	50	151	78	7	47	6	5	5
4	245	291	874	172	136	236	23	173
5	177	356	336	1003	681	210	715	134
6	59	220	220	456	1217	319	125	1190
7	53	84	100	172	232	464	207	251
8	83	77	50	71	114	94	150	164
9	45	114	54	52	31	38	52	120
10	17	54	54	43	32	19	15	41
11	5	27	50	54	41	39	24	8

Table 62. Acoustic survey catch-at-age for herring spring spawners, in Chaleur - Miscou strata, 1990-1997. Values are in numbers at age (x 1000) weighted by acoustic biomass estimate. Where samples during the acoustic survey were not available the following substitutions were made: Cape Breton strata for 1995 used the bottom trawl survey samples from eastern 4T in September to derive the catch-at-age, Cape Breton for 1996 used the seiner samples within one week of the survey, 1996 North PEI used 1996 bottom trawl survey samples for September. Blank year, indicates no survey.

Chaleur - Miscou (excludes Tracadie and Gaspé)

	Chaleur-Miscou							
AGE	1990	1991	1992	1993	1994	1995	1996	1997
0	29335	0	0	0	28994	186	58521	0
1	2875986	15299	91349	23362	748	17561	45237	9665
2	3112748	37000	59770	234348	3987	57445	359731	105449
3	182087	17476	33459	21532	143019	6338	125893	68610
4	12150	6386	81373	39138	56129	34369	23760	63282
5	5595	1753	18129	31446	47865	2623	98692	5309
6	15907	824	9172	0	41505	13666	4950	83464
7	0	1329	3316	0	10199	8205	16364	14948
8	0	945	3617	0	564	2884	6749	14617
9	5595	1267	2024	0	3592	1242	0	14199
10	0	431	2455	0	1698	0	0	0
11+	0	863	0	0	1764	0	0	0
Total	6239404	83575	304664	349826	340063	144520	739896	379544
4+	39247	13799	120086	70584	163315	62991	150515	195819

PEI (includes Milne)

AGE	1990	1991	1992	1993	1994	1995	1996	1997
0							2907	0
1							138472	169213
2							13319	97024
3							1634	15379
4							0	9949
5							8168	2418
6							0	0
7							2937	0
8							0	0
9							1073	0
10							0	0
11+							2492	0
Total							171000	293984
4+							14669	12367

4Vn

AGE	1990	1991	1992	1993	1994	1995	1996	1997
0	0	0	0	0		0	0	0
1	582	0	2850	837		3	0	0
2	8051	64	2894	2871		1978	545	2488
3	1333	44	3230	745		997	197	0
4	14756	0	1277	332		2234	0	0
5	5838	0	0	0		236	1809	0
6	1670	96	622	1434		351	0	0
7	8142	0	0	0		215	1428	0
8	0	0	0	0		0	0	0
9	2382	0	1293	0		0	0	0
10	1734	0	0	0		0	0	0
11+	0	0	0	0		0	0	0
Total	44488	204	12166	6219		6014	3978	2488
4+	34522	96	3191	1766		3036	3237	0

Total 4TVn

AGE	1990	1991	1992	1993	1994	1995	1996	1997
0	29335	0	0	0	28994	186	61428	0
1	2876569	15299	94199	24199	748	17564	183709	142948
2	3120799	37064	62664	237218	3987	59423	373595	184359
3	183420	17520	36689	22277	143019	7335	127724	80724
4	26906	6386	82649	39470	56129	36603	23760	71119
5	11433	1753	18129	31446	47865	2859	108669	7214
6	17576	920	9794	1434	41505	14018	4950	83464
7	8142	1329	3316	0	10199	8420	20729	14948
8	0	945	3617	0	564	2884	6749	14617
9	7977	1267	3317	0	3592	1242	1073	14199
10	1734	431	2455	0	1698	0	0	0
11+	0	863	0	0	1764	0	2492	0
Total	6283892	83778	316830	356044	340063	150534	914876	613591
4+	73769	13895	123277	72350	163315	66026	168421	205560

Table 63. Abundance index for spring spawners from acoustic survey using Chaleur-Miscou and 4Vn strata.

Age	1990	1991	1992	1993	1994	1995	1996	1997
0	29335	0	0	0	28994	186	58521	0
1	2876569	15299	94199	24199	748	17561	45237	9665
2	3120799	37064	62664	237218	3987	57445	359731	107937
3	183420	17520	36689	22277	143019	6338	125893	68610
4	26906	6386	82649	39470	56129	34369	23760	63282
5	11433	1753	18129	31446	47865	2623	98692	5309
6	17576	920	9794	1434	41505	13666	4950	83464
7	8142	1329	3316	0	10199	8205	16364	14948
8	0	945	3617	0	564	2884	6749	14617
9	7977	1267	3317	0	3592	1242	0	14199
10	1734	431	2455	0	1698	0	0	0
11	0	863	0	0	1764	0	0	0

Table 64. ADAPT input summary for spring herring Division 4T, 1997 using DMP CUE index.

Parameters:
- year-class estimates: N_i I=4 - 10
- calibration contants: K_i I=4 - 10

Strucuture:
- F for oldest age group (11+) assumed equal to F at age 10 (CALC-F-OLD)

Input:
- $catch_{i,t}$ and $weight_{i,t}$ i=2-11+, t=1978-1997
- log Numbers $_{at}$ I=2 -11+ t=1990-1997
- natural mortality=0.2

Objective function:
- minimize $\sum\sum(\text{observed log CPUE}_{i,t}) - (\text{predicted log CPUE}_{i,t})$

Summary:
- number of parameters: 14
- number of observations: 56

Table 65. Diagnostics for ADAPT-VPA spring spawners using DMP CUE index.

approximate statistics assuming linearity near solution

orthogonality offset 0.00236

mean square residuals 0.19097

	par est	std err	cv	t-stat	% bias
4	96763.8655	47793.0677	0.493914	2.024642	12.684227
5	13686.3809	5905.06301	0.431455	2.317737	8.498113
6	86106.3026	36327.7459	0.421894	2.370263	7.345327
7	16753.4753	6894.19333	0.411508	2.430085	6.585410
8	17851.9181	7011.10567	0.392737	2.546234	5.973158
9	18289.0447	6779.87587	0.370707	2.697549	5.358464
10	4867.41408	1832.21422	0.376425	2.656575	5.158299
4	0.001522	0.000273	0.179300	5.577252	0.688859
5	0.004605	0.000788	0.171104	5.844409	0.814827
6	0.005687	0.000960	0.168847	5.922531	0.996627
7	0.005824	0.000978	0.167908	5.955641	1.177606
8	0.005496	0.000917	0.166844	5.993622	1.342534
9	0.005892	0.000965	0.163831	6.103854	1.413859
10	0.006686	0.001069	0.159940	6.252363	1.412075

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	0.11	0.09	0.07	0.06	0.04	0.03	-0.38	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01
2	0.11	1.00	0.12	0.10	0.08	0.06	0.05	-0.28	-0.32	-0.07	-0.05	-0.04	-0.02	-0.01
3	0.09	0.12	1.00	0.13	0.10	0.08	0.06	-0.23	-0.25	-0.30	-0.07	-0.05	-0.03	-0.02
4	0.07	0.10	0.13	1.00	0.13	0.10	0.08	-0.19	-0.21	-0.24	-0.30	-0.06	-0.04	-0.02
5	0.06	0.08	0.10	0.13	1.00	0.13	0.10	-0.15	-0.16	-0.19	-0.24	-0.29	-0.05	-0.03
6	0.04	0.06	0.08	0.10	0.13	1.00	0.12	-0.11	-0.12	-0.14	-0.19	-0.24	-0.28	-0.03
7	0.03	0.05	0.06	0.08	0.10	0.12	1.00	-0.09	-0.10	-0.11	-0.14	-0.17	-0.22	-0.26
8	-0.38	-0.28	-0.23	-0.19	-0.15	-0.11	-0.09	1.00	0.17	0.12	0.10	0.07	0.04	0.02
9	-0.06	-0.32	-0.25	-0.21	-0.16	-0.12	-0.10	0.17	1.00	0.14	0.10	0.08	0.05	0.02
10	-0.05	-0.07	-0.30	-0.24	-0.19	-0.14	-0.11	0.12	0.14	1.00	0.12	0.09	0.06	0.03
11	-0.04	-0.05	-0.07	-0.30	-0.24	-0.19	-0.14	0.10	0.10	0.12	1.00	0.11	0.07	0.04
12	-0.03	-0.04	-0.05	-0.06	-0.29	-0.24	-0.17	0.07	0.08	0.09	0.11	1.00	0.09	0.05
13	-0.02	-0.02	-0.03	-0.04	-0.05	-0.28	-0.22	0.04	0.05	0.06	0.07	0.09	1.00	0.06
14	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.26	0.02	0.02	0.03	0.04	0.05	0.06	1.00

mean square residuals 0.19097

mean residual 0.00001

sum of all residuals 0.00075

residuals for calibration index 1

	90	91	92	93	94	95	96	97
4	0.58	0.43	0.62	-0.39	-0.03	-0.63	-0.58	0.00
5	-0.18	0.28	-0.20	-0.00	0.23	-0.34	-0.26	0.47
6	-0.96	0.35	0.06	0.34	0.48	-0.24	-0.59	0.56
7	-0.97	-0.23	0.06	0.30	0.20	0.15	-0.13	0.62
8	-0.35	-0.11	-0.28	0.27	0.61	-0.08	-0.30	0.25
9	-0.43	0.47	-0.06	0.18	-0.07	0.20	-0.17	-0.12
10	-0.58	0.27	0.28	0.25	0.29	0.10	-0.01	0.06

sum of residuals 0.6678

mean residual 0.01193

Table 66. Spring spawners beginning of year numbers and biomass, and fishing mortality using CUE index, ADAPT,VPA. ER=exploitation rate.

Numbers

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	92801	78924	59494	178513	242667	230727	279858	153120	107409	141130	172502	221587	540526	280550	153147	477267	45954			
3	51284	62051	51728	38738	141560	195103	184951	227378	123289	85793	114932	136267	181062	439318	228395	124046	390077	37588		
4	125732	31534	29598	20941	17031	91887	140396	145519	178355	92968	67610	89097	106369	142434	349753	182047	100767	314933	29358	112699
5	21152	65133	12017	6572	9463	9217	50388	100945	102914	124629	67052	46640	56177	71822	103421	254424	141406	75672	237381	20843
6	17156	13764	26332	2630	2547	6446	5231	33238	68757	69902	77786	43307	31780	34772	44157	71935	171003	86593	47701	142937
7	14633	7930	7407	8044	417	1634	4861	3924	22047	43521	43566	45146	27828	21875	19465	27616	41013	89805	50887	28141
8	4851	6082	3765	1224	3336	45	1231	3927	1981	14747	24939	24694	26803	19356	14144	12434	15631	23585	44479	26998
9	2986	2558	3219	617	210	2409	4	950	2586	772	7639	11892	14554	15800	11725	9704	7067	7076	13273	25915
10	4386	838	1600	707	93	0	1972	0	620	1912	165	3298	6074	8620	8321	7481	5016	4122	3525	7522
11	12588	5446	2196	1525	588	0	0	1613	1193	1150	2040	759	1880	4866	7418	9166	7793	6993	4443	2904
4+	203484	133285	86134	42260	33685	111638	204083	290116	378453	349601	290797	264833	271465	319545	558404	574807	489696	608779	431047	367959
5+	77752	101751	56536	21319	16654	19751	63687	144597	200098	256633	223187	175736	165096	177111	208651	392760	388929	293846	401689	255260
7+	39444	22854	18187	12117	4644	4088	8068	10414	28427	62102	78349	85789	77139	70517	61073	66401	76520	131581	116607	91480

Biomass

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	13329	11336	8545	25640	34854	33139	40196	21993	15427	20271	24776	31827	77636	40295	21997	68550	6600			
3	8060	8814	8177	6639	25161	31908	32570	40577	20654	13102	18133	19160	31945	72496	33280	15680	51513	5162		
4	23024	5510	5261	4123	3460	17808	25485	29613	35566	17178	13056	16446	20304	26015	58235	28435	15049	49976	4453	18628
5	4811	14664	2536	1618	2390	2148	10803	22510	24066	27171	15173	10283	12363	15165	20203	45950	24668	13161	41286	3751
6	4471	3383	6675	743	781	1733	1363	8263	17682	18204	19775	11204	7991	8305	10107	14988	33200	16813	9254	27504
7	4138	2245	1954	2425	146	517	1384	1201	6624	12043	12527	13125	7634	5812	4872	6655	8932	19223	10757	5835
8	1459	1893	1111	362	1187	13	420	1316	659	4574	7641	7581	8046	5465	3749	3261	3907	5587	10337	6099
9	990	835	1069	208	72	804	1	417	861	237	2520	3907	4557	4738	3425	2798	1991	1897	3251	6406
10	1503	263	576	250	36	0	754	0	252	569	55	1162	2017	2698	2536	2220	1535	1243	1007	1857
11	4579	1968	749	593	235	0	0	579	431	418	688	257	632	1607	2357	2824	2419	2153	1373	902
4+	44975	30761	19932	10322	8307	23025	40211	63899	86141	80394	71435	63965	63545	69804	105484	107130	91701	110054	81720	70981
5+	21951	25252	14670	6199	4847	5216	14726	34286	50574	63215	58379	47519	43241	43789	47249	78695	76652	60078	77266	52354
7+	12669	7205	5459	3838	1676	1335	2560	3513	8826	17841	23431	26031	22887	20320	16939	17758	18784	30104	26726	21099

Fishing Mortality

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	0.20	0.22	0.23	0.03	0.02	0.02	0.01	0.02	0.03	0.01	0.04	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01
3	0.29	0.54	0.70	0.62	0.23	0.13	0.04	0.04	0.08	0.04	0.06	0.05	0.04	0.03	0.03	0.01	0.01	0.05	0.03	0.01
4	0.46	0.77	1.31	0.59	0.41	0.40	0.13	0.15	0.16	0.13	0.17	0.26	0.19	0.12	0.12	0.05	0.09	0.08	0.14	0.09
5	0.23	0.71	1.32	0.75	0.18	0.37	0.22	0.18	0.19	0.27	0.24	0.18	0.28	0.29	0.16	0.20	0.29	0.26	0.31	0.32
6	0.57	0.42	0.99	1.64	0.24	0.08	0.09	0.21	0.26	0.27	0.34	0.24	0.17	0.38	0.27	0.36	0.44	0.33	0.33	0.39
7	0.68	0.55	1.60	0.68	2.02	0.08	0.01	0.48	0.20	0.36	0.37	0.32	0.16	0.24	0.25	0.37	0.35	0.50	0.43	0.40
8	0.44	0.44	1.61	1.56	0.13	2.12	0.06	0.22	0.74	0.46	0.54	0.33	0.33	0.30	0.18	0.37	0.59	0.38	0.34	0.28
9	1.07	0.27	1.32	1.69	11.17	0.00	10.40	0.23	0.10	1.34	0.64	0.47	0.32	0.44	0.25	0.46	0.34	0.50	0.37	0.21
10	0.95	0.87	0.73	1.15	12.44	0.01	0.00	0.11	0.26	0.21	0.88	0.58	0.30	0.41	0.35	0.57	0.41	0.73	0.65	0.24
11	0.95	0.87	0.73	1.15	12.44	0.01	0.00	0.11	0.26	0.21	0.88	0.58	0.30	0.41	0.35	0.57	0.41	0.73	0.65	0.24
ave 5-9	0.60	0.48	1.37	1.26	2.75	0.53	2.15	0.26	0.30	0.54	0.43	0.31	0.25	0.33	0.22	0.35	0.40	0.39	0.36	0.32
wt 4+	0.47	0.66	1.25	0.75	0.39	0.37	0.15	0.17	0.19	0.25	0.31	0.27	0.23	0.22	0.15	0.19	0.32	0.22	0.32	0.27
Ave 5-9 ER	45	38	74	72	94	41	88	23	26	42	35	27	22	28	20	30	33	33	30	27
Wt 4+ ER	37	48	71	53	33	31	14	16	17	22	26	24	20	20	14	17	27	20	27	24

Table 67. Spring spawner projection using CUE ADAPT-VPA, beginning of year numbers and bioimass were used.

	Weight		Average	Numbers			Biomass			Catch (t) $F_{0.1}$	
Age	Begin	Catch	PR	1997	1998	1999	1997	1998	1999	1998	1999
2	0.0994	0.1197	0.01	142986	142986	142986	16404	14217	14217	61	61
3	0.1284	0.1452	0.06	105529	105529	105529	13682	13553	13553	369	369
4	0.1586	0.1728	0.24	111594	84160	84108	18445	13344	13336	1332	1331
5	0.1764	0.1845	0.68	23883	82349	61955	4332	14527	10929	3557	2676
6	0.1935	0.2048	0.80	156630	14625	50088	30138	2830	9694	812	2781
7	0.2109	0.2182	1.00	30591	90838	8414	6343	19160	1775	6442	597
8	0.2317	0.2414	0.75	29468	16293	47898	6657	3776	11100	1005	2954
9	0.2534	0.2597	0.79	28725	17493	9600	7100	4433	2433	1214	666
10	0.2781	0.2835	0.79	8076	16756	10124	1993	4659	2815	1269	767
11	0.3093	0.3189	0.79	3118	4711	9698	969	1457	2999	401	826
2+				640601	575740	530401	106064	91957	82851	16462	13027
4+				392085	327225	281885	75978	64187	55081	16032	12598

Table 68. ADAPT input summary for spring herring Division 4T, 1997 using acoustic index and CUE index.

Parameters:
- year-class estimates: N_i i=2-6
- calibration constants (acoustic index): K_i i=2-6
- calibration constants (CUE index):Qi i=4-10

Strucuture:
- F for oldest age group (11+) assumed equal to F at age 10 (CALC-F-OLD)
- imposed PR as estimated by model using DMP index

Input:
- $catch_{i,t}$ and $weight_{i,t}$ I=2-11+, t=1978-1997
- log Acoustic Numbers $_{it}$ I=2 -11+ t=1990-1997
- log CUE $_{it}$ I=2-11+, t=1990-1997
- natural mortality=0.2

Objective function:
- minimize $\Sigma\Sigma$ ((observed log Numbers i,t)- (predicted log Numbers i,t) - (observed log CUE i,t)-(predicted log CUEi,t))

Summary:
- number of parameters: 21
- number of observations: 96

Table 69. Diagnostics for spring herring ADAPT-VPA model using acoustic and DMP CUE indices.

approximate statistics assuming linearity near solution

orthogonality offset 0.00287

mean square residuals 0.64565

	par est	std err	cv	t-stat	% bias
2	248735.829	218725.172	0.879347	1.137207	41.336915
3	435356.998	273984.503	0.629333	1.588984	22.243889
4	170893.807	79401.1872	0.464623	2.152283	12.707220
5	16526.4733	7689.88707	0.465307	2.149118	11.268141
6	159258.087	68057.5233	0.427341	2.340051	9.418106
7	14780.4268	9007.82365	0.609443	1.640843	13.821931
8	19969.0084	12063.2836	0.604100	1.655354	13.557958
9	25454.7285	14783.5699	0.580779	1.721826	13.008343
10	3948.51871	2839.08390	0.719025	1.390772	17.980469
4	0.001333	0.000410	0.307710	3.249815	2.828265
5	0.004272	0.001294	0.302995	3.300389	3.059458
6	0.005295	0.001599	0.301936	3.311961	3.362928
7	0.005771	0.001761	0.305213	3.276399	4.185504
8	0.005328	0.001621	0.304239	3.286888	4.612633
9	0.005768	0.001730	0.299912	3.334314	4.730464
10	0.006840	0.002023	0.295737	3.381386	4.924856
2	0.000042	0.000015	0.347525	2.877491	3.722941
3	0.000024	0.000008	0.322034	3.105258	2.966722
4	0.000027	0.000008	0.309054	3.235685	2.898154
5	0.000018	0.000006	0.306483	3.262829	3.276346
6	0.000020	0.000006	0.306231	3.265508	3.636270

Table 69. (cont).

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.03	-0.06	-0.05	-0.04	-0.04	-0.03	-0.02	-0.01
2	0.13	1.00	0.15	0.13	0.12	0.10	0.09	0.08	0.04	-0.08	-0.06	-0.05	-0.05	-0.04	-0.03	-0.01
3	0.11	0.15	1.00	0.17	0.16	0.14	0.12	0.10	0.06	-0.25	-0.08	-0.07	-0.06	-0.05	-0.03	-0.02
4	0.10	0.13	0.17	1.00	0.18	0.16	0.15	0.12	0.08	-0.22	-0.23	-0.08	-0.08	-0.06	-0.04	-0.02
5	0.09	0.12	0.16	0.18	1.00	0.19	0.17	0.15	0.10	-0.21	-0.21	-0.22	-0.09	-0.08	-0.05	-0.03
6	0.08	0.10	0.14	0.16	0.19	1.00	0.19	0.16	0.11	-0.18	-0.19	-0.21	-0.26	-0.08	-0.05	-0.03
7	0.07	0.09	0.12	0.15	0.17	0.19	1.00	0.18	0.12	-0.16	-0.17	-0.19	-0.23	-0.26	-0.06	-0.03
8	0.06	0.08	0.10	0.12	0.15	0.16	0.18	1.00	0.14	-0.14	-0.14	-0.16	-0.20	-0.23	-0.25	-0.04
9	0.03	0.04	0.06	0.08	0.10	0.11	0.12	0.14	1.00	-0.09	-0.10	-0.11	-0.14	-0.17	-0.21	-0.26
10	-0.06	-0.08	-0.25	-0.22	-0.21	-0.18	-0.16	-0.14	-0.09	1.00	0.11	0.09	0.09	0.07	0.05	0.02
11	-0.05	-0.06	-0.08	-0.23	-0.21	-0.19	-0.17	-0.14	-0.10	0.11	1.00	0.10	0.09	0.07	0.05	0.03
12	-0.04	-0.05	-0.07	-0.08	-0.22	-0.21	-0.19	-0.16	-0.11	0.09	0.10	1.00	0.10	0.08	0.06	0.03
13	-0.04	-0.05	-0.06	-0.08	-0.09	-0.26	-0.23	-0.20	-0.14	0.09	0.09	0.10	1.00	0.10	0.07	0.04
14	-0.03	-0.04	-0.05	-0.06	-0.08	-0.08	-0.26	-0.23	-0.17	0.07	0.07	0.08	0.10	1.00	0.08	0.04
15	-0.02	-0.03	-0.03	-0.04	-0.05	-0.05	-0.06	-0.25	-0.21	0.05	0.05	0.06	0.07	0.08	1.00	0.06
16	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.04	-0.26	0.02	0.03	0.03	0.04	0.04	0.06	1.00
17	-0.40	-0.33	-0.28	-0.24	-0.23	-0.20	-0.18	-0.15	-0.07	0.15	0.12	0.10	0.09	0.07	0.05	0.02
18	-0.09	-0.32	-0.27	-0.24	-0.22	-0.19	-0.17	-0.15	-0.10	0.15	0.12	0.10	0.09	0.08	0.05	0.03
19	-0.06	-0.08	-0.26	-0.23	-0.21	-0.19	-0.17	-0.14	-0.10	0.14	0.11	0.10	0.09	0.07	0.05	0.03
20	-0.05	-0.07	-0.09	-0.25	-0.22	-0.20	-0.18	-0.15	-0.10	0.12	0.12	0.10	0.10	0.08	0.05	0.03
21	-0.04	-0.06	-0.08	-0.09	-0.24	-0.24	-0.21	-0.18	-0.12	0.10	0.11	0.12	0.11	0.09	0.06	0.03

	17	18	19	20	21
1	-0.40	-0.09	-0.06	-0.05	-0.04
2	-0.33	-0.32	-0.08	-0.07	-0.06
3	-0.28	-0.27	-0.26	-0.09	-0.08
4	-0.24	-0.24	-0.23	-0.25	-0.09
5	-0.23	-0.22	-0.21	-0.22	-0.24
6	-0.20	-0.19	-0.19	-0.20	-0.24
7	-0.18	-0.17	-0.17	-0.18	-0.21
8	-0.15	-0.15	-0.14	-0.15	-0.18
9	-0.07	-0.10	-0.10	-0.10	-0.12
10	0.15	0.15	0.14	0.12	0.10
11	0.12	0.12	0.11	0.12	0.11
12	0.10	0.10	0.10	0.10	0.12
13	0.09	0.09	0.09	0.10	0.11
14	0.07	0.08	0.07	0.08	0.09
15	0.05	0.05	0.05	0.05	0.06
16	0.02	0.03	0.03	0.03	0.03
17	1.00	0.22	0.15	0.13	0.11
18	0.22	1.00	0.15	0.13	0.11
19	0.15	0.15	1.00	0.12	0.11
20	0.13	0.13	0.12	1.00	0.11
21	0.11	0.11	0.11	0.11	1.00

Table 69. (cont).

residuals for calibration index 1

	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
4	-27.9	-26.4	-26.1	-26.0	-25.9	-27.6	-28.1	-28.1	-28.3	-27.7	-27.4	-27.6	0.71	0.59	0.68	-0.29	0.15	-0.85	-0.58	-0.42
5	-27.4	-28.3	-26.3	-26.0	-26.6	-26.5	-28.2	-28.9	-29.0	-29.1	-28.5	-28.2	-0.10	0.35	-0.09	-0.01	0.27	-0.22	-0.59	0.39
6	-27.2	-27.1	-27.5	-24.9	-25.4	-26.4	-26.2	-28.0	-28.7	-28.7	-28.8	-28.3	-0.89	0.42	0.13	0.46	0.44	-0.22	-0.45	0.11
7	-27.1	-26.5	-26.0	-26.5	-23.0	-25.2	-26.3	-25.9	-27.7	-28.3	-28.3	-28.4	-0.96	-0.23	0.07	0.31	0.27	-0.01	-0.19	0.73
8	-26.0	-26.2	-25.3	-24.2	-25.8	-20.6	-24.8	-25.9	-25.0	-27.1	-27.6	-27.7	-0.32	-0.08	-0.25	0.30	0.64	0.04	-0.51	0.18
9	-25.3	-25.5	-25.3	-23.5	-18.5	-25.6	-14.9	-24.5	-25.6	-23.9	-26.5	-27.0	-0.41	0.49	-0.04	0.20	-0.05	0.22	-0.02	-0.40
10	-25.9	-24.3	-25.0	-24.0	-17.3	-11.9	-25.5	-8.80	-24.3	-25.4	-22.7	-25.8	-0.69	0.16	0.18	0.15	0.19	-0.01	-0.12	0.14

sum of residuals -2159.9

mean residual -15.428

residuals for calibration index 2

	90	91	92	93	94	95	96	97
2	2.73	-1.02	0.17	-0.03	-1.58	-0.71	0.45	0.01
3	1.68	-1.67	-0.25	-0.09	0.24	-0.32	0.85	-0.44
4	0.25	-1.51	0.03	-0.07	0.97	-1.09	1.16	0.26
5	0.51	-1.61	0.30	-0.16	0.96	-1.25	0.75	0.50
6	1.42	-1.45	0.59	-1.70	0.68	0.21	-0.09	0.99

sum of residuals 0.67988

mean residual 0.017

Table 70. Spring spawner beginning of year numbers and biomass, and fishing mortality for CUE and acoustic indices ADAPT-VPA. ER= exploitation rate.

Numbers

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	92801	78924	59494	178513	242667	230727	279858	153120	107409	141130	172502	216034	564439	282479	143476	652384	50714	291755	506649	178405
3	51284	62051	51728	38738	141560	195103	184951	227378	123289	85793	114932	136267	176516	458896	229974	116128	533451	41486	237968	414563
4	125732	31534	29598	20941	17031	91887	140396	145519	178355	92968	67610	89097	106369	138711	365782	183340	94284	432317	32549	191581
5	21152	65133	12017	6572	9463	9217	50388	100945	102914	124629	67052	46640	56177	71822	100373	267548	142465	70365	333487	23456
6	17156	13764	26332	2630	2547	6446	5231	33238	68757	69902	77786	43307	31780	34772	44157	69440	181748	87459	43356	221622
7	14633	7930	7407	8044	417	1634	4861	3924	22047	43521	43566	45146	27828	21875	19465	27616	38971	98602	51596	24584
8	4851	6082	3765	1224	3336	45	1231	3927	1981	14747	24939	24694	26803	19356	14144	12434	15631	21912	51681	27579
9	2986	2558	3219	617	210	2409	4	950	2586	772	7639	11892	14554	15800	11725	9704	7067	7076	11903	31812
10	4386	838	1600	707	93	0	1972	0	620	1912	165	3298	6074	8620	8321	7481	5016	4122	3525	6401
11	12588	5446	2196	1525	588	0	0	1613	1193	1150	2040	759	1880	4866	7418	9166	7793	6993	4443	2471
4+	203484	133285	86134	42260	33685	111638	204083	290116	378453	349601	290797	264833	271465	315822	571385	586729	492975	728846	532540	529506
5+	77752	101751	56536	21319	16654	19751	63687	144597	200098	256633	223187	175736	165096	177111	205603	403389	398691	296529	499991	337925
7+	39444	22854	18187	12117	4644	4088	8068	10414	28427	62102	78349	85789	77139	70517	61073	66401	74478	138705	123148	92847

Biomass

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	13329	11336	8545	25640	34854	33139	40196	21993	15427	20271	24776	31029	81070	40572	20607	93702	7284	41905	72770	25624
3	8060	8814	8177	6639	25161	31908	32570	40577	20654	13102	18133	19160	31143	75727	33510	14679	70447	5698	28152	52392
4	23024	5510	5261	4123	3460	17808	25485	29613	35566	17178	13056	16446	20304	25335	60904	28637	14081	68604	4937	31666
5	4811	14664	2536	1618	2390	2148	10803	22510	24066	27171	15173	10283	12363	15165	19607	48320	24853	12238	58001	4222
6	4471	3383	6675	743	781	1733	1363	8263	17682	18204	19775	11204	7991	8305	10107	14468	35286	16981	8411	42644
7	4138	2245	1954	2425	146	517	1384	1201	6624	12043	12527	13125	7634	5812	4872	6655	8487	21106	10907	5097
8	1459	1893	1111	362	1187	13	420	1316	659	4574	7641	7581	8046	5465	3749	3261	3907	5191	12011	6230
9	990	835	1069	208	72	804	1	417	861	237	2520	3907	4557	4738	3425	2798	1991	1897	2916	7863
10	1503	263	576	250	36	0	754	0	252	569	55	1162	2017	2698	2536	2220	1535	1243	1007	1580
11	4579	1968	749	593	235	0	0	579	431	418	688	257	632	1607	2357	2824	2419	2153	1373	768
4+	44975	30761	19932	10322	8307	23025	40211	63899	86141	80394	71435	63965	63545	69124	107558	109182	92559	129414	99564	100070
5+	21951	25252	14670	6199	4847	5216	14726	34286	50574	63215	58379	47519	43241	43789	46654	80546	78478	60810	94626	68404
7+	12669	7205	5459	3838	1676	1335	2560	3513	8826	17841	23431	26031	22887	20320	16939	17758	18339	31591	28215	21539

Fishing Mortality

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
2	0.20	0.22	0.23	0.03	0.02	0.02	0.01	0.02	0.03	0.01	0.04	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
3	0.29	0.54	0.70	0.62	0.23	0.13	0.04	0.04	0.08	0.04	0.06	0.05	0.04	0.03	0.03	0.01	0.01	0.04	0.02	0.00
4	0.46	0.77	1.31	0.59	0.41	0.40	0.13	0.15	0.16	0.13	0.17	0.26	0.19	0.12	0.11	0.05	0.09	0.06	0.13	0.05
5	0.23	0.71	1.32	0.75	0.18	0.37	0.22	0.18	0.19	0.27	0.24	0.18	0.28	0.29	0.17	0.19	0.29	0.28	0.21	0.28
6	0.57	0.42	0.99	1.64	0.24	0.08	0.09	0.21	0.26	0.27	0.34	0.24	0.17	0.38	0.27	0.38	0.41	0.33	0.37	0.24
7	0.68	0.55	1.60	0.68	2.02	0.08	0.01	0.48	0.20	0.36	0.37	0.32	0.16	0.24	0.25	0.37	0.38	0.45	0.43	0.47
8	0.44	0.44	1.61	1.56	0.13	2.12	0.06	0.22	0.74	0.46	0.54	0.33	0.33	0.30	0.18	0.37	0.59	0.41	0.29	0.28
9	1.07	0.27	1.32	1.69	11.17	0.00	10.40	0.23	0.10	1.34	0.64	0.47	0.32	0.44	0.25	0.46	0.34	0.50	0.42	0.17
10	0.95	0.87	0.73	1.15	12.44	0.01	0.00	0.11	0.26	0.21	0.88	0.58	0.30	0.41	0.35	0.57	0.41	0.73	0.65	0.29
11	0.95	0.87	0.73	1.15	12.44	0.01	0.00	0.11	0.26	0.21	0.88	0.58	0.30	0.41	0.35	0.57	0.41	0.73	0.65	0.29
ave 5-9	0.60	0.48	1.37	1.26	2.75	0.53	2.15	0.26	0.30	0.54	0.43	0.31	0.25	0.33	0.22	0.35	0.40	0.39	0.34	0.28
wt 4+	0.47	0.66	1.25	0.75	0.39	0.37	0.15	0.17	0.19	0.25	0.31	0.27	0.23	0.23	0.14	0.18	0.31	0.18	0.25	0.18
Ave 5-9 ER	45	38	74	72	94	41	88	23	26	42	35	27	22	28	20	30	33	32	29	25
Wt 4+ ER	37	48	71	53	33	31	14	16	17	22	26	24	20	20	13	17	27	17	22	16

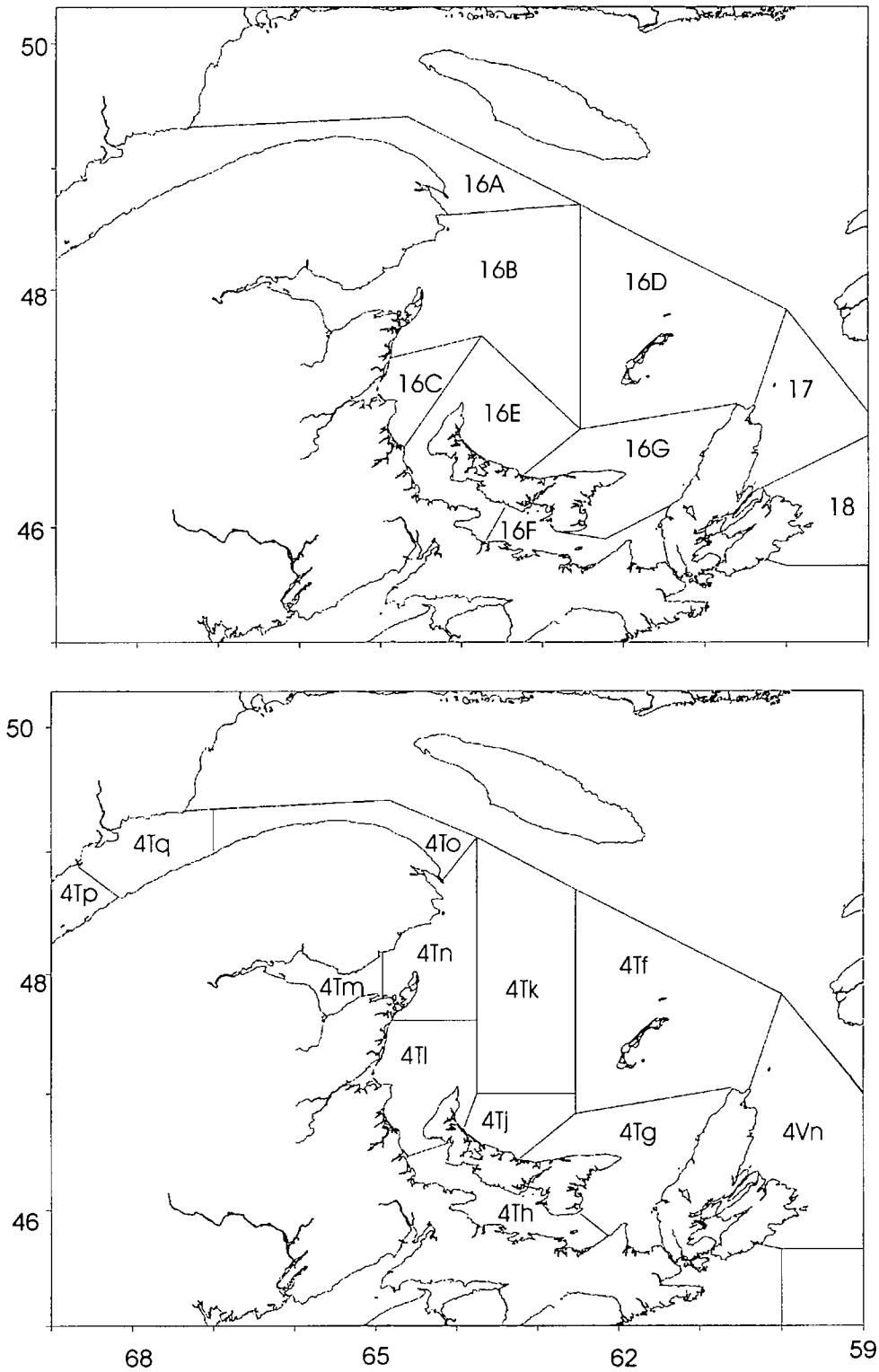


Fig. 1. Herring 4T managment zones (upper) and Northwest Atlantic Fisheries Organization (NAFO) unit areas in 4T (lower)

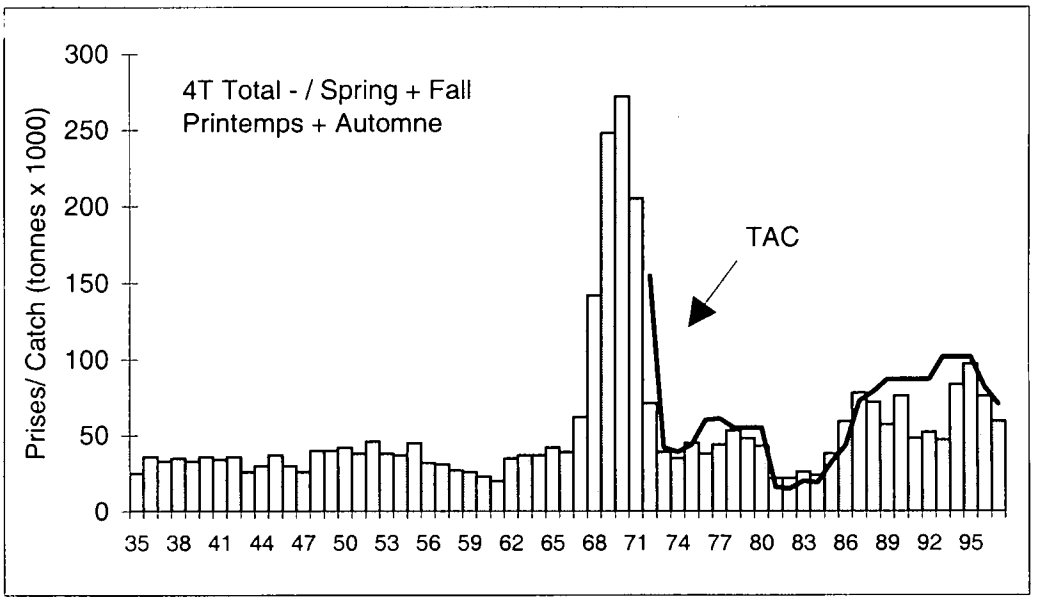


Fig. 2. Combined catch of spring and fall spawners compared to overall TAC (4T only, excluding 4Vn) from 1935 to 1997.

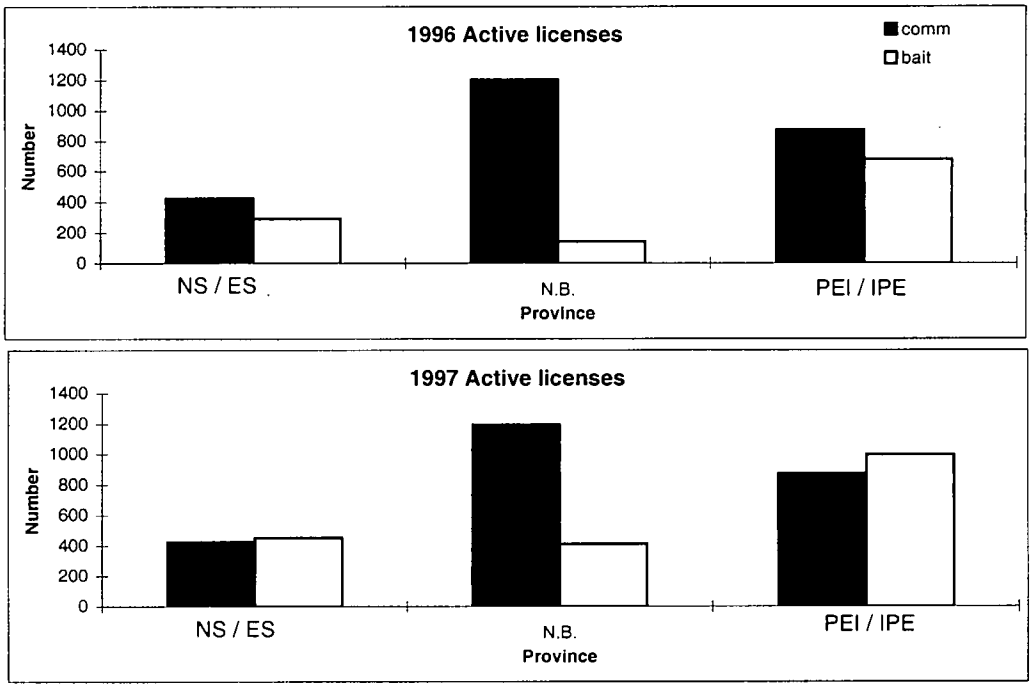


Fig. 3. Number of bait and commercial licenses for 4T areas of New Brunswick, Nova Scotia, and Prince Edward Island in 1996 and 1997.

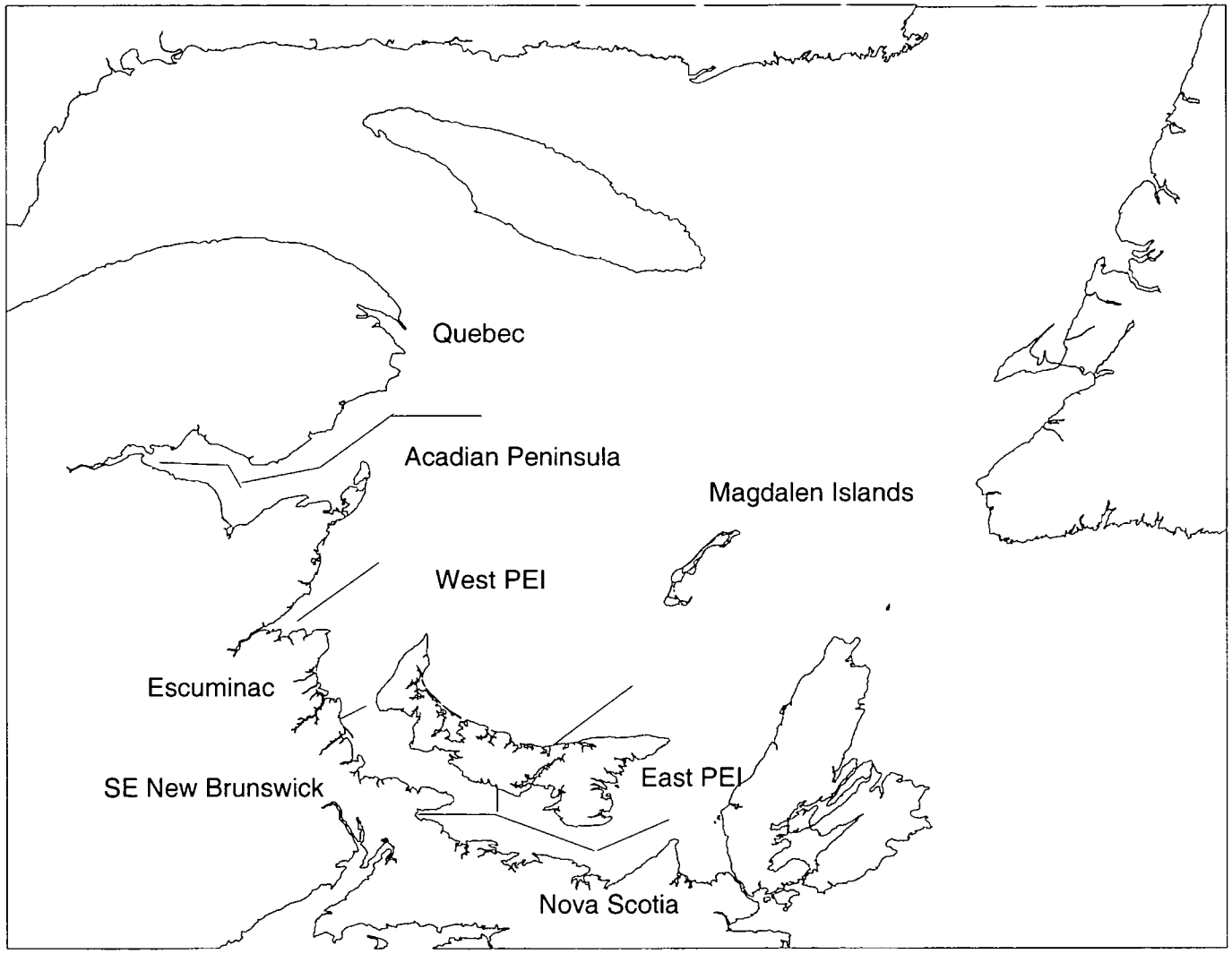


Fig. 4. Geographic ares in the southern Gulf of St. Lawrence used in the herring gillnet fishery telephone survey.

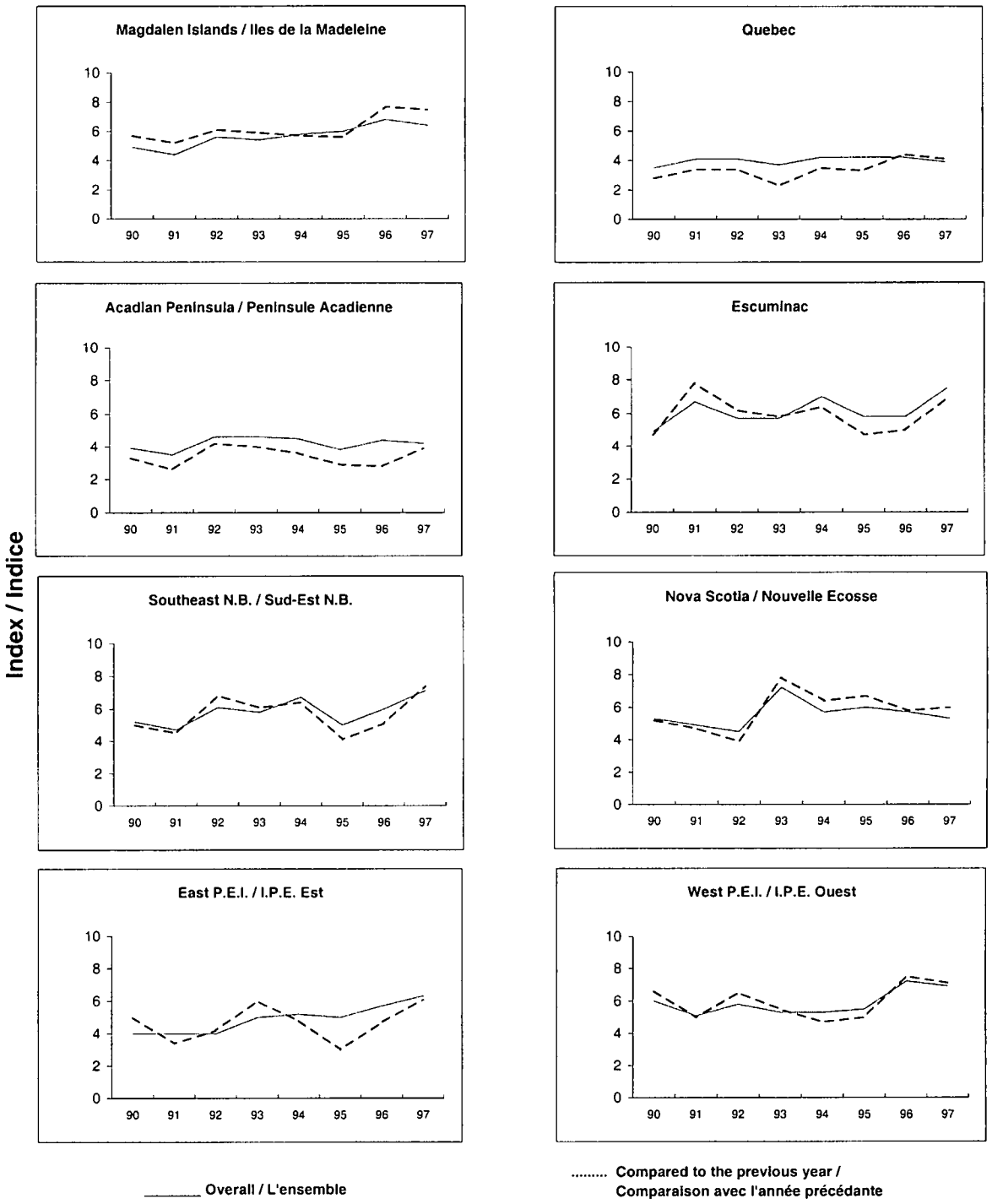


Fig. 5. Spring indices of abundance by area from phone survey
Fig. 5. Indices d'abondance au printemps d'après le sondage

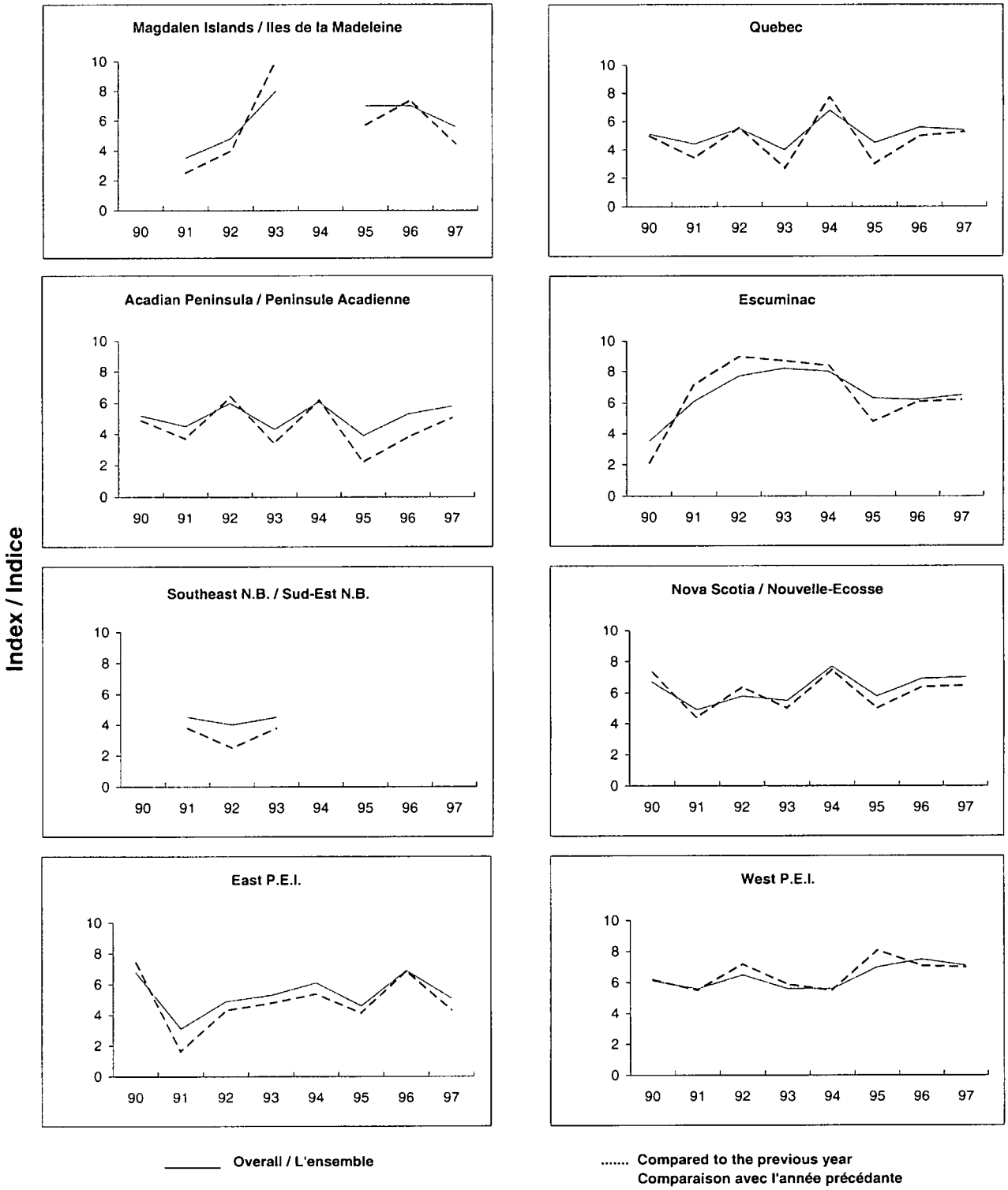


Fig. 6. Fall indices of abundance by area from phone survey
Fig. 6. Indices d'abondance de l'automne d'après le sondage

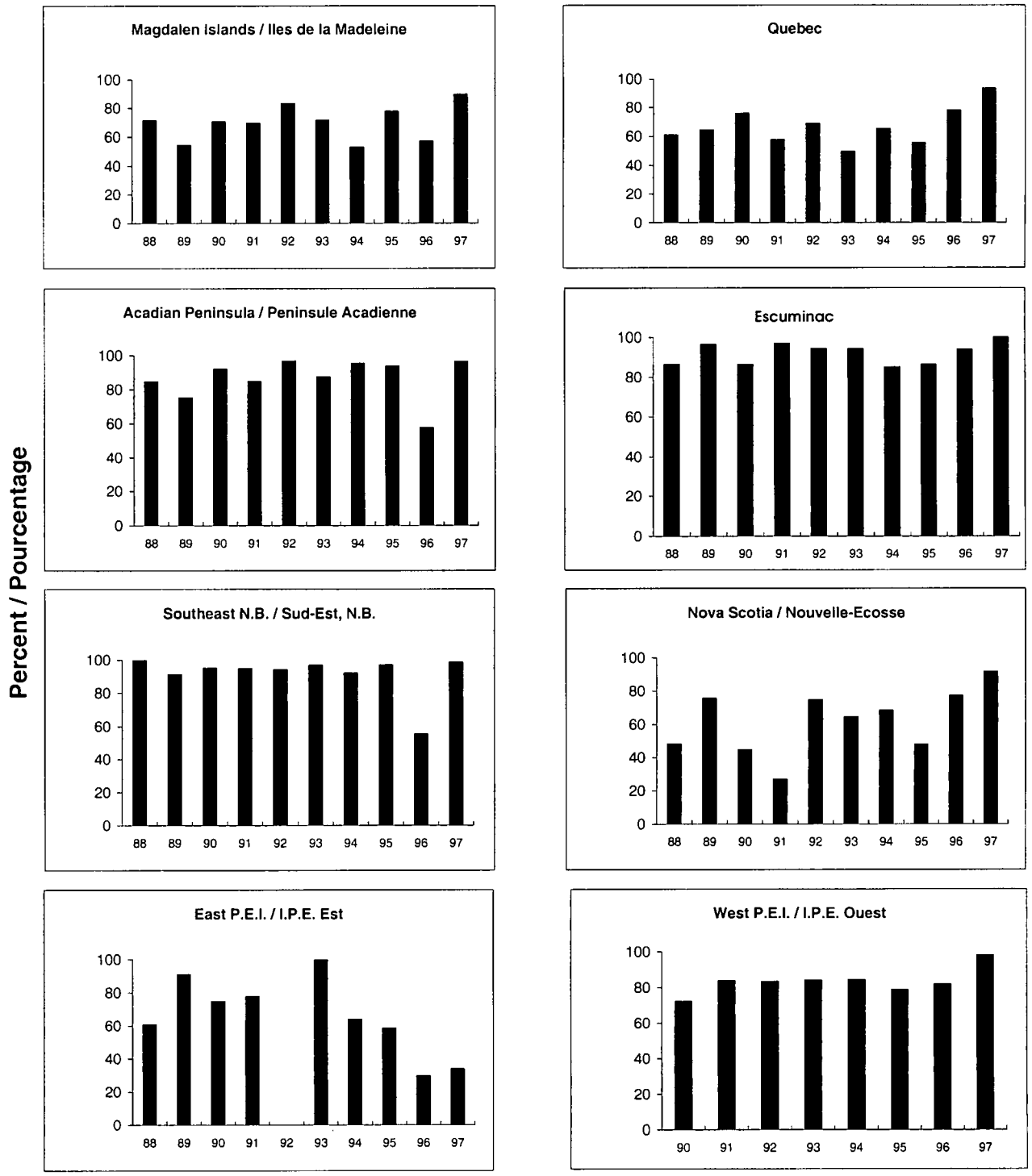


Fig. 7. Percent of nets fished that are between 2 1/4" and 2 1/2" mesh in the 4T spring fishery.

Fig. 7. Pourcentage de filets pêchés avec mailles entre 2 1/4" et 2 1/2" dans la zone 4T - printemps.

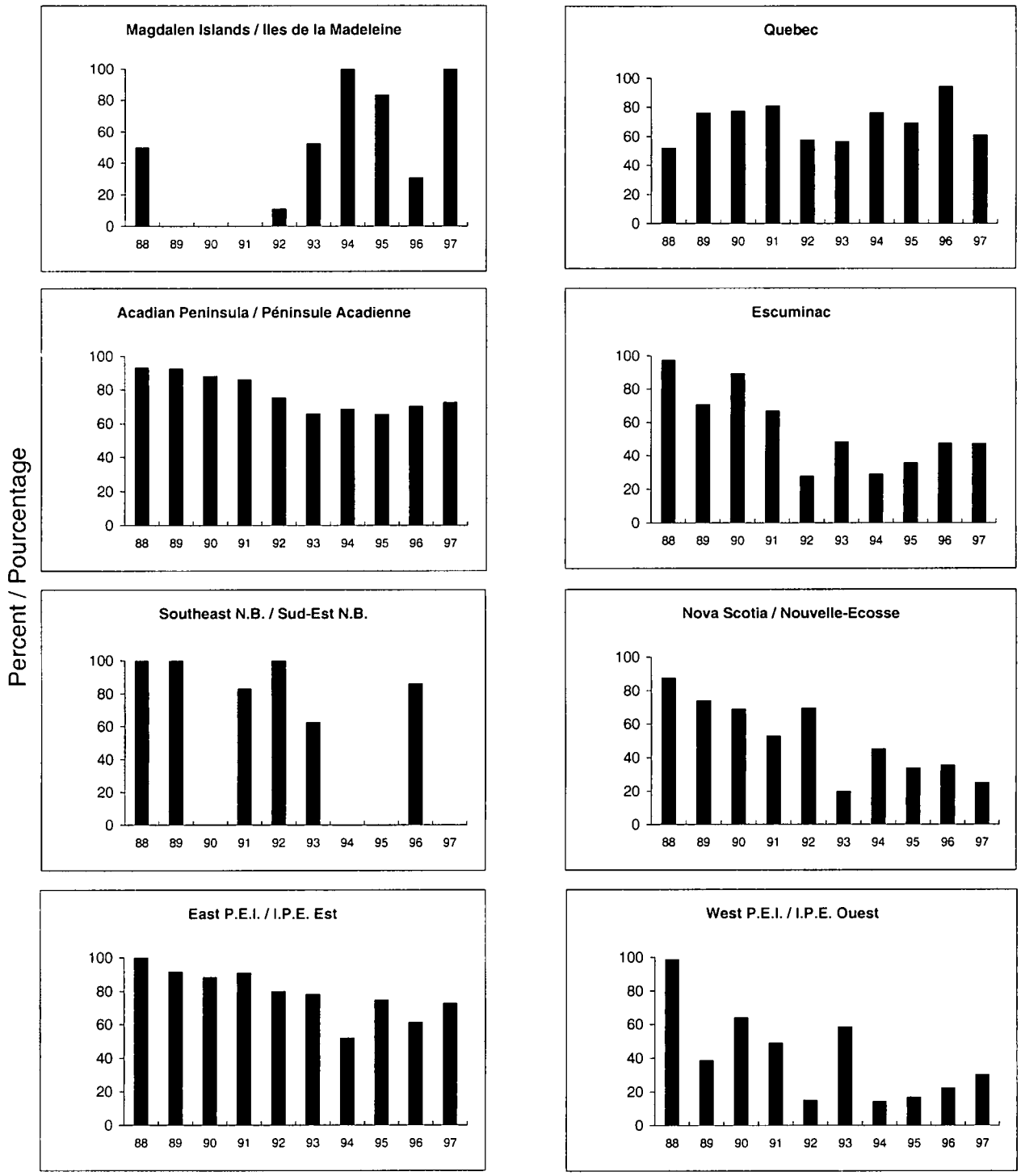


Fig. 8. Percent of nets fished that are 2 5/8" mesh in the 4T fall fishery
Fig. 8. Pourcentage des filets pêchés avec mailles de 2 5/8"dans la zone 4T - automne.

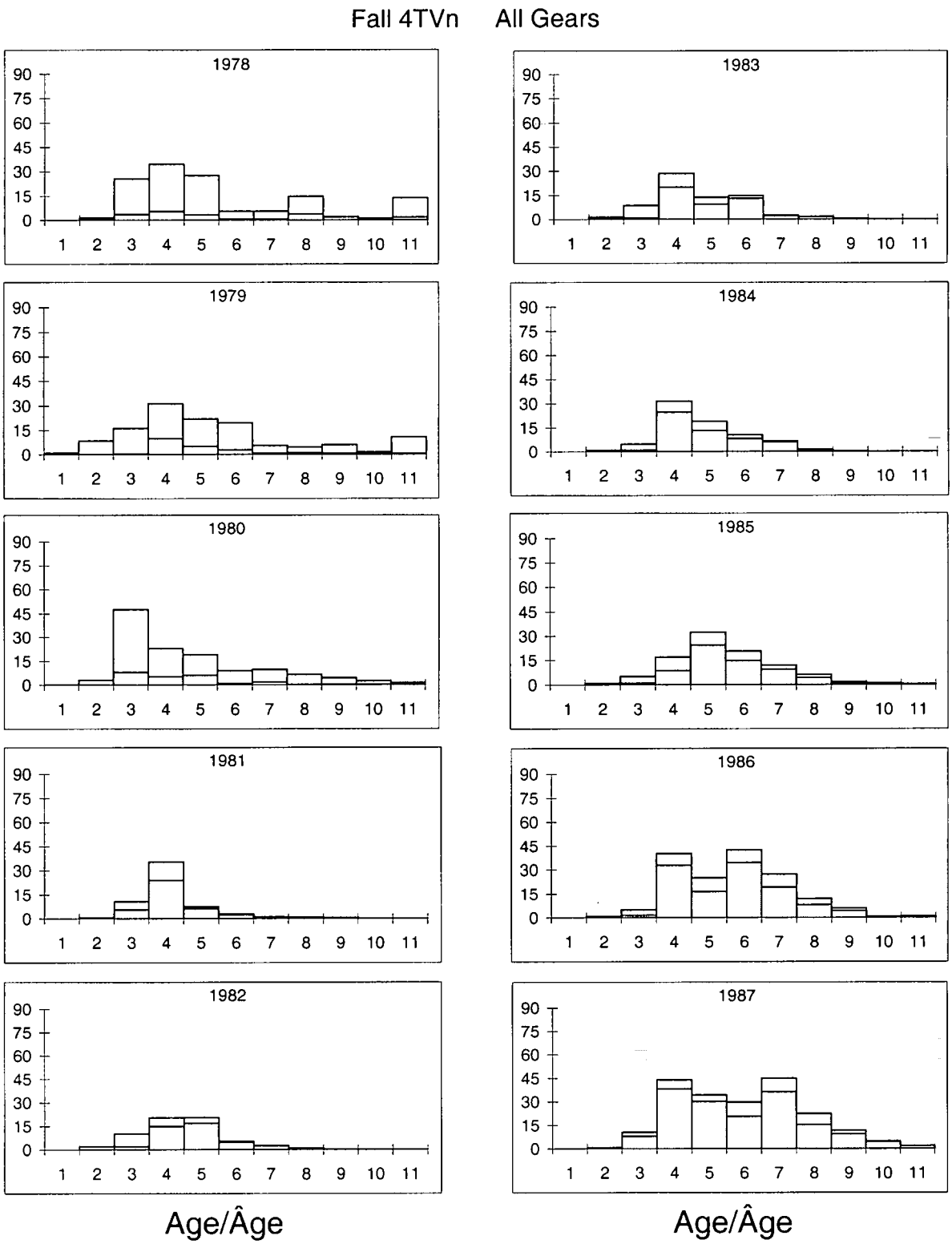


Fig. 9. Fall spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

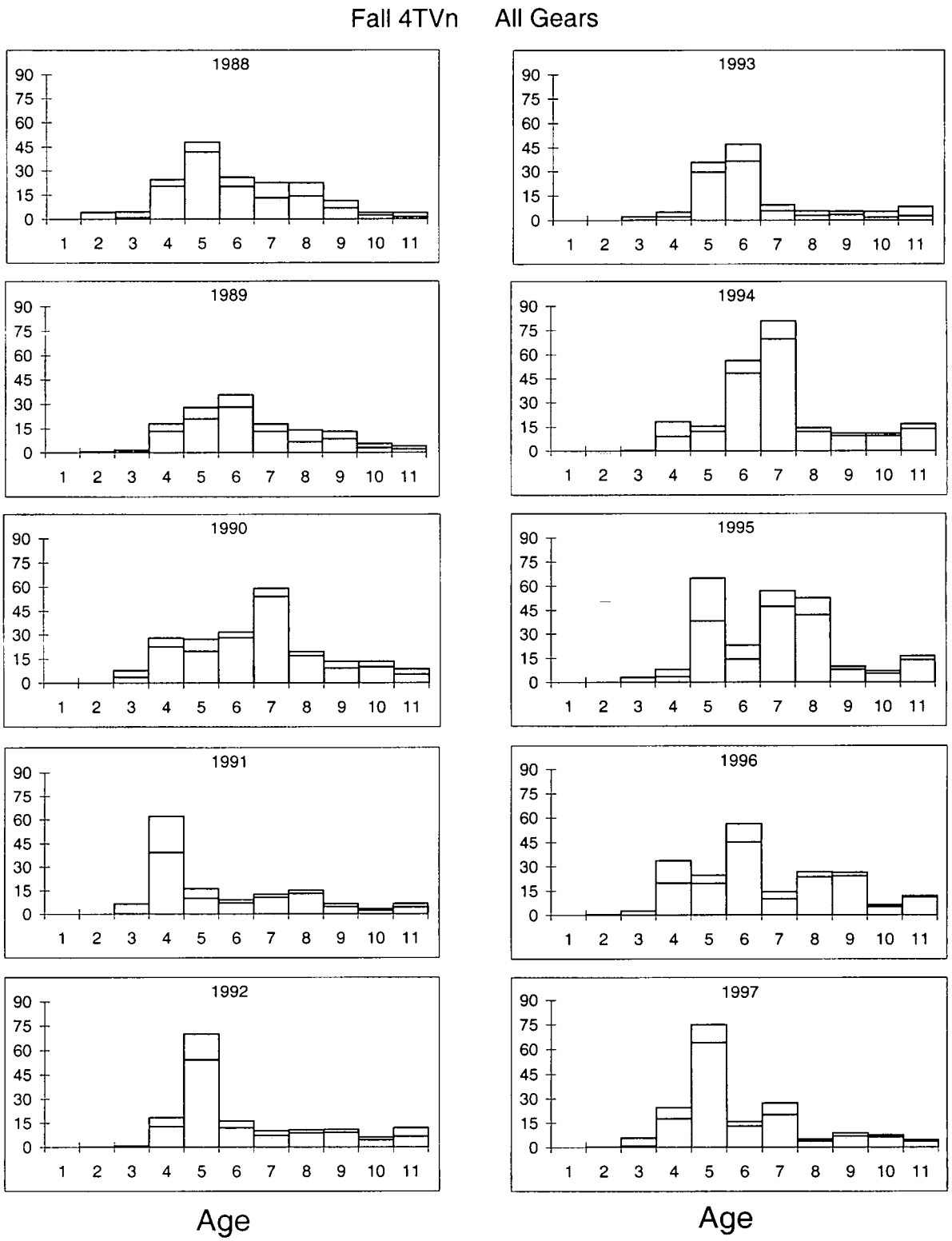


Fig. 9. (continued) Fall spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

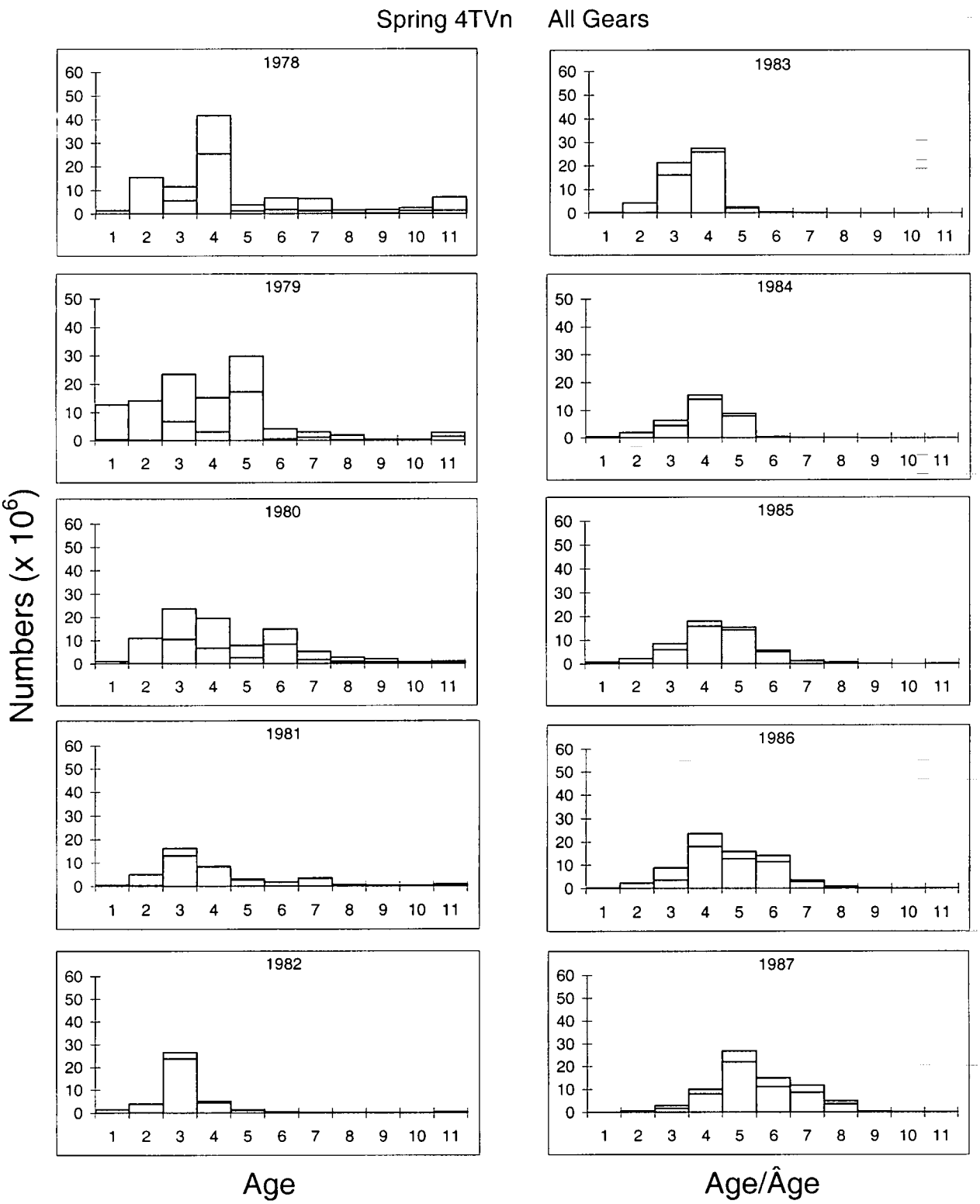


Fig. 10. Spring spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

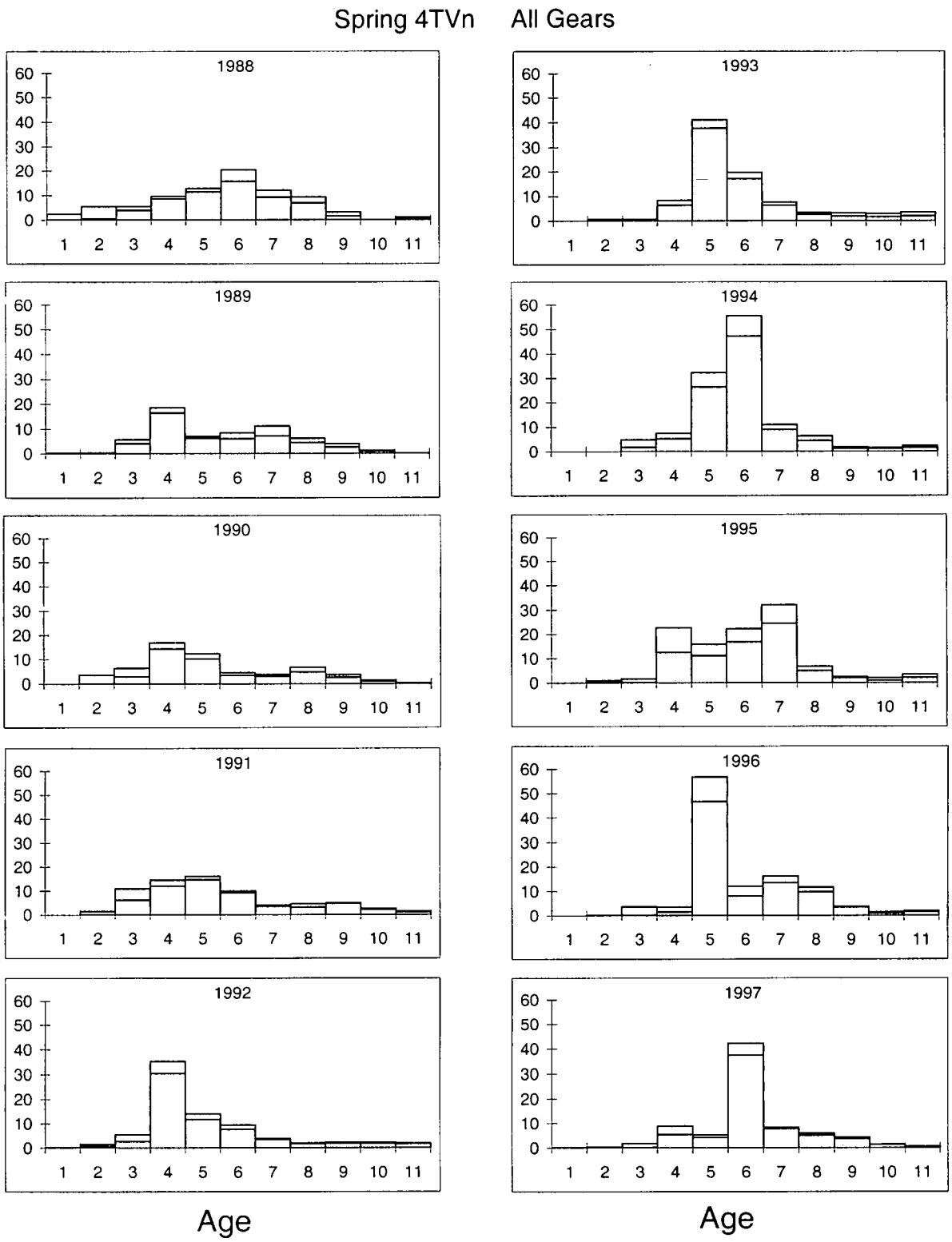


Fig. 10. (continued) Spring spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

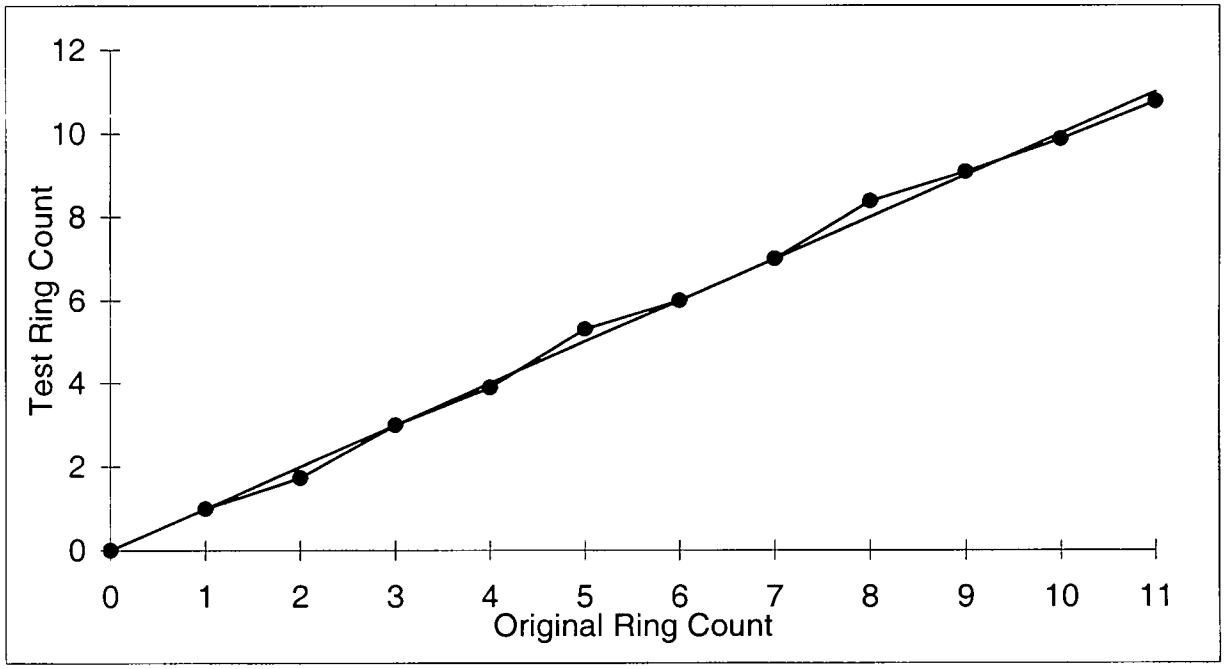


Fig. 11. Bias plot from aging consistency test.

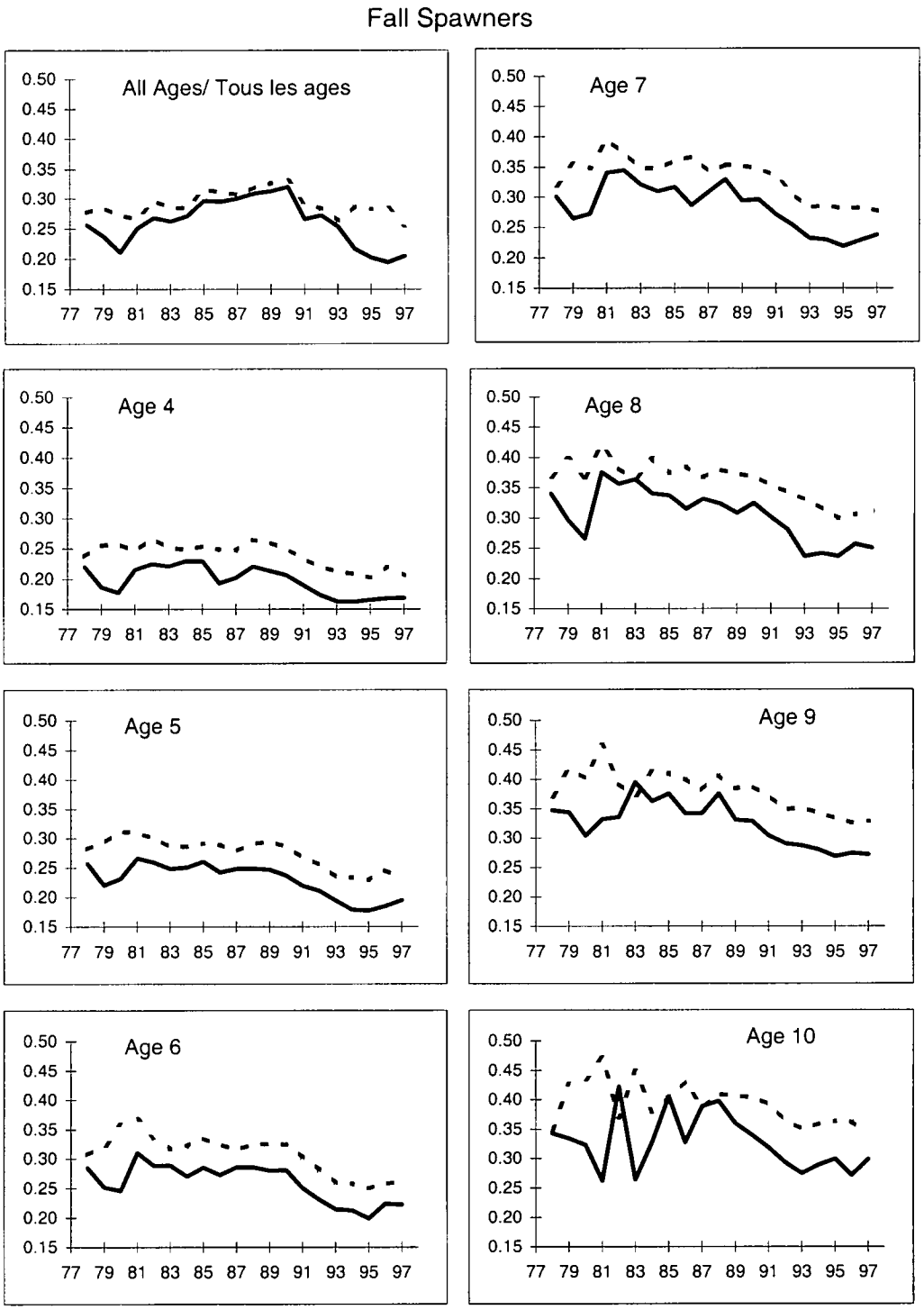


Fig. 12. Fall Spawners mean weight-at-age for all gears and for fixed and mobile gears, ages 4-10. Dotted line is fixed gear and solid line is mobile gear. Weight is in kilograms.

Spring Spawners
All Gears

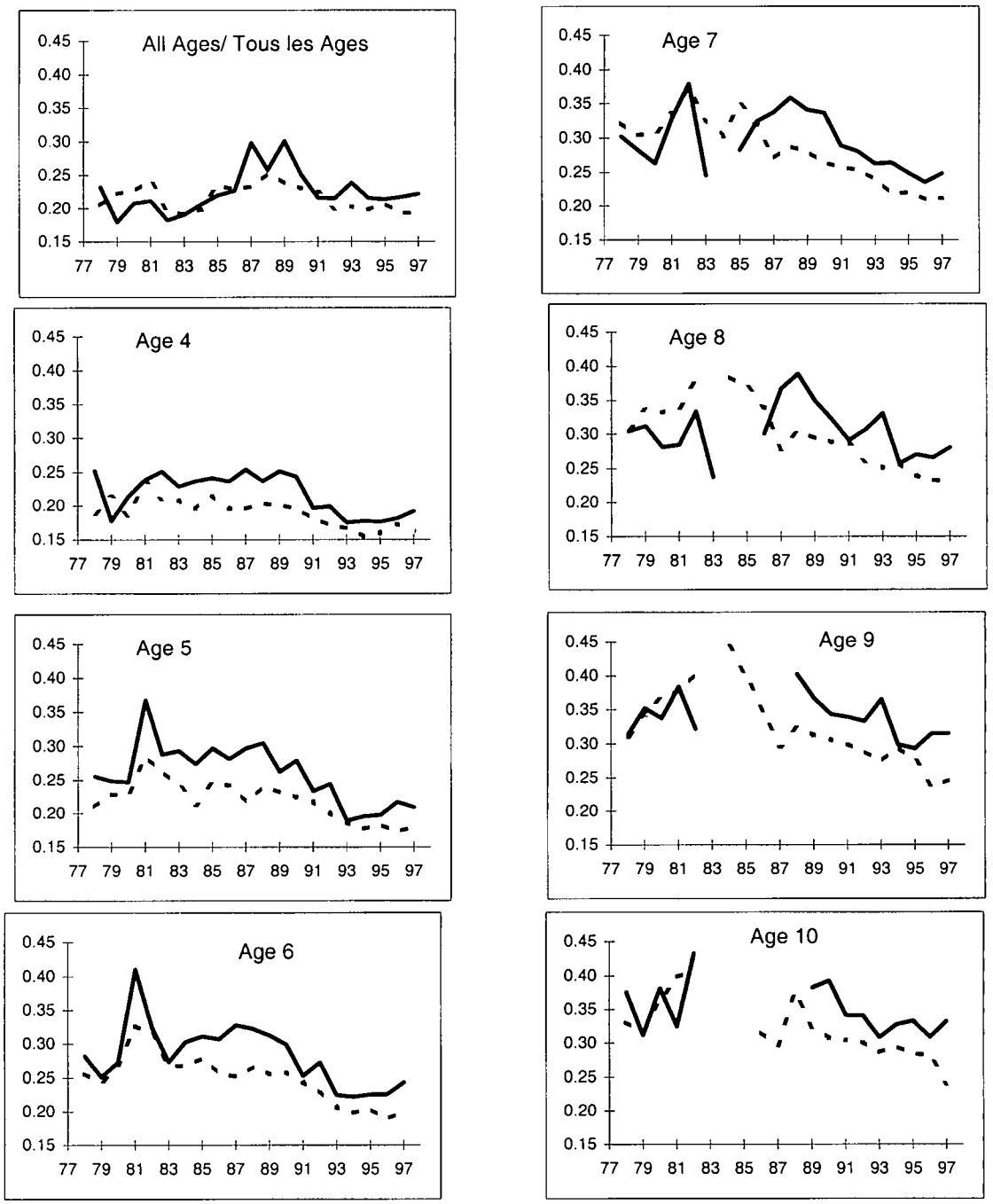
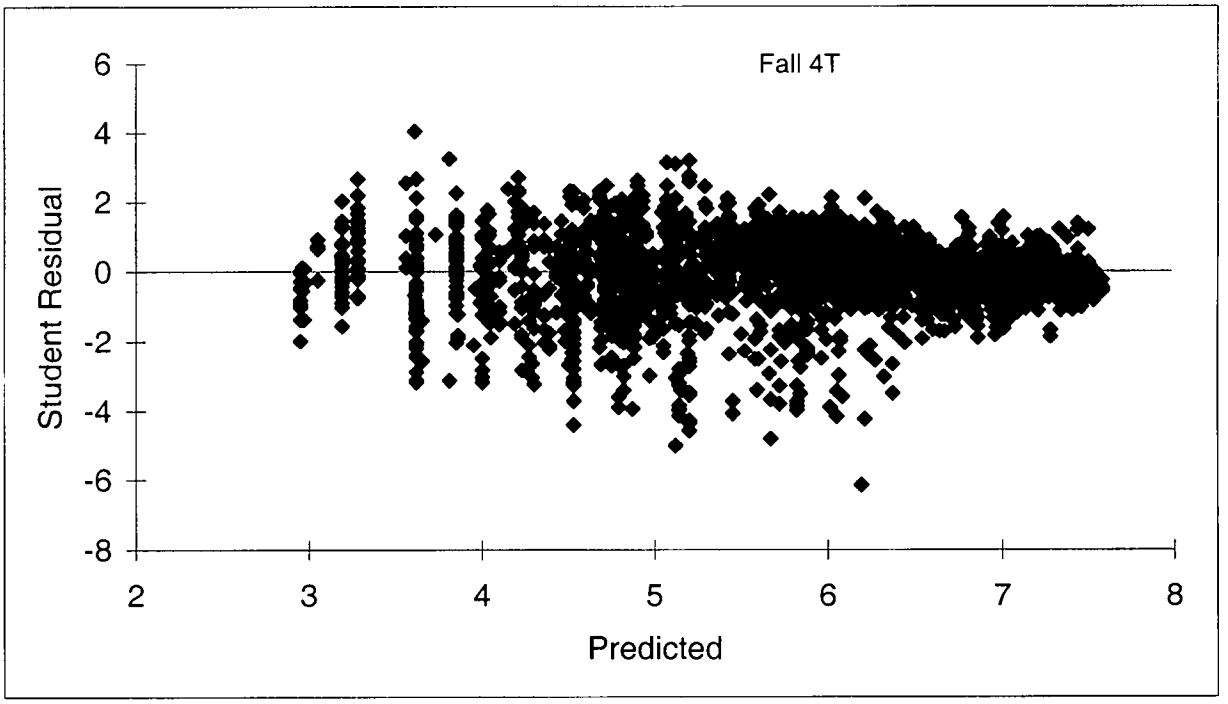


Fig. 13. Spring Spawners mean weight-at-age for all gears and for fixed and mobile gears, ages 4-10. Dotted line is fixed gear and solid line is mobile gear. Weight is in kilograms.



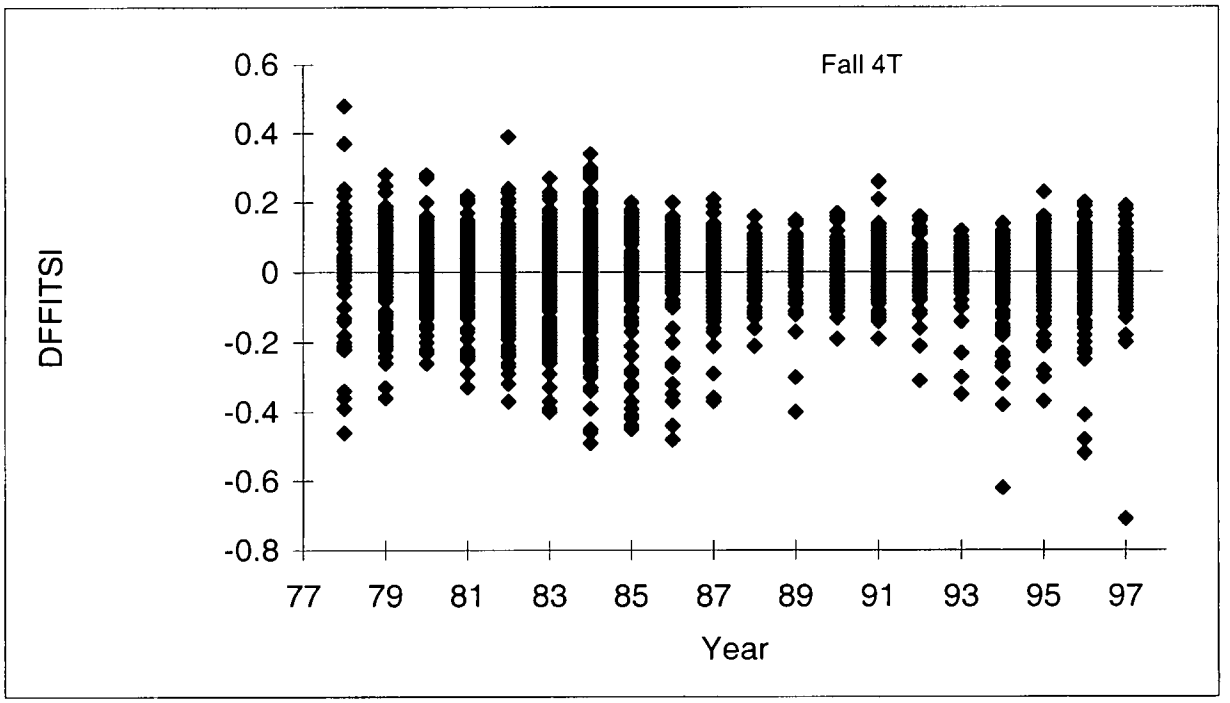


Fig. 14. Diagnostics for 4T fall spawners from mulitplicative catch rate analysis.

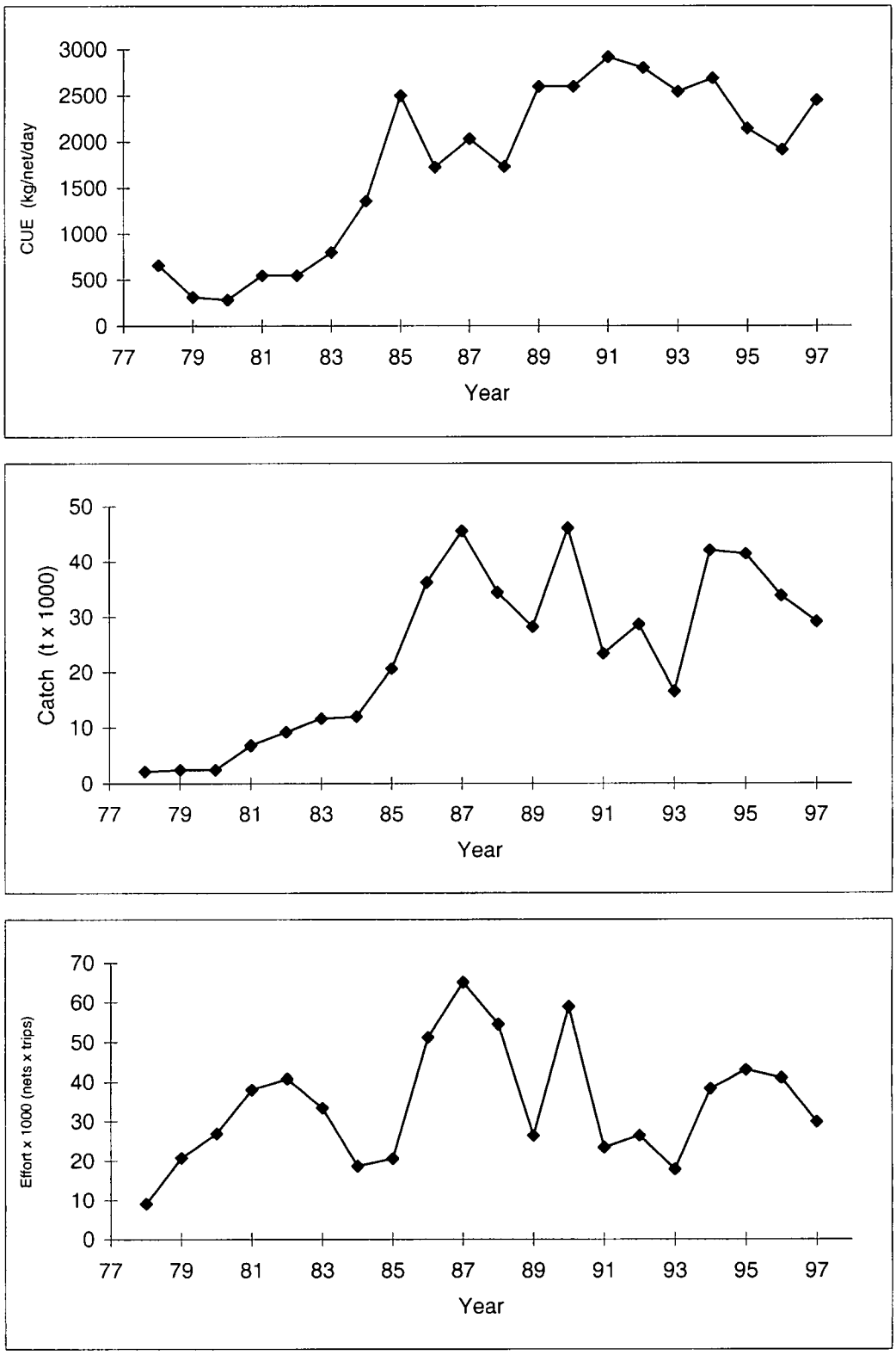


Fig. 15. Fall spawner catch rates (top), catch (middle), and effort (bottom).

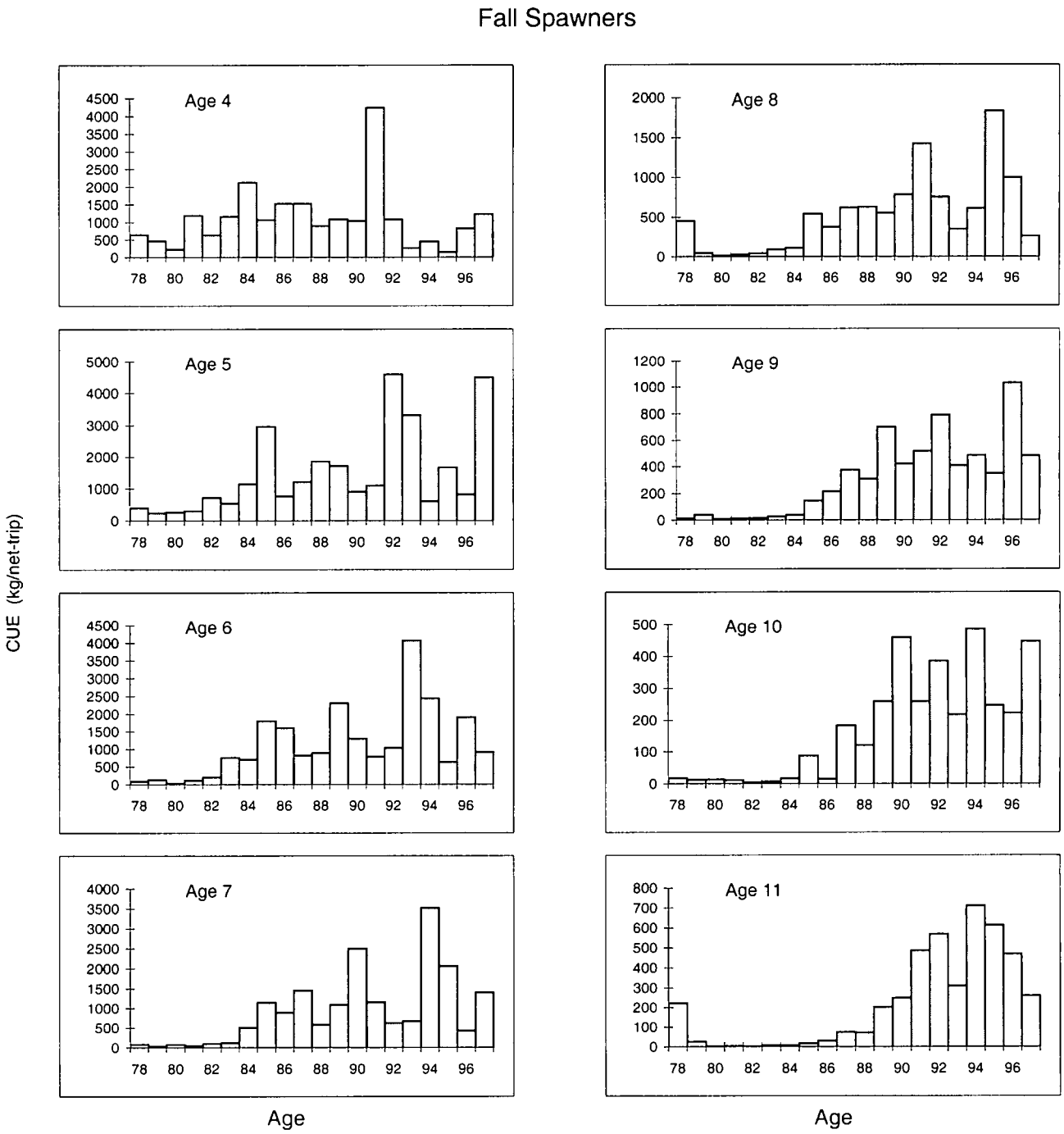


Fig. 16. Commercial catch rate abundance index for fall spawners by age.

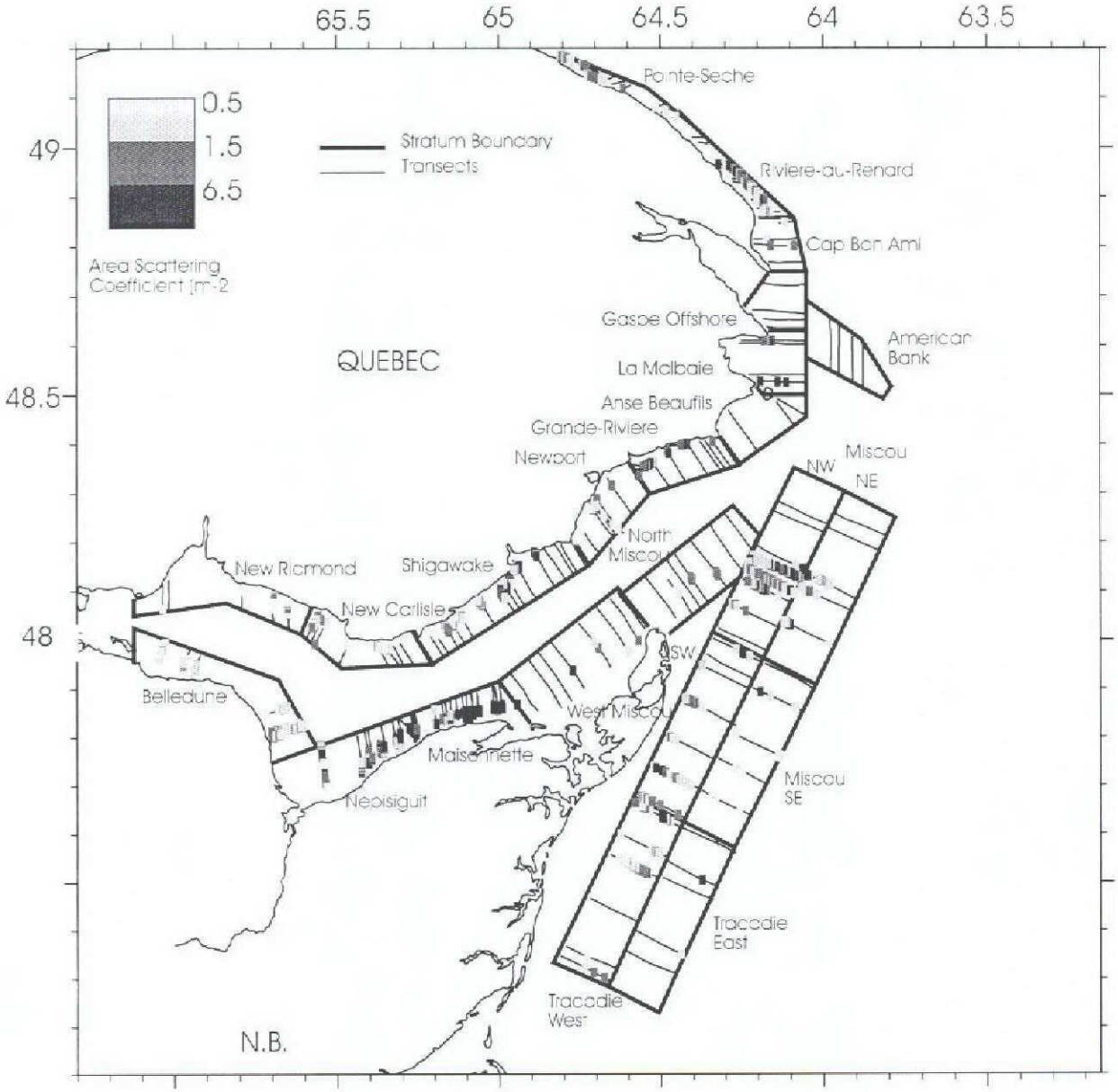


Fig. 17. Chaleur-Miscou area stratum and acoustic transect locations, with relative backscatter detected between Sept. 21 and Oct. 2, 1997.

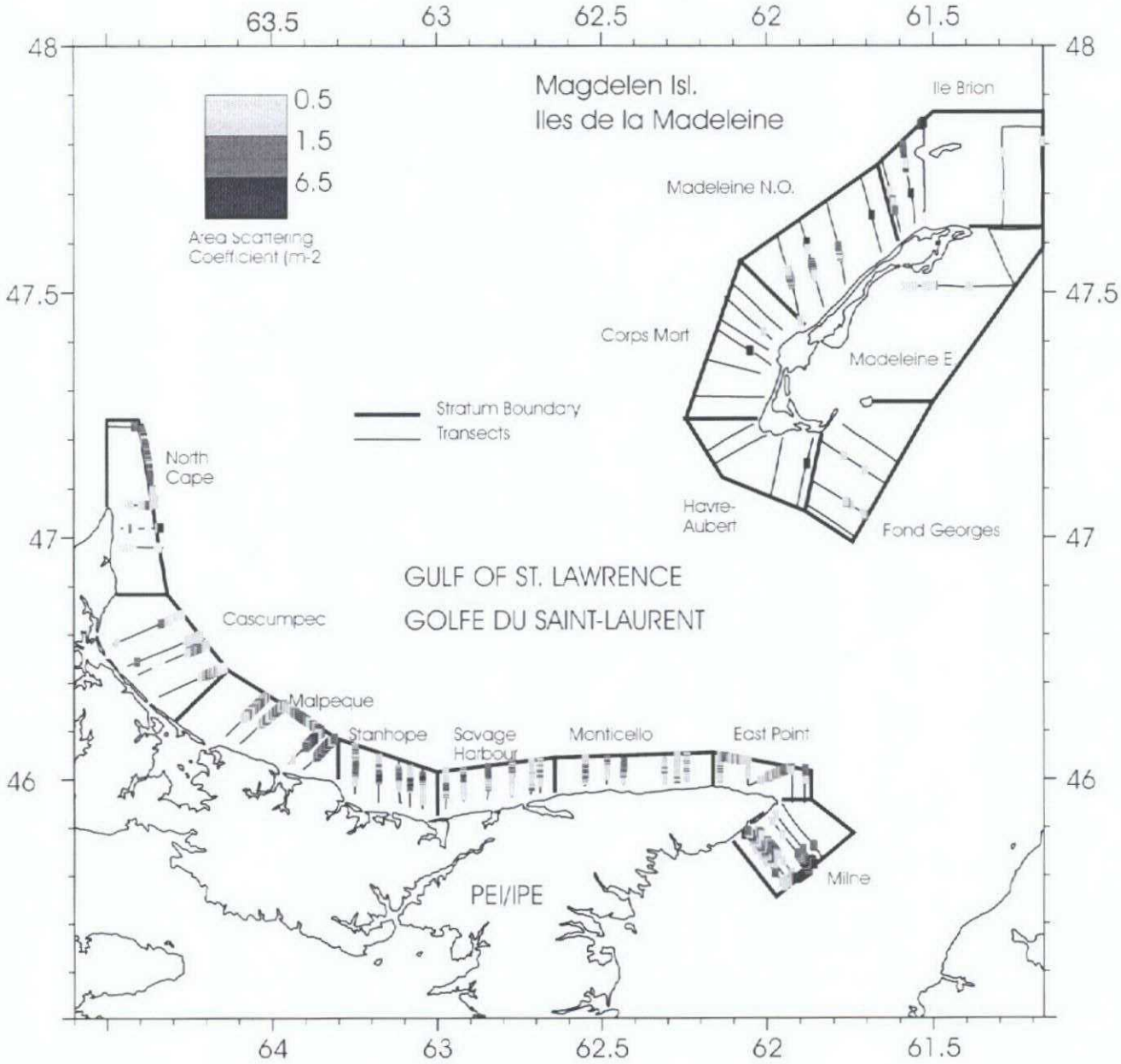


Fig. 18. Prince Edward Island and Magdelen Islands area stratum and acoustic transect locations, with relative backscatter detected between Oct. 3 and 8, 1997.

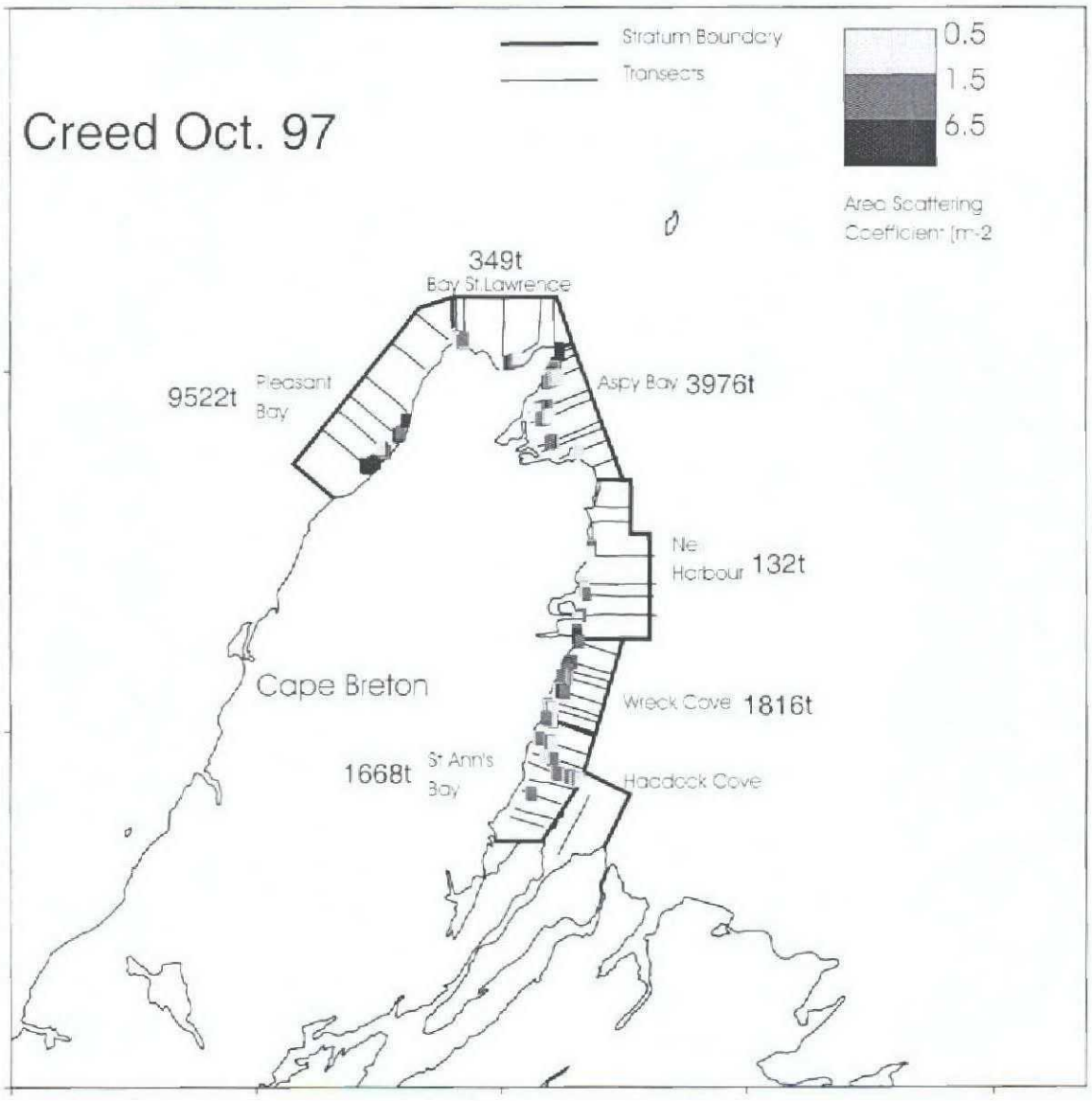


Fig. 19. Cape Breton area stratum and acoustic transect locations, with relative backscatter detected between Oct. 8 and 11, 1997.

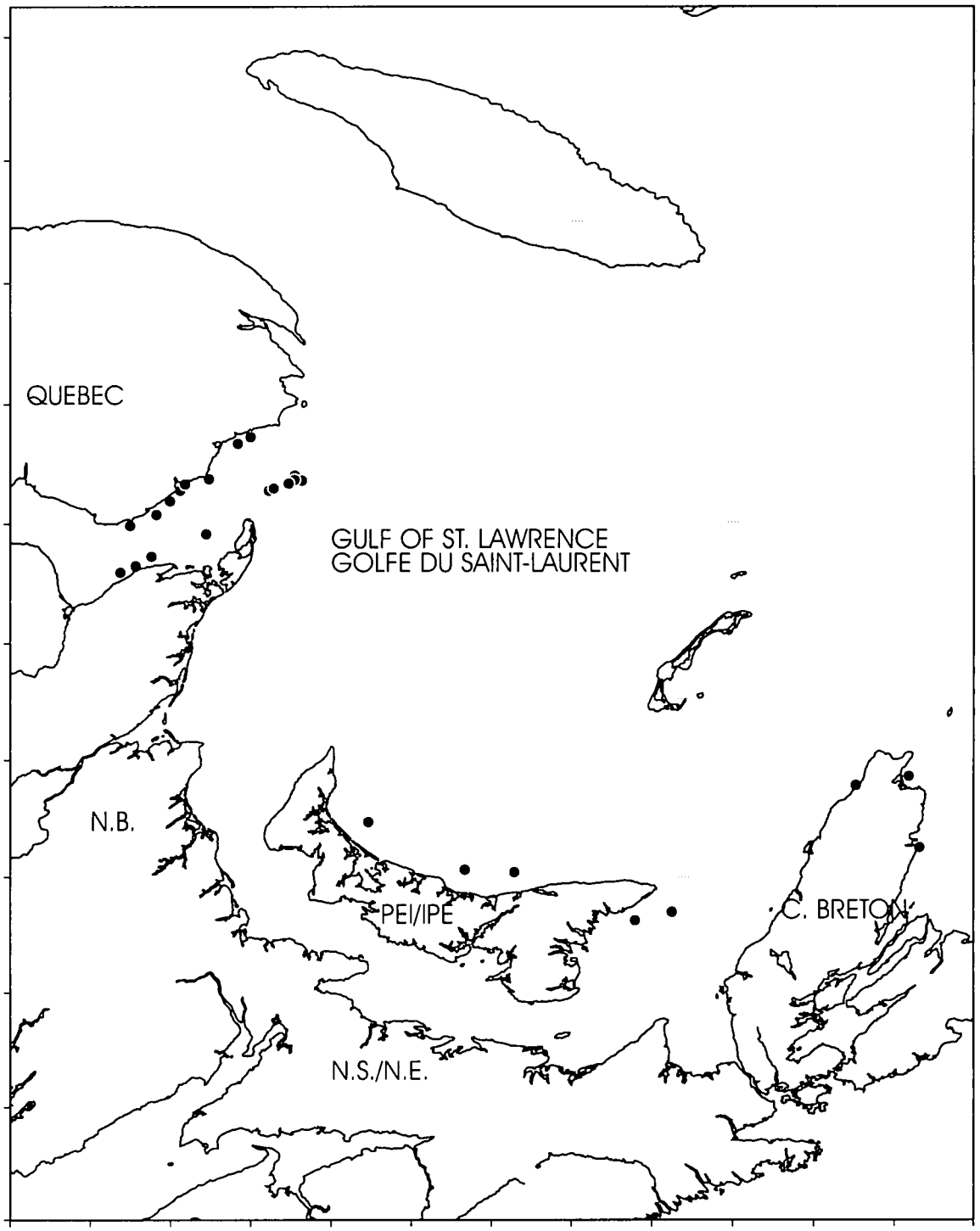
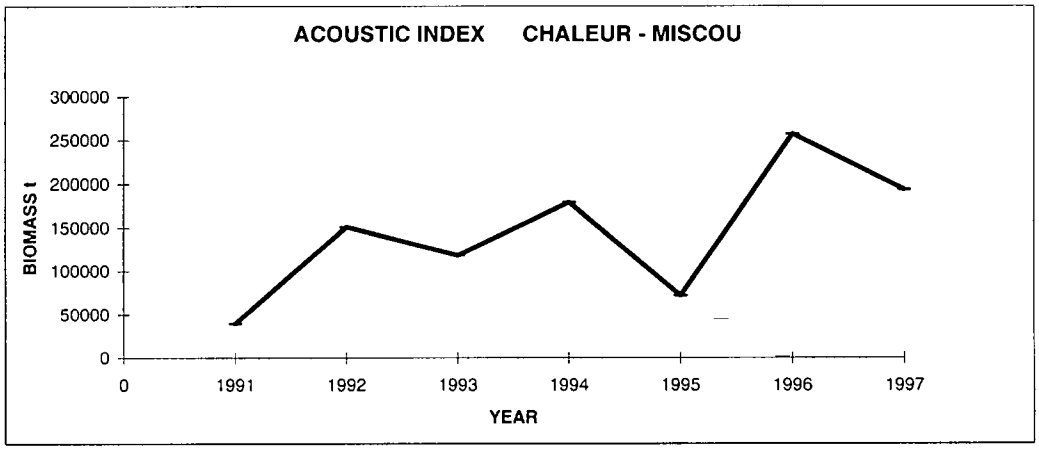


Fig. 20. Acoustic survey set locations Sept. 21 - Oct. 11, 1997



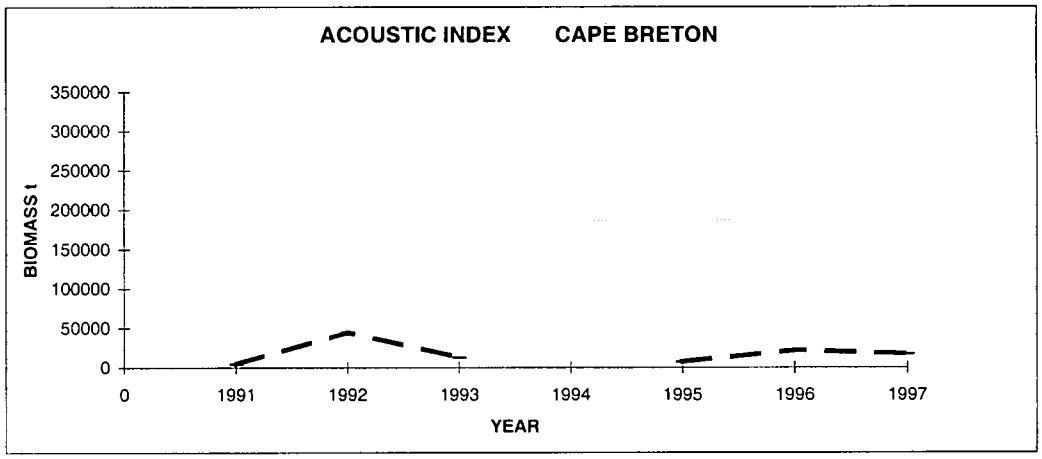


Fig. 21. Acoustic biomass indices for fall and spring spawners combined.

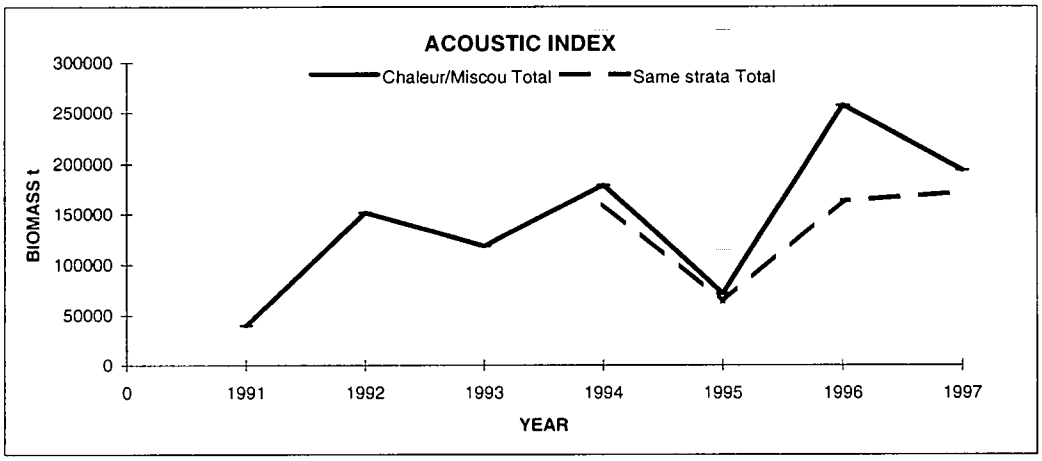


Fig. 22. Acoustic biomass indices for fall and spring spawners combned comparing strata that were consistent for all years.

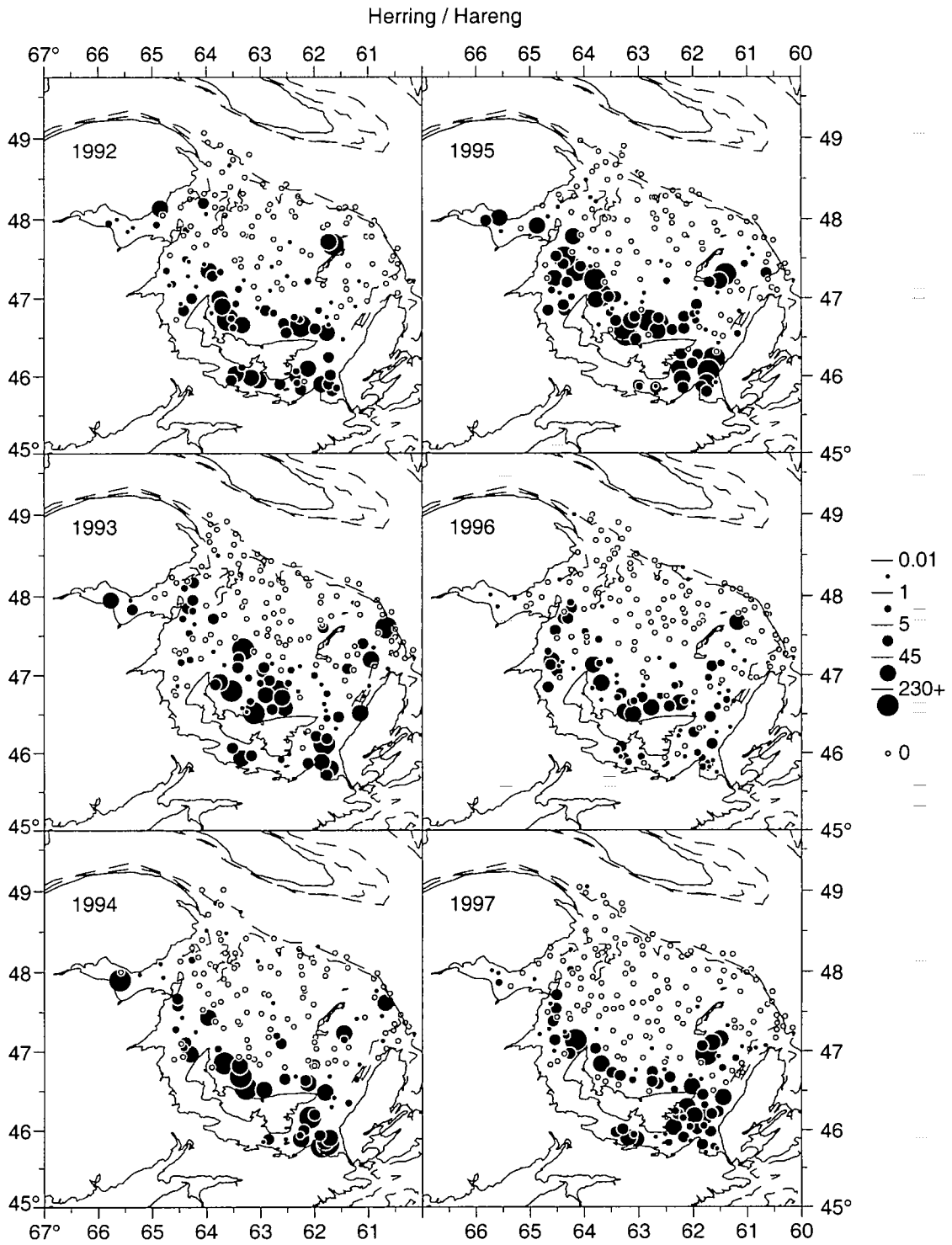


Figure 23. Herring catches (kg) in the southern Gulf of St. Lawrence September groundfish survey from 1992 to 1997.

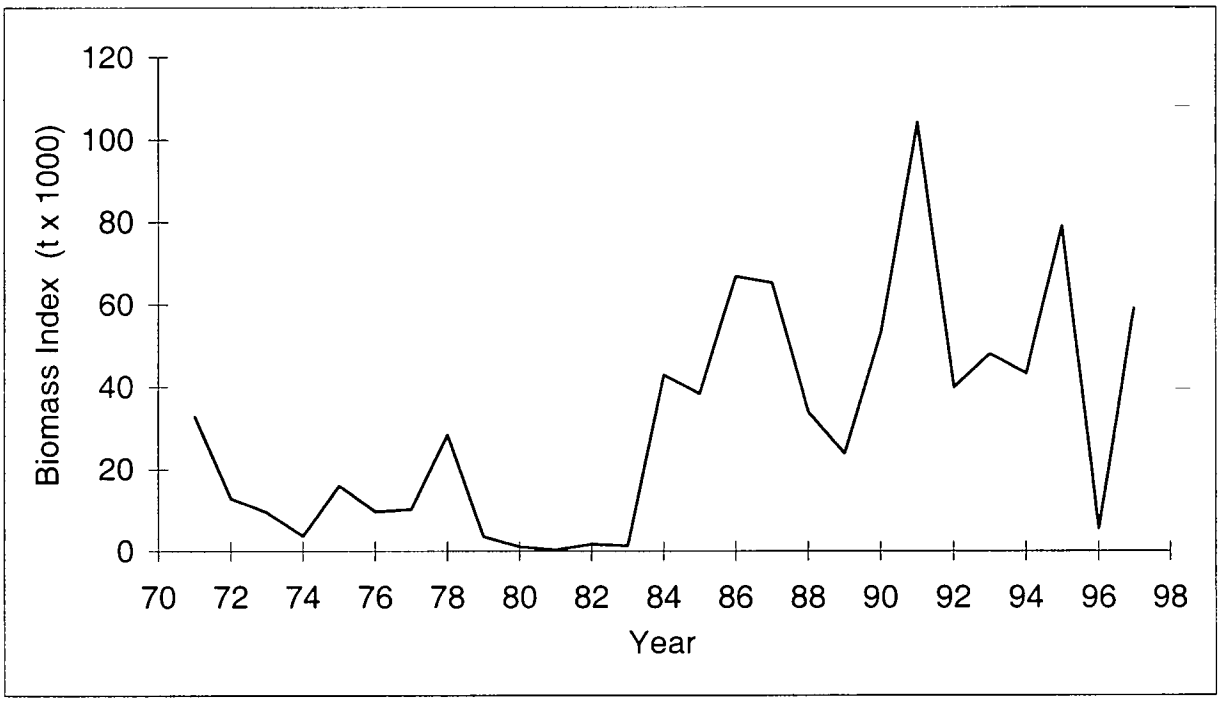


Fig. 24. Bottom trawl survey abundance index for spring and fall herring combined.

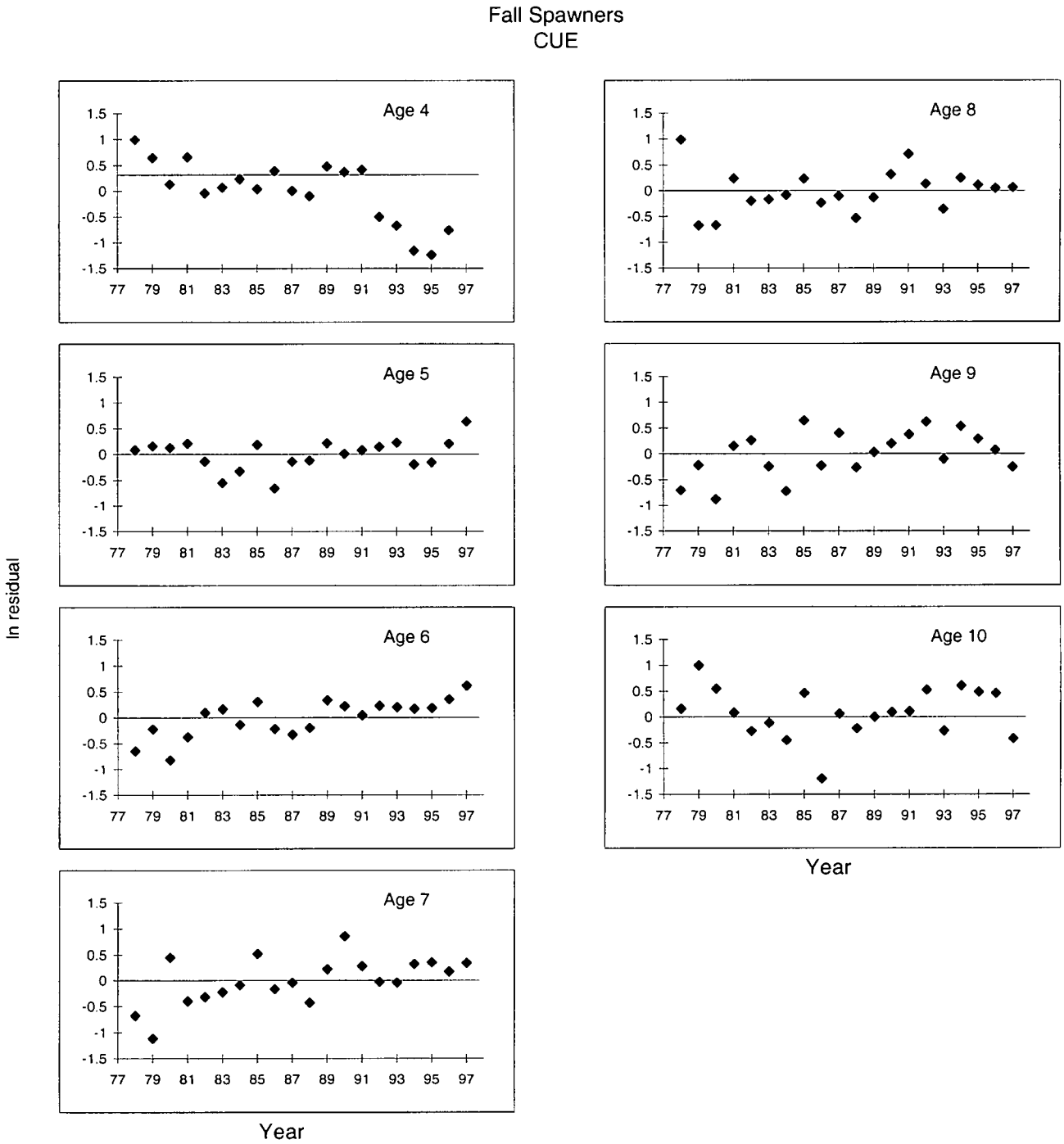
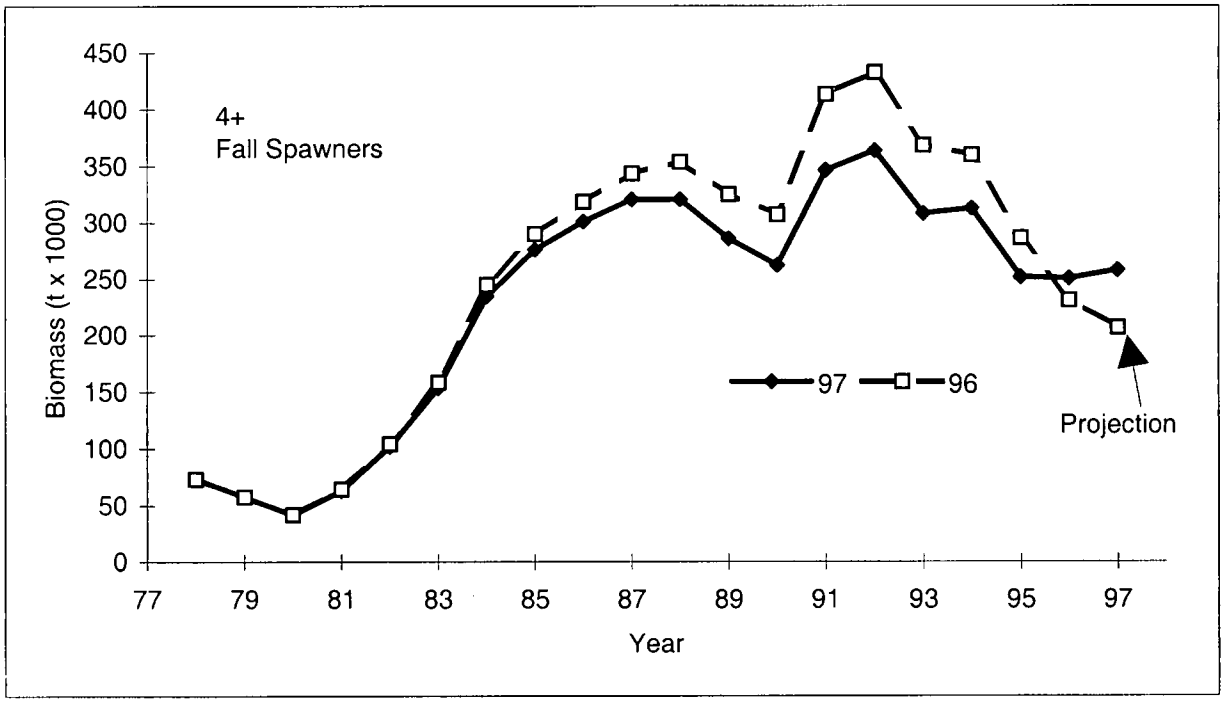


Fig. 25. Residuals for ADAPT-VPA model using single CUE index as in previous assessments.



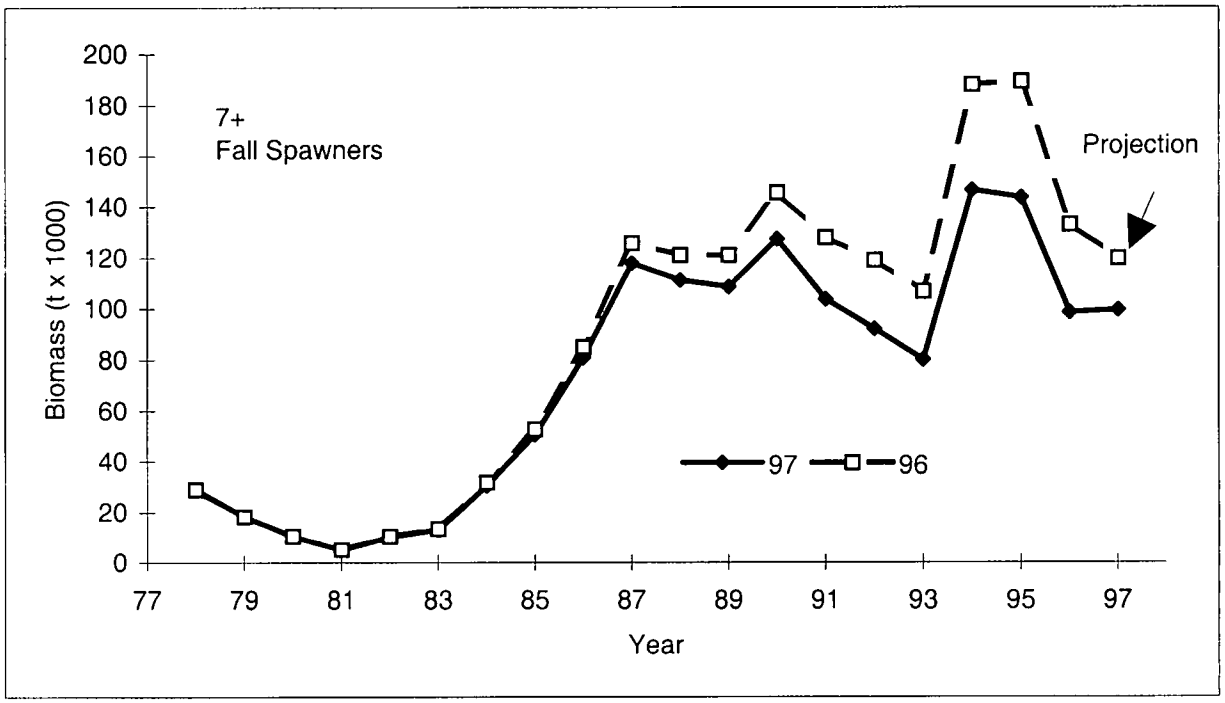


Fig. 26. Retrospective analysis comparing 1997 ADAPT-VPA model with single CUE index, with results obtained using the same method in last year's 1996 assessment.

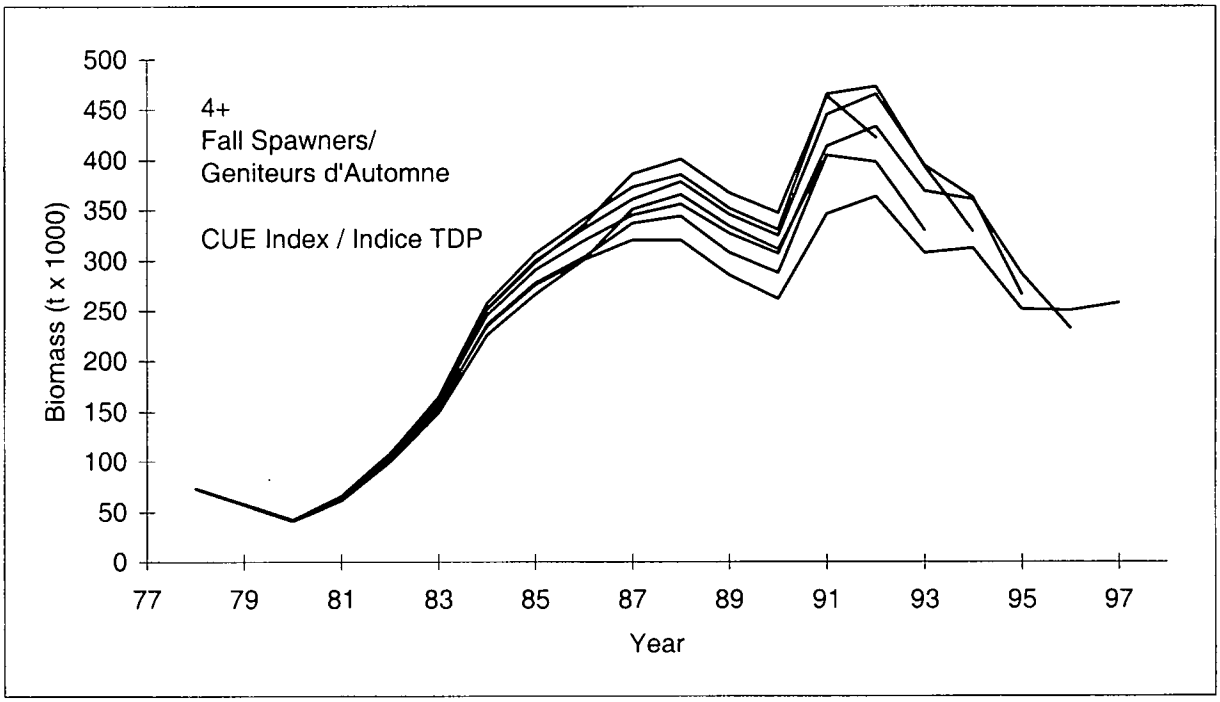


Fig. 27. Retrospective analysis by deleting single years from the ADAPT-VPA analysis using a single CUE index.

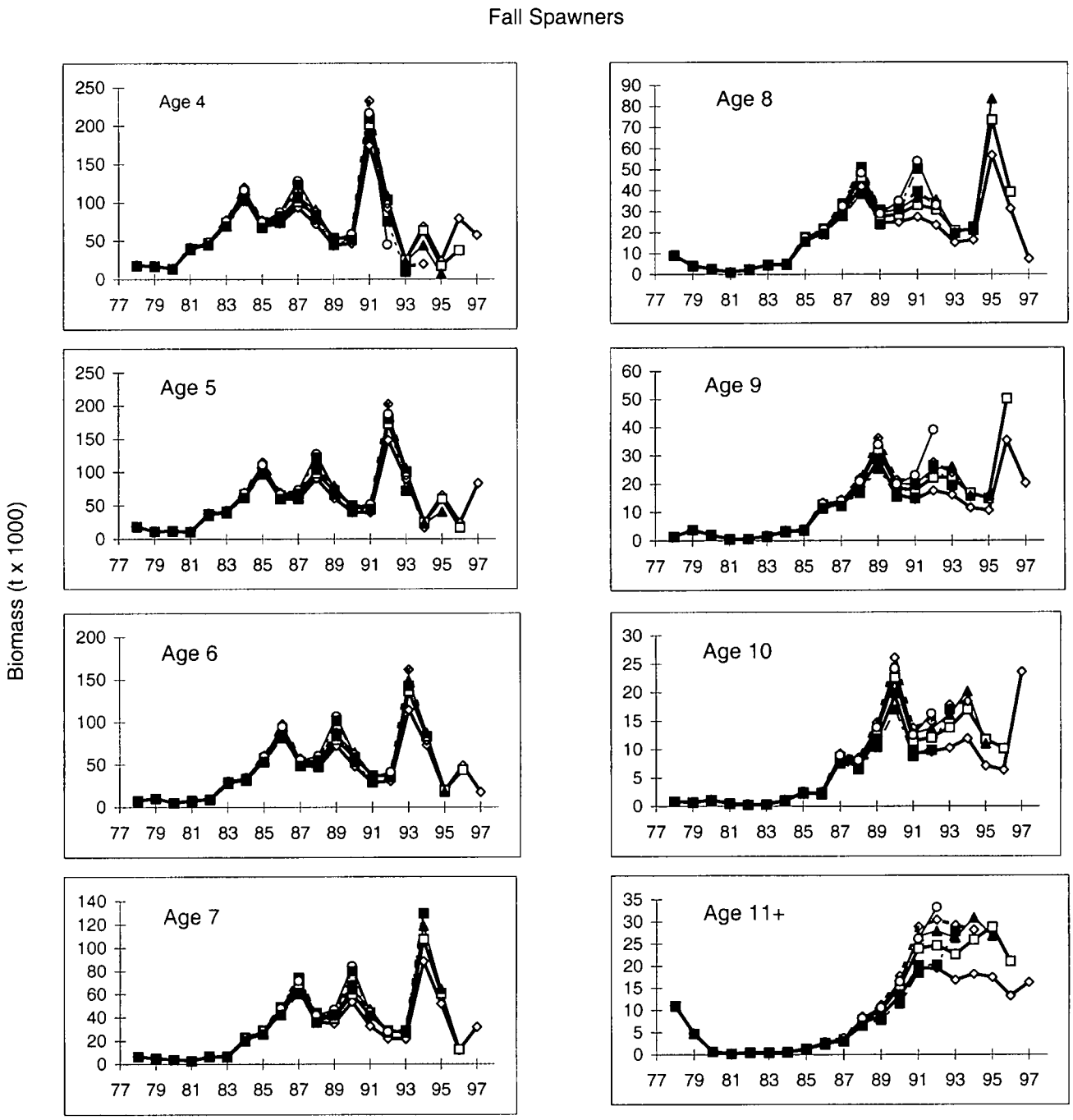
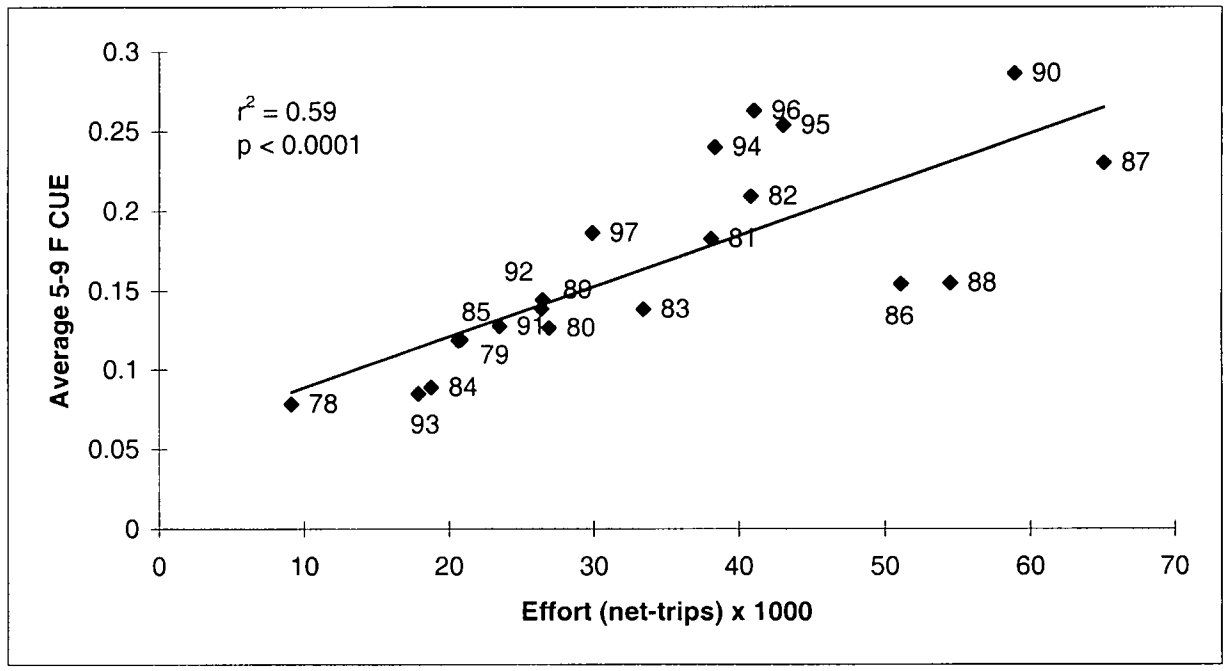


Fig. 28. Age by age retrospective plots by deleting sinlge years from ADAPT-VPA analysis using the single CUE Index.



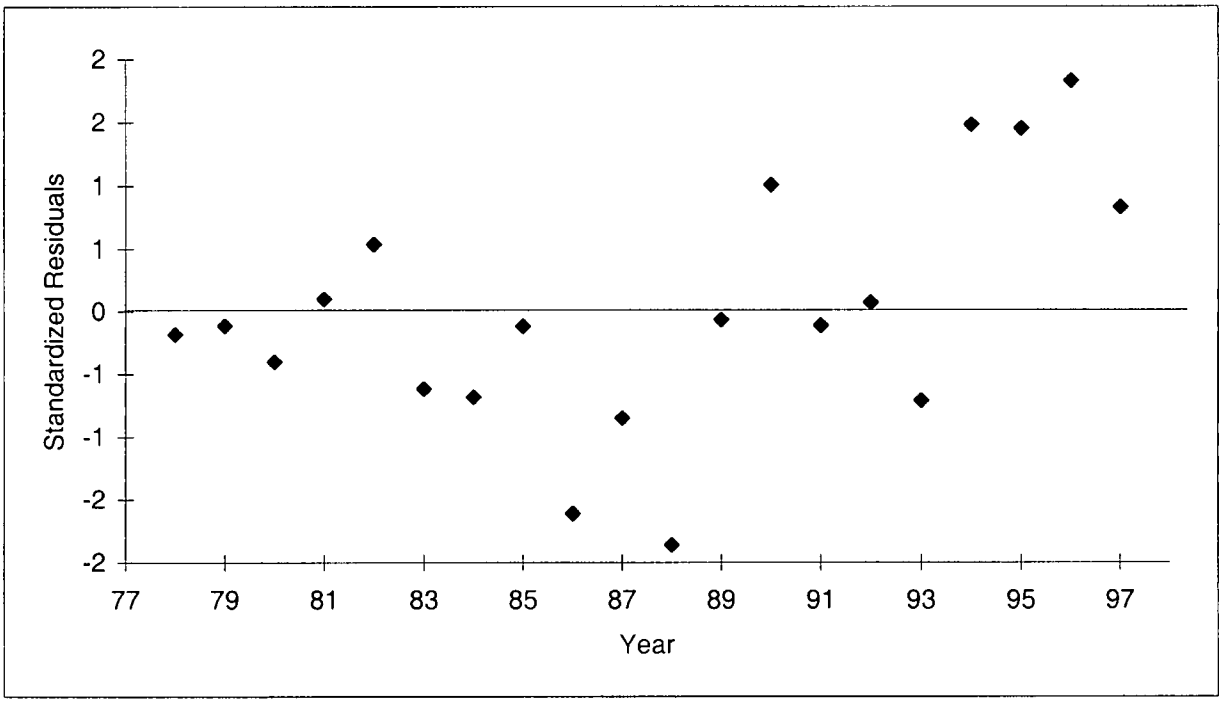


Fig. 29. Regression analysis with diagnostics for fishing mortality versus effort for 4T fall spawners.

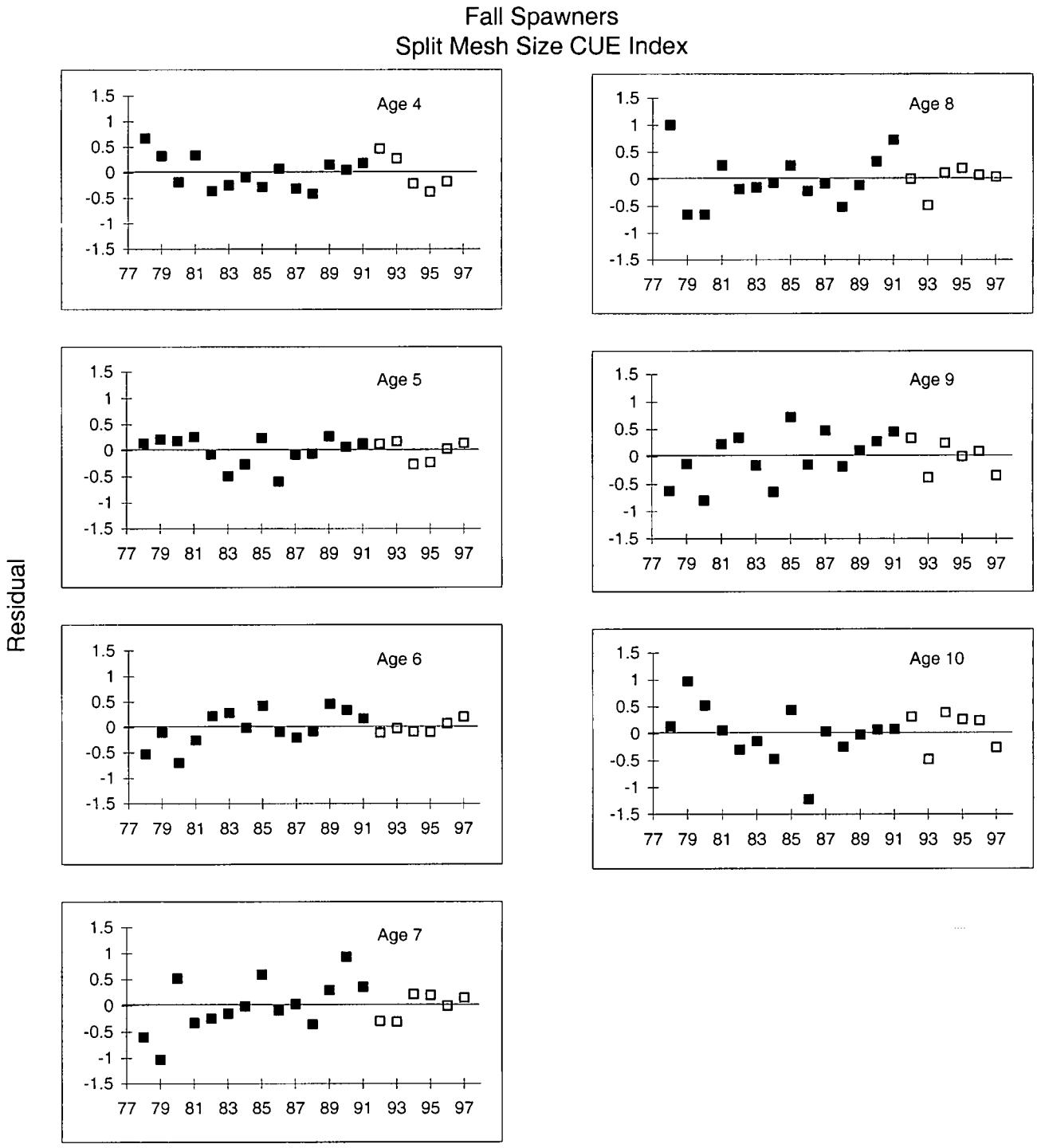


Fig. 30. Residuals by age for fall spawners using split mesh size CUE index for ADAPT-VPA calibration.

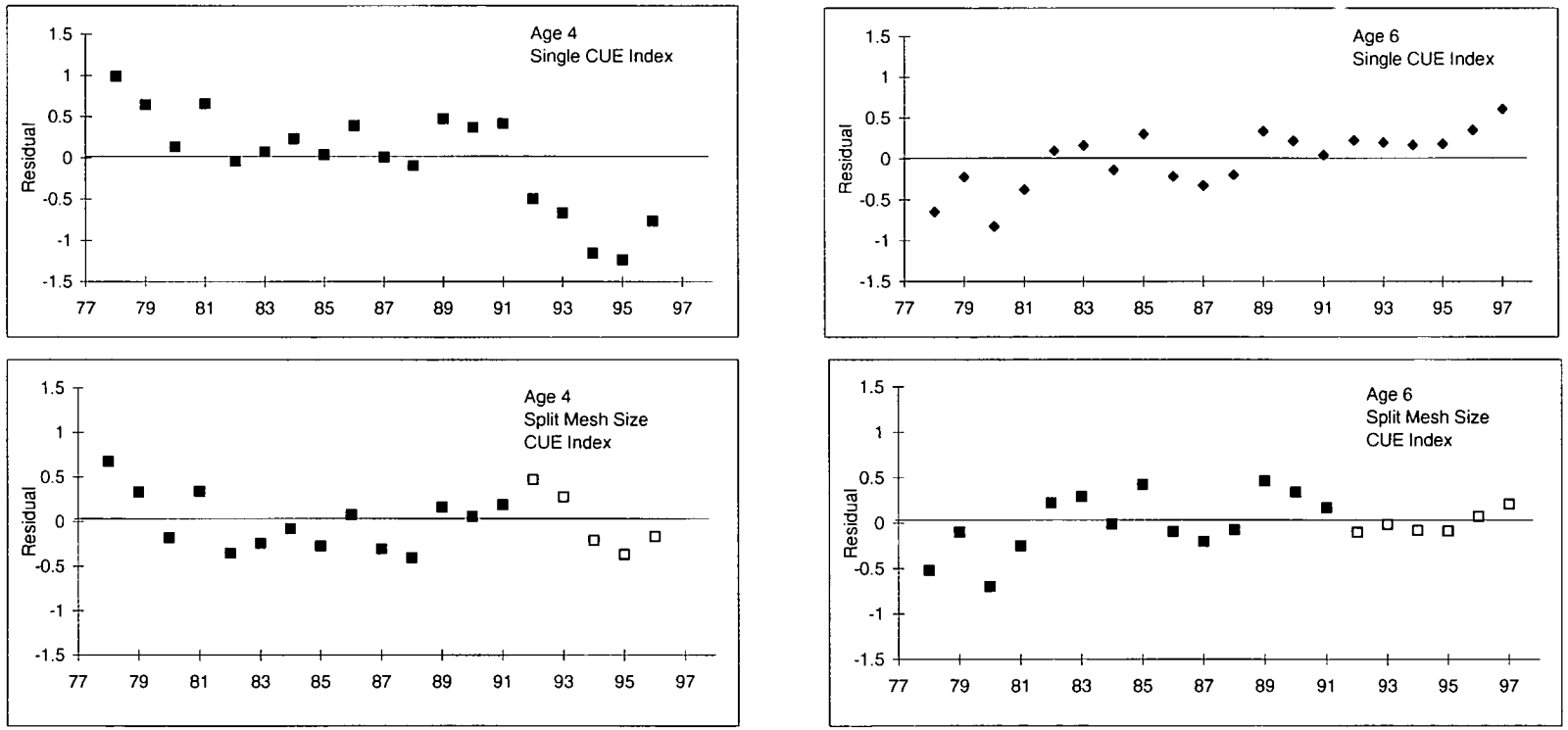
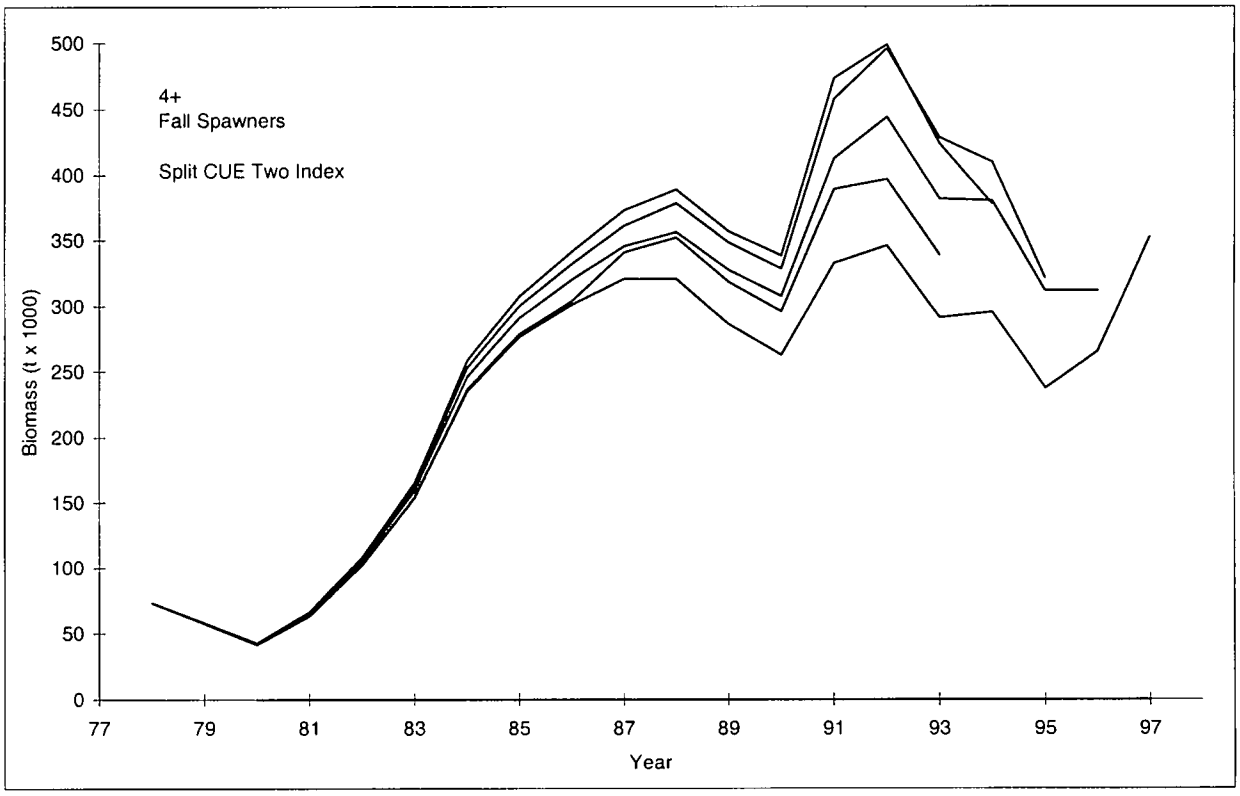


Fig. 31. Comparison of problem age residuals using single and split CUE indices for fall spawners.



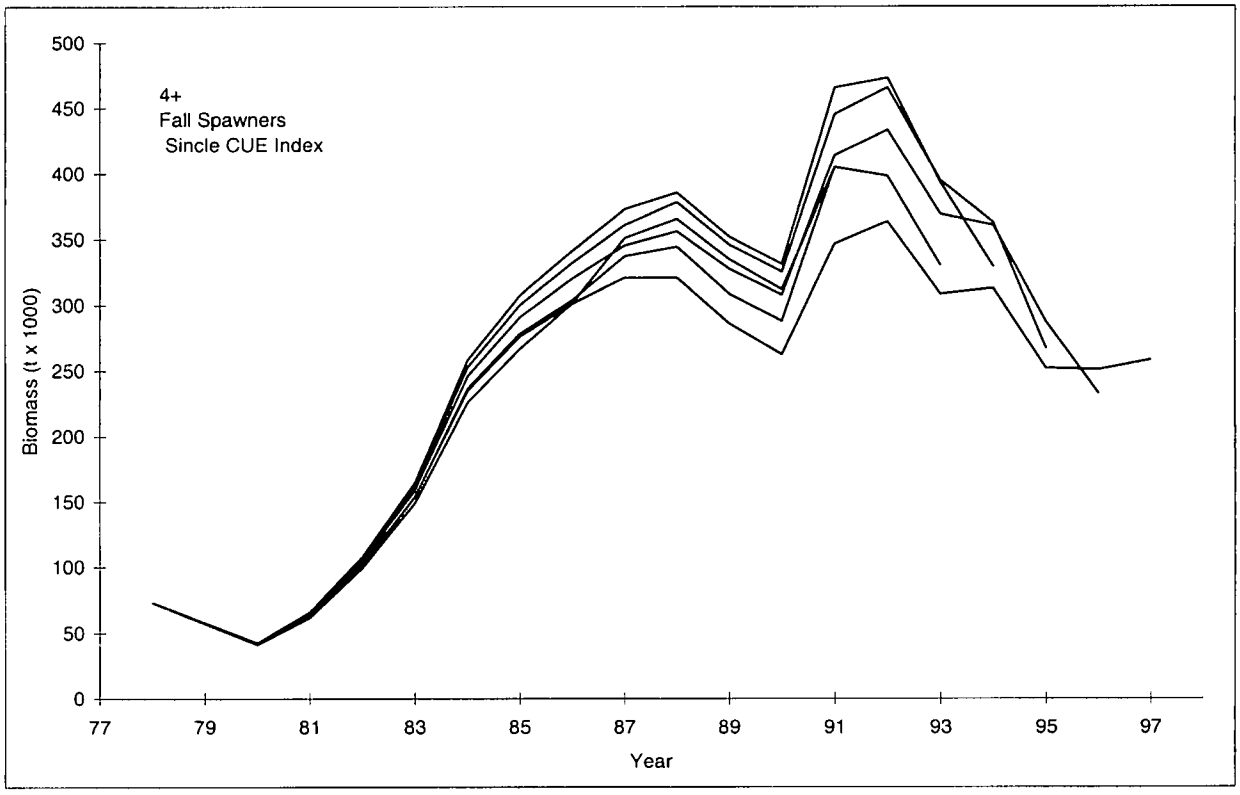


Fig. 32. Comparison of retrospective patterns for split and single CUE indices for fall spawners.

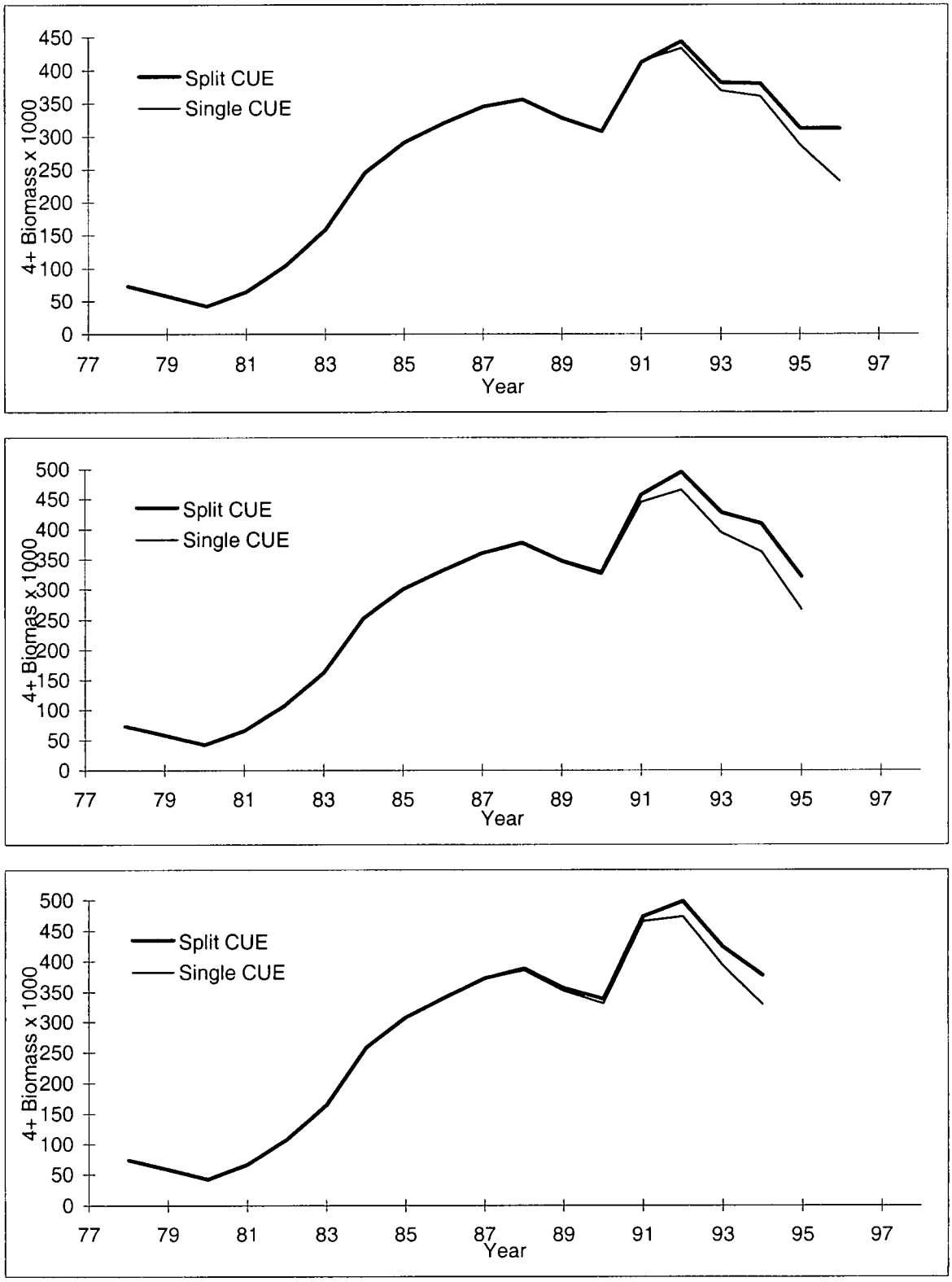


Fig. 33. Comparison of retrospective analysis from single CUE and split mesh size CUE indices for 1994-1996.

Fall Spawners

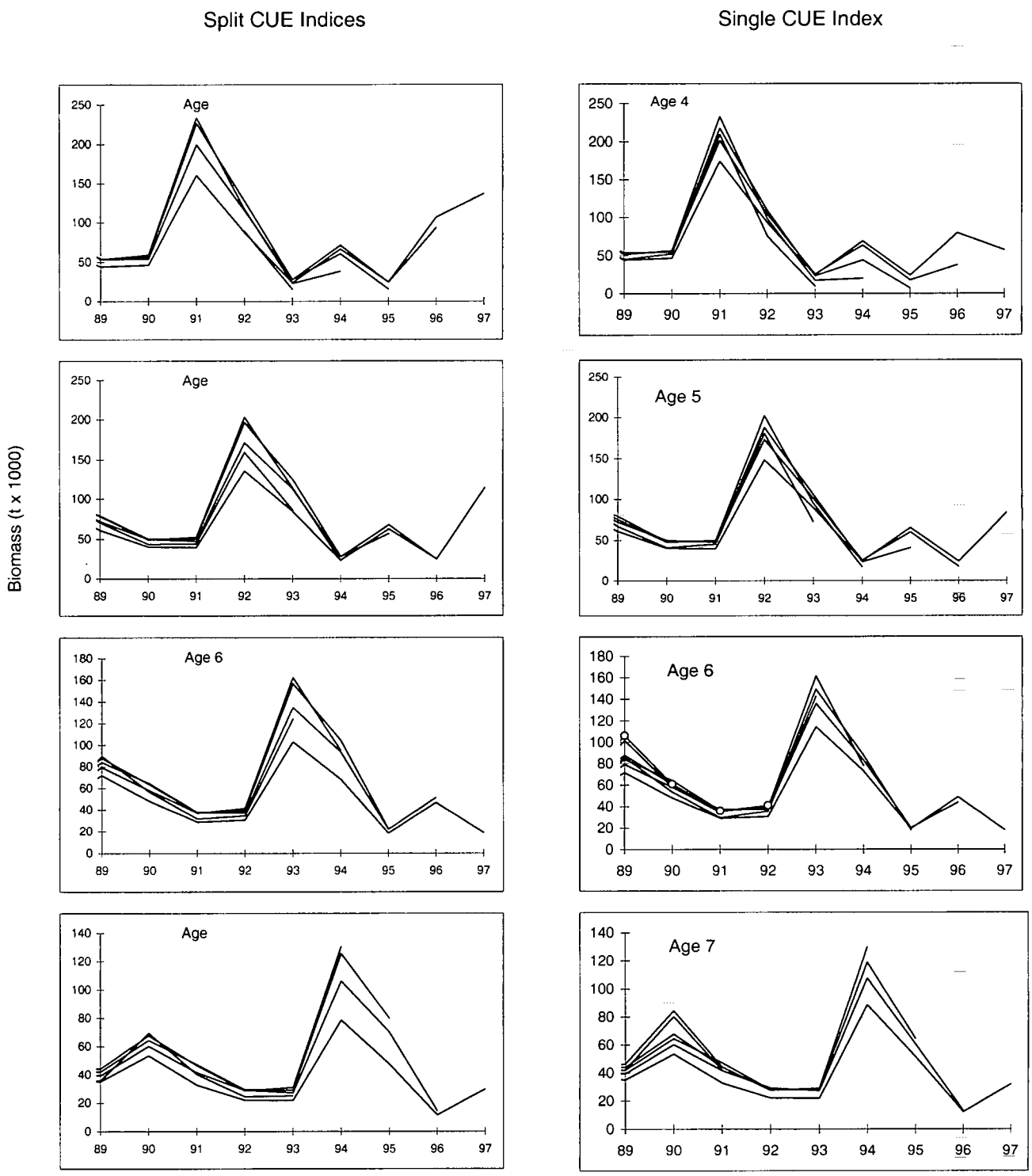


Fig. 34. Age by age comparison of retrospective patterns for split and single CUE indices, ages 4-7.

Fall Spawners

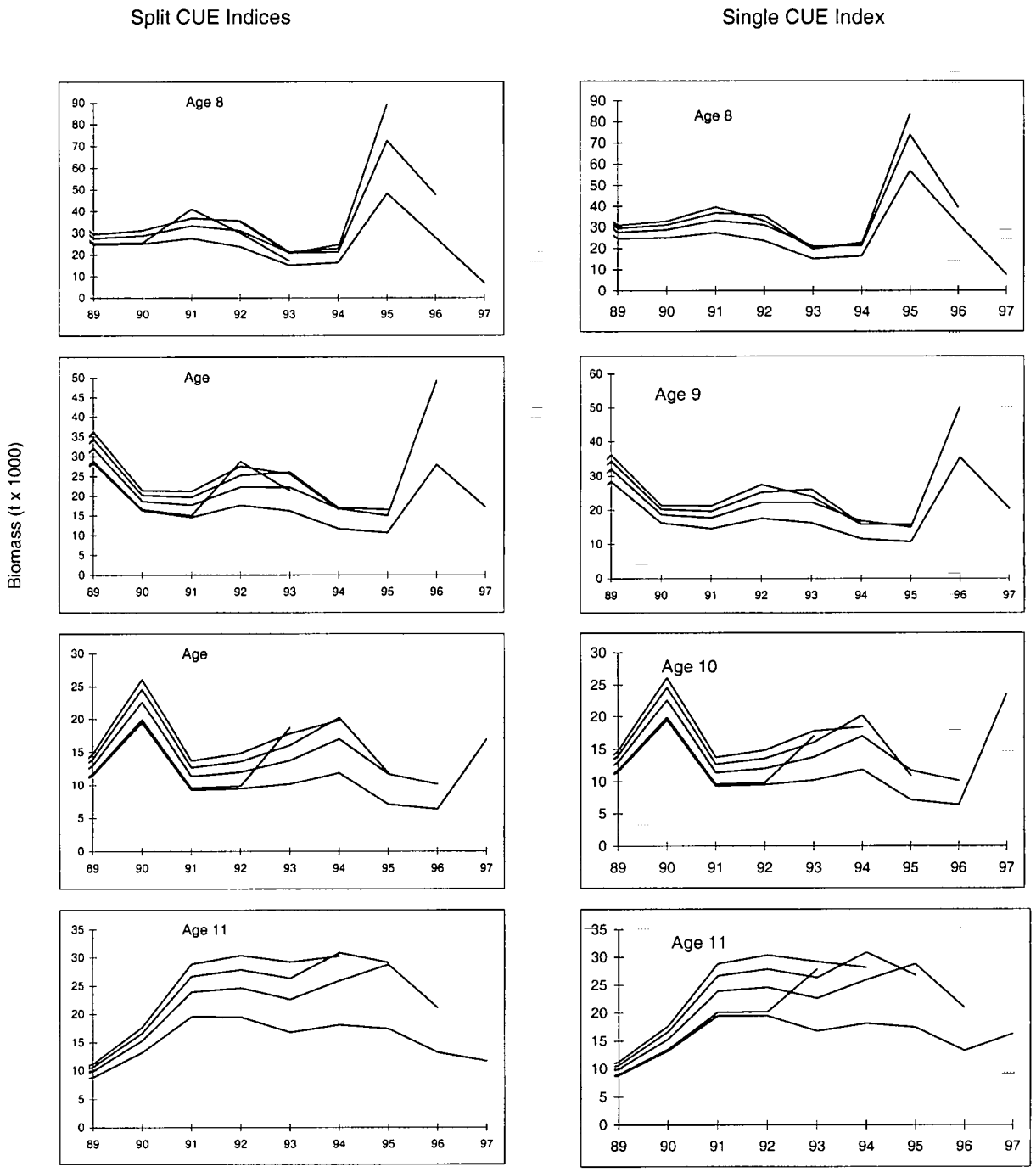
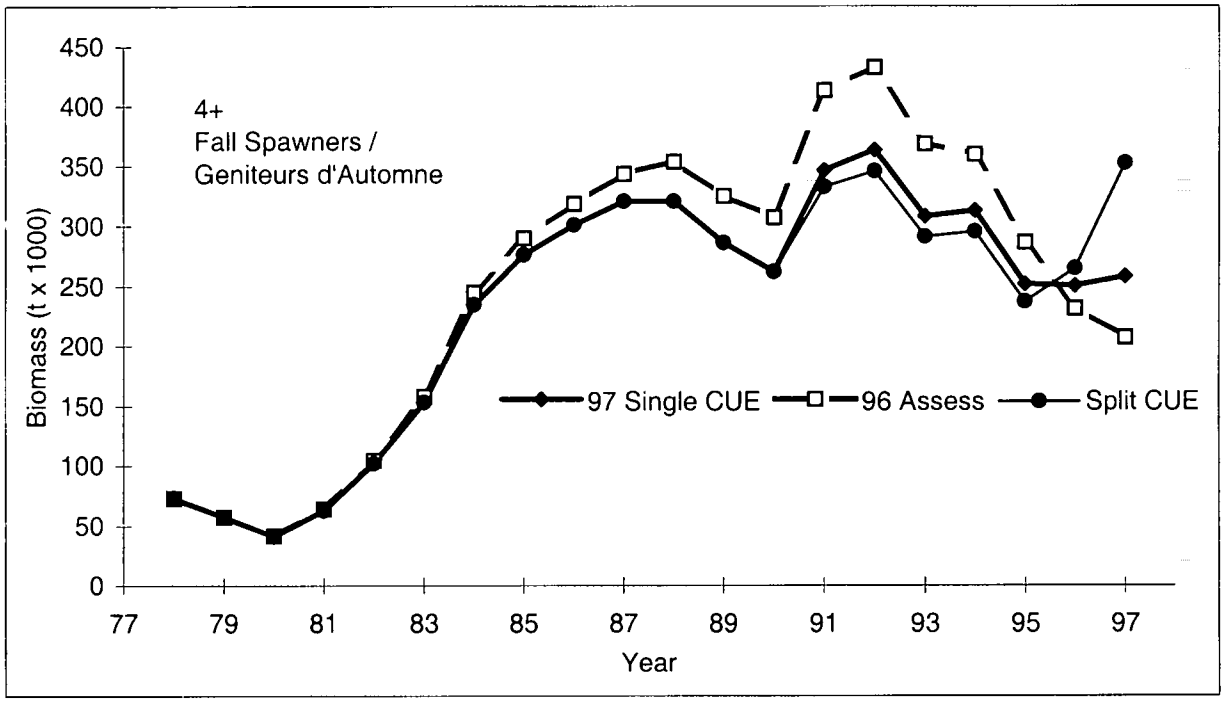


Fig. 35. Age by age comparison of retrospective patterns for split and single CUE indices, ages 8-11.



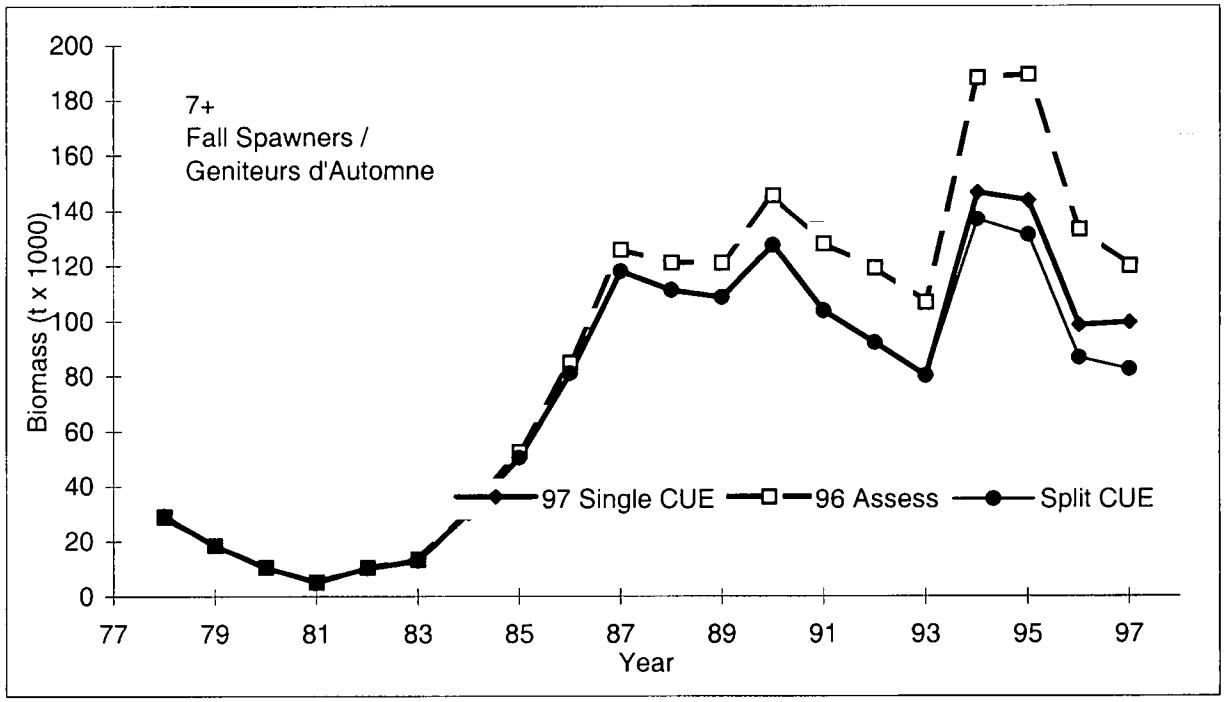


Fig. 36. Comparison of single CUE index, split mesh size CUE indices,a nd 1996 assessment results for fall spawners using ADAPT-VPA.

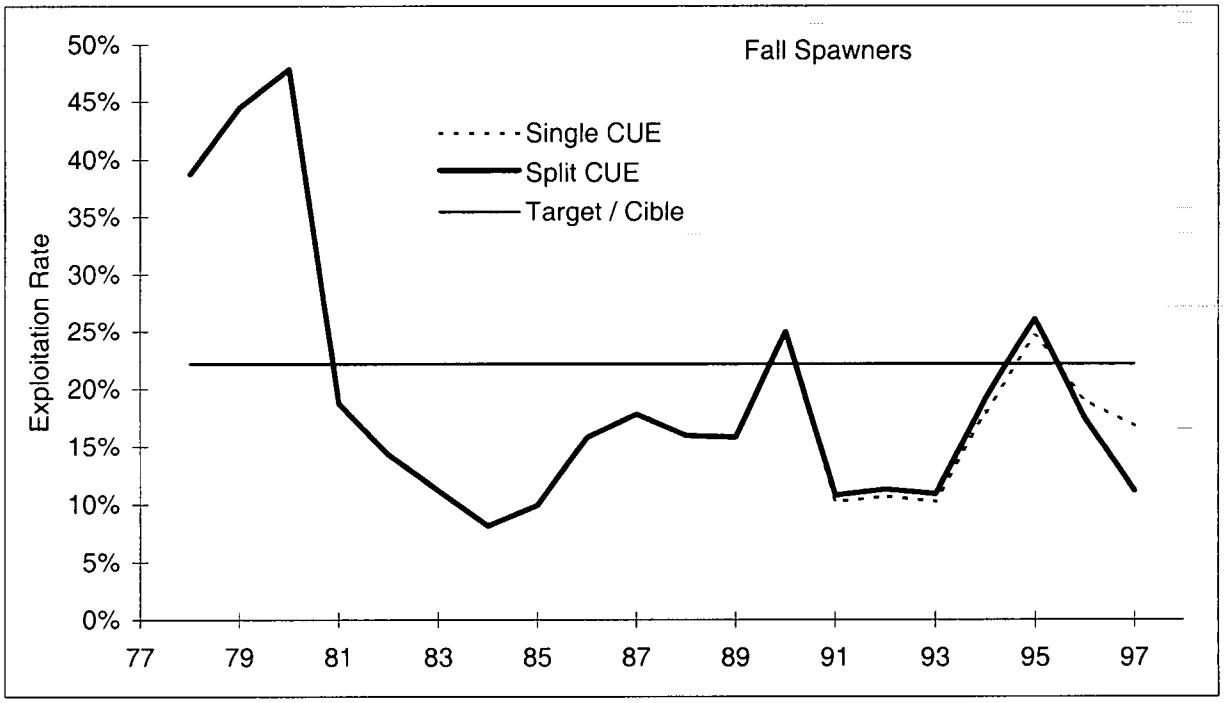


Fig. 37. Comparison of fishing mortalities estimated using single CUE and split CUE models for fall spawners.

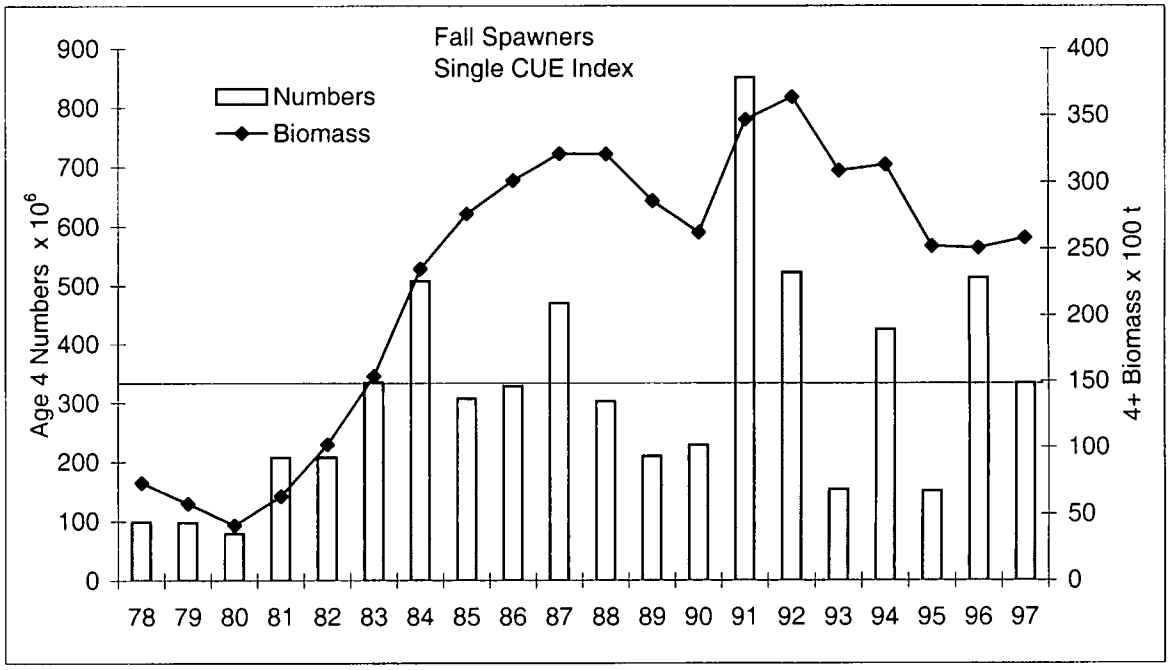


Fig. 38. Biomass (4+) and number of recruits (age 4) estimated for fall spawners using single CUE index. Horizontal line is average number of 4 year-olds.

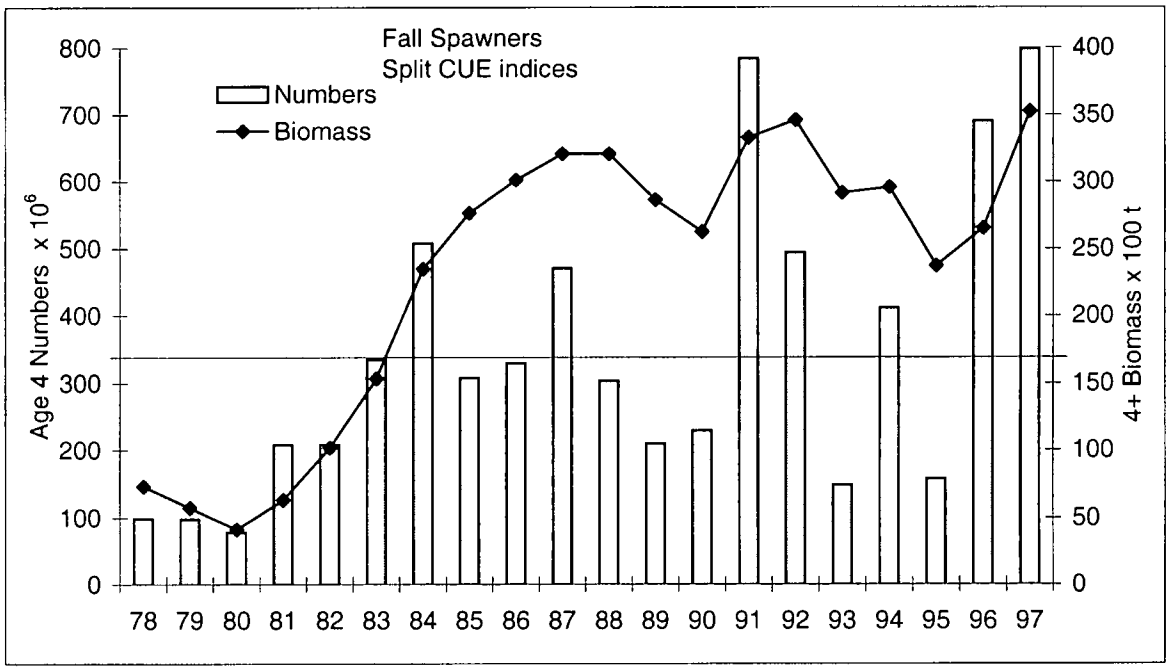


Fig. 39. Biomass (4+) and number of recruits (age 4) estimated for fall spawners using split CUE index. Horizontal line is average number of 4 year-olds.

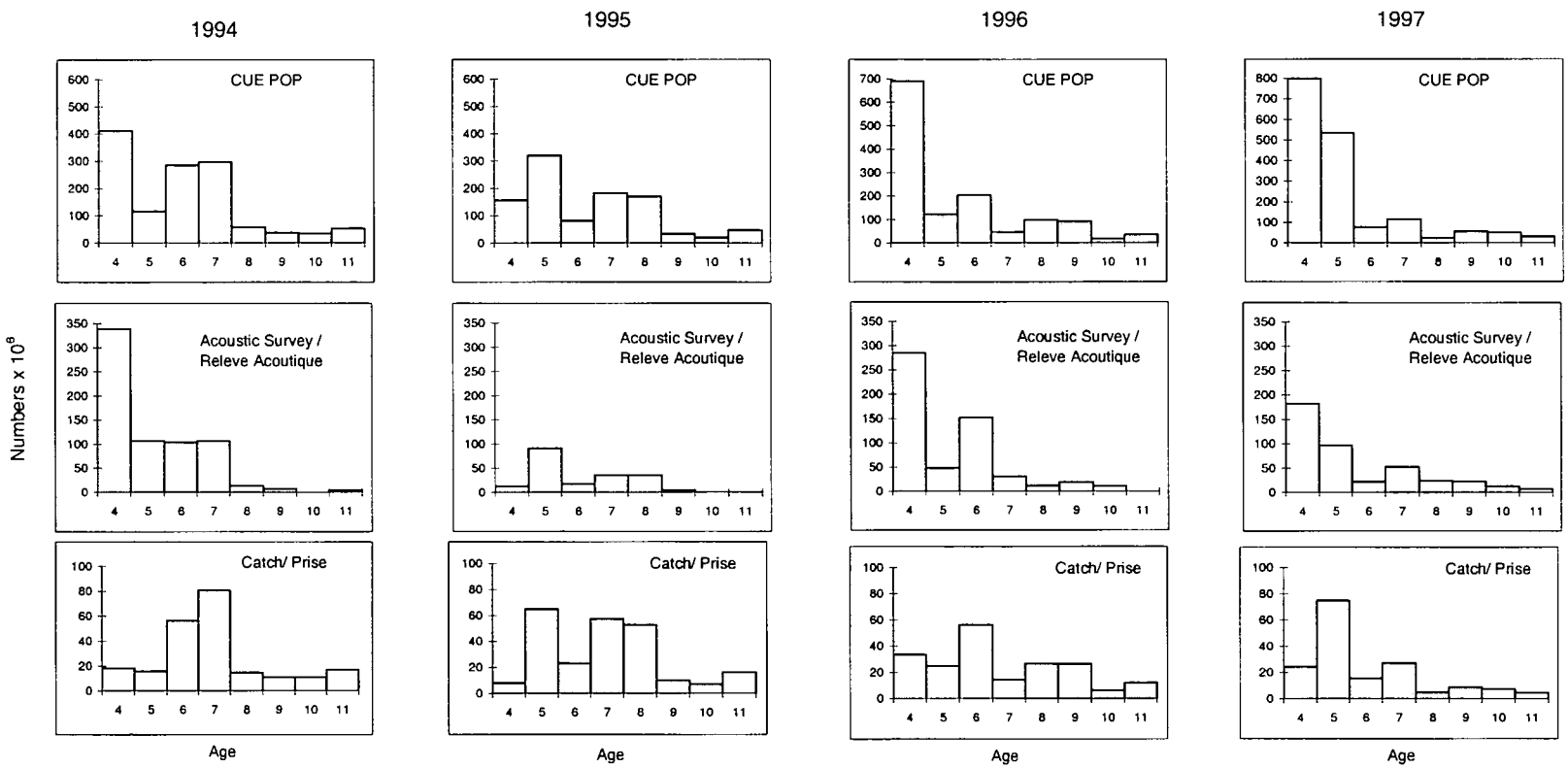


Fig. 40. Comparison of fall spawner age structure from ADAPT-VPA using split mesh size CUE indices (top row), acoustic survey (middle row), and catch (bottom row).

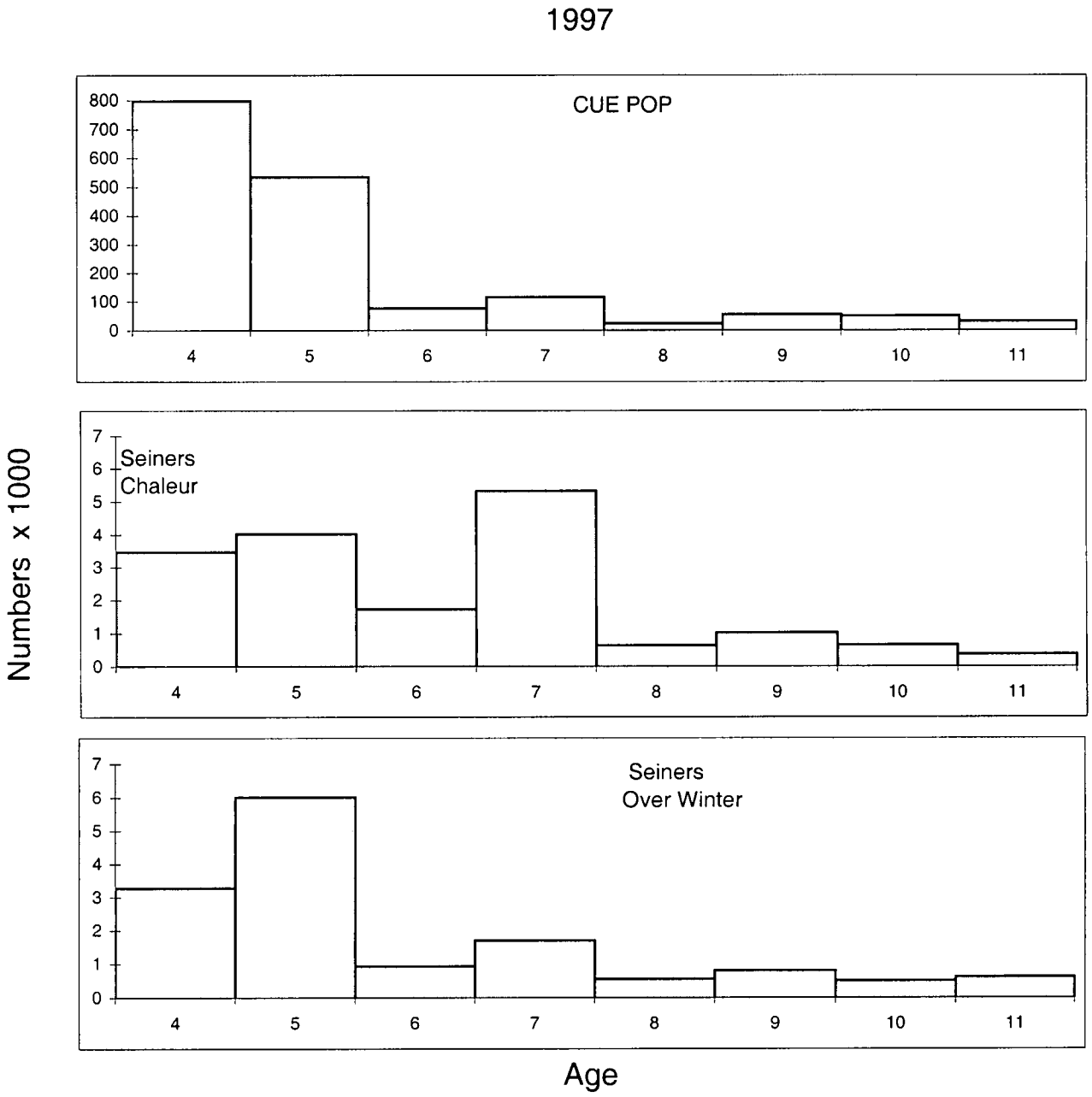
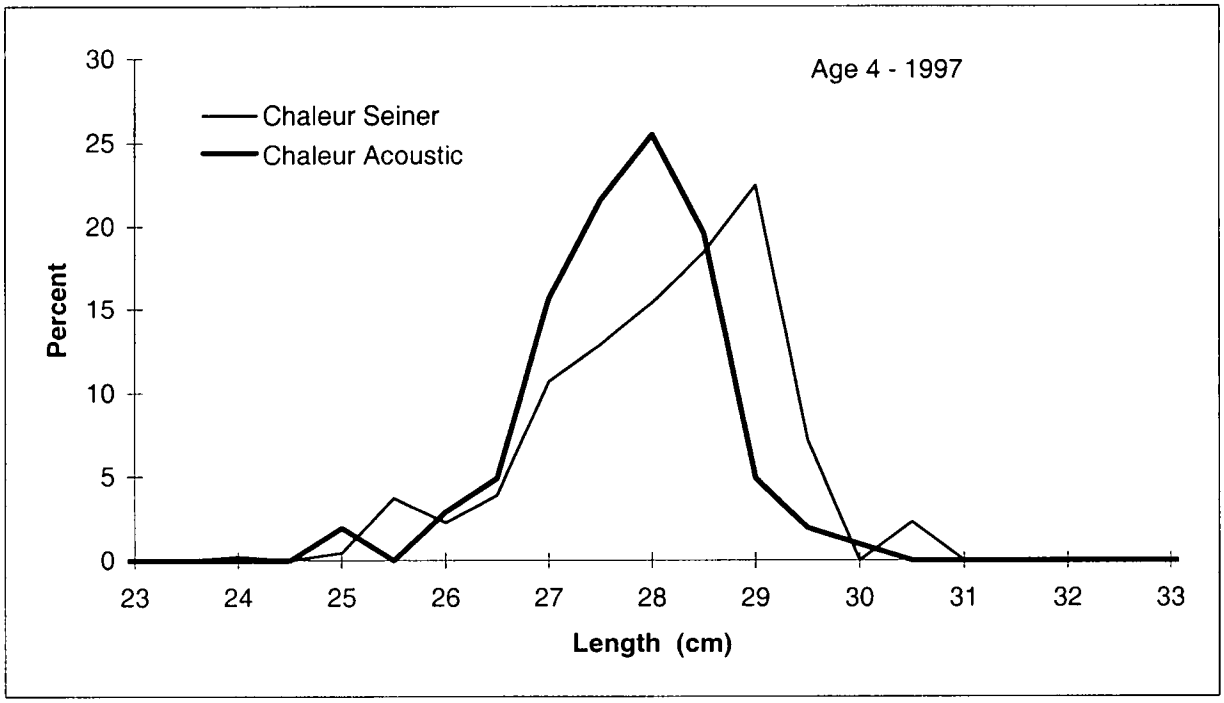


Fig. 41. Comparison of fall spawner age structure from ADAPT-VPA using split CUE indices (top), seiner catches in Chaleur Bay (middle), and seiner catches in 4Vn (bottom).



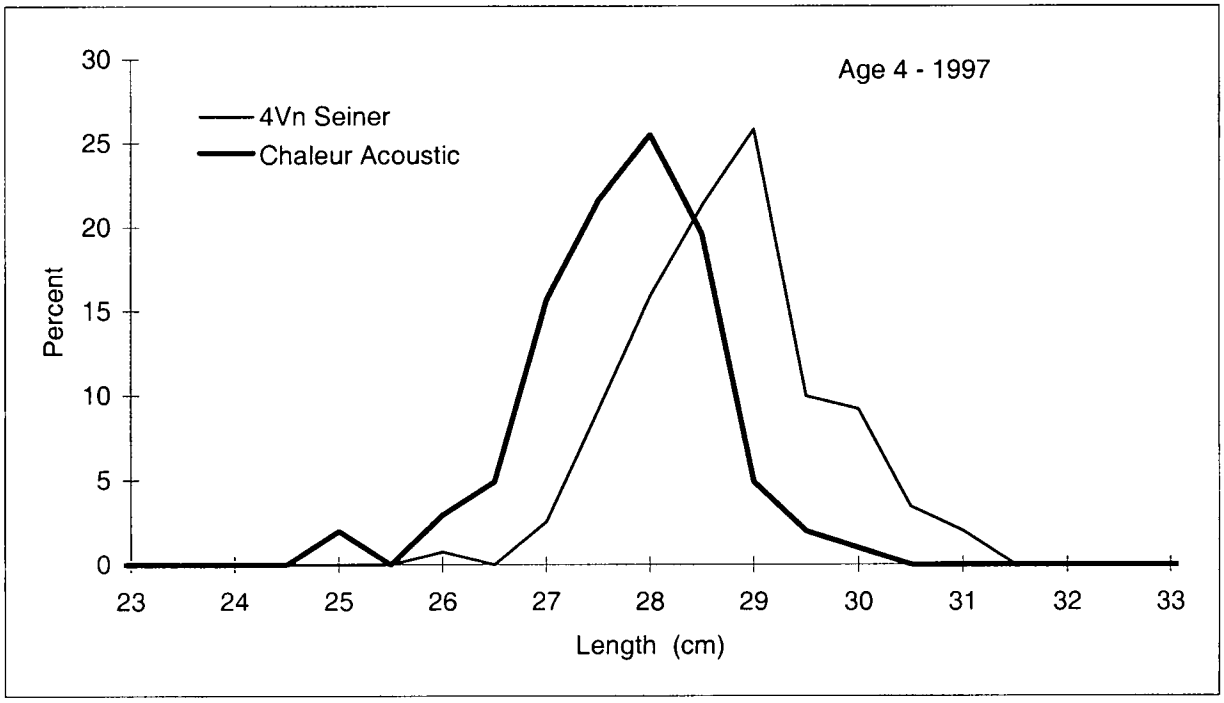


Fig. 42. Comparison of length at age 4 for fall spawners sampled during acoustic survey in Chaleur Bay, Chaleur Bay seiner fishery, and 4Vn seiner fishery in 1997.

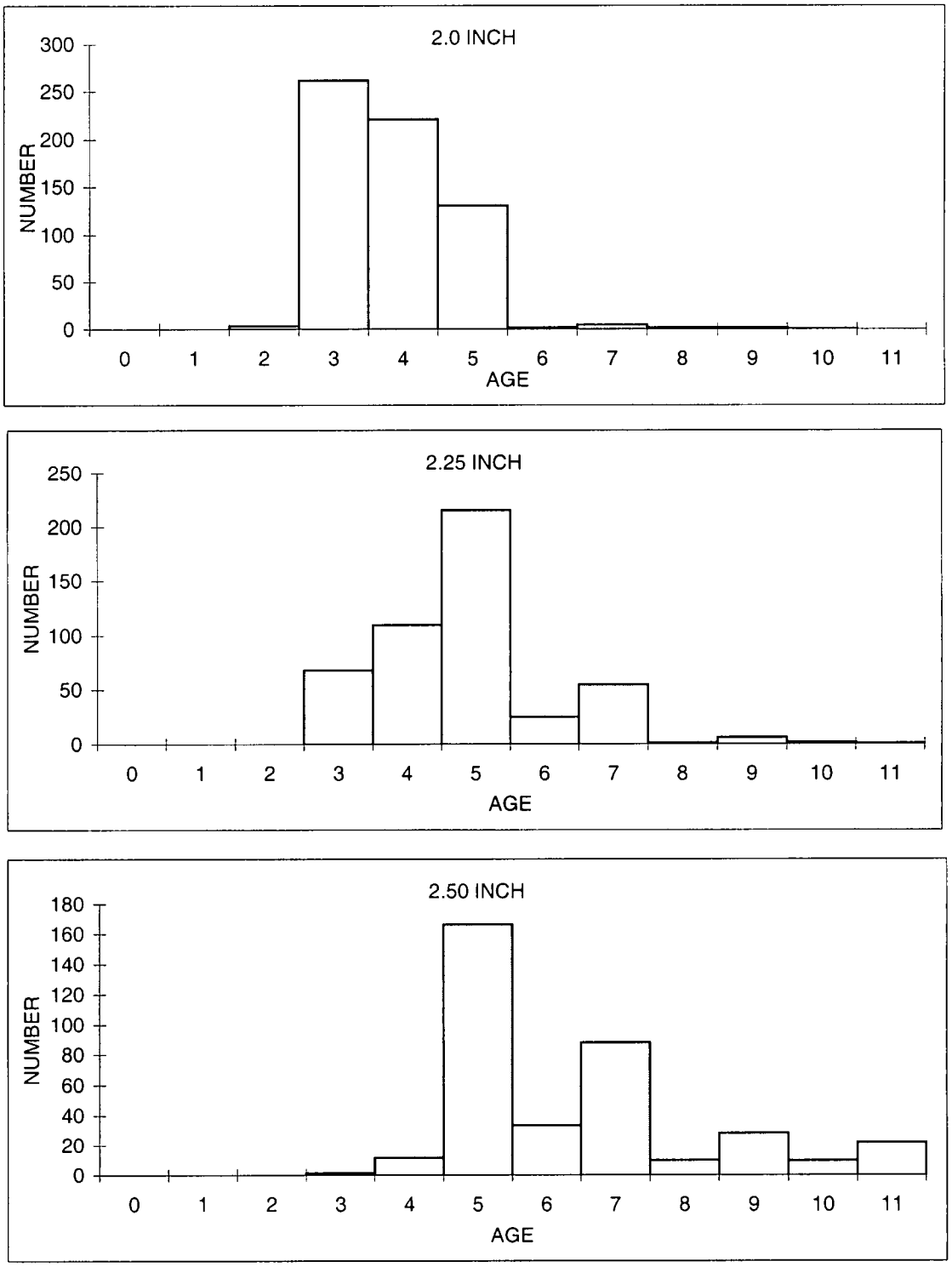
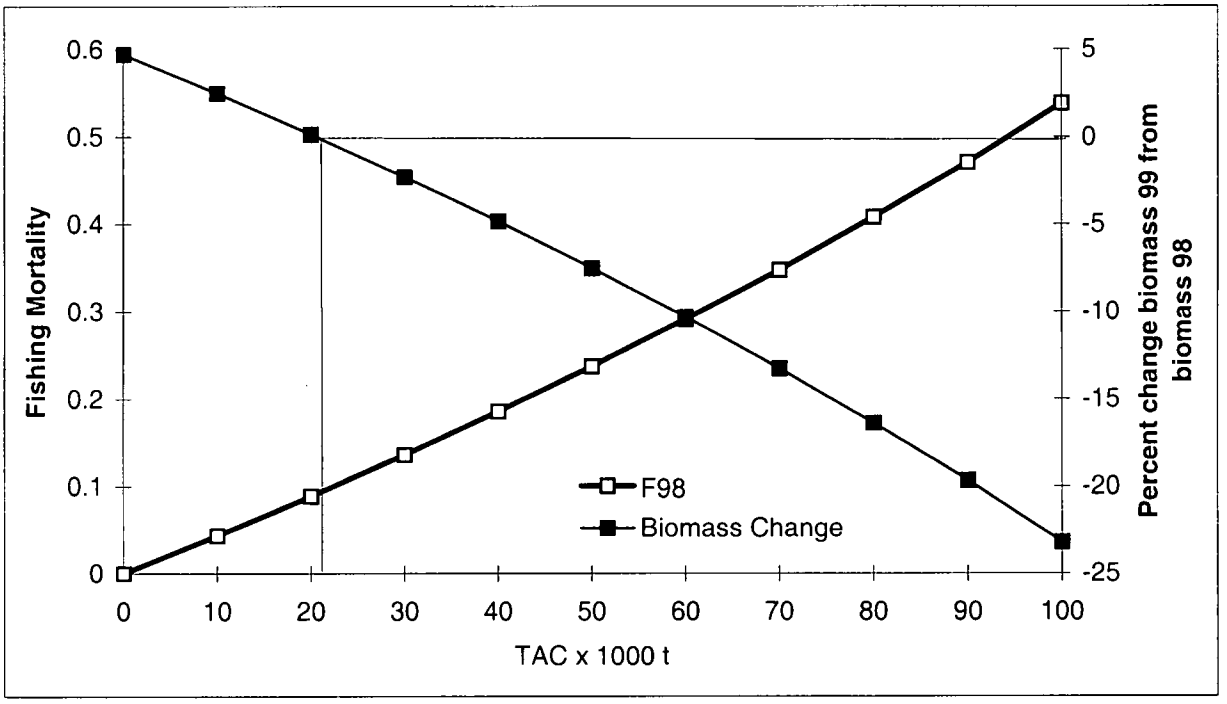


Fig. 43. Comparison of age structure in experimental nets for indicated mesh size fished in Pictou, Nova Scotia in fall, 1997.



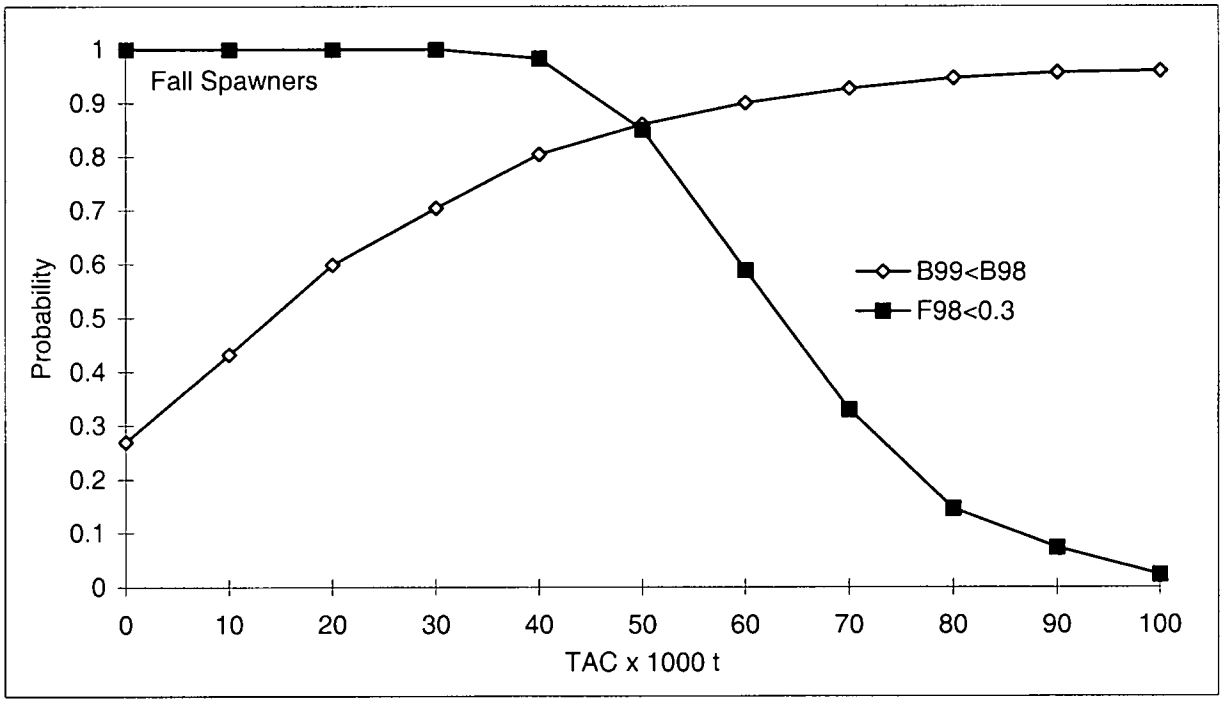


Fig. 44. Risk plots for fall spawners based on results from split mesh size CUE indices model.

Fall Spawners

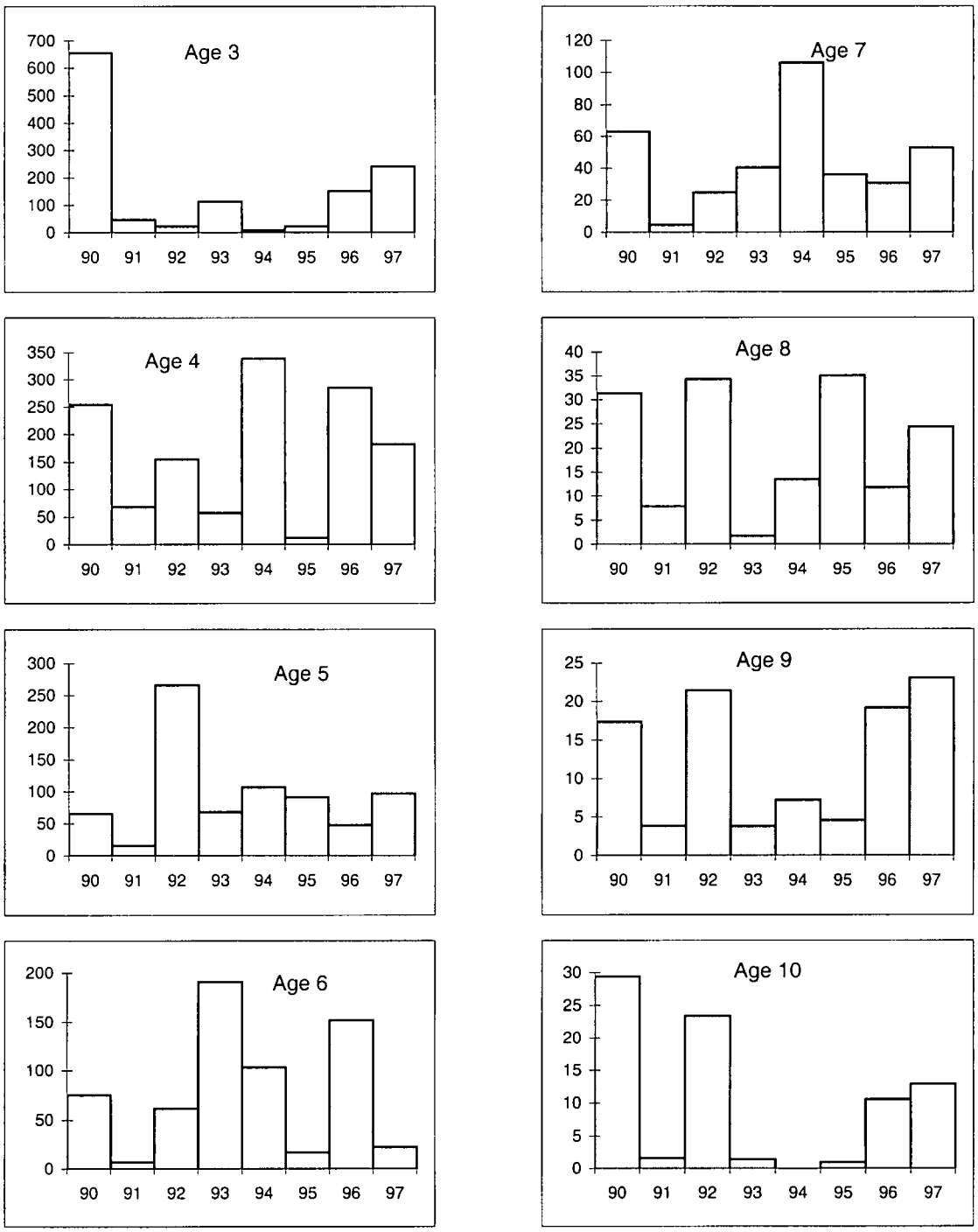


Fig. 45. Abundance index from acoustic survey including areas 4Tmnol and 4Vn.

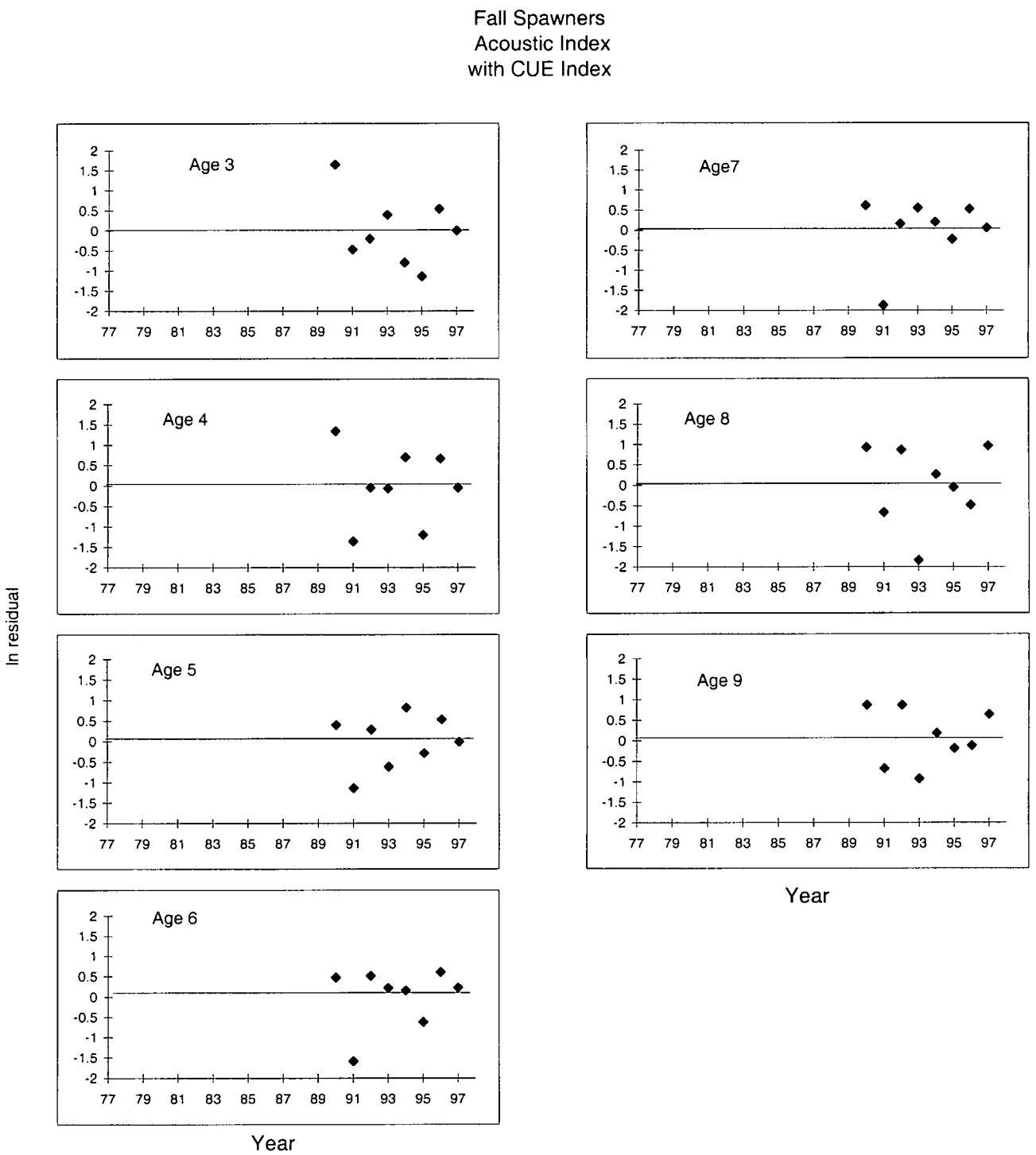
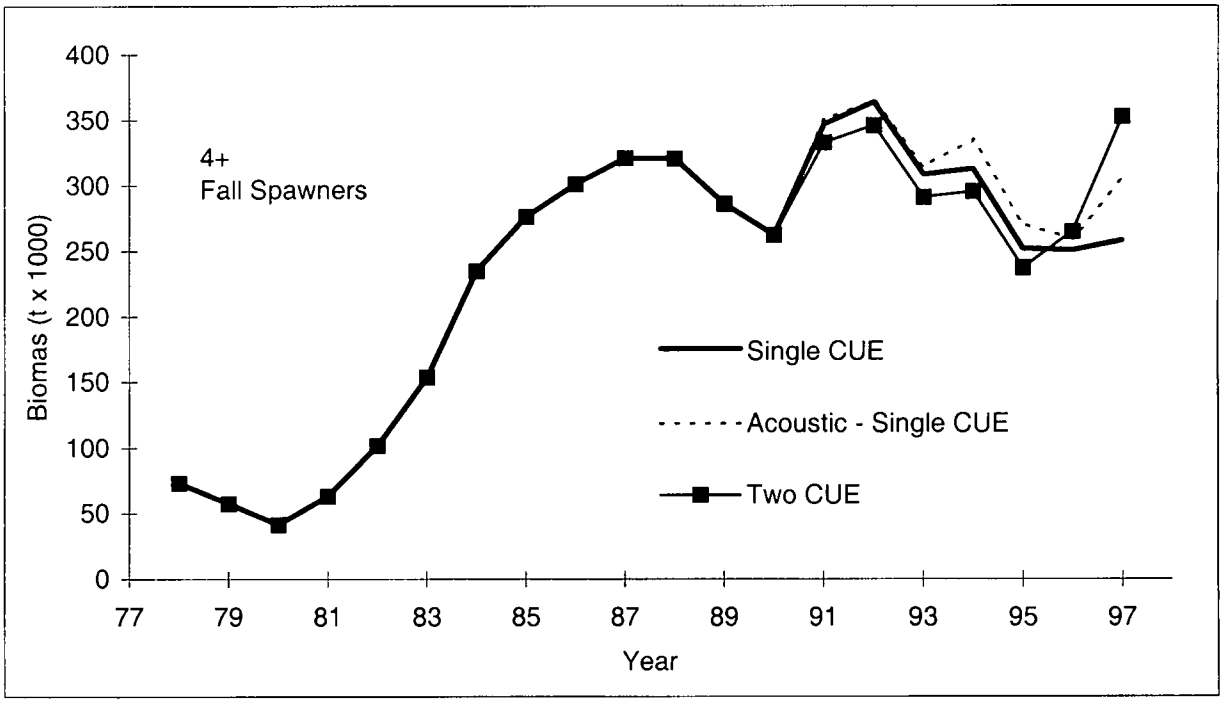


Fig. 46. Residuals from acoustic index portion of ADAPT-VPA using acoustic and single CUE indices.



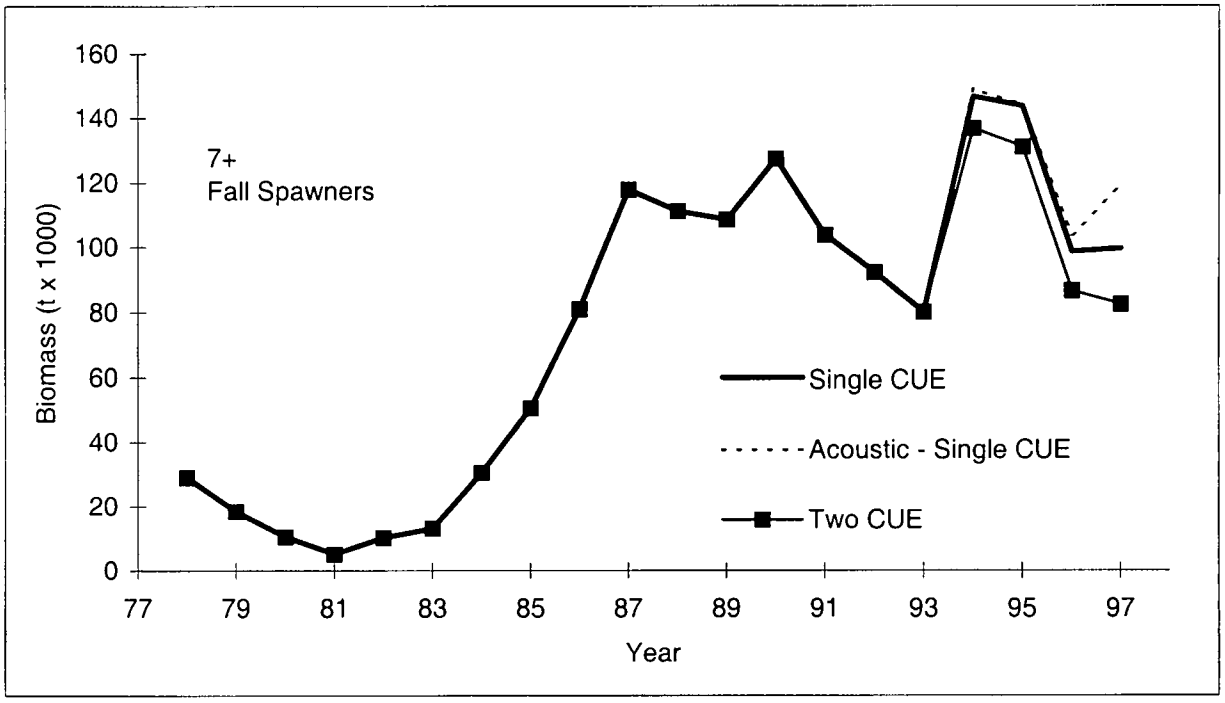


Fig. 47. Comparison of biomass estimates using CUE models and single CUE model combined with acoustic index.

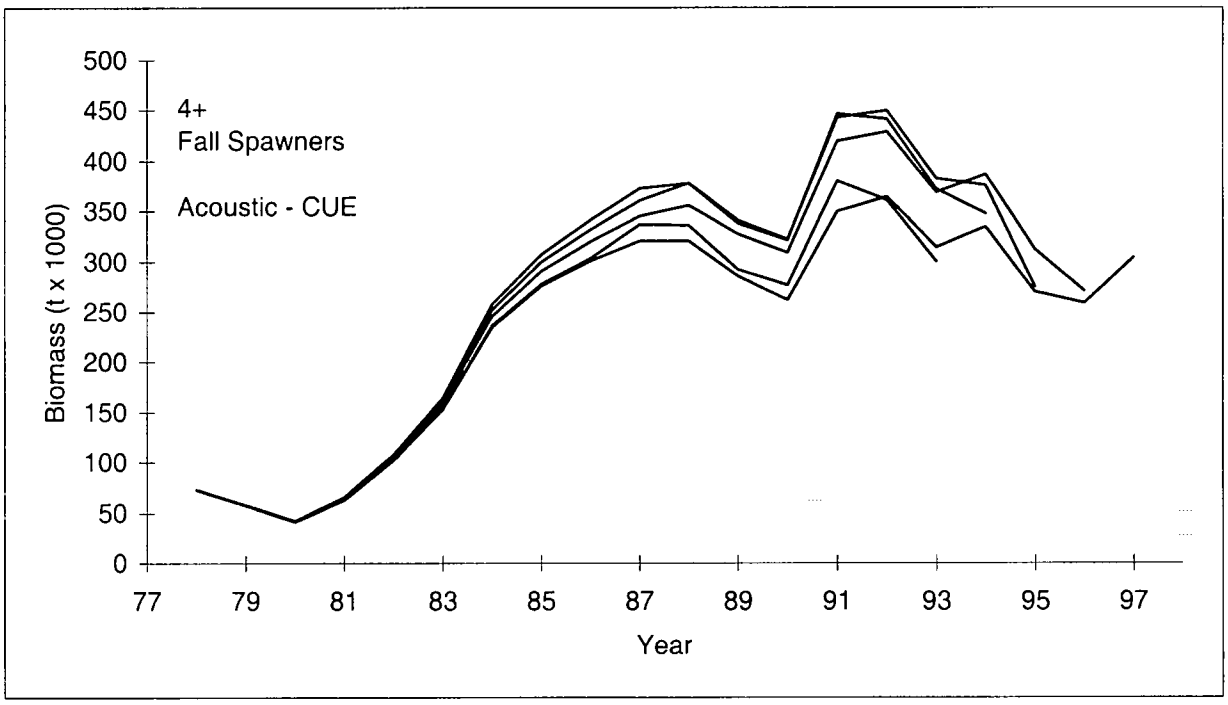


Fig. 48. Retrospective analysis for combined acoustic and single CUE model.

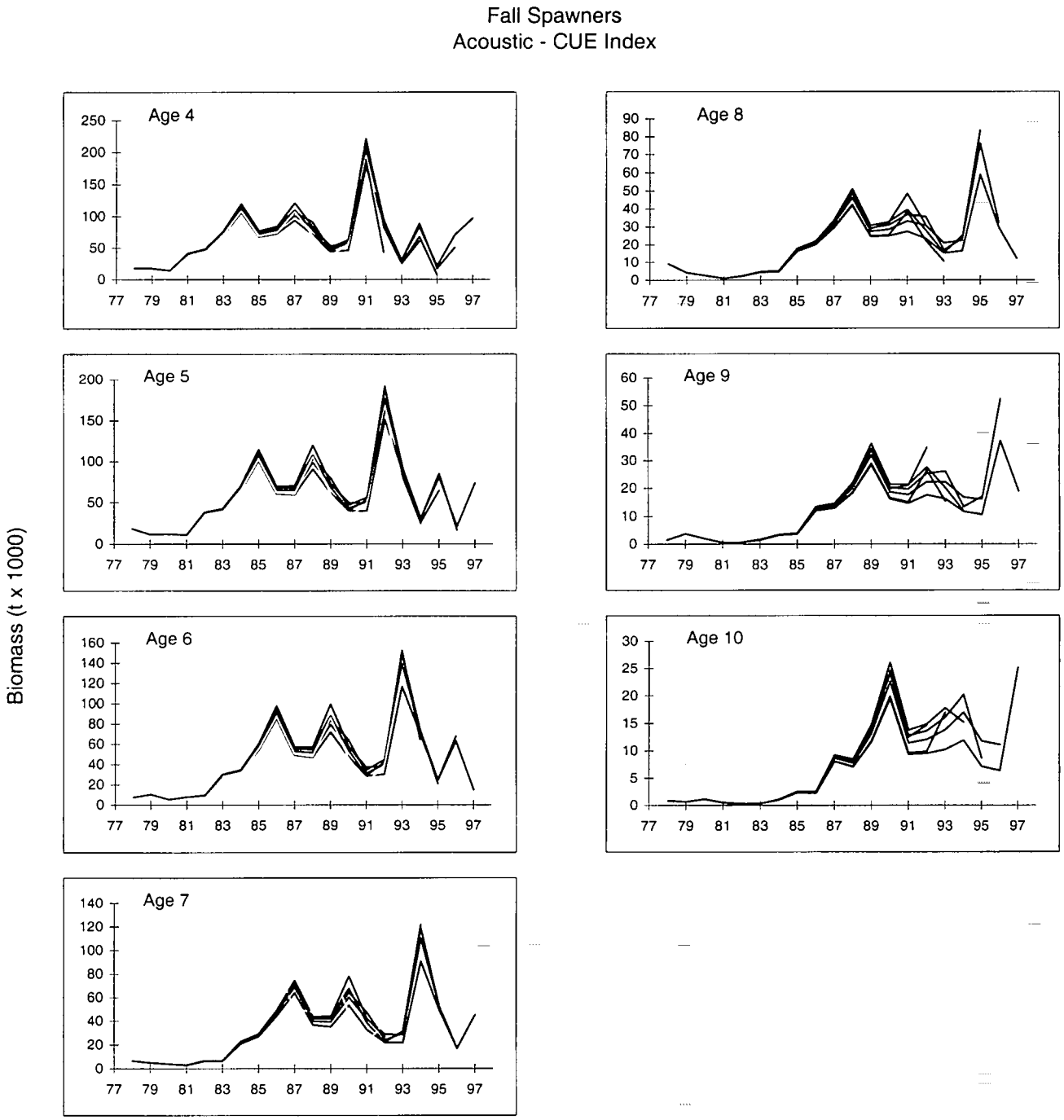
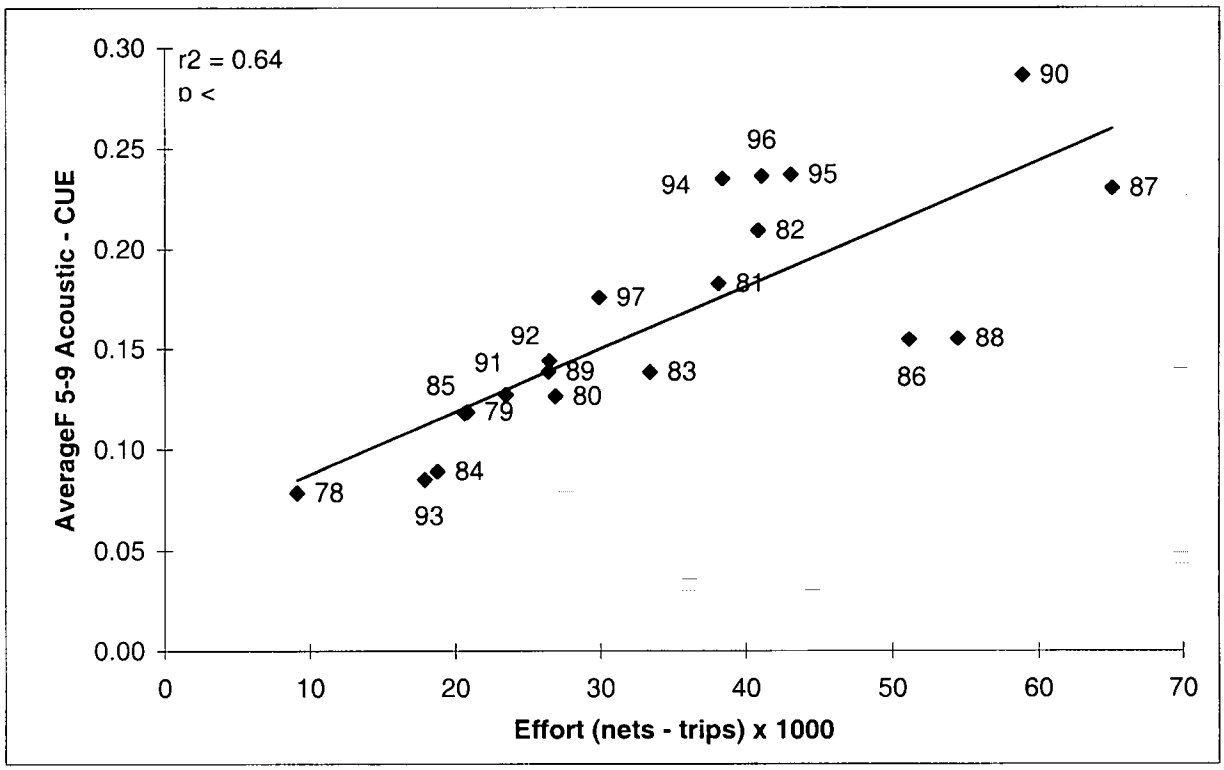


Fig. 49. Age by age retrospective analysis for combined acoustic and single CUE model.



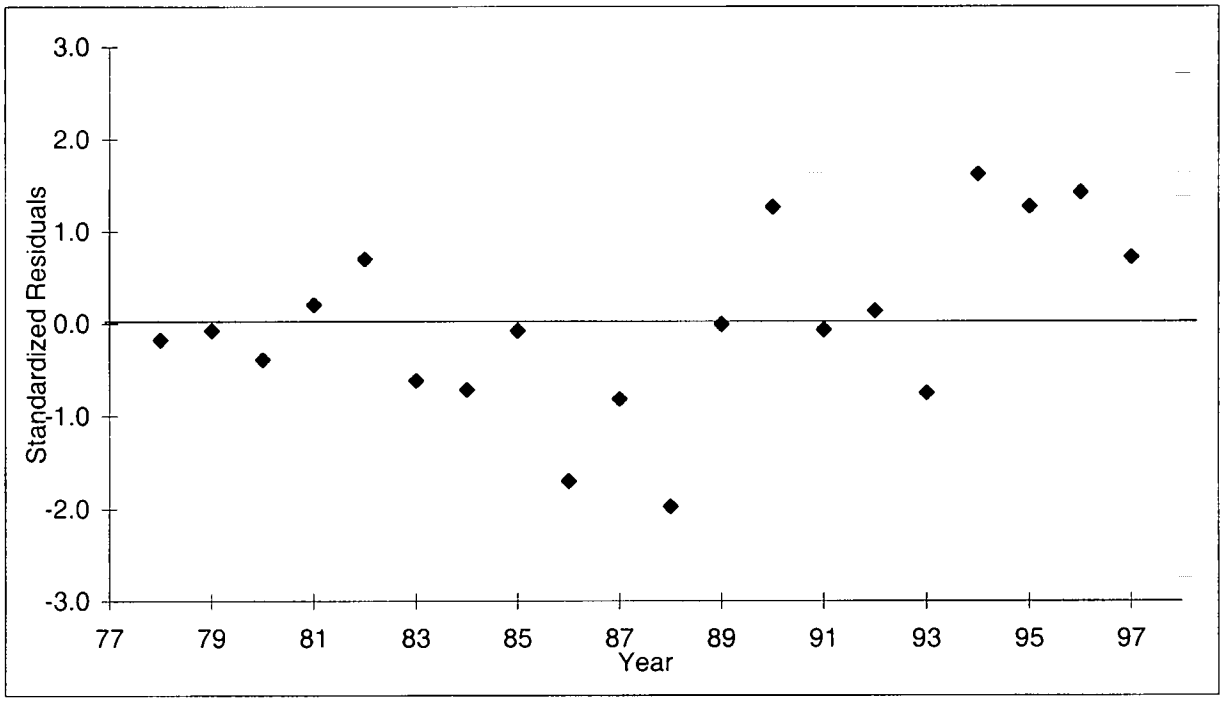
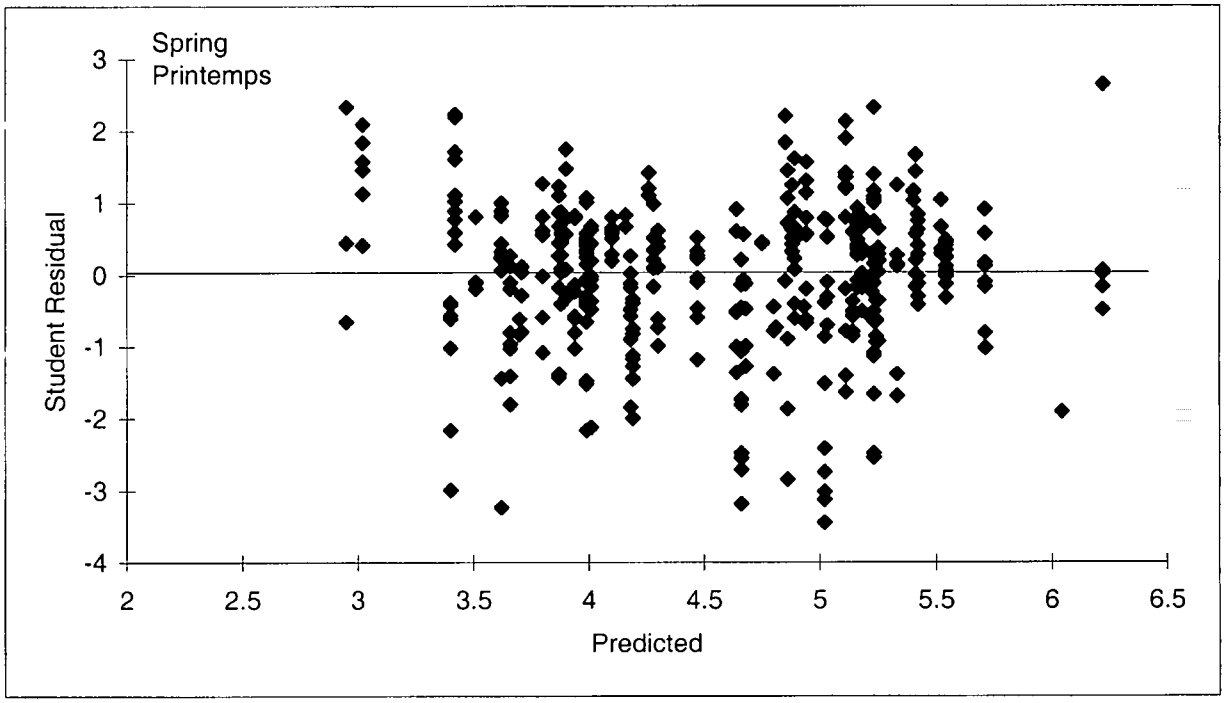


Fig. 50. Regression analysis of fishing mortality versus effort for combined acoustic and single CUE index fall spawner model.



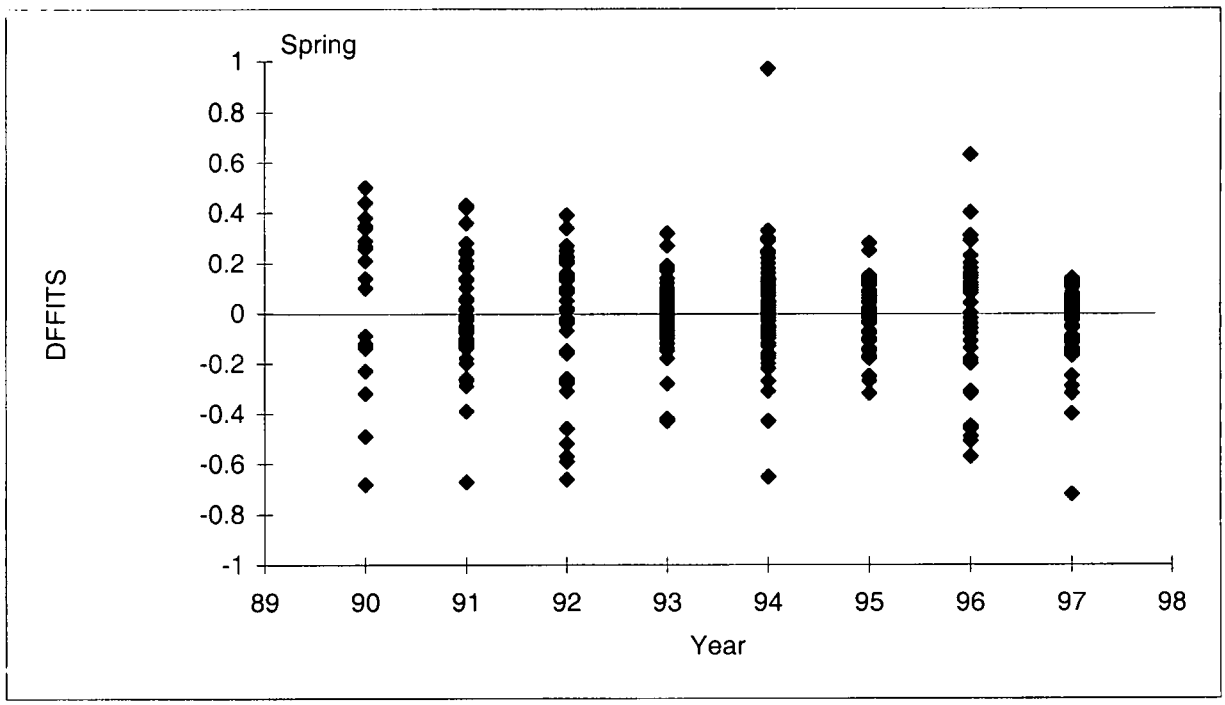


Fig. 51. Diagnostic for multiplicative catch rate model for spring gillnetters.

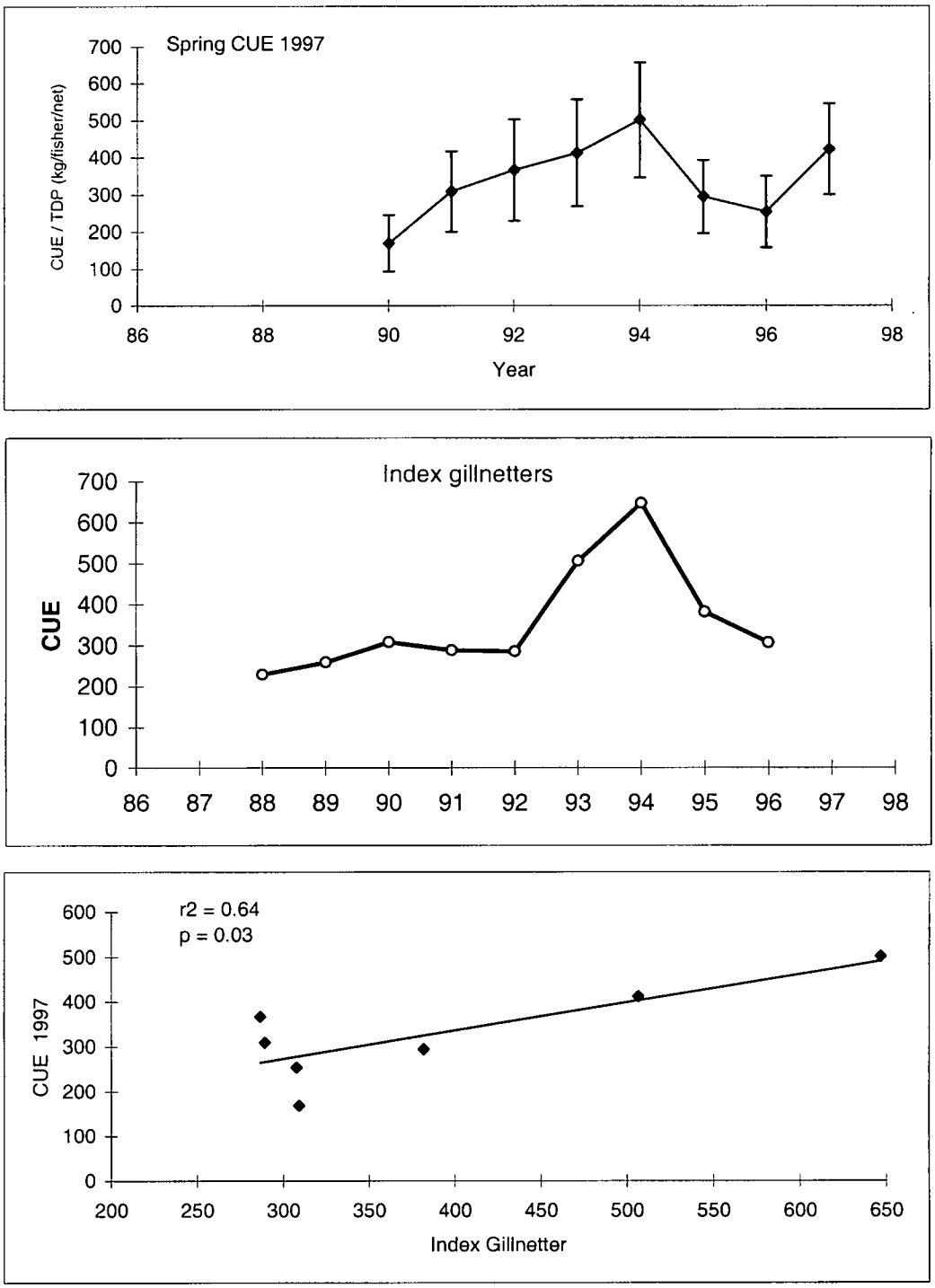


Fig. 52. Catch rate trends (top) for combined market co-ordinator and catch monitoring program derived index, for index gillnetter catch rate trends used last year (middle), and correlation between the two time series (bottom).

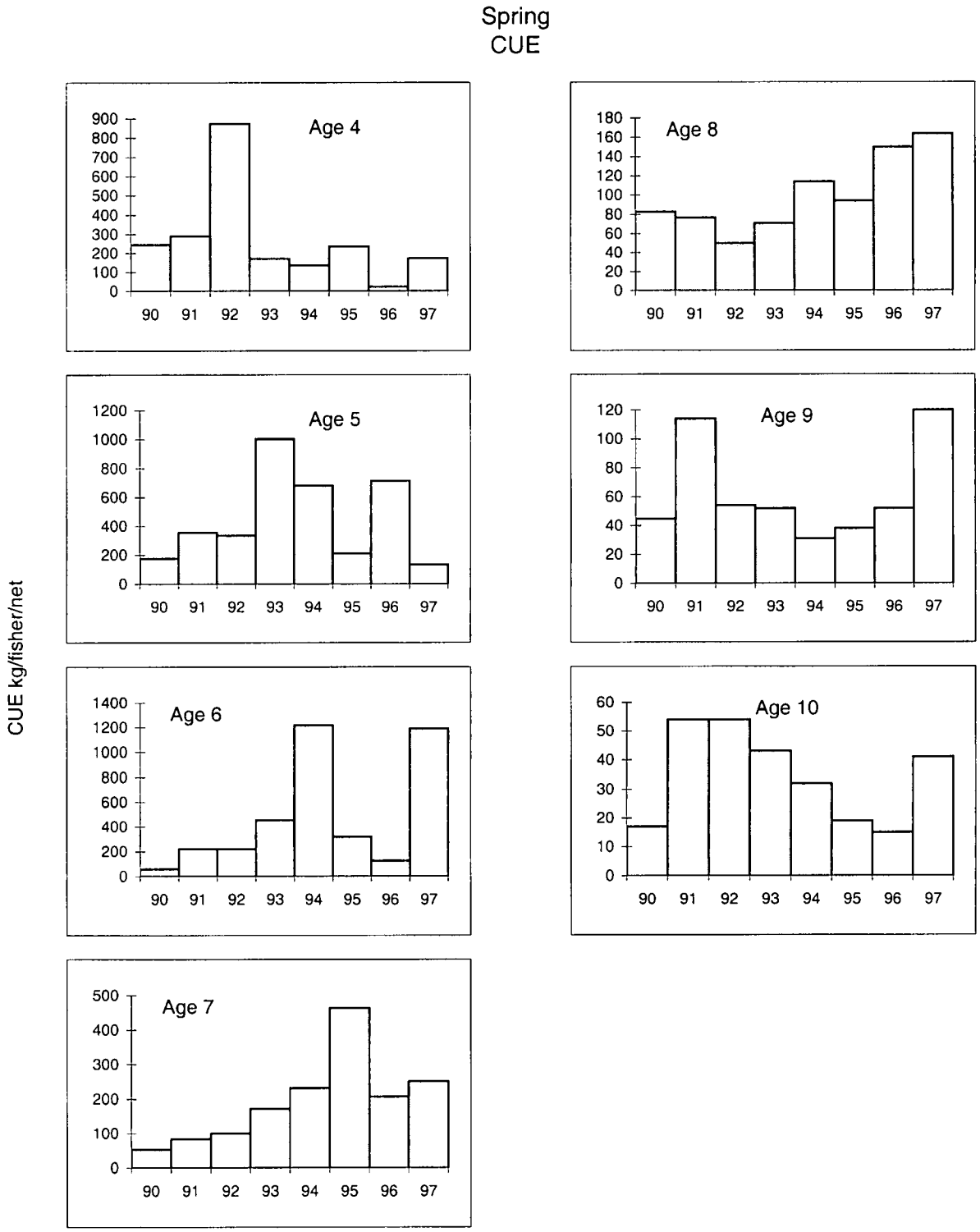


Fig. 53. Abundance index by age for spring spawners from combined market co-ordinator and catch monitoring program index.

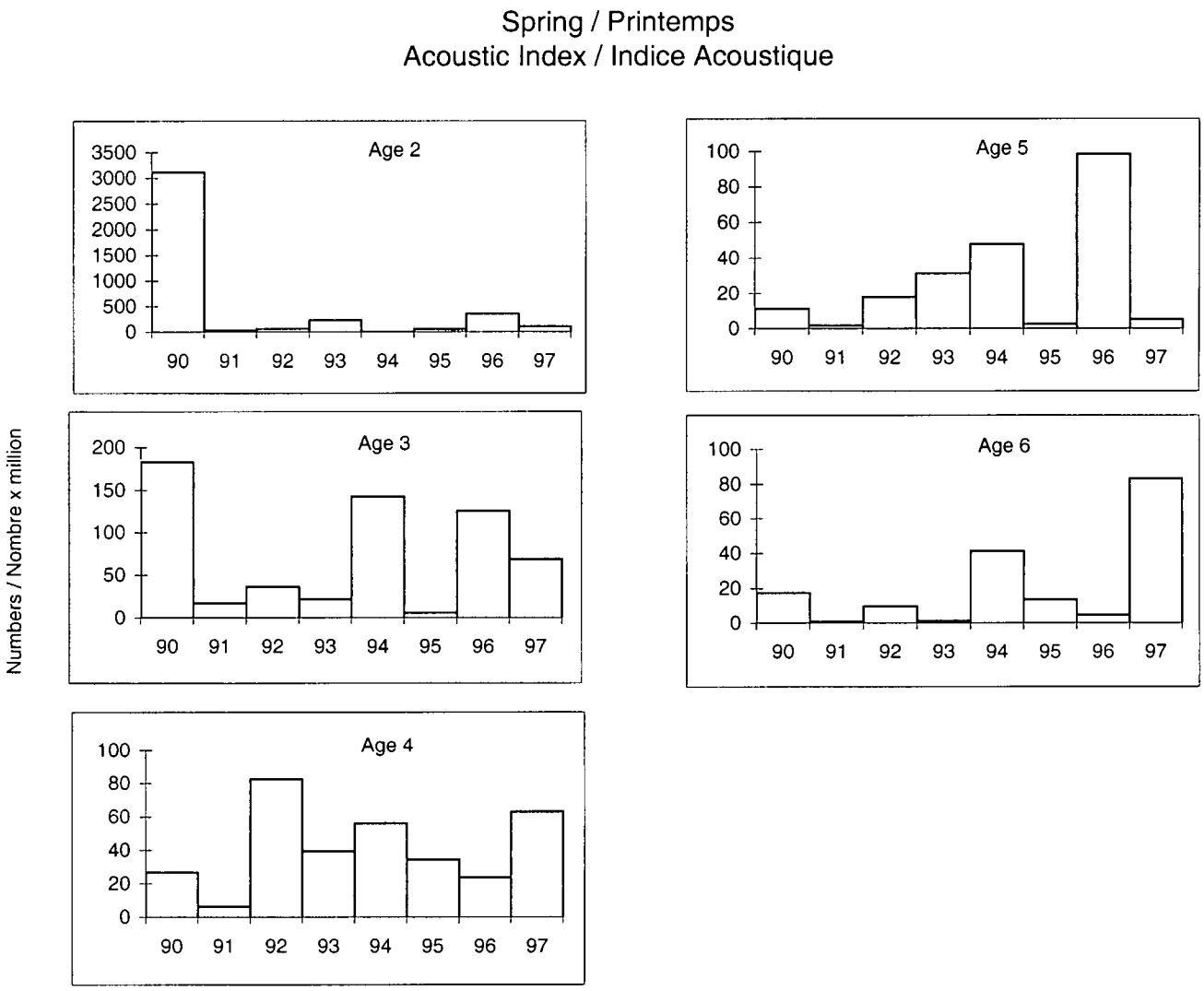


Fig. 54. Abundance index for spring spawners from acoustic survey.

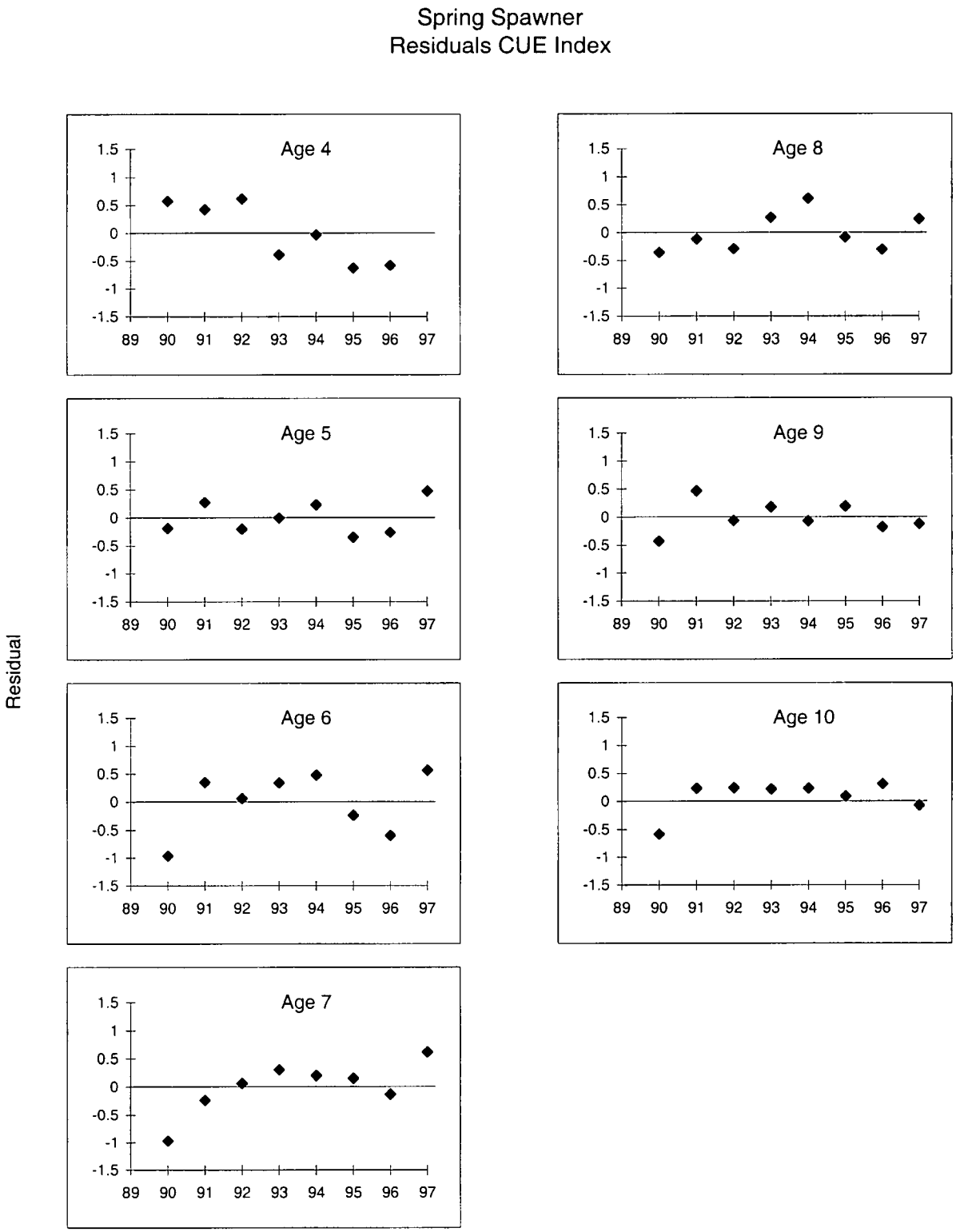
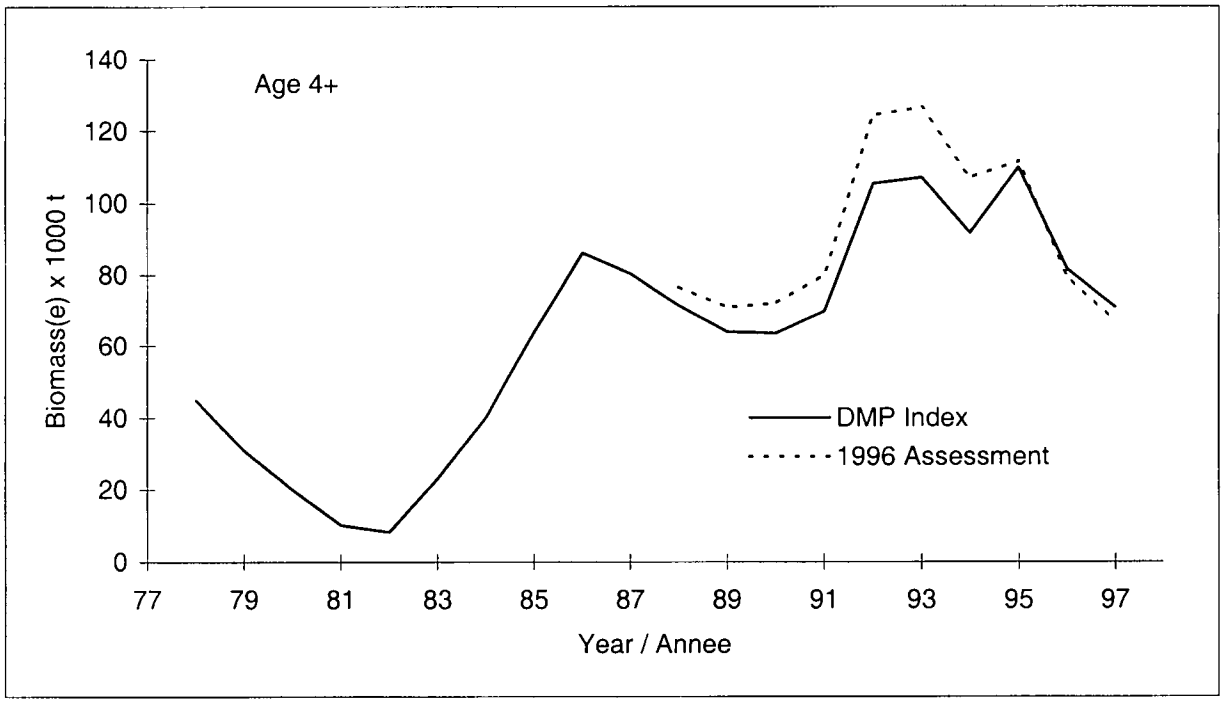


Fig. 55. Residuals by age for spring ADAPT-VPA using catch rate index.



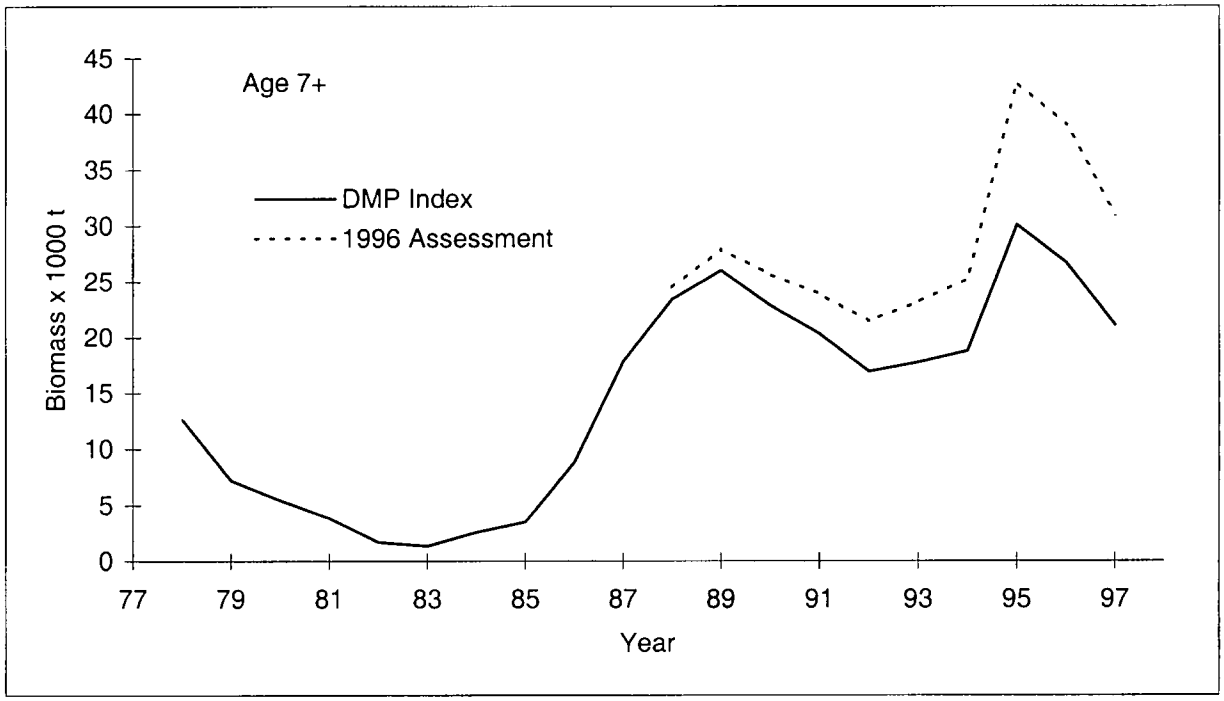
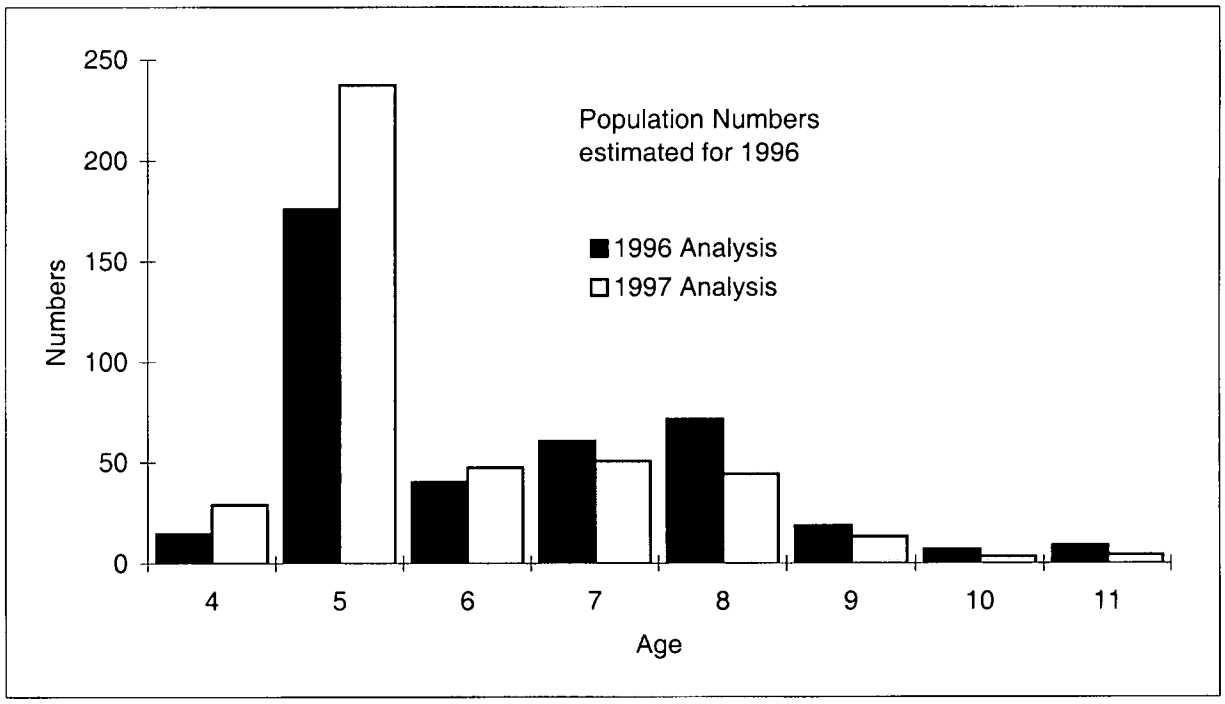


Fig. 56. Retrospective analysis for spring spawners, comparing 1996 assessment results using the index gillnetter catch rates, with those using the 1997 catch rate index. The 1997 point from the 1996 assessment is the projection based on the results from that year.



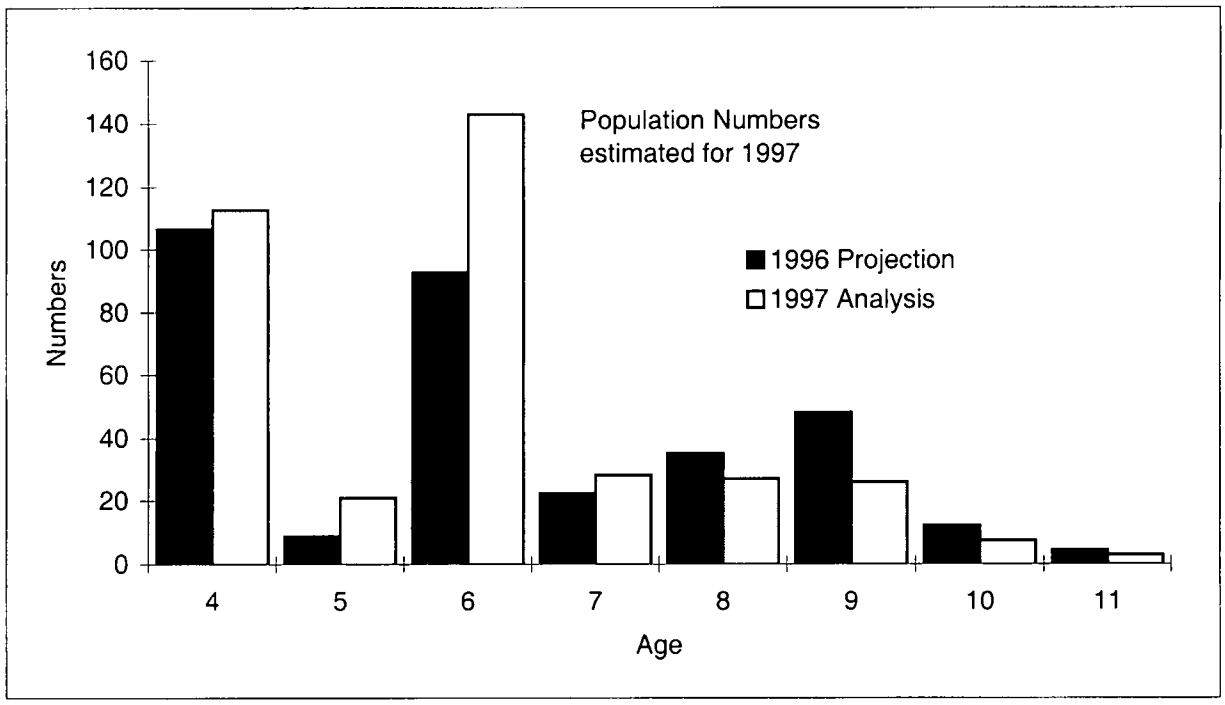


Fig. 57. Age by age comparison of population numbers estimated in 1996 assessment compared to those estimated using the 1997 catch rate index in this assessment.

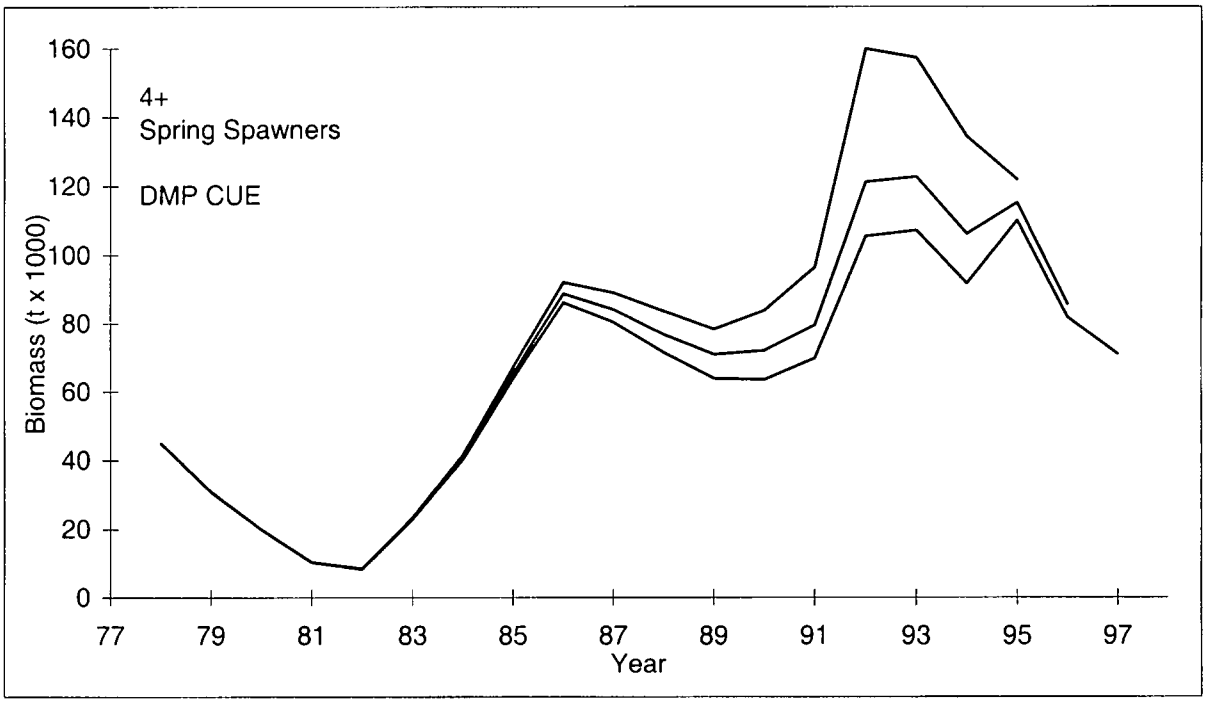


Fig. 58. Retrospective analysis for 1997 spring spawners using catch rate index.

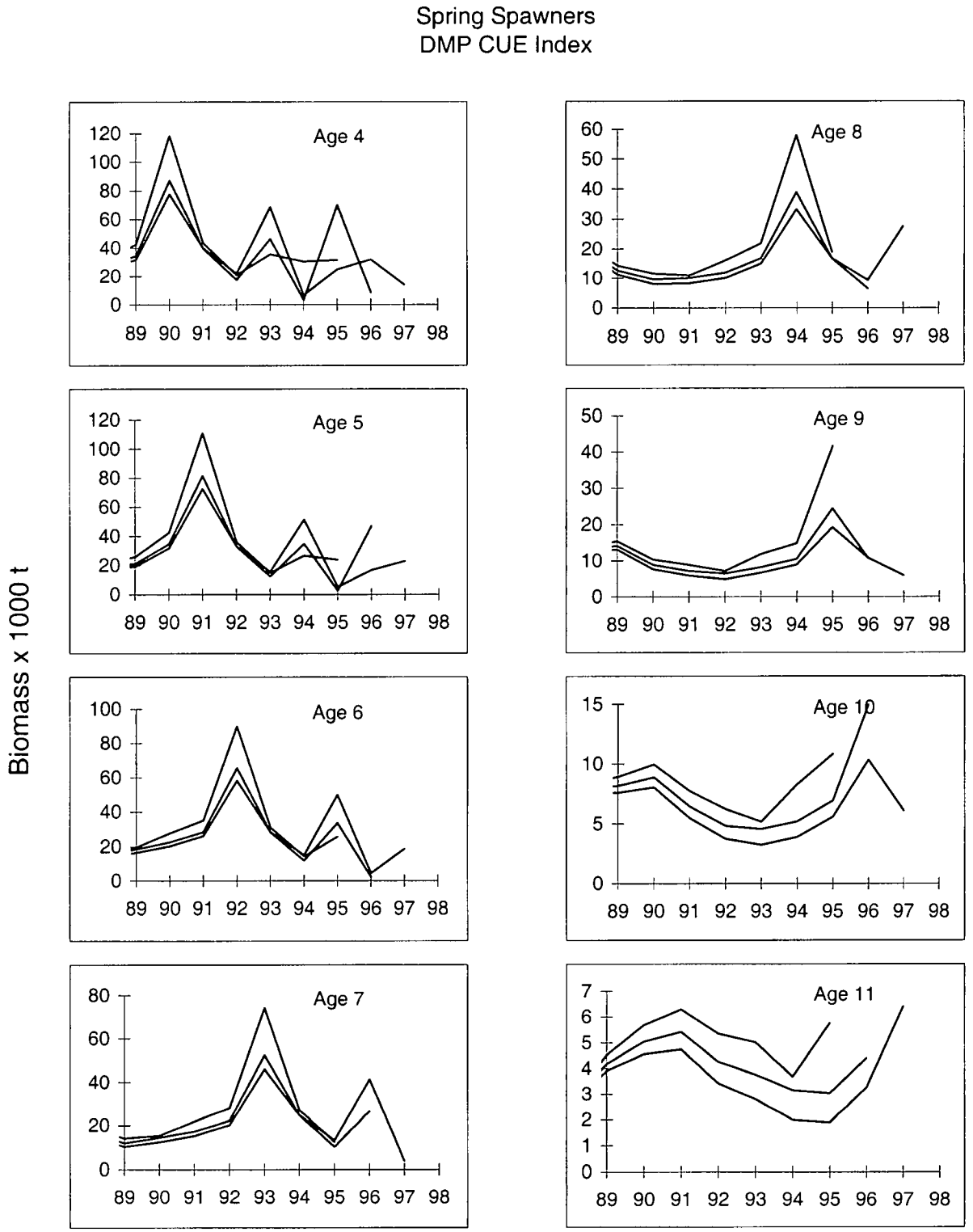
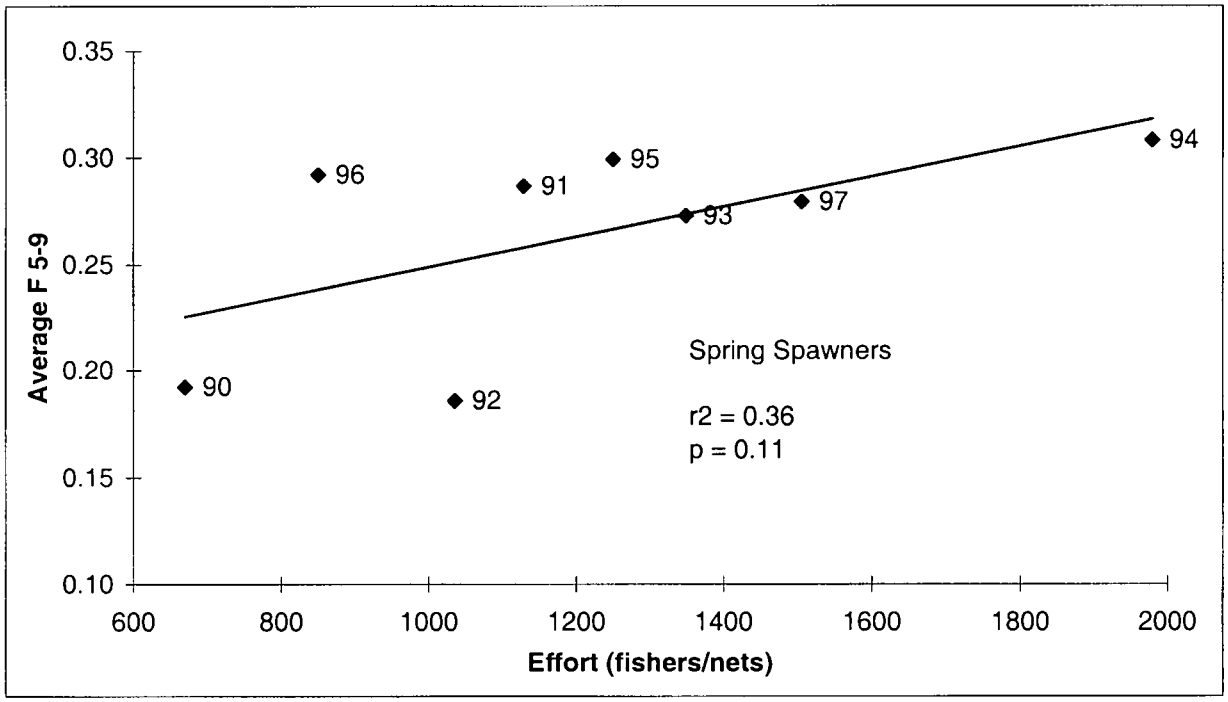


Fig. 59. Age by age retrospective analysis for 1997 spring spawner ADAPT-VPA.



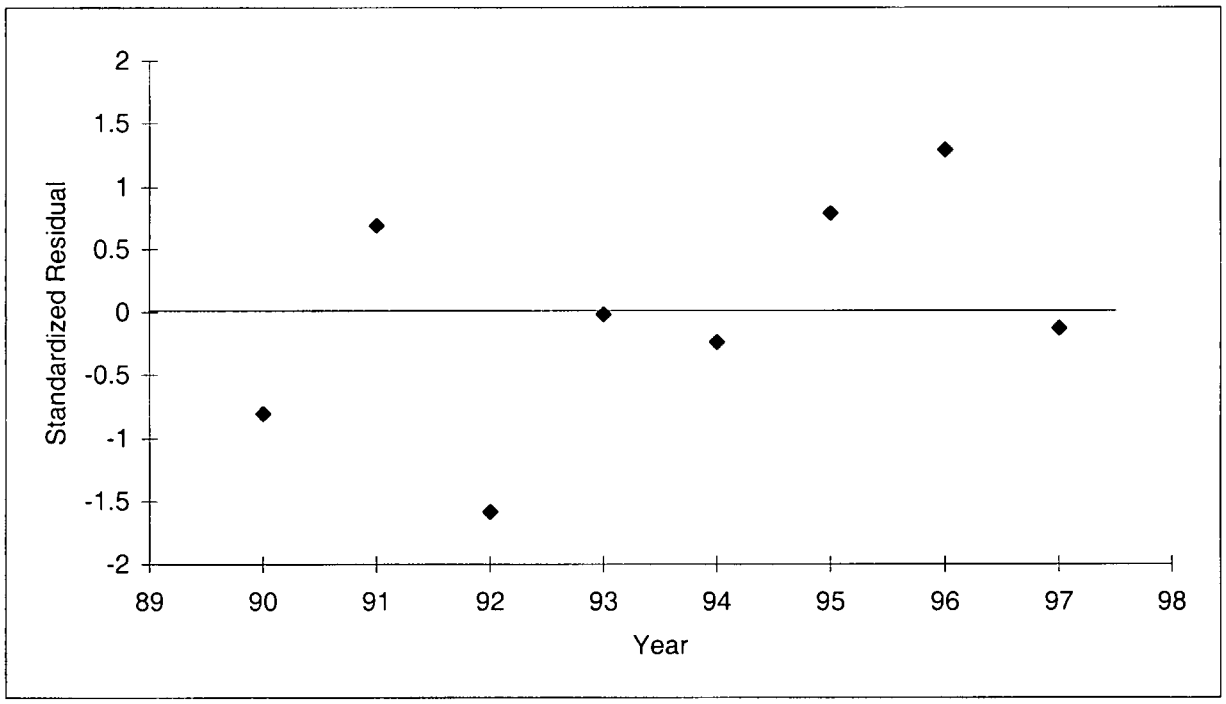


Fig. 60. Regression results for the relationship between fish mortality and effort for spring spawners.

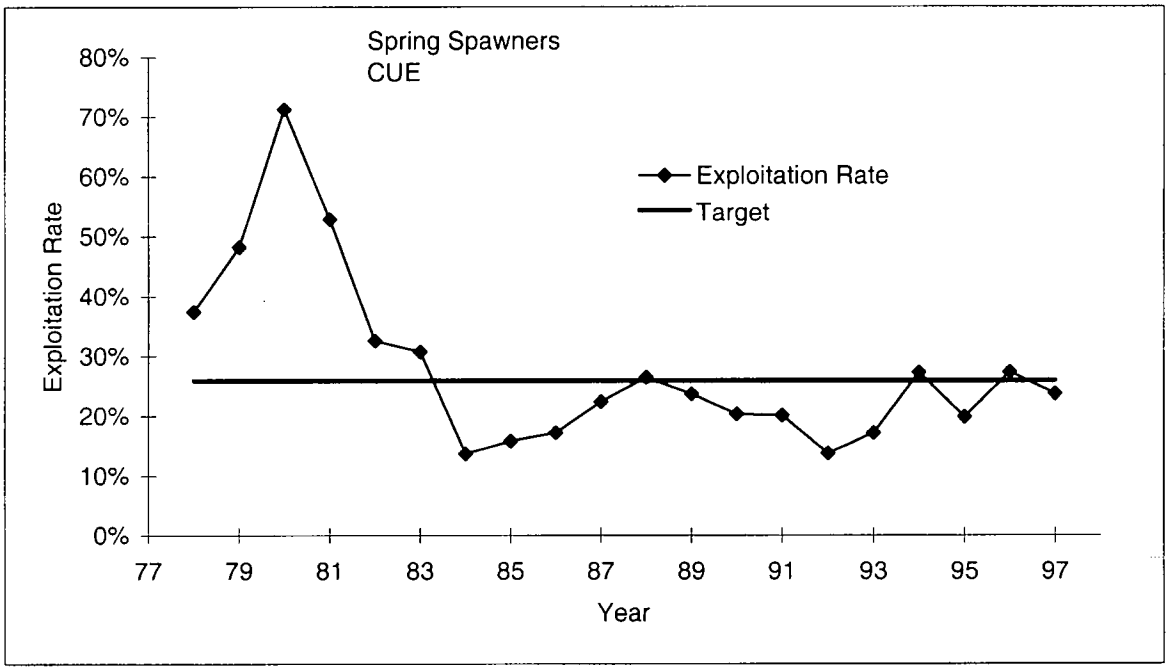


Fig. 61. Spring spawner fishing mortalities estimated by ADAPT-VPA compared to the target fishing mortality rate.

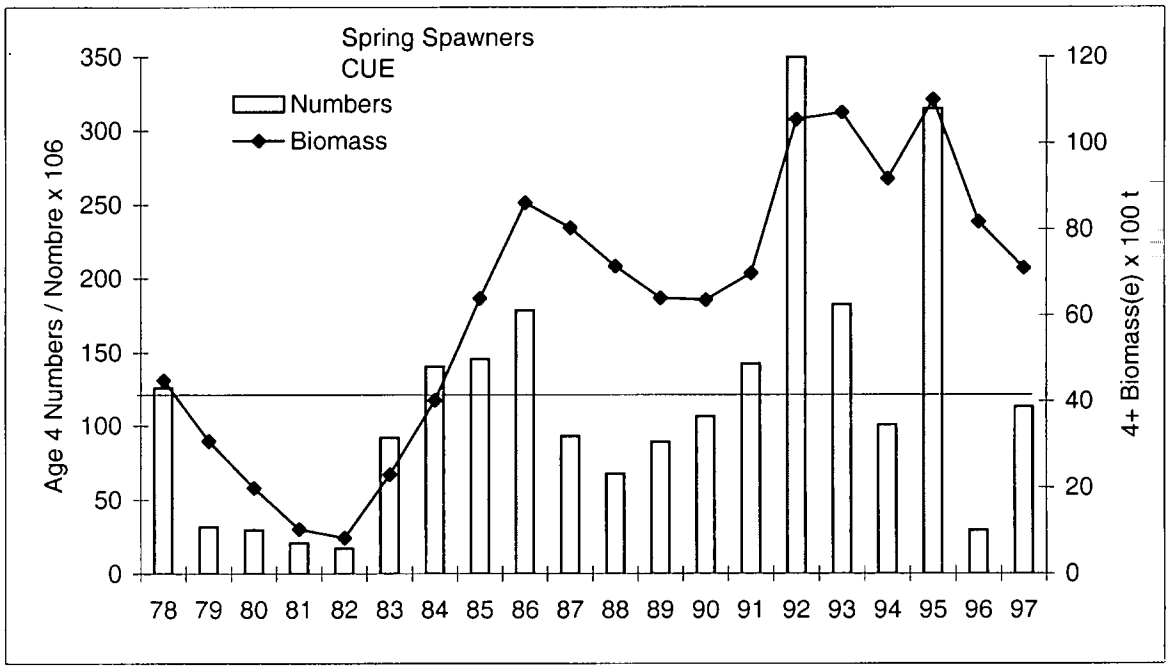


Fig. 62. Recruitment (age 4) and 4+ biomass trends for spring spawners. Horizontal line indicates average recruitment.

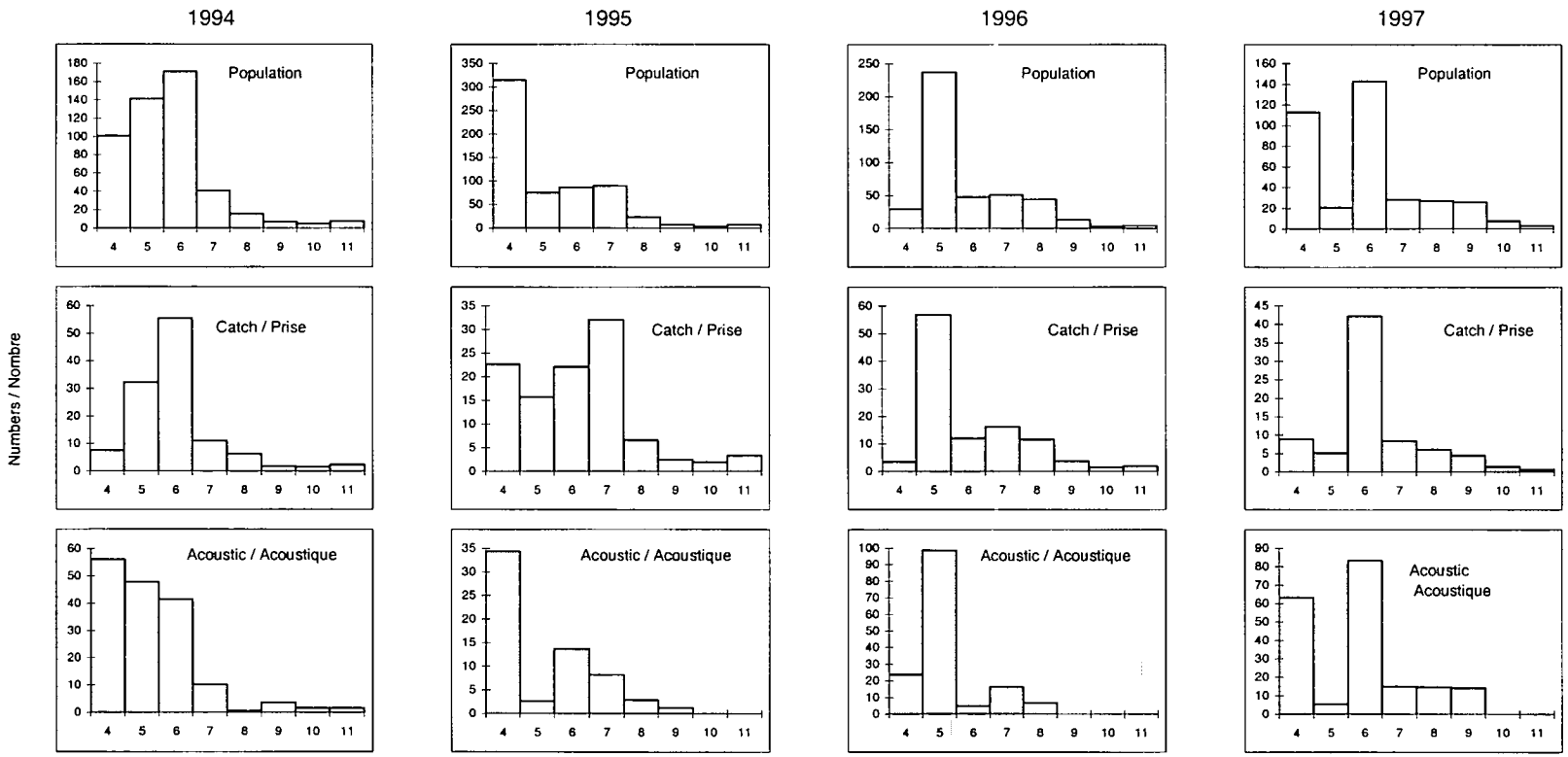


Fig. 63. Spring spawners age structure comparing population estimate from ADAPT-VPA (top row), catch (middle row), and acoustic survey (bottom row).

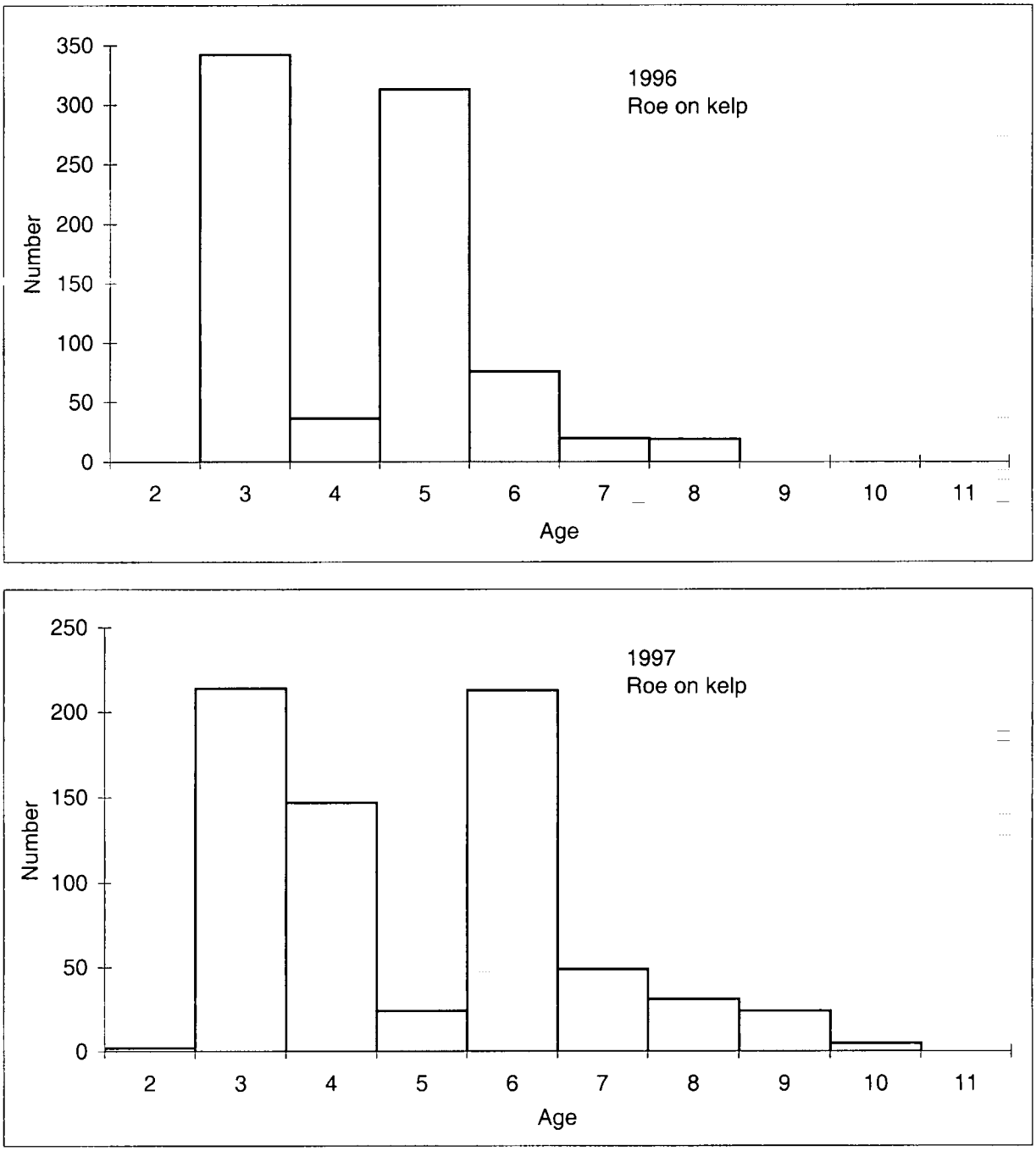
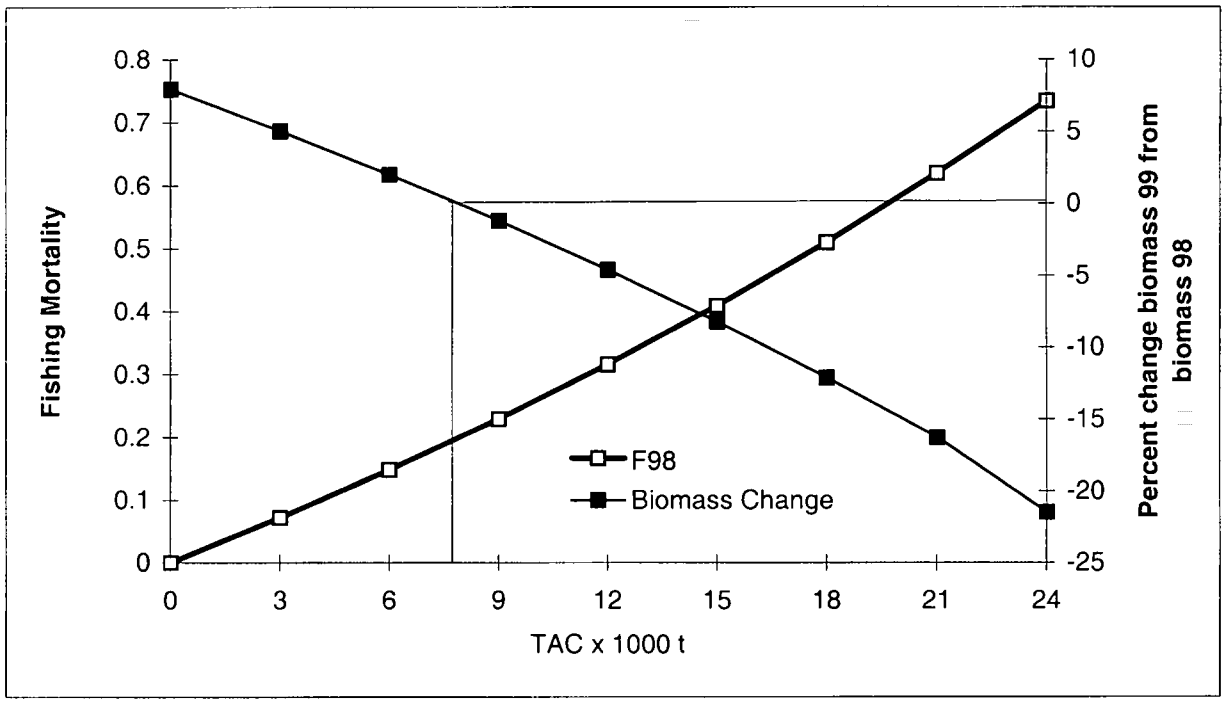


Fig. 64. Age structure of spring spawners in roe on kelp experimental trapnets, 1996-97.



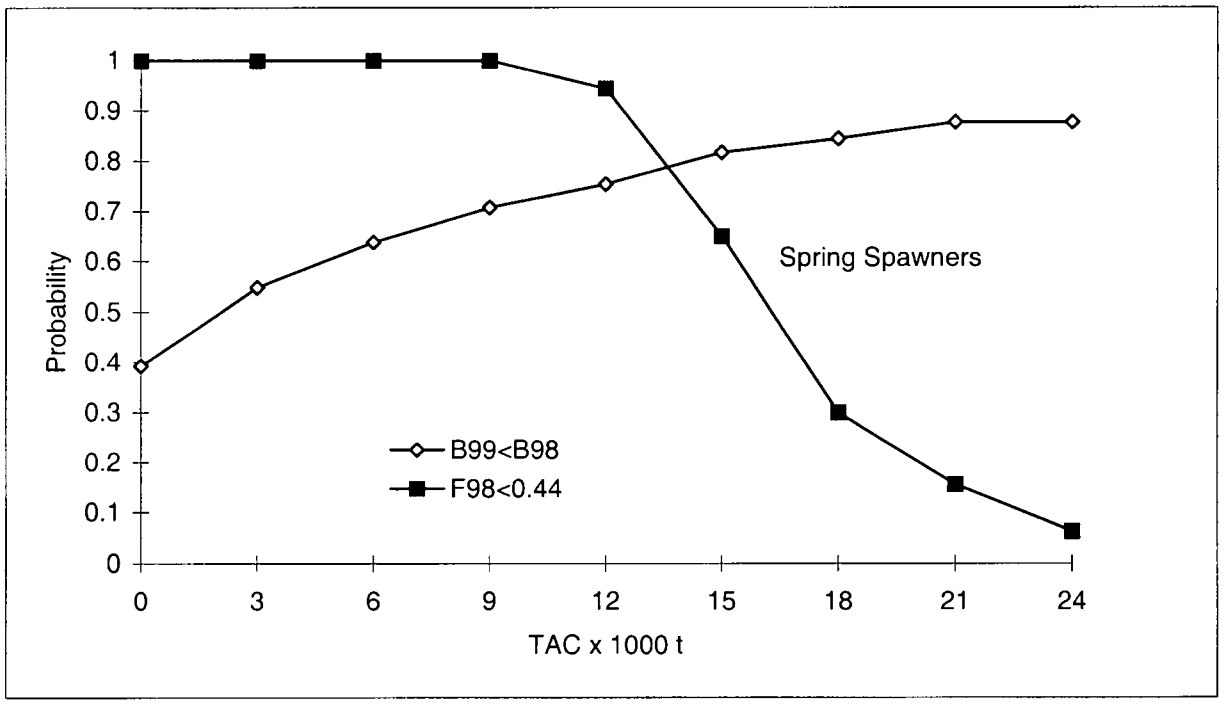


Fig. 65. Risk plots for spring spawners.

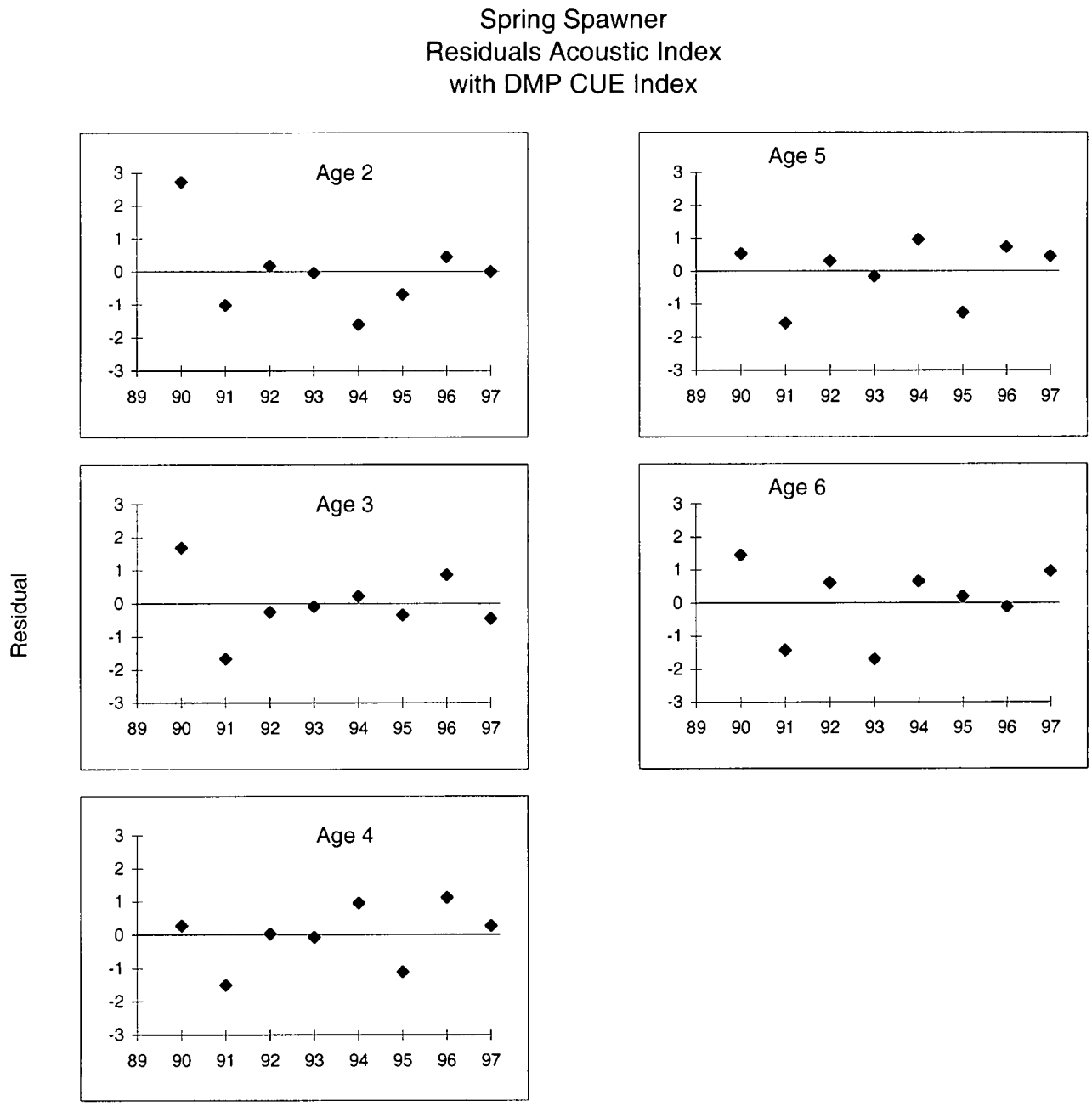
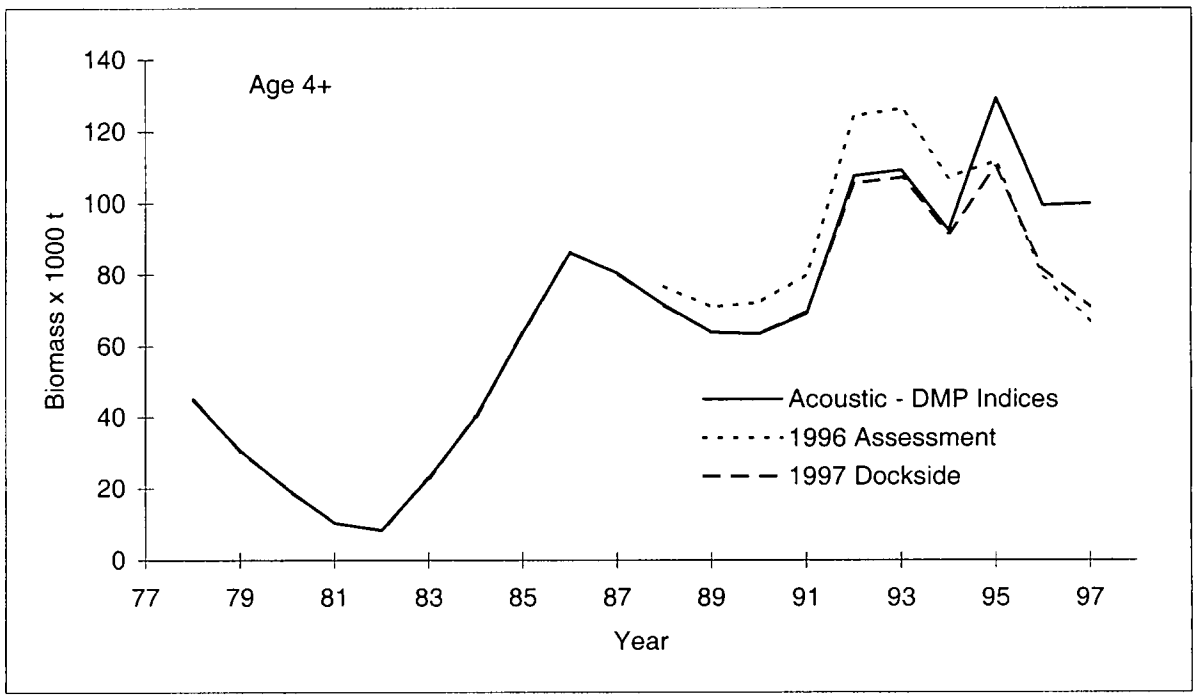


Fig. 66. Residuals by age from spring spawners ADAPT-VPA using acoustic and CUE index.



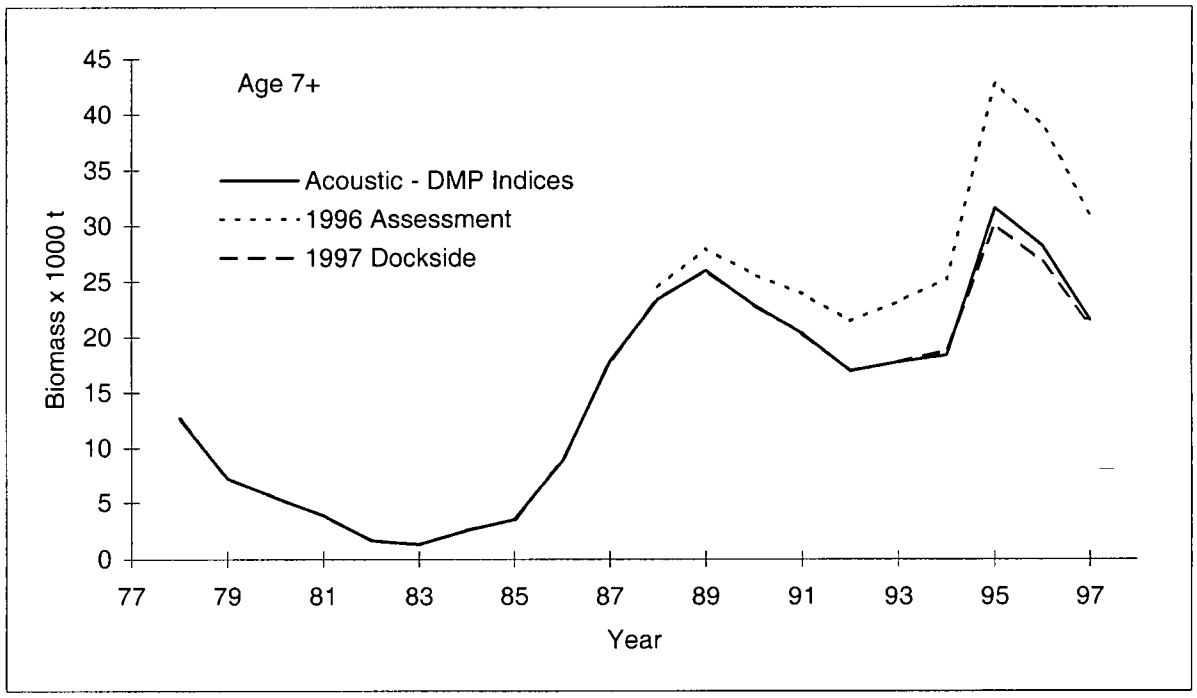


Fig. 67. Comparison of 1996 assessment results with 1997 assessment results using only the CUE index and using the CUE and acoustic indices in an ADAPT-VPA model.

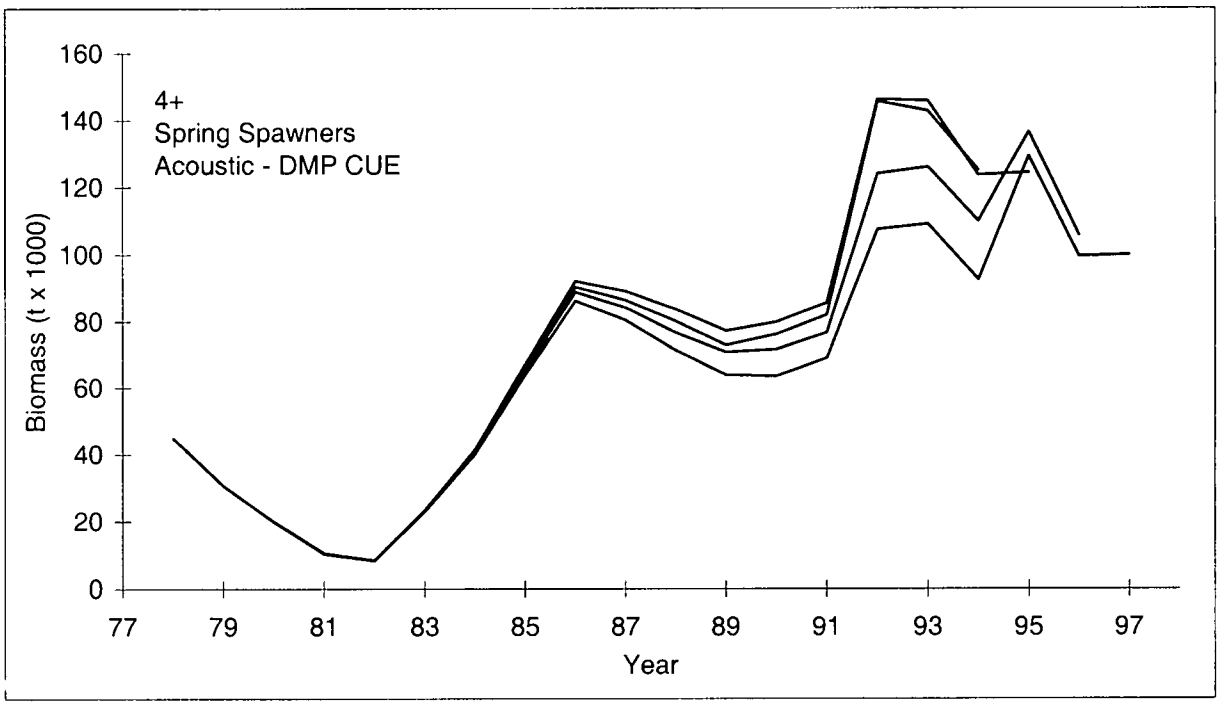


Fig. 68. Retrospective analysis of ADAPT-VPA using combined acoustic and CUE indices.

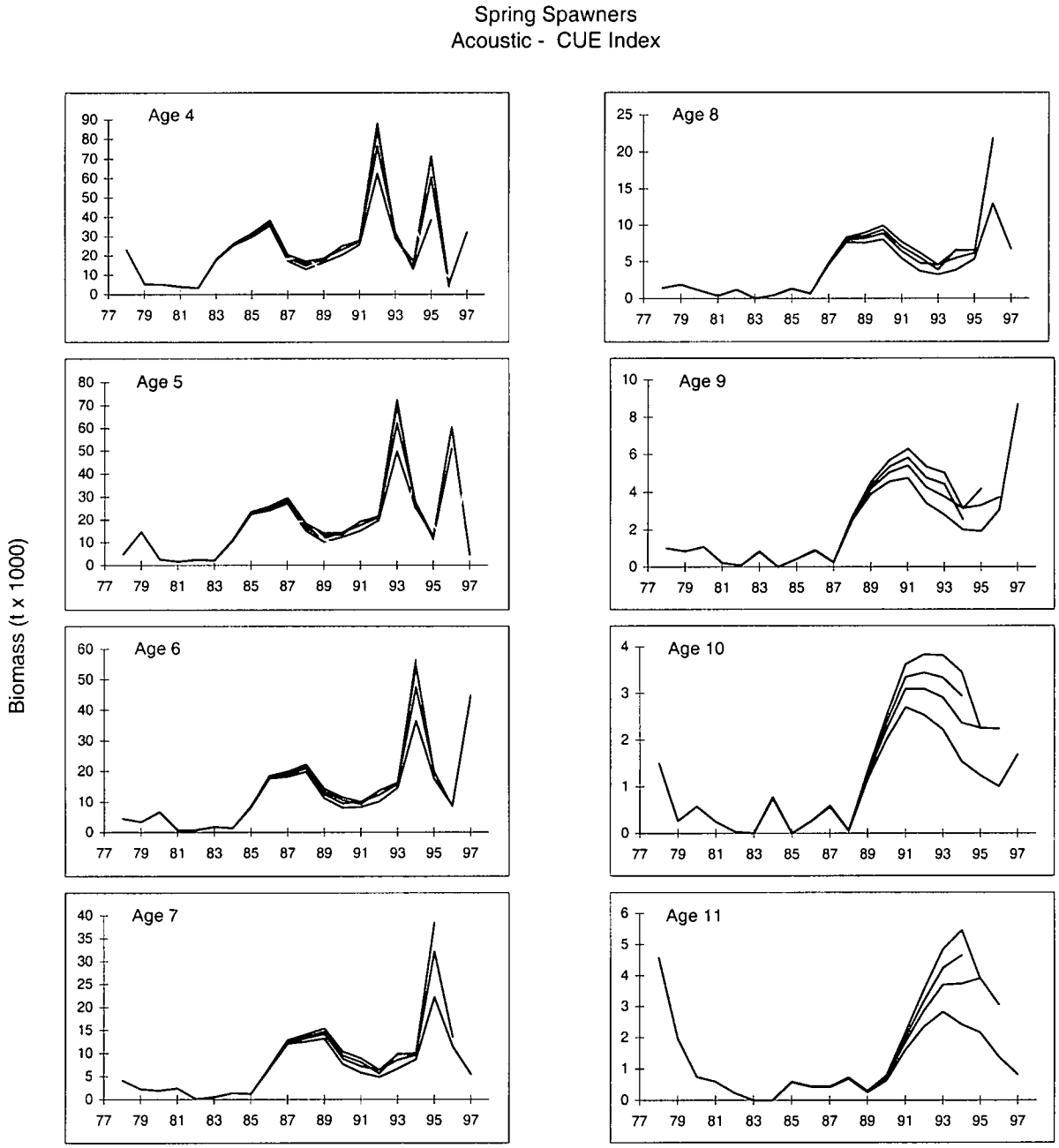
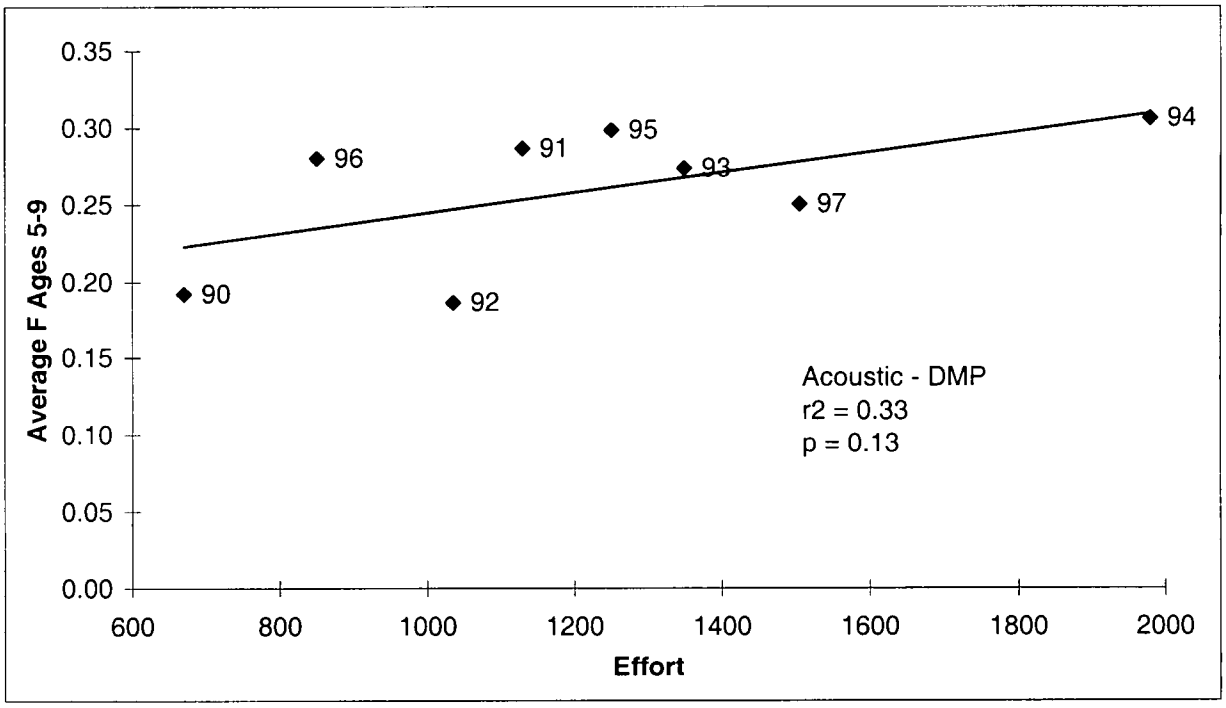


Fig. 69. Age by age retrospective analysis from ADAPT-VPA using combined acoustic and CUE indcies.



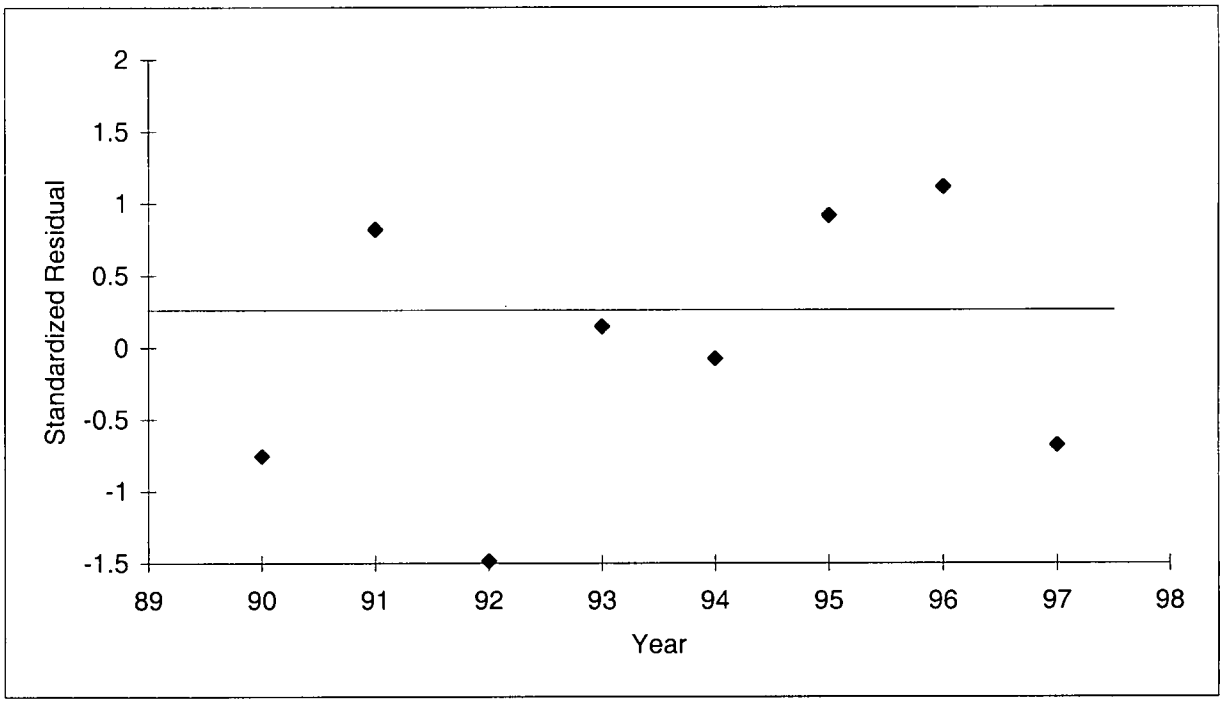


Fig. 70. Regression analysis of relationship between fishing mortality and effort for ADAPT-VPA using combined acoustic and CUE indices.

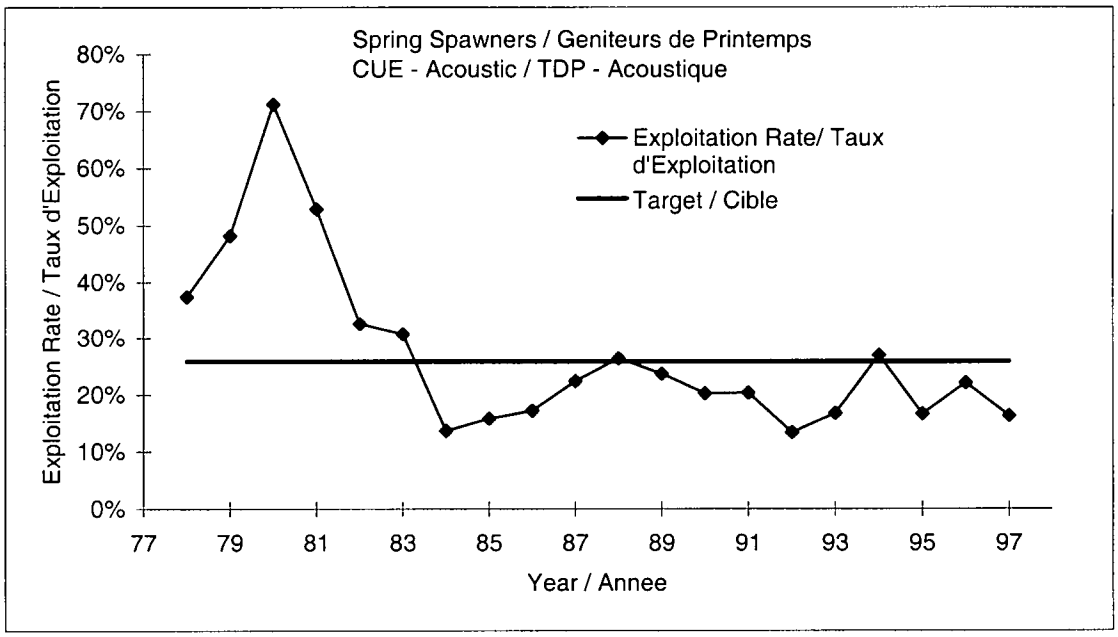


Fig. 71. Fishing mortality estimated by ADAPT-VPA for spring spawners using combined acoustic and CUE indices compared to target fishing mortality.

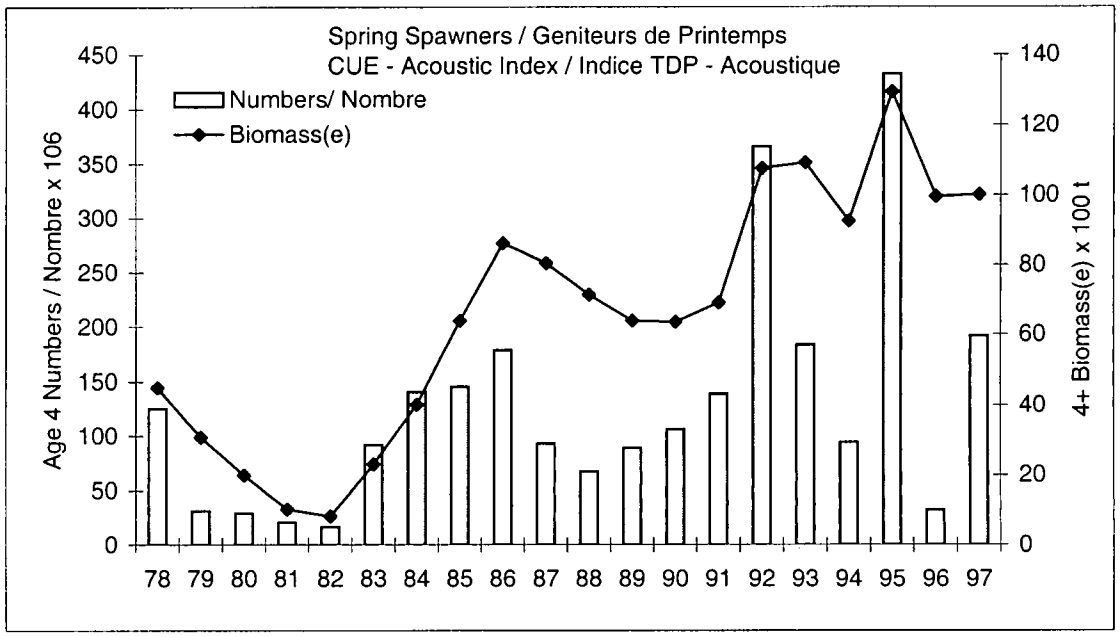


Fig. 72. Recruitment (age 4) and 4+ biomass trends for spring spawners. Horizontal line indicates average recruitment.

Table A1. Acoustic survey total herring biomass density and estimates in the Southern Gulf of St. Lawrence, 1991-1997. Chaleur-Miscou includes Tracadie and northern Gaspé strata in some years. Not all strata in each area were done every year. For details see individual acoustic survey reports identified in reference list.

Year Date	Area	Number of Trensects	Mean Density (kg/m^2)	Estimated Biomass Index (t/area)	C.V.	Proportion recorded at night
1997	CHALEUR-MISCOU	156	0.0285	193656	0.27	1
Sept. 21 to	PEI-MAGDELEN ISLANDS	64	0.0109	70373	0.09	1
11-Oct	CAPE BRETON	42	0.0158	17463	0.38	1
	1997 TOTAL	262	0.0196	281492	0.19	1
1996	CHALEUR-MISCOU INSHORE	142	0.0494	241992	0.16	1
Sept 24-	CHALEUR-MISCOU OFFSHORE	36	0.0052	15090	0.28	1
16-Oct	PEI-PICTOU-GEORGES	55	0.0128	62846	0.19	1
	CAPE BRETON INSHORE	28	0.026	21869	0.19	1
	1996 TOTAL	261	0.0252	341797	0.12	1
1995	CHALEUR-MISCOU INSHORE	98	0.0181	62229	0.22	1
Sept 23-	CHALEUR-MISCOU OFFSHORE	18	0.0058	9156	0.2	1
8-Oct	MILNE - GEORGES	21	0.0083	10564	--	1
	CAPE BRETON INSHORE	35	0.0066	7295	0.5	1
	1995 TOTAL	172	0.0121	89244	0.16	1
1994	CHALEUR-MISCOU INSHORE	106	0.0415	162585	0.11	1
Oct 16-28	CHALEUR-MISCOU OFFSHORE	27	0.0063	16838	0.34	1
	1994 TOTAL	133	0.0272	179423	0.1	1
1993	CHALEUR-MISCOU INSHORE	163	0.0202	114052	0.35	0.93
Oct 2-20	CHALEUR-MISCOU OFFSHORE	45	0.001	4284	0.41	0
	CAPE BRETON INSHORE	91	0.0039	7945	0.23	0.68
	CAPE BRETON OFFSHORE	39	0.0019	4567	0.41	0.09
	1993 TOTAL	338	--	130848	0.31	0.85
1992	CHALEUR-MISCOU INSHORE	216	0.0207	48258	0.1	0.65
Oct 1-22	CHALEUR-MISCOU OFFSHORE	102	0.0078	96582	0.52	0.75
	CAPE BRETON INSHORE	78	0.0227	44762	0.25	0.85
	CAPE BRETON OFFSHORE	22	0.0008	83	0.69	0
	1992 TOTAL	418	--	189685	0.29	0.75
1991	CHALEUR-MISCOU INSHORE	158	0.0054	16724	0.46	0.87
Oct 10-24	CHALEUR-MISCOU OFFSHORE	50	0.0015	23214	0.55	0.65
	CAPE BRETON INSHORE	49	0.0026	4418	0.32	0.98
	1991 TOTAL	257	--	44356	0.33	0.75

Table A2. Length of transects in strata consistently surveyed from 1994 to 1997.

Stratum Name	Transect Length surveyed per stratum (km)			
	1997	1996	1995	1994
Grande Riviere	58.2	74.8	64.5	61.4
Newport	51.8	79.2	72.5	85.6
Shigawake	120.0	128.9	123.0	100.2
New Carlilse	44.3	52.4	57.1	68.5
New Richmond	32.0	37.2	42.0	84.5
Belledune	37.3	35.4	40.1	53.4
Nepisiguit	58.8	82.7	79.4	66.3
Maisonnette	70.2	68.3	73.9	69.6
East Miscou NW	100.0	89.1	50.6	76.0
East Miscou NE	64.6	63.2	91.3	78.3
East Miscou SW	88.2	90.9	88.2	61.7
East Miscou SE	64.1	63.1	75.7	50.5
Total Distance Surveyed (km)	789.5	865.2	858.3	856.1
Distance with backscatter (km)	82.4	140.0	92.9	136.6
Total Biomass index (t)	171830	163195	63676	159983
Percent of Total Distance Surveyed with bacscatter	10.4	16.2	10.8	16.0

Table A3. 1997 Acoustic Survey stratum and area herring biomass estimates.

Area and Stratum	Average TS (dB/kg)	Stratum Area (km^2)	Weighted Mean Sa (dB/m^2)	Biomass Density (kg/m^2)	Biomass index per Stratum Total (tons)	SE (tons)	SE % of Total
Chaleur - Miscou							
Pte-Sèche	-35.1	65.9	-57.8	0.0054	359	198	55
Riv-Renard	-35.2	124.6	-46.2	0.0802	9991	7476	75
Cap_Bon_Ami	-35.2	109.8	-59.7	0.0035	389	156	40
American_Bank	-35.2	187.4	-1030.4	0.0000	0	0	4
Gaspé_Off	-35.2	150.0	-83.4	0.0000	2	2	8
La_Malbaie	-35.2	191.2	-58.4	0.0048	916	604	66
Anse_Beaufils	-35.2	191.9	-1029.2	0.0000	0	0	17
Grande-Rivière	-35.2	173.8	-51.9	0.0216	3756	2376	63
Newport	-34.4	187.0	-59.3	0.0032	592	144	24
Shigawake	-34.3	323.3	-46.2	0.0645	20850	9158	44
New_Carlisle	-34.3	167.0	-56.8	0.0057	956	320	33
New_Richmond	-34.3	253.6	-56.9	0.0055	1393	728	52
Belledune	-34.4	348.0	-52.5	0.0156	5439	897	17
Nepisiguit	-35.2	278.0	-42.4	0.1909	53082	34090	64
Maisonnette	-34.5	137.5	-44.8	0.0930	12794	4169	33
West_Miscou	-34.5	354.0	-60.9	0.0023	810	365	45
North_Miscou	-34.5	417.8	-59.8	0.0030	1240	580	47
Miscou_NW	-34.8	524.0	-44.5	0.1052	55115	36130	66
Miscou_NE	-34.8	524.0	-52.4	0.0173	9088	4605	51
Miscou_SW	-34.8	524.0	-53.8	0.0124	6483	1856	29
Miscou_SE	-34.8	524.0	-58.4	0.0044	2282	729	32
Tracadie_W	-34.8	524.0	-53.5	0.0134	7002	3224	46
Tracadie_E	-34.8	524.0	-61.5	0.0021	1117	624	56
TOTAL		6804.8			193656		
MEAN				0.0285		51659	
CV						0.27	
PEI - Magdelen							
North_Cape	-34.1	415.9	-57.1	0.0050	2070	449	22
Cascumpec	-34.1	515.0	-55.0	0.0080	4119	1205	29
Malpeque	-34.1	489.3	-48.9	0.0331	16200	4448	27
Stanhope	-34.5	230.0	-47.8	0.0465	10701	1157	11
Savage_Hbr	-34.5	231.8	-49.7	0.0300	6965	1177	17
Monticello	-34.5	260.6	-50.4	0.0252	6563	921	14
East_Point	-34.5	180.3	-54.0	0.0112	2024	1089	54
Milne	-33.2	312.5	-49.8	0.0217	6788	1983	29
Fond_Georges	-34.5	428.0	-62.6	0.0015	663	349	53
Havre_Aubert	-34.5	428.0	-74.6	0.0001	42	15	36
Corps_Mort	-34.5	484.0	-65.0	0.0009	426	353	83
Madeleine_NO	-34.5	574.0	-54.0	0.0110	6341	1027	16
Ile_Brion	-34.5	945.0	-57.2	0.0053	4995	2981	60
Madeleine_E	-34.5	955.0	-60.3	0.0026	2476	1667	67
TOTAL		6449.4			70373		
MEAN				0.0109		6565	
C.V.						0.09	
Cape Breton							
Pleasant_Bay	-34.7	281.3	-49.4	0.0338	9522	6119	64
Bay_St.Lawrence	-35	126.9	-60.6	0.0028	349	236	68
Aspy_Bay	-35.1	168.3	-51.4	0.0236	3976	2589	65
Neil_Hbr	-35.1	259.5	-68.1	0.0005	132	52	40
Wreck_Cove	-35.4	109.7	-53.2	0.0166	1816	389	21
St-Anns_Bay	-35.4	159.0	-55.2	0.0105	1668	502	30
TOTAL		1104.7			17463		
MEAN				0.0158		6679	
C.V						0.38	

Table A4. 1997 Acoustic Survey Chaleur - Miscou transect backscatter and biomass density.

Stratum Date	Transect Number	Transect Length (km)	Target Strength (dB/kg)	Average Sa (dB/m²)	Biomass Density (kg/m²)	Set Number
Pte-Sèche	7	0.73	-35.23	-50.97	0.0267	
21-Sep	9	2.85	-35.23	-55.05	0.0104	
	11	3.01	-34.23	-58.90	0.0034	
	12	3.23	-35.23	-66.99	0.0007	
	13	2.03	-35.23	-55.56	0.0093	
	14	2.48	-35.23	-63.86	0.0014	
	15	2.62	-35.23	-59.34	0.0039	
	16	1.42	-35.23	-58.97	0.0042	
Riv-Renard	17	3.24	-35.23	-60.71	0.0028	
21-Sep	18	2.48	-35.23	-63.87	0.0014	
	19	3.39	-35.23	-38.28	0.4956	
	21	3.17	-35.23	-49.69	0.0358	
	22	2.90	-35.23	-58.33	0.0049	
	24	3.01	-35.23	-47.16	0.0642	
	25	3.88	-35.23	-54.15	0.0128	
	26	4.46	-35.23	-53.83	0.0138	
Cap_Bon_Ami	27	3.49	-35.23	-57.38	0.0061	
21-Sep	28	9.67	-35.23	-60.12	0.0032	
	29	10.08	-35.23	-57.56	0.0058	
	35	8.27	-35.23	-1029.18	0.0000	
American_Bank	30	10.24	-35.23	-1030.10	0.0000	
21-Sep	31	10.21	-35.23	-1030.09	0.0000	
	33	11.58	-35.23	-1030.64	0.0000	
	34	11.59	-35.23	-1030.64	0.0000	
Gaspé_Off	36	9.99	-35.23	-1030.00	0.0000	
22-Sep	37	12.29	-35.23	-1030.90	0.0000	
	38	9.48	-35.23	-77.03	0.0001	
	39	9.04	-35.23	-1029.56	0.0000	
La_Malbaie	40	14.74	-35.23	-53.91	0.0136	
22-Sep	41	15.05	-35.23	-70.18	0.0003	
	42	13.19	-35.23	-1031.20	0.0000	
	43	10.84	-35.23	-58.32	0.0049	
Anse_Beaufils	44	7.46	-35.23	-1028.73	0.0000	
22-Sep	45	6.40	-35.23	-1028.06	0.0000	
	46	11.29	-35.23	-1030.53	0.0000	
Grande-Rivière	48	7.94	-35.23	-62.55	0.0019	
22-Sep	49	8.36	-35.23	-69.00	0.0004	
	50	8.25	-35.23	-73.30	0.0002	
	51	8.72	-35.23	-52.51	0.0187	13
	53	9.08	-35.23	-52.91	0.0171	14
	54	7.91	-35.23	-53.78	0.0140	
	56	7.94	-35.23	-45.15	0.1020	
Newport	57	9.98	-34.35	-58.93	0.0035	
23-Sep	58	9.23	-34.35	-57.56	0.0048	
	59	9.11	-34.35	-59.75	0.0029	
	60	8.83	-34.35	-57.18	0.0052	5
	61	7.80	-34.35	-63.66	0.0012	
	62	6.88	-34.35	-66.96	0.0005	

Table A4. (cont).

Stratum Date	Transect Number	Transect Length (km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (kg/m^2)	Set Number
Shigawake	63	6.69	-34.33	-70.40	0.0002	
23-Sep	64	7.64	-34.33	-1028.83	0.0000	
	65	8.15	-34.33	-1029.11	0.0000	
	66	8.45	-34.33	-73.67	0.0001	
	67	9.59	-34.33	-48.06	0.0424	
	68	10.15	-34.33	-50.14	0.0263	
	70	8.18	-34.33	-39.16	0.3294	1
	71	7.72	-34.33	-40.10	0.2654	2
	72	7.59	-34.33	-40.11	0.2648	4
	73	6.69	-34.33	-53.16	0.0131	6
	74	6.25	-34.33	-56.42	0.0062	
	75	5.91	-34.33	-58.31	0.0040	
	76	6.45	-34.33	-51.07	0.0212	
	77	6.96	-34.33	-59.89	0.0028	
	78	7.31	-34.33	-63.99	0.0011	
	79	6.32	-34.33	-78.60	0.0000	
New_Carlisle	80	5.86	-34.33	-67.01	0.0005	
24-Sep	81	5.32	-34.33	-70.52	0.0002	
	82	5.28	-34.33	-55.66	0.0074	
	83	5.78	-34.33	-55.85	0.0070	
	84	4.96	-34.33	-60.31	0.0025	
	85	5.62	-34.33	-56.42	0.0062	
	87	5.81	-34.33	-58.02	0.0043	
	88	5.65	-34.33	-51.98	0.0172	3
New_Richmond	89	6.90	-34.33	-52.51	0.0152	
24-Sep	90	6.22	-34.33	-55.11	0.0084	
	91	5.69	-34.33	-64.53	0.0010	
	92	6.94	-34.33	-1028.42	0.0000	
	93	6.21	-34.33	-61.06	0.0021	
Belledune	95	5.78	-34.33	-52.79	0.0143	
24-Sep	96	5.22	-34.33	-53.25	0.0128	
	97	4.08	-34.33	-53.21	0.0130	
	98	6.47	-34.33	-55.06	0.0085	
	99	7.49	-34.33	-52.98	0.0137	
	100	8.27	-34.56	-50.23	0.0271	
Nepisiguit	101	10.86	-35.56	-45.79	0.0949	
25-Sep	102	8.76	-35.56	-51.38	0.0262	
	103	8.00	-35.56	-49.11	0.0441	
	104	7.95	-35.56	-47.63	0.0621	
	105	3.53	-35.56	-45.10	0.1112	
	106	6.45	-35.56	-48.98	0.0455	
	107	6.91	-33.56	-39.46	0.2567	7
	108	6.34	-35.56	-35.34	1.0506	8
Maisonnette	110	5.02	-34.47	-39.55	0.3105	
25-Sep	111	4.26	-34.47	-52.23	0.0167	
	112	4.23	-34.47	-56.52	0.0062	
	113	4.41	-34.47	-45.65	0.0762	
	114	4.95	-34.47	-49.67	0.0302	
	117	4.96	-34.47	-56.14	0.0068	
	118	5.47	-34.47	-44.03	0.1109	
	119	6.21	-34.47	-42.44	0.1595	9
	120	5.72	-34.47	-39.36	0.3244	10
	121	5.28	-34.47	-47.95	0.0449	
	122	6.37	-34.47	-48.38	0.0407	
	123	6.33	-34.47	-49.31	0.0328	
	124	6.98	-34.47	-49.95	0.0283	

Table A4. (cont).

Stratum Date	Transect Number	Transect Length (km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (kg/m^2)	Set Number
West_Miscou	125	10.39	-34.48	-54.58	0.0098	19
25-Sep	126	10.56	-34.48	-71.16	0.0002	
	127	13.24	-34.48	-65.45	0.0008	
	128	13.35	-34.48	-69.80	0.0003	
	129	12.97	-34.48	-57.90	0.0046	
	130	12.55	-34.48	-61.23	0.0021	
	131	12.63	-34.48	-61.97	0.0018	
	132	12.20	-34.48	-63.24	0.0013	
	133	10.48	-34.48	-67.78	0.0005	
North_Miscou	134	11.60	-34.51	-68.20	0.0004	
26-Sep	135	10.01	-34.51	-61.62	0.0019	
	137	13.38	-34.51	-78.00	0.0000	
	138	13.72	-34.51	-55.69	0.0076	11
	139	13.53	-34.51	-55.25	0.0084	12
	140	12.34	-34.51	-67.24	0.0005	
	141	10.43	-34.51	-71.86	0.0002	
Miscou_NW	142	12.38	-34.77	-67.82	0.0005	
26-Sep	143	12.39	-34.77	-1030.93	0.0000	
	144	12.27	-34.77	-46.61	0.0654	15
	145	13.08	-34.77	-37.18	0.5738	16
	147	12.79	-34.77	-47.12	0.0581	17
	153	12.51	-34.77	-44.31	0.1111	18
	154	12.22	-34.77	-57.32	0.0056	
	155	12.41	-34.77	-67.52	0.0005	
Miscou_NE	148	12.65	-34.77	-54.25	0.0113	
27-Sep	149	12.69	-34.77	-48.23	0.0451	
	150	12.94	-34.77	-1031.12	0.0000	
	151	13.36	-34.77	-65.04	0.0009	
	165	13.00	-34.77	-49.96	0.0303	
Miscou_SW	156	12.53	-34.77	-51.36	0.0219	
27-Sep	157	12.58	-34.77	-67.40	0.0005	
	158	12.52	-34.77	-60.54	0.0026	
	159	13.12	-34.77	-51.79	0.0199	
	160	12.21	-34.77	-58.53	0.0042	
	167	12.66	-34.77	-52.51	0.0168	
	171	12.56	-34.77	-51.75	0.0200	
Miscou_SE	161	12.97	-34.77	-62.05	0.0019	
28-Sep	162	12.77	-34.77	-57.83	0.0049	
	163	12.67	-34.77	-55.00	0.0095	
	164	12.91	-34.77	-61.63	0.0021	
	168	12.74	-34.77	-59.29	0.0035	
Tracadie_W	170	13.01	-34.77	-50.37	0.0275	
28-Sep	172	12.32	-34.77	-54.87	0.0098	
	175	12.86	-34.77	-49.16	0.0364	
	176	12.30	-34.77	-62.65	0.0016	
	179	13.14	-34.77	-65.20	0.0009	
	180	12.94	-34.77	-59.39	0.0035	
Tracadie_E	169	13.64	-34.77	-64.35	0.0011	
29-Sep	173	13.19	-34.77	-56.49	0.0067	
	174	12.89	-34.77	-69.38	0.0003	
	177	13.27	-34.77	-68.45	0.0004	
	178	12.43	-34.77	-61.64	0.0021	

Table A5. 1997 Acoustic Survey PEI - Magdelen Islands transect backscatter and biomass density.

Stratum Date	Transect Number	Transect Length (km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (kg/m^2)	Set Number
PEI - IPE						
North_Cape	192	7.39	-34.08	-59.05	0.0032	
2-Oct	194	7.01	-34.08	-56.59	0.0056	
	195	9.27	-34.08	-55.18	0.0077	
	196	10.20	-34.08	-58.86	0.0033	
Cascumpec	197	18.13	-34.08	-58.57	0.0036	
3-Oct	198	18.57	-34.08	-57.42	0.0046	
	199	18.00	-34.08	-52.96	0.0129	20
	200	17.06	-34.08	-53.59	0.0112	
Malpeque	201	13.29	-34.08	-50.71	0.0217	
3-Oct	202	13.51	-34.08	-51.26	0.0191	
	204	10.43	-34.08	-46.45	0.0579	
	205	10.43	-34.08	-47.95	0.0410	
Stanhope	206	10.87	-34.46	-48.56	0.0389	
3-Oct	207	11.09	-34.46	-47.46	0.0501	
	208	10.25	-34.46	-49.51	0.0313	
	209	10.33	-34.46	-46.92	0.0568	21
	210	9.57	-34.46	-46.96	0.0563	
Savage_Hbr	211	8.54	-34.46	-48.69	0.0378	
3-Oct	212	7.13	-34.46	-47.89	0.0454	
	213	7.42	-34.46	-48.80	0.0368	
	214	7.38	-34.46	-49.86	0.0288	
	215	7.57	-34.46	-52.82	0.0146	
	216	7.18	-34.46	-52.36	0.0162	
Monticello	217	6.59	-34.46	-48.37	0.0407	
4-Oct	218	6.14	-34.46	-50.16	0.0269	
	219	6.20	-34.46	-50.80	0.0232	
	220	6.17	-34.46	-52.78	0.0147	
	221	6.35	-34.46	-51.16	0.0214	
	222	5.88	-34.46	-50.81	0.0232	
East_Point	223	5.37	-34.46	-49.63	0.0304	
4-Oct	225	5.41	-34.46	-54.97	0.0089	
	227	7.83	-34.46	-58.79	0.0037	
	228	7.89	-34.46	-55.84	0.0073	
Milne	229	15.65	-33.19	-54.59	0.0072	
4-Oct	230	15.53	-33.19	-50.29	0.0195	
	231	15.20	-33.19	-49.02	0.0261	
	233	15.04	-33.19	-46.33	0.0486	22
	234	15.11	-33.19	-49.39	0.0240	
	235	15.40	-33.19	-55.48	0.0059	
Magdelen Isl. - Iles-de-la-Madeleine						
Fond_Georges	236	12.63	-34.46	-74.17	0.0001	
5-Oct	237	14.56	-34.46	-58.73	0.0037	
	238	17.22	-34.46	-62.29	0.0016	
	239	15.01	-34.46	-67.32	0.0005	
Havre_Aubert	240	16.01	-34.46	-82.76	0.0000	
5-Oct	241	13.53	-34.46	-74.15	0.0001	
	242	13.26	-34.46	-71.78	0.0002	
	243	12.05	-34.46	-74.52	0.0001	
Corps_Mort	244	16.14	-34.46	-75.03	0.0001	
6-Oct	245	12.24	-34.46	-78.64	0.0000	
	246	14.63	-34.46	-57.92	0.0045	
	247	12.81	-34.46	-71.72	0.0002	
	248	14.47	-34.46	-70.68	0.0002	
	249	15.33	-34.46	-74.08	0.0001	
Madeleine_NO	250	19.93	-34.46	-54.78	0.0093	
6-Oct	251	20.63	-34.46	-52.58	0.0154	
	252	18.98	-34.46	-55.91	0.0072	
	253	17.41	-34.46	-53.62	0.0121	
Ile_Brion	254	17.73	-34.46	-59.62	0.0030	
7-Oct	255	18.52	-34.46	-52.06	0.0174	
	257	25.09	-34.46	-56.43	0.0064	
	258	21.91	-34.46	-67.18	0.0005	
	260	21.49	-34.46	-69.39	0.0003	
Madeleine_E	261	11.56	-34.46	-71.54	0.0002	
7-Oct	263	25.31	-34.46	-58.79	0.0037	

Table A6. 1997 Acoustic Survey Cape Breton transect backscatter and biomass density.

Stratum Date	Transect Number	Transect Length (km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (kg/m^2)	Set Number
Pleasant_Bay	265	9.65	-34.53	-43.19	0.1361	23
9-Oct	267	9.47	-35.53	-53.27	0.0168	
	268	9.86	-35.53	-52.25	0.0213	
	270	8.30	-35.53	-75.62	0.0001	
	271	6.39	-35.53	-81.97	0.0000	
	272	6.10	-35.53	-79.80	0.0000	
Bay_St.Lawrence	273	6.46	-34.53	-55.31	0.0084	
10-Oct	275	6.75	-35.53	-57.22	0.0068	
	276	10.22	-35.53	-80.30	0.0000	
	278	6.19	-35.53	-79.24	0.0000	
	279	6.92	-35.53	-80.83	0.0000	
Aspy_Bay	281	1.88	-35.12	-71.36	0.0002	
10-Oct	282	3.82	-35.12	-43.55	0.1438	24
	284	6.64	-35.12	-48.34	0.0477	
	285	9.92	-35.12	-49.97	0.0328	
	286	10.19	-35.12	-52.48	0.0184	
	287	10.50	-35.12	-52.82	0.0170	
	288	10.31	-35.12	-65.90	0.0008	
	289	9.07	-35.12	-66.79	0.0007	
	290	4.34	-35.12	-67.33	0.0006	
Neil_Hbr	291	8.00	-35.12	-81.58	0.0000	
10-Oct	292	5.19	-35.12	-80.62	0.0000	
	293	5.84	-35.12	-88.51	0.0000	
	295	10.22	-35.12	-76.92	0.0001	
	296	11.76	-35.12	-65.97	0.0008	
	298	10.45	-35.12	-71.22	0.0002	
	299	14.78	-35.12	-63.75	0.0014	
Wreck_Cove	301	6.60	-35.37	-54.37	0.0126	
11-Oct	302	6.96	-35.37	-52.39	0.0199	
	304	7.07	-35.37	-53.86	0.0142	
	305	7.55	-35.37	-51.87	0.0224	25
	306	8.12	-35.37	-50.35	0.0318	
	307	8.60	-35.37	-63.26	0.0016	
	309	8.25	-35.37	-53.87	0.0141	
St-Anns_Bay	310	8.32	-35.37	-54.14	0.0133	
11-Oct	311	8.46	-35.37	-53.55	0.0152	
	312	8.77	-35.37	-54.96	0.0110	
	313	8.58	-35.37	-51.24	0.0259	
	315	7.33	-35.37	-64.86	0.0011	
	316	6.62	-35.37	-56.03	0.0086	
	317	6.16	-35.37	-78.73	0.0000	
	319	5.53	-35.37	-67.62	0.0006	

Table A7. Mean lengths and weights, spawning group and target strength of herring from 199 acoustic survey samples.

Strata	Mean Lenght (cm)	Number sampled	Weight at Mean Length (g)	Length-Weight Relation	Percent of Fall Spawners by Weight	Target Strength (dB/Kg)
1997						
CHALEUR-MISCOU					*	
Grande-Riviere	28.3	95	172.5	$0.00072*len^{3.706}$	61.8	-35.23
Newport	25.4	46	113.0	$0.00353*len^{3.209}$	"	-34.35
Shigawake	24.5	239	104.7	$0.00188*len^{3.418}$	"	-34.33
Nepisiquit	28.8	47	193.0	$0.00045*len^{3.858}$	"	-35.56
Maisonnette	25.1	119	114.3	$0.00113*len^{3.574}$	"	-34.47
West Miscou	25.3	60	115.9	$0.00138*len^{3.510}$	"	-34.48
North Miscou	25.5	89	119.0	$0.0035*len^{3.220}$	"	-34.51
Miscou NW	26.6	198	137.4	$0.00146*len^{3.489}$	"	-34.77
PEI						
Cascumpec	24.9	68	102.1	$0.00440*len^{3.128}$	70.2	-34.08
Stanhope	25.9	74	120.9	$0.00284*len^{3.276}$	"	-34.46
Milne	20.3	68	55.5	$0.00914*len^{2.893}$	"	-33.19
CAPE BRETON						
Pleasant Bay	32.4	48	241.8	$0.00734*len^{2.992}$	98.2	-35.53
Aspy Bay	30.3	76	193.0	$0.00829*len^{2.948}$	"	-35.12
Wreck Cove	30.8	32	210.8	$0.00853*len^{2.951}$	"	-35.37