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The Complete 2001 Assessment of Grand Bank Yellowtail Flounder Stock
in NAFO Divisions 3LNO

by

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Abstract

All available information on the biology, assessment, fishery and management of Grand Bank yellowtail flounder stock, Division 3LNO, are drawn together to assess the status of the stock. Recent surveys by Canada and Spain indicate that stock size has been increasing since the moratorium was declared in 1994. Catches rates in the 1998-2000 Canadian fisheries were comparable to the mid 1960s.

A surplus production model, incorporating current and historical survey and catch indices, was used to assess relative biomass, fishing mortality rates and short and medium term yield projections. Results are presented in a precautionary approach framework.

I. Fishery and Management

A. TAC regulation

The stock has been under TAC regulation since 1973, when a precautionary level of 50,000 t was established. In 1976, the TAC was lowered to 9000 t, following a series of high catches (Fig.1; Table 1) and a reduction in stock size. From 1977 to 1988, the TAC varied between 12,000 t and 23,000 t and was unchanged at 15,000 t for the last 4 years of that period. The TAC was set at 5, 000 t in 1989 and maintained at that level for 1990, following sharp declines in stock size after the large catches in 1985 and 1986. From 1991-1993, a TAC of 7, 000 t was set because there appeared to be a slight improvement in recruitment to the fishable stock. In 1994, a TAC of 7, 000 t was recommended by Scientific Council, but the NAFO Fisheries Commission decided that no directed fisheries would be permitted for this stock and the 2 other flatfish fisheries on the Grand Bank (American plaice and witch flounder). From 1995 to 1997, the TAC has been set at zero and a fishery moratorium was imposed. Following an increasing trend in survey biomass, Scientific Council recommended a re-opening of the yellowtail flounder fishery in 1997 with a pre-cautionary TAC of 4,000 t for the 1998 fishery. In addition, with the cessation of the moratorium, other management measures were imposed which recommended that the re-opening be delayed to August of 1998 to allow the majority of yellowtail flounder spawning to be completed and that the fishery be restricted to Divisions 3N and 3O. For the 1999 fishery, a TAC was set to 6, 000 t and again restricted to Divisions 3N and 3O, but there were no restrictions on the time period. For the 2000 fishery, a TAC of 10,000 t was recommended and for the 2001 the TAC was increased to 13,000 t.

B. Catch trends

The nominal catch increased from negligible levels in the early 1960's to a peak of 39,000 t in 1972 (Table 1; Fig. 1). With the exception of 1985 and 1986, when the nominal catch was around 30,000 t, catches have been in the range of 10,000 to 18,000 t from 1976 to –1993, the year before the moratorium. Canada and the USSR were the major participants in the fishery up to 1975, with Canada taking virtually all the catch from 1976-81 (Table 1). Canadian catches were consistently around the TAC in the mid-to-late 1970's, but were under the TACs in the early 1980s as much of the fishery for flounders was directed toward American plaice in Div. 3L. Canadian catches were stable around 6, 700 t from 1991-93, but declined to " 0" t in 1994.

Catches by other nations began to increase in 1982 as freezer trawlers started to fish in the NAFO Regulatory Area on the Tail of the Bank Divisions 3NO (Tables 1&2) (see also Walsh et al. 1995). In 1985 and 1986, as well as for the period of 1989-1994, catches for all other nations combined exceeded those of Canada. USA catches declined steadily from 3,800 t in 1985 to zero in 1991 and 1992 (Table 2) and increased to 700 t during the 1993-94 period. Catches by Spain and Portugal have also decreased to relatively low levels during the period of 1992-96. South Korea, which had been involved in this fishery since 1982, and caught between 3, 500 and 5, 900 t per year from 1989 to 1992, has had no vessels in this fishery since early 1993. It should be noted that the catches for S. Korea in many years included a substantial amount of yellowtail flounder determined from breakdowns of catches reported as unspecified flounder.

Before the moratorium in 1994

Overall, the catches from this stock exceeded the TAC in each year from 1985-93, often by a factor of two (Table 1; Fig.1). However, there is still considerable doubt about the precise catch levels from this stock in the recent years before the moratorium. Up to one-third of the catch in some years (almost two-thirds in 1994) was being determined from Canadian surveillance reports and estimates of the proportion of yellowtail flounder in catches of unspecified flounder by S. Korea (Table 2; see also Brodie et al. 1994).

During the moratorium 1994-1997

The nominal catch of yellowtail flounder in 1995 was 67 t, of which EU-Spain took 65 t in the Regulatory Area of Div. 3NO. In 1996, the nominal catch was 287 tons of which EU-Spain took 232 t in the Regulatory Area, mainly Div 3N, (Tables 1 and 2). In 1996, Canada reported a catch of 55 t in a co-operative Department of Fisheries and Oceans (DFO) and fishing industry exploratory survey. In the 1996 Statlant 21A statistics, EU-Spain reported a catch of 27 t on the Flemish Cap, NAFO Div 3M. STACFIS noted that this catch was probably an error in reporting or identification since the yellowtail flounder distribution doesn't extend to the Flemish Cap. In 1997, EU-Spain reported 657 t as a by-catch in the skate fishery and Canada reported a catch of 145 t in the co-operative Department of Fisheries and Oceans (DFO) and fishing industry exploratory survey and 1 t by-catch in other bottom trawl fisheries (Table 1 & 2).

After the moratorium 1998-2000

In 1998, a total catch of 4300 t was taken 1) in a directed commercial fishery by Canada (3, 700 t), 2) as a bycatch (85 t) in the Portuguese Greenland halibut otter trawl fishery in the NAFO Regulatory Area of Div. 3N and 3) as a bycatch (562 t) in the Spanish skate fishery in the NAFO Regulatory Area of Div. 3NO (Table 1 & 2).

In 1999 four countries reported landings and a total catch of 6,561 t was taken 1) in directed fishery by Canada (5,413t), 2) as a bycatch (300 t) in the Portuguese Greenland halibut/redfish fishery, 3) as a bycatch (752 t) in the Spanish skate fishery and 4) as bycatch (96 t) in the Russian Greenland halibut fishery. The latter three fisheries took place in the NAFO Regulatory Area of Divisions 3NO (Tables 1 and 2).

In the 2000 fishery, Spain, Portugal, Russia , Estonia reported a total catch of 1,696 t in the NAFO Regulatory Area of Divisions 3NO and Canada reported a catch of 9, 423 from otter trawl fisheries inside the zone (Tables 1 and 2).

Noteworthy is that in the 1998, 1999 and 2000 fisheries, the TACs have been exceeded by, on average, 10%.

Table 3 shows a breakdown of the catches from Canadian vessels by year, division and gear. With the exception of the 1991-1993 period when Canadian vessels pursued a mixed fishery for plaice and yellowtail flounder in Div 3O, the majority of catches have been taken in Div. 3N and by otter trawls.

C. Commercial CPUE Data

A multiplicative model was used to analyze the catch and effort data for this stock as in past assessments before the 1994-97 moratorium (Brodie et al. 1994). Because available data from NAFO Statistical Bulletins exists only from 1974 onward in a format that identifies main species - yellowtail data, it was decided to use Canada (Newfoundland) trawler data from the 1965 to 1993 and 1998-2000 data obtained from the commercial statistics branch of the Department of Fisheries and Oceans in St. John's to derive a standardized catch rate series. It should be noted that for some years, particularly the late 1970's, the Canadian fleet provided the only source of CPUE data for this stock. The data used in the model were the same data used to calculate the CPUE series in previous assessments (Brodie et al, 1994).

Factors included in each model were a combination country-gear-tonnage-class category type (CGT), month, NAFO Division and year. Consistent with previous catch rate standardizations individual observations of catch less than 10 tons or effort less than 10 hours fished were eliminated prior to analysis. Subsequently, any remaining categories where there were less than five occurrences in the database were also eliminated. Plots of residuals from a preliminary run indicated data with higher levels of catch and effort tended to be less variable. Therefore a weighted regression was conducted. Table 4 show the results of the analysis and Fig 2 shows the standardized series from 1965 to 2000.

In the top panel of Figure 2, the catch per unit of effort declined steadily from 1965 to 1976, then increased marginally to a relatively stable level from 1980-85. The index again declined sharply in 1986 and remained at this relatively low level through to 1990. In 1991 the CPUE declined by almost half to the lowest level observed but increased in 1992 and again in 1993 to about the 1990 level. The catch rate in 1998, after four years of the stock under moratorium, increased sharply to a level comparable to the late 1960's. Catch rate increased by 20% in 1999 and the preliminary 2000 data indicated a further increase to become the second highest rate in the series.

Standardizations of the data separately by division (Fig. 2, lower panel) showed that, overall, the historical trend was the same, although the catch rate is generally lower in Div. 3O than in Div. 3N, and, large fluctuations tend to occur more frequently in Div. 3O, primarily before 1985.

The decline in the combined index in 1991 and 1992 was due primarily to the switch in effort of the fleet to Div. 3O. A substantial part of the effort labelled 'directed' for one species or the other in this Division was actually effort directed at a mixed fishery for American plaice and yellowtail flounder during 1991-1993 as seen in the by-catch totals . Given this major shift in the fishery from the 1965-90 and the 1991-93 periods, some caution must be used in comparison of catch rates between these periods. Nonetheless, it is reasonable to interpret the 1991-1993 values for CPUE to indicate that the stock was at a relatively low level. Since the resumption of the fishery in 1998, there has been a by-catch restriction of 5% for both American plaice and cod which directly affected the fishing pattern of the Canadian fleet. The fleet spent additional time searching for good catches of yellowtail with low by-catches of both restricted species, which they found mainly in the central area of Div. 3N (Kulka 1999) where yellowtail are aggregated (Simpson and Walsh 1999). Once again caution should be used in comparing post moratorium catch rates with other fishery periods, however, the increase in catch rates since 1998 under the constraint of 5% by-catch limitations would indicate that the stock size is at a relatively high level in accordance with a similar perception from survey indices (Walsh et al. 2001; Maddock-Parsons et al. 2001).

D. The 2000 Canadian fishery description (SCR Doc. 01/71)

The Canadian fishery began in February and ended in early December and differed from the fisheries in 1998 and 1999 in that it extended for the first time, since the lifting of the moratorium in 1998, into Division 3L. The fishery, like 1999, covered 9.4% of the total area of the Grand Bank inside the 100 m isobath. Bycatch levels of cod (1.2%) and plaice (6%) were reported. Low bycatch of cod was due to the use of a sorting grid in front of the codend. Average codend mesh size in the fishery was 150 mm and the average size of males and females in the catches was 36.4 cm and 39. 3 cm, respectively (Fig. 3), similar to the 1999 fishery.

E. The 2000 Non-Canadian fisheries' descriptions (SCS Doc. 01/09,11,18)

A comparison of the length frequencies of yellowtail flounder in various otter trawl fisheries is presented in Fig. 3 and 4. The modal length of yellowtail flounder in the catches by the Portugal (April, July, August, October, November) and Russia (June and July) fleets was similar at approximately 32 cm. The Spanish fis hery (July, August, September, November, December) had a modal length of approximately 35 cm close to that measured in the Canadian catch data..

II. Research survey data

A. Sampling gear studies (NAFO SCR Doc. 01/69, 74)

Comparative fishing experiments between Canada and Spain took place in the Regulatory Area of Div. 3NO from May 21-23, 2001. Similar to the 2000 experiments, side-by-side tows were carried out between the *C/V Playa de Menduiña* towing its Pedreira survey trawl and *the CCGS Wilfred Templeman* towing its Campelen survey trawl. Eighteen (18) hauls were made with 9*30 minute tows and 9*15 minute tows at selected Spanish and Canadian, respectively, survey stations. The catches of yellowtail flounder by the Pedreira trawl were on average 12 times higher in weight than that caught by the Campelen. There was a strong linear relationship in the catches (numbers and weights) of yellowtail flounder. Similar large differences were reported for plaice, skate, co and witch flounder.

A preliminary investigation of the efficiency of the Canadian and Spanish survey trawls from analyses of 1) comparative fishing trials on the Grand Banks to derive conversion factors for the new survey trawl, by Canada in 1996, and 2) the 1999 - 2001 Spanish comparative fishing trials in the Regulatory Area of Div. 3N, to derive conversion factors for their new survey gear, was presented. Based on the analysis of the Canadian 1996 data there was no difference in the efficiency of the old Engel trawl when compared with the new Campelen trawl for large plaice and yellowtail flounder. In the 2000 side by side fishing trials between Canada and EU-Spain, the catches of the Spanish Pedreira trawl far exceeded that of the Canadian Campelen trawl sometimes by a factor of 10. In the 1999 experiments aboard the Spanish survey vessel, a direct comparison of the catch rates of the Pedreira and Campelen trawls was made. By rigging the Campelen trawl with the same long sweeps and trawl doors as used with the Pedreira trawl, the differences in the catches between the two gears were much smaller. Although there was an increase in catches at length for plaice and yellowtail flounder in the Pedreira trawl, when compared to the Campelen, there were minor difference in length selection.

These large differences in catchability between the Pedreira and the Campelen survey trawls were attributed to the increase in herding effect created by using long sweep lines (in excess of 260 m Spanish v. 46 m Canadian) and the reduction in escapement underneath the trawl with the use of a smaller footgear (15 cm Spanish vs. 35 cm Canadian).

B. Canadian stratified-random surveys spring and fall surveys (SCR Doc. 50).

Abundance and biomass trends

Figures 5 and 6 and Table 5 compare the population abundance and biomass estimates of yellowtail flounder in the spring and fall surveys. Survey estimates of abundance show similar trends in both series although the fall estimates have generally been higher. The fall survey indicates that the upward trend in stock size started in 1993 while the spring survey showed the trend increasing in 1995. In addition, biomass estimates are consistently higher in Div. 3N during the fall surveys from 1992 onward and for Division 3O, in general there doesn't appear to be an obvious trend between spring and fall estimates (Fig. 6). In Div 3L, the fall biomass has generally been higher since 1995. In the 1999 spring survey, both the abundance and biomass sharply increased in size over the 1998 estimate and can be regarded as a "year' effect caused by a change in catchability. Similar results were seen in 3LNO plaice stock. In the 1999 fall survey abundance and biomass estimates were lower and in lined with expected values.

Figure 7 shows the result of a regression of the biomass estimates from the spring and fall time series. A linear relationship is evident with 90% of the variation being explained by the model. Two time regimes may be evident here but the significance of this occurrence is not yet clear. The 1999 survey estimates of stock biomass were 366, 000 tons (81% higher than the 1998 estimate) in the spring and 249, 000 tons (8% higher than the 1998 estimate) in the fall (Table 5). In 2000 the spring biomass was 22%, at 288, 000 t lower than the 1999 estimate while the fall estimates were 34% (335, 000 t) than the 1999 fall survey. In this survey, one large catch in stratum 376 (~1000 kg) in Div 3N contributed 60, 000 t to the biomass total.

Size and age composition

Length

Figures 8 and 9 show the length composition of survey catches from spring and fall surveys by year for Div. 3LNO combined. Size composition in most years showed a bimodal distribution. More smaller fish were present in the survey catches beginning in the fall of 1995 onward due to the increase in efficiency of the new Campelen survey gear over the old gear. Annual shifts in modal peaks are evident of year classes moving through the time series. Sex ratios in the surveys show a dominance of male fish in the catches of both the spring and fall surveys (Fig 10).

Age (SCR Doc. 01/51,52)

Traditionally, stocks of yellowtail flounder on the southern Grand Bank are aged by reading the surface of the whole otolith. However, returns from tagging studies in the early 1990s showed that there was underestimation in the ageing. A comparison of ageing methods revealed that age estimates from thin sections gave the oldest ages after the age of 7, compared to the traditional whole otolith method, the baked thin section method and ages derived from scales. However, the accuracy of ages derived from these methods had not been quantitatively validated. Several methods of indirect age validation were carried out to validate methods for the youngest and middle ages of yellowtail flounder, and two direct validation methods were used to validate the ageing of older fish. The latter included tag-return analysis and bomb radiocarbon assays. It is concluded that even thin-sections may underestimate the oldest fish in the population, but that this method is the most accurate. Yellowtail flounder were aged up to at least 25 years in the bomb radiocarbon assays.

Abundance at age

Given that there is still some uncertainty with the age reading the interpretation of Tables 6 and 7 and Figures 11 are presented for illustration. Estimates of fish beyond age 7 were put in a 'plus' category.

C. Co-operative DFO/fishing industry seasonal surveys (SCR Doc. 01/70).

Co-operative quarterly surveys between Canadian Department of Fisheries and Oceans (DFO) and the Canadian fishing industry in Div. 3NO have been carried out since 1996 using a commercial fishing gear without a codend liner. These surveys indicate very low catch rates of yellowtail flounder and other species in March of 1997, 1998 and 1999 compared with surveys at other times of the year which may be due to change in catchability. CPUE observed in the 10 other co-operative surveys was relatively high compared to historic CPUE data from the fishery. The CPUE for the indexed grid blocks for July surveys from 1996-2000 has varied around a mean CPUE of 784 kg/h. In 1999, the seasonal component of these annual surveys concluded in July. In July 2000, the grid was expanded to cover an additional 100 grid blocks an are equal in size and adjacent to the original grid. It included a larger area mainly to the north.

Yellowtail flounder in these surveys ranged in size from 4-57 cm and only 11% of the catch in any one survey had yellowtail less than 30 cm. These surveys also pointed out the limited area available for conducting a directed fishery for yellowtail flounder within the 5% American plaice by-catch restriction.

D. Spanish stratified-random spring surveys in the Regulatory Area of Div. 3NO (SCR Doc. 00/46).

No information was available for the 2001 survey so the results for the surveys up to 2000 are presented here from last year's report.

Beginning in 1995, EU-Spain has conducted stratified-random surveys for groundfish in the Regulatory Area of Div. 3NO. These surveys cover a depth range of approximately 45 to 1300 m. The biomass index increased between 1995 (27 704 tons) and 1996 (129 642 tons), decreased in 1997 (115 728 tons), increased in 1998 (425 375 tons) and again in 1999 to 589 200 tons. In 2000, the survey biomass showed a 24% decrease to 447,400 tons (Fig. 12A). Whether the decrease in stock size in 2000 is a natural decrease or whether the 1999 survey was an anomalous year as seen in the 1999 Canadian spring survey where a strong 'year' effect was evident is unknown.

Figure 12B shows the length composition of the 2000 survey catches of yellowtail flounder with a mode of 29 cm similar to the 1999 survey value.

E. Stock distribution (SCR Doc. 01/, 32, 50, 78)

An analysis of near-bottom temperature trends and spatial distribution of yellowtail flounder from the Canadian 1990-99 spring and bottom trawl surveys showed that bottom temperatures were low during the first half of the 1990s and have warmed up during the last half of the decade. Coincident with this trend was a shift in the spatial range and population size.

Analysis of the Canadian 1999 and 2000 spring and fall surveys showed the stock was more widely distributed in all three divisions and continues to occupy depths less than 100 m. The majority of the stock is consistently concentrated in Div. 3N on and to the area west of the Southeast Shoal.. In the 1999 and 200 surveys, expansion of the range into Div. 3L was evident as the population increased and its range expanded accordingly and yellowtail flounder were found on all traditional grounds similar to historic times. There was poor survey coverage in the fall of 2000 in Div. 3L.

An analysis of spatial distribution of juvenile yellowtail flounder from Canadian survey data shows that on average 82% (S.D. 15.6) of all juveniles ages 0 to 3 yrs on the Grand Bank are found in the 4 strata that define the Southeast Shoal and the area immediately west of the shoal (360, 361, 375 and 376) in Div 3N. Typically the majority of these juveniles are found in strata 360 and 376. Inter-annual variation in the spatial pattern is evident which may be density or temperature related.

F. Biological studies

Maturity

Maturity at size was estimated using Canadian spring survey data from 1984-2000. Estimates were produced using a probit model with a logit link function and a binomial error structure (SAS, 1989). L_{50} has declined in males, by about 6 cm from around 30 cm to 24 cm. Female L_{50} has been fairly stable with at most a 1 cm decline from 34 to 33 cm (Fig. 13).

G. Assessment Results

Spawning stock biomass

Due to the almost but not yet resolved problem of ageing of older fish, we present a length based female spawning stock biomass.

Estimates of female proportion mature at length, population numbers at length, and annual length weight relationships were used to produce an index of female SSB from the spring survey. Annual length weight relationships were unavailable prior to 1990 so for those years a relationship produced using data from 1990-1993 was used (Table 8). The specific length weight relationships are given in Table 8. Female SSB declined from 1984 to 1992 (Fig 14). Since 1995 it has increased substantially. The average index over the 1996-1998 period was 66 000 t, similar to levels in the mid-1980's. There was a large increase in the index in 1999 consistent with the large increase in the overall survey abundance index for that year. The estimate for the year 2000 is 118,000 t, less than the 1999 estimate but substantially higher than the 1998 estimate.

Relative cohort strength

Relative cohort strength was estimated from a multiplicative model using ages 3 and 4 abundance from the 1984-1999 Canadian spring and 1990-1999 Canadian fall research vessel surveys. The model took the form:

$$\log(N_{ijk})=\tau + \alpha_i+\beta_j+\delta_k+\varepsilon$$

where: N_{ijkt} = number at age i from survey j belonging to cohort k

τ = intercept

α_i = age effect for i=3 and 4

β_j = survey effect for j=spring and fall

δ_k = cohort effect

ε = residuals from the fitted model

The model showed no obvious pattern in the residuals and a significant fit to the data. However there was no significant survey effect.

R^2=0.64, n=56

Source	DF	Type III SS	Mean Square	F Value	Pr > F
AGE	1	20.33476277	20.33476277	26.54	0.0001
COHORT	17	26.96265013	1.58603824	2.07	0.0329
SURVEY	1	1.60568777	1.60568777	2.10	0.1564

Since there was no significant survey effect the model was rerun using the same data but without estimating a survey effect. As in the previous model there was both a significant age and cohort effect. There was no obvious pattern in the residuals (Fig. 15).

Source	DF	Type III SS	Mean Square	F Value	Pr > F
AGE	1	20.66575962	20.66575962	26.19	0.0001
COHORT	17	29.32671765	1.72510104	2.19	0.0232

Estimates of relative cohort strength from this model are plotted in Fig 16. Cohort strength reached a minimum in 1990 but has increased since. Based on the analysis, recruitment has been improving since 1992.

SSB/R relationship

The estimates of relative cohort strength from the multiplicative model are plotted against the index of female SSB from the spring survey in Fig 16. There is some tendency for recruitment to increase with SSB, although a range of recruitment appears to be possible from any given SSB.

Surplus production Model

<u>Input data</u>

A nonequilibrium surplus production model incorporating covariates (ASPIC; Prager 1994, 1995) was applied to nominal catch and survey biomass indices similar to the 2000 assessment (Walsh et al. 2000). The production model that provided the best fit to the data, as recommended by STACFIS in 2000 (NAFO 2000) included: 1) the nominal catch data (1965-2001); 2) Russian spring surveys (1972-1991); 3) Canadian spring (Yankee) surveys (1971-1982); 4) Canadian Campelen spring (1984-2000) and 5) Canadian Campelen fall surveys (1990-2000); and 6) the Spanish Pedreira spring (1995-2000) survey.

The input data for surplus production model are listed in Table 9. Estimated landings were used as nominal catch, but do not include discards or unreported landings. A substantial portion of total nominal catch from the mid 1980s and early 1990s were from Canadian surveillance reports or prorated from unspecified flounder catches by South Korea. Nominal catch increased from negligible levels in the 1960s to a peak of 39,000 t in 1972. Annual landings decreased to an annual average of 13,000 t from 1976 to 1984, increased to approximately 30,000 t in 1985 and 1986, decreased to an average of 14,000 t from 1987 to 1993, and were less than 1,000 t (bycatch) from 1995 to

1997, during the moratorium. Since the moratorium was lifted, the catches have increases to 11,000 t in 2000 (Fig.17).

The Canadian spring surveys used a variety of survey gears since it began annual stratified random bottom trawl surveys in 1971. A ‘Yankee’ otter trawl was used from 1971 to 1982, an ‘Engel’ otter trawl was used from 1984 to 1995 (spring), and since the fall of 1995 a ‘Campelen’ shrimp trawl has been used (McCallum and Walsh 1997). Comparative tows of the Yankee and Engel trawls were used to derive a conversion factor of 1.4 for the Yankee catches by number but not by weight (biomass). The unconverted Yankee survey biomass was used here. Comparative tows of the Engel and Campelen trawls were used to derive a size based conversion function (Warren et al. 1997; Walsh et al 1998). Methods to link the 1971-1982 Yankee series to the 1984-2000 Campelen series have not been developed. Therefore the 1971-1982 and 1984-2000 series were considered to be separate biomass indices.

Figure 17 shows a plot of all the time series. The was Canadian Yankee biomass index showed a downward trend from 1971 to 1982. The 1984-2000 Campelen spring biomass index (Walsh et al. 2001) showed a downward trend from 1984 to 1995 before beginning to increase. By 1999, the biomass had doubled the previous highest point (1984) in the time series (Fig. 17). The biomass index from the Canadian fall Campelen trawl surveys increased from low levels in the early 1990s to a high index in 2000 (Fig. 17). The biomass index from the fall 1986-94 Canadian juvenile groundfish surveys (Walsh et al. 1995) was not used because of a reported negative correlation with most indices (e.g., the fall index increased during the early 1990s when most other indices were decreasing (Walsh and Cadrin 2000). The biomass index from the 1972-1991 Russian bottom trawl survey sharply declined from relatively high levels in the 1970s and early 1980s to low levels in the late 1980s and early 1990s (Brodie and Walsh 1992). The 1995-2000 biomass index from the Spanish survey has generally shown a strong upward trend (Fig 17)

<u>Surplus Production Model</u>

The production model assumes logistic population growth, in which the change in stock biomass over time (dB_t/dt) is a quadratic function of biomass (B):

$$dB_t/dt = rB_t - (r/K)B^2_t \qquad (1)$$

where r is the intrinsic rate of population growth, and K is carrying capacity. For a fished stock, the rate of change is also a function of catch biomass (C):

$$dB_t/dt = rB_t - (r/K)B_t^2 - C_t \qquad (2)$$

Biological reference points can be calculated from the production model parameters:

$$MSY = K\,r / 4 \qquad (3)$$
$$B_{msy} = K / 2 \qquad (4)$$
$$F_{msy} = r / 2 \qquad (5)$$

Initial biomass (expressed as a ratio to B_{msy}: *B1R*), r, MSY, and catchability coefficients for each biomass index (q_i) were estimated using non-linear least squares of survey residuals. Survey residuals were randomly re-sampled 500 times to derive bias-corrected probability distributions for parameter estimates.

Correlations among biomass indices varied widely (Table 10). Of the six pairwise correlations among the remaining five series of biomass indices included in the production analysis, six were strong (r>0.8), and one was weak (r=0.2).

In this run and for all projections the input data assumed that the 2001 fishery would catch the TAC plus an additional 10% overrun, i.e. 14 300 tons, similar to last year’s formulation

Because of differences in catchability among the various indices, relative indices of biomass and fishing mortality rate were used instead of absolute values. As this stock was assessed with a production model, fishing mortality refers to yield/biomass ratio.

Results

The model fit the data relatively well (for detailed output see tables 10-12). The majority of variance in survey indices was explained by the model, but fit varied among indices (r^2 ranged from 0.3 to 0.9; Table 10). Residuals appeared to be randomly distributed for all survey indices, except the Russian series, which had a strong pattern of positive residuals during the 1970s and early 1980s and negative residuals for subsequent years (Table 12). The Russian spring survey index showed a more rapid decline in stock size than that detected by the Canadian spring survey index in the mid 1980s.

The production model suggests that a maximum sustainable yield (MSY) of 17 000 tons can be produced when the total stock biomass is 81 000 tons (B_{msy}) and the fishing mortality rate is 0.21 (F_{msy}) (Table10). The MSY estimate is the same estimated in last year's assessment (Walsh et al. 2000). Because of differences in selectivity of survey gears and the commercial gears (mainly otter trawl) used in the production model, estimates of absolute stock biomass and fishing mortality in a given year (t) are usually estimated less precisely than MSY and F_{msy} . To remove the effects of these difference in catchabilities, we use the ratios to MSY reference points (e.g., B_t/B_{msy} and F_t/F_{msy}) as relative indices. The relative levels of biomass B_t/B_{msy} describes whether a population is above or below the level at which MSY can be produced, and the relative level of fishing mortality rate F_t/F_{msy} suggests whether an increase or decrease in fishing effort might provide a higher sustainable yield (Prager 1994). Estimates of relative biomass and fishing mortality rates are shown in Figure 18 . Biomass showed a continuous decline from the late 1960s to the mid 1970s, stabilized through till the mid 1980s before further declining till about 1994, when the moratorium was announced. The analysis showed that relative biomass (B_t / B_{msy}) has been below the level at which MSY can be produced from 1973 to 1994 (Fig 18). Since 1994 the stock has been rebuilding to a point where B_t/B_{msy} reached the level which MSY can be obtained in the year 2000, i.e. $B_{2000} = B_{msy}$. = B_t / B_{msy} . In 2002 the relative biomass was above the reference level with B_t / B_{msy} = 1.14 (Table 11; Fig. 18). These variables are comparable to last year's assessment (Walsh et al 2000).

The relative fishing mortality rate (F_t / F_{msy}) was high during most of the history of the fishery, in particular during the mid to late 1980s to the early 1990s when landings were often doubled the TAC (Fig.1). Since the fishery re-opened in 1998, the fishing mortality rate has been gradually increasing to a level of being 73% of F_{msy} in 2001, if the TAC in 2001 (+ 10% over-run), i.e. 13000 t is taken (Table 11 and Fig. 18). This is an increase in relative fishing mortality of 16% over last years estimate (Walsh et al. 2000). The estimated yield trajectory indicated that since 1994 the yield has remained well below sustainable production (Fig 19). This is probably due to a turnaround in stock decline during and after the moratorium and low Fs since the fishery opened in 1998.

Bootstrap analysis (500 iterations of survey residuals) was used to derive bias corrected estimates of all parameters using ASPIC. The analysis showed that B1R, K and MSY were well estimated (relative interquartile range, IQR<11%), r, survey catchability coefficients (q) were somewhat more variable (IQR=19% to 32% and ratios of current conditions to MSY conditions were also less precise (IQR= 23 to 28%) (Table 13).

Short-term yield projections:

The bootstrap output was used to derive estimates of short term yield projections for 2002 assuming a status quo F ($F_{2001} = F_{2002}$) and assuming $F_{2002} = 2/3F_{msy}$.

For estimation of status quo fishing mortality, a F multiplier table was created from the bootstrap projections with a catch constraint of 14, 300 t in 2001 (Table 14) A F multiplier of 1.0 gave the closest fit to the bootstrap estimate of F_{2001} of 0.156 for the 50% percentile and was used in the ASPIC projections. By constraining the catch in 2001 to 14300 t (assumes 10% over-ride in TAC), a status quo F resulted in an estimated yield of 14 700 tons in 2002 (Table 15; Figs. 20-21).

For estimation of fishing mortality at 2/3 F_{msy} , a F multiplier of 0.9 (Table 14) gave the closest fit to the bootstrap estimate of 2/3 F_{msy} of 0.143 for the 50% percentile and was used in the ASPIC projections (Tables 16; Figs. 22-23) The yield in 2002 was estimated to be 13,332 t using a F =2/3 F_{msy}.

Medium term yield projections

Medium term projections were carried out by extending the ASPIC bootstrap projections forward to the year 2011 under an assumption of constant fishing mortality at 2/3 F_{msy} . F was constrained to 2/3 F_{msy}, i.e. 0.143 and projections were made for a 10-year period. The output shows that yield reaches a maximum at 15 000 tons in the year 2011 (Table 17 and Figs. 24-25). The results depicted in Table 18 Figure 26 show the percentiles of predicted absolute yield and biomass, yield relative to MSY, and biomass relative to B_{msy}. The probability of biomass falling below B_{msy} is between 10 and 20% from 2003 onward (Fig. 26). The projections are conditional on the estimated values of r, the intrinsic rate of population growth and K , the carrying capacity.

Reference points

Stock-recruitment relationships

The estimates of relative cohort strength from the multiplicative model are plotted against the index of length-based female SSB from the spring survey in Fig 27 There is no indication of a stock recruit relationship. This is not surprising given the lack of contrast in year class strength over the time period

Precautionary approach

The stock trajectory estimated in the surplus production analysis is depicted in Fig. 28 against a proposed harvest control rule. This is an update of the work by Rivard and Walsh (2000). Also illustrated is the trajectory of a projection based on a scenario of status quo fishing mortality, together with the confidence intervals of the relative fishing mortality and relative biomass at the end of 2002.

In this framework, the precautionary reference points were defined as follows. The limit fishing mortality, F_{lim}, was taken as F_{MSY}. The limit biomass reference point was taken as the estimate of the biomass when the fishery was closed, as concerns with the biomass level (estimated with 1993 data) were key considerations in the 1994 discussions leading to the moratorium. It is noted that at that level of biomass, the stock responded rapidly to the reduction of fishing pressure. The fishing mortality target was taken as 2/3 F_{MSY}, which represents the reference point typically requested by managers when production models are used. No target has been determined by managers for biomass, and B_{MSY} is used here, as an interim value, as the biomass target. Rather than provide buffer reference points, it is proposed to use risk analyses to make annual evaluations of the risk of passing limit reference points.

The management measure in place in recent years, which included moratorium on directed fisheries (1995, 1996 and 1997) and TACs based on a fishing mortality much below the 2/3 F_{MSY} target, have led to a rapid increase of the stock so that the biomass is now estimated to be above B_{MSY}. The harvest control rule described here captures many of the strategies that have governed the management of yellowtail flounder in recent years. In hindsight, such strategies appear to have been instrumental in rebuilding this stock. The formal adoption of such a framework as a working model would help to cast future management strategies in the perspective of such a precautionary approach. Further work is expected.

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Table 1. Nominal catches by country and TACs (tons) of yellowtail in NAFO Div. 3LNO.

Year	Canada	France	USSR/ Russia	South Korea	Other [b]	Total	TAC
1960	7	-	-	-	-	7	
1961	100	-	-	-	-	100	
1962	67	-	-	-	-	67	
1963	138	-	380	-	-	518	
1964	126	-	21	-	-	147	
1965	3,075	-	55	-	-	3,130	
l966	4,185	-	2,834	-	7	7,026	
l967	2,l22	-	6,736	-	20	8,878	
l968	4,l80	l4	9,l46	-	-	l3,340	
l969	l0,494	l	5,207	-	6	l5,708	
l970	22,8l4	l7	3,426	-	l69	26,426	
l97l	24,206	49	l3,087	-	-	37,342	
l972	26,939	358	ll,929	-	33	39,259	
l973	28,492	368	3,545	-	4l0	32,8l5	50,000
l974	l7,053	60	6,952	-	248	24,3l3	40,000
l975	l8,458	l5	4,076	-	345	22,894	35,000
l976	7,9l0	3l	57	-	59	8,057	9,000
1977	ll,295	245	97	-	l	ll,638	l2,000
l978	l5,09l	375	-	-	-	l5,466	l5,000
l979	l8,ll6	202	-	-	33	l8,35l	l8,000
l980	l2,0ll	366	-	-	-	l2,377	l8,000
l98l	l4,l22	558	-	-	-	l4,680	2l,000
l982	ll,479	ll0	-	1,073	657	13,319	23,000
l983	9,085	l65	-	1,223	-	10,473	l9,000
l984	l2,437	89	-	2,373	1,836 [b]	16,735	l7,000
l985	13,440	-	-	4,278	11,245 [b]	28,963	l5,000
1986	14,168	77	-	2,049	13,882 [b]	30,176	15,000
1987	13,420	51	-	125	2,718	16,314	15,000
1988	10,607	-	-	1,383	4,166b [b]	16,158	15,000
1989	5,009	139	-	3,508	1,551	10,207	5,000
1990	4,966	-	-	5,903	3,117	13,986	5,000
1991	6,589	-	-	4,156	5,458	16,203	7,000
1992	6,814	-	-	3,825	123	10,762	7,000
1993	6,697	-	-	-	6,868	13,565	7,000
1994	-	-	-	-	2069	2069	7,000 [d]
1995	[c] 2	-	-	-	65	67	0 [d]
1996	[c] 55	-	-	-	232	287	0 [d]
1997	[c] 146	-	-	-	657	803	0 [d]
1998	[c] 3,701	-	-	-	647	4,348	4,000
1999	[c] 5,413		96	-	1,052 [b]	6,561	6,000
2000	[c] 9,423		212		1,486	11,121	10,000

[a] see text for explanation of South Korean catches
[b] includes catches estimated from Canadian surveillance reports
[c] Provisional
[d] no directed fishery permitted

.

Table 2. Breakdown of 1984-2000 catches from Table 1 listed as "other."

Year	Spain	Portugal	Panama	USA	Cayman Islands	Estonia	Misc.	Total
1984	25	-	1,800	-	-	-	11	1,836
1985	2,425	-	4,208	3,797	803 [a]	-	12	11,245
1986	366	5,521	4,044	2,221	1,728 [a]	-	2	13,882
1987	1,183	-	-	1,535	-	-	-	2,718
1988	3,205	-	-	863	-	-	100 [b]	4,163
1989	1,126	5	-	319	-	-	101 [b]	1,551
1990	119	11	-	6	-	-	2,981 [b]	3,117
1991	246	-	-	-	-	-	5,212b [b]	5,458
1992	122	1	-	-	-	-	-	123
1993	-	-	-	68	-	-	6,800 [a]	6,868
1994	719	-	-	700 [a]	-	-	650 [a]	2,069
1995	65	-	-	-	-	-	-	65
1996	232	-	-	-	-	-	-	232
1997	657	-	-	-	-	-	-	657
1998	562	85	-	-	-	-	-	647
1999	752	300 [a]	-	-	-	-	-	1,052
2000	1,114 [b]	247	-	-	-	53	-	1,486

[a] Not reported to NAFO Catches estimated from surveillance reports.

[b] Includes some estimated catches.

Table 3. Canadian catches of yellowtail flounder by division, from 1973-2000. Data for 1990-93 and 1998-99 are from preliminary Canadian statistics, and are slightly different from STATLANT data. Catches given for 1994-97 are by-catch totals for all gears, from STATLANT 21A data.

	OTTER TRAWL				OTHER GEARS
Year	3L	3N	3Ø	3LNO	3LNO
1973	4188	21470	2827	28475	17
1974	1107	14757	1119	16983	70
1975	2315	13289	2852	18456	2
1976	448	4978	2478	7904	6
1977	2546	7166	1583	11295	0
1978	2537	10705	1793	15035	56
1979	2575	14359	1100	18034	82
1980	1892	9501	578	11971	40
1981	2345	11245	515	14105	17
1982	2305	7554	1607	11466	13
1983	2552	5737	770	9059	26
1984	5264	6847	318	12429	8
1985	3404	9098	829	13331	9
1986	2933	10196	1004	14133	35
1987	1584	10248	1529	13361	59
1988	1813	7146	1475	10434	173
1989	844	2407	1506	4757	252
1990	1263	2725	664	4652	317
1991	815	2980	2283	6078	564
1992	95	1266	4636	5997	812
1993	1	2030	3902	5933	764
1994				0	
1995				2	
1996				0	
1997				1	
1998	0	2940	726	3666	26
1999	0	5319	91	5410	3
2000	1407	7724	298	9409	5

Table 4. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for yellowtail flounder in NAFO Div. 3LNO (2000 based on preliminary data)

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R.............. 0.744
MULTIPLE R SQUARED..... 0.553

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	4.47E1	4.47E1	
REGRESSION	46	6.93E0	1.51E-1	22.051
Cntry|Gear|TC	2	7.48E-1	3.74E-1	54.706
Division	2	7.78E-1	3.89E-1	56.919
Month	11	5.95E-1	5.41E-2	7.916
Year	31	4.18E0	1.35E-1	19.734
RESIDUALS	820	5.60E0	6.83E-3	
TOTAL	867	5.72E1		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	3125	INT	0.151	0.121	867
Division	34				
Month	10				
Year	65				
1	3114	1	-0.292	0.032	162
	3124	2	-0.218	0.032	151
2	32	3	-0.222	0.028	201
	35	4	-0.262	0.030	181
3	1	5	-0.215	0.084	19
	2	6	-0.292	0.080	22
	3	7	-0.207	0.063	36
	4	8	-0.198	0.052	61
	5	9	-0.224	0.044	114
	6	10	-0.322	0.045	114
	7	11	-0.307	0.045	117
	8	12	-0.219	0.045	111
	9	13	-0.074	0.046	94
	11	14	-0.110	0.052	57
	12	15	-0.134	0.062	41
4	66	16	-0.058	0.151	11
	67	17	-0.075	0.150	12
	68	18	-0.216	0.145	14
	69	19	-0.359	0.136	20
	70	20	-0.386	0.125	42
	71	21	-0.423	0.124	41
	72	22	-0.536	0.125	45
	73	23	-0.402	0.124	50
	74	24	-0.820	0.127	37
	75	25	-0.821	0.126	38
	76	26	-0.918	0.134	26
	77	27	-0.730	0.127	38
	78	28	-0.707	0.124	51
	79	29	-0.677	0.125	47
	80	30	-0.571	0.129	30
	81	31	-0.567	0.130	30
	82	32	-0.660	0.133	24
	83	33	-0.532	0.132	24
	84	34	-0.565	0.133	28
	85	35	-0.524	0.130	30
	86	36	-0.838	0.131	30
	87	37	-0.795	0.131	30
	88	38	-0.868	0.133	26
	89	39	-0.894	0.142	17
	90	40	-0.726	0.141	16
	91	41	-1.403	0.138	21
	92	42	-1.253	0.142	15
	93	43	-0.770	0.138	18
	98	44	-0.278	0.151	11
	99	45	-0.090	0.146	12
	100	46	-0.032	0.133	25

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1965	0.1507	0.0148	1.158	0.140	3075	2655
1966	0.0930	0.0114	1.095	0.116	4185	3822
1967	0.0753	0.0117	1.076	0.116	2122	1973
1968	-0.0651	0.0087	0.936	0.087	4180	4465
1969	-0.2079	0.0064	0.812	0.065	10494	12917
1970	-0.2355	0.0035	0.791	0.047	22814	28825
1971	-0.2725	0.0032	0.763	0.043	24206	31730
1972	-0.3852	0.0031	0.682	0.038	26939	39525
1973	-0.2508	0.0029	0.780	0.042	28492	36543
1974	-0.6697	0.0036	0.513	0.031	17053	33261
1975	-0.6702	0.0033	0.513	0.029	18458	36015
1976	-0.7678	0.0052	0.464	0.033	7910	17032
1977	-0.5792	0.0040	0.561	0.035	11295	20129
1978	-0.5566	0.0031	0.574	0.032	15091	26282
1979	-0.5267	0.0033	0.592	0.034	18116	30620
1980	-0.4201	0.0046	0.658	0.045	12011	18262
1981	-0.4164	0.0044	0.660	0.044	14122	21390
1982	-0.5090	0.0051	0.602	0.043	11479	19080
1983	-0.3818	0.0046	0.683	0.047	9085	13294
1984	-0.4141	0.0051	0.661	0.047	12437	18801
1985	-0.3734	0.0042	0.689	0.045	13440	19498
1986	-0.6870	0.0044	0.504	0.033	14168	28127
1987	-0.6441	0.0043	0.526	0.034	13420	25523
1988	-0.7173	0.0049	0.489	0.034	10607	21711
1989	-0.7431	0.0071	0.476	0.040	5009	10532
1990	-0.5756	0.0068	0.562	0.046	4966	8831
1991	-1.2522	0.0063	0.286	0.023	6642	23228
1992	-1.1026	0.0070	0.332	0.028	6809	20511
1993	-0.6193	0.0064	0.538	0.043	6697	12438
1998	-0.1276	0.0097	0.879	0.086	3739	4254
1999	0.0608	0.0082	1.062	0.096	5413	5097
2000	0.1188	0.0049	1.127	0.079	9460	8393

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.074

LEGEND FOR AVOVA RESULTS:

CGT CODES: 3114 = Can(NFLD) TC 4 Side Trawler
3124 = " TC 4 Stern Trawler
3125 = " TC 5 "

DIVISION CODES: 32 = 3L, 34 = 3N, 35 = 30

Table 5. A comparison of spring and fall abundance and biomass estimates derived from annual bottom trawl surveys in Div. 3LNO (SCR Doc. 01/50)

BIOMASS (000t)			**Abundance (million)**		
	SPRING	*FALL*		*SPRING*	*FALL*
1984	217.7	.	**1984**	544.2	
1985	146.8	.	**1985**	374.1	
1986	138.2	.	**1986**	326.5	
1987	124.6	.	**1987**	394.2	
1988	81	.	**1988**	203.1	
1989	103.8	.	**1989**	532.9	
1990	103.1	65.8	**1990**	367.4	192.5
1991	93.4	82.4	**1991**	320.3	297.1
1992	61.4	64.5	**1992**	217.4	215.9
1993	93.3	112.8	**1993**	246.3	371.9
1994	55.6	106.4	**1994**	148.4	287.9
1995	70.6	129.8	**1995**	187.4	592.2
1996	175.6	134.3	**1996**	639.4	579.1
1997	174.9	222.9	**1997**	695.5	781.5
1998	202.2	231.6	**1998**	733.6	828.2
1999	365.7	249.9	**1999**	1,289.9	937.1
2000	287.5	335	**2000**	922.5	1152.3

Table 6A. Abundance (millions) at age (sexes combined) by year, Div 3LNO Yellowtail Flounder - Spring

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.5	1.5	1.0	5.3
2	0.0	0.2	0.0	10.2	0.7	4.0	0.2	1.7	1.1	0.3	0.0	0.0	33.4	7.3	18.3	63.5	23.2
3	5.3	16.7	2.4	29.0	4.7	40.0	12.1	5.8	17.5	3.3	5.0	1.6	88.8	71.3	22.9	70.4	65.2
4	32.6	37.8	10.2	81.9	25.5	249.9	78.9	58.7	55.8	35.7	7.4	20.0	120.2	152.8	93.0	116.4	63.9
5	85.5	35.5	39.5	37.7	15.5	98.5	92.4	89.0	36.5	43.3	26.7	24.4	97.6	165.1	243.8	290.4	150.2
6	141.1	91.3	57.8	58.4	21.5	55.2	58.4	73.8	47.4	53.3	42.5	57.3	99.1	116.8	190.9	401.2	381.2
7	184.5	132.2	141.6	104.9	63.2	56.8	65.9	58.0	37.5	68.3	44.0	55.7	129.5	116.9	100.7	221.7	134.9
8+	95.2	60.4	75.1	72.0	72.0	28.6	59.4	33.3	21.7	42.2	22.8	28.4	66.2	64.8	62.3	124.4	98.7
Age 1+	**544.2**	**374.1**	**326.6**	**394.2**	**203.0**	**532.9**	**367.5**	**320.2**	**217.5**	**246.3**	**148.4**	**187.3**	**639.4**	**695.5**	**733.3**	**1288.9**	**922.5**
Age 1-4	**37.9**	**54.7**	**12.6**	**121.1**	**30.9**	**293.9**	**91.3**	**66.3**	**74.4**	**39.3**	**12.4**	**21.5**	**247.1**	**231.8**	**135.6**	**251.2**	**157.5**
Age 5+	**506.3**	**319.4**	**314.0**	**273.1**	**172.2**	**239.0**	**276.2**	**254.0**	**143.1**	**207.1**	**136.0**	**165.8**	**392.3**	**463.7**	**597.7**	**1037.7**	**765.0**
Age 7+	**279.7**	**192.6**	**216.6**	**176.9**	**135.2**	**85.4**	**125.3**	**91.2**	**59.2**	**110.5**	**66.8**	**84.1**	**195.7**	**181.7**	**163.0**	**346.0**	**233.6**

Table 6B. Abundance (millions) at age by year, Div 3LNO Yellowtail Flounder-Fall

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1						8.8	0.9	2.7	6.7	2.8	11.0
2	1.3	1.6	1.2	0.9	2.3	83.9	17.8	7.9	12.6	35.2	20.6
3	11.3	37.2	18.6	6.6	5.9	122.4	63.6	44.4	26.3	72.6	85.8
4	28.9	64.5	53.5	74.4	38.5	89.7	132.6	125.7	75.0	70.3	93.8
5	44.3	46.9	34.0	104.5	48.4	70.6	145.1	204.9	243.8	213.4	185.5
6	38.5	61.2	33.7	77.5	70.9	87.7	97.9	178.9	256.5	323.3	414.7
7	45.0	52.4	45.6	67.3	69.8	84.4	82.7	142.5	143.7	148.2	246.8
8+	23.2	33.3	30.3	40.7	52.1	44.7	39.3	74.9	63.7	74.4	94.3
age1+	**192.5**	**297.1**	**217.1**	**372.0**	**288.0**	**592.3**	**579.8**	**781.8**	**828.2**	**940.3**	**1,152.4**
ages1-4	**41.5**	**103.3**	**73.4**	**82.0**	**46.7**	**304.8**	**214.9**	**180.6**	**120.5**	**180.9**	**211.1**
age 5+	**151.0**	**193.8**	**143.7**	**290.0**	**241.3**	**287.5**	**364.9**	**601.2**	**707.7**	**759.4**	**941.3**
age7+	**68.2**	**85.7**	**76.0**	**108.0**	**121.9**	**129.2**	**121.9**	**217.4**	**207.4**	**222.7**	**341.1**

Table 7A. Biomass estimates ('000t) at age (sexes combined) by year, Div. 3LNO Yellowtail Flounder - Spring

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1													0.0	0.0	0.0	0.0	0.0
2		0.0		0.1	0.0	0.0	0.0	0.0	0.0	0.0			0.4	0.1	0.2	0.8	0.3
3	0.2	1.3	0.1	1.2	0.2	1.7	0.7	0.3	0.9	0.2	0.3	0.1	3.6	2.9	1.0	2.7	3.0
4	2.9	3.6	1.1	5.1	2.2	21.9	6.5	5.1	5.2	3.5	0.8	2.2	11.9	14.9	8.9	11.5	5.7
5	15.4	6.9	6.5	5.7	2.0	15.5	12.8	15.7	6.5	8.1	5.2	4.6	17.1	28.5	44.0	49.8	26.9
6	47.5	29.9	16.6	16.3	5.4	16.0	15.5	21.8	14.7	16.6	13.4	17.9	29.8	35.3	57.7	112.1	113.6
7	89.3	64.3	64.6	48.5	25.5	27.2	27.9	26.6	18.0	33.4	21.0	26.1	58.8	53.0	46.0	100.9	53.2
8+	62.8	41.6	50.2	48.4	46.2	20.6	40.1	23.3	16.1	32.5	16.1	20.2	47.2	44.6	42.8	85.4	67.2
Age 1+	**218.2**	**147.7**	**139.0**	**125.3**	**81.5**	**103.0**	**103.4**	**92.7**	**61.4**	**94.4**	**56.9**	**71.0**	**168.8**	**179.3**	**200.8**	**363.3**	**270.0**
Age 1-4	**3.2**	**4.9**	**1.2**	**6.3**	**2.4**	**23.7**	**7.2**	**5.4**	**6.1**	**3.8**	**1.1**	**2.3**	**15.9**	**17.9**	**10.2**	**15.1**	**9.1**
Age 5+	**215.0**	**142.8**	**137.8**	**119.0**	**79.2**	**79.3**	**96.2**	**87.4**	**55.3**	**90.7**	**55.7**	**68.7**	**152.9**	**161.4**	**190.6**	**348.2**	**260.9**
Age 7+	**152.1**	**105.9**	**114.8**	**96.9**	**71.7**	**47.8**	**68.0**	**49.9**	**34.1**	**65.9**	**37.1**	**46.3**	**106.0**	**97.6**	**88.8**	**186.3**	**120.4**

Table 7B. Biomass ('000t) at age by year, Div. 3LNO Yellowtail Flounder-Fall

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1						0.0	0.0	0.0	0.0	0.0	0.1
2	0.0	0.0	0.0	0.0	0.0	1.2	0.2	0.1	0.2	0.6	0.3
3	1.0	1.9	1.0	0.3	0.3	4.9	2.6	1.8	1.0	2.7	4.4
4	3.6	5.8	5.3	8.5	4.1	8.4	12.6	12.2	7.0	6.4	8.4
5	8.9	8.5	6.0	19.6	9.1	12.8	24.5	35.0	41.6	36.4	31.3
6	13.6	18.3	10.2	24.2	22.4	27.6	29.3	51.4	70.6	89.0	113.4
7	21.8	24.4	20.6	32.2	32.8	39.0	37.9	62.3	60.1	62.2	97.5
8+	15.4	23.1	20.6	29.2	37.3	31.6	27.6	50.2	42.1	51.0	59.8
age1+	**64.3**	**82.0**	**63.7**	**114.0**	**106.0**	**125.6**	**134.7**	**213.1**	**222.6**	**248.3**	**315.2**
ages1-4	**4.7**	**7.8**	**6.4**	**8.8**	**4.4**	**14.5**	**15.4**	**14.2**	**8.2**	**9.7**	**13.2**
age 5+	**59.6**	**74.3**	**57.4**	**105.2**	**101.6**	**111.0**	**119.2**	**199.0**	**214.4**	**238.6**	**302.1**
age7+	**37.1**	**47.4**	**41.2**	**61.4**	**70.1**	**70.7**	**65.4**	**112.6**	**102.3**	**113.2**	**157.4**

Table 8. Length weight relationships used to produce an index of female SSB from the spring survey. The relationships are of the form log(weight)=(*a**log(length))+*b*)

Year	*a*	*b*
prior to 1990	3.10	-5.19
1990	3.19	-5.33
1991	3.05	-5.12
1992	3.02	-5.06
1993	3.11	-5.20
1994	3.09	-5.19
1995	3.10	-5.20
1996	3.09	-5.15
1997	3.09	-5.17
1998	3.05	-5.11
1999	3.15	-5.27
2000	3.17	-5.32

Table 9. Input data for ASPIC stock production model

year	Nominal catch (000 t)	Yankee survey (000 t)	Russian survey (000 t)	Campelen (000 t)	Campelen fall (000 t)	Spain survey (000 t)
1965	3.130					
l966	7.026					
l967	8.878					
l968	13.340					
l969	15.708					
l970	26.426					
l97l	37.342	96.9				
l972	39.259	79.2	106.0			
l973	32.815	51.7	217.0			
l974	24.313	40.3	129.0			
l975	22.894	37.4	126.0			
l976	8.057	41.7	131.0			
1977	11.638	65.0	188.0			
l978	15.466	44.3	110.0			
l979	18.351	38.5	98.0			
l980	12.377	51.4	164.0			
l98l	14.680	45.0	158.0			
l982	13.319	43.1	125.0			
l983	10.473					
l984	16.735		132.0	217.7		
l985	28.963		85.0	146.8		
1986	30.176		42.0	138.2		
1987	16.314		30.0	124.6		
1988	16.158		23.0	81.0		
1989	10.207		44.0	103.8		
1990	13.986		27.0	103.1	66.4	
1991	16.203		27.5	93.4	82.8	
1992	10.762			61.4	64.2	
1993	13.565			63.3	114.8	
1994	2.069			55.6	106.8	
1995	0.067			70.6	126.8	27.7
1996	0.287			175.6	136.0	129.6
1997	0.800			174.9	215.0	115.7
1998	4.348			202.2	231.6	425.4
1999	6.561			365.7	246.9	589.2
2000	11.121			287.5	335.0	447.4
2001	14.300*					

* assumes TAC will be taken in 2001 with a 10% over-run

Table 10. Output from ASPIC production model for Div. 3LNO yellowtail flounder (biomass in Kt) assuming a catch of 14300 t (10% 0verride in the 13000 t TAC) in the 2001 fishery.

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3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery                                      Page 1
                                                                                            07 Jun 2001 at 16:13.21
ASPIC -- A Surplus-Production Model Including Covariates (Ver. 3.81)                                      FIT Mode

Author: Michael H. Prager; NOAA/NMFS/S.E. Fisheries Science Center                             ASPIC User's Manual
        101 Pivers Island Road; Beaufort, North Carolina  28516  USA                           is available gratis
                                                                                                  from the author.
Ref:    Prager, M. H.  1994.  A suite of extensions to a nonequilibrium
        surplus-production model.  Fishery Bulletin 92: 374-389.


CONTROL PARAMETERS USED (FROM INPUT FILE)
------------------------------------------------------------------------------------------------------------------------
Number of years analyzed:                    37            Number of bootstrap trials:                               0
Number of data series:                        5            Lower bound on MSY:                               1.000E+00
Objective function computed:          in effort            Upper bound on MSY:                               5.000E+01
Relative conv. criterion (simplex):   1.000E-06            Lower bound on r:                                 1.000E-01
Relative conv. criterion (restart):   3.000E-06            Upper bound on r:                                 5.000E+00
Relative conv. criterion (effort):    1.000E-02            Random number seed:                                 9114894
Maximum F allowed in fitting:             5.000            Monte Carlo search mode, trials:                2     50000


PROGRAM STATUS INFORMATION (NON-BOOTSTRAPPED ANALYSIS)                                                          code  0
------------------------------------------------------------------------------------------------------------------------
Normal convergence.


CORRELATION AMONG INPUT SERIES EXPRESSED AS CPUE (NUMBER OF PAIRWISE OBSERVATIONS BELOW)
------------------------------------------------------------------------------------------------------------------------
                                       |
 1  Canadian Campelen Survey           |   1.000
                                       |      17
                                       |
 2  Canadian Yankee Survey             |   0.000   1.000
                                       |       0      12
                                       |
 3  Canadian Fall Survey               |   0.855   0.000   1.000
                                       |      11       0      11
                                       |
 4  Russian Survey                     |   0.933   0.198   1.000   1.000
                                       |       8      11       2      19
                                       |
 5  Spanish Survey                     |   0.915   0.000   0.768   0.000   1.000
                                       |       6       0       6       0       6
                                       --------------------------------------------------
                                               1       2       3       4       5


GOODNESS-OF-FIT AND WEIGHTING FOR NON-BOOTSTRAPPED ANALYSIS
------------------------------------------------------------------------------------------------------------------------
                                                    Weighted              Weighted       Current     Suggested    R-squared
Loss component number and title                          SSE      N            MSE        weight        weight      in CPUE

Loss(-1)  SSE in yield                             0.000E+00
Loss( 0)  Penalty for B1R > 2                      1.397E-02    1              N/A     1.000E+00           N/A
Loss( 1)  Canadian Campelen Survey                 7.383E-01   17      4.922E-02     1.000E+00     1.331E+00        0.800
Loss( 2)  Canadian Yankee Survey                   2.645E-01   12      2.645E-02     1.000E+00     2.476E+00        0.800
Loss( 3)  Canadian Fall Survey                     8.319E-01   11      9.243E-02     1.000E+00     7.086E-01        0.888
Loss( 4)  Russian Survey                           4.880E+00   19      2.870E-01     1.000E+00     2.282E-01        0.306
Loss( 5)  Spanish Survey                           2.955E+00    6      7.387E-01     1.000E+00     8.867E-02        0.339
TOTAL OBJECTIVE FUNCTION:                     9.68298059E+00

NOTE: B1-ratio constraint term contributing to loss. Sensitivity analysis advised.

Number of restarts required for convergence:              13
Est. B-ratio coverage index (0 worst, 2 best):        1.7782                < These two measures are defined in Prager
Est. B-ratio nearness index (0 worst, 1 best):        1.0000                <      et al. (1996), Trans. A.F.S. 125:729


MODEL PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
------------------------------------------------------------------------------------------------------------------------
Parameter                                           Estimate    Starting guess    Estimated    User guess

B1R       Starting biomass ratio, year 1965        2.251E+00         2.000E+00            1             1
MSY       Maximum sustainable yield                1.739E+01         1.300E+01            1             1
r         Intrinsic rate of increase               4.276E-01         5.000E-01            1             1
........  Catchability coefficients by fishery:
q( 1)     Canadian Campelen Survey                 3.117E+00         3.000E+00            1             1
q( 2)     Canadian Yankee Survey                   8.039E-01         1.000E+00            1             1
q( 3)     Canadian Fall Survey                     3.408E+00         3.000E+00            1             1
q( 4)     Russian Survey                           1.632E+00         1.000E+00            1             1
q( 5)     Spanish Survey                           3.454E+00         3.000E+00            1             1


MANAGEMENT PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
------------------------------------------------------------------------------------------------------------------------
Parameter                                           Estimate           Formula       Related quantity

MSY       Maximum sustainable yield                1.739E+01              Kr/4
K         Maximum stock biomass                    1.627E+02
Bmsy      Stock biomass at MSY                     8.133E+01               K/2
Fmsy      Fishing mortality at MSY                 2.138E-01               r/2

F(0.1)    Management benchmark                     1.924E-01          0.9*Fmsy
Y(0.1)    Equilibrium yield at F(0.1)              1.721E+01          0.99*MSY

B-ratio   Ratio of B(2002) to Bmsy                 1.142E+00
F-ratio   Ratio of F(2001) to Fmsy                 7.310E-01
F01-mult  Ratio of F(0.1) to F(2001)               1.231E+00
Y-ratio   Proportion of MSY avail in 2002          9.799E-01         2*Br-Br^2    Ye(2002) = 1.704E+01

........  Fishing effort at MSY in units of each fishery:
fmsy( 1)  Canadian Campelen Survey                 6.860E-02         r/2q( 1)       f(0.1) = 6.174E-02

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery                                     Page 2
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Table 11. Estimates of relative biomass and fishing mortality rates for 3LNO yellowtail flounder from ASPIC production model.

ESTIMATED POPULATION TRAJECTORY (NON-BOOTSTRAPPED)

Obs	Year or ID	Estimated total F mort	Estimated starting biomass	Estimated average biomass	Observed total yield	Model total yield	Estimated surplus production	Ratio of F mort to Fmsy	Ratio of biomass to Bmsy
1	1965	0.018	1.831E+02	1.776E+02	3.130E+00	3.130E+00	-6.982E+00	8.245E-02	2.251E+00
2	1966	0.042	1.729E+02	1.679E+02	7.026E+00	7.026E+00	-2.328E+00	1.958E-01	2.127E+00
3	1967	0.056	1.636E+02	1.595E+02	8.878E+00	8.878E+00	1.304E+00	2.603E-01	2.012E+00
4	1968	0.088	1.560E+02	1.513E+02	1.334E+01	1.334E+01	4.510E+00	4.125E-01	1.918E+00
5	1969	0.110	1.472E+02	1.428E+02	1.571E+01	1.571E+01	7.450E+00	5.146E-01	1.810E+00
6	1970	0.202	1.389E+02	1.306E+02	2.643E+01	2.643E+01	1.096E+01	9.463E-01	1.708E+00
7	1971	0.336	1.235E+02	1.112E+02	3.734E+01	3.734E+01	1.488E+01	1.571E+00	1.518E+00
8	1972	0.442	1.010E+02	8.883E+01	3.926E+01	3.926E+01	1.705E+01	2.067E+00	1.242E+00
9	1973	0.467	7.878E+01	7.030E+01	3.281E+01	3.281E+01	1.700E+01	2.183E+00	9.687E-01
10	1974	0.416	6.297E+01	5.848E+01	2.431E+01	2.431E+01	1.597E+01	1.945E+00	7.742E-01
11	1975	0.455	5.462E+01	5.037E+01	2.289E+01	2.289E+01	1.485E+01	2.126E+00	6.716E-01
12	1976	0.161	4.657E+01	4.993E+01	8.057E+00	8.057E+00	1.479E+01	7.548E-01	5.726E-01
13	1977	0.210	5.330E+01	5.530E+01	1.164E+01	1.164E+01	1.560E+01	9.844E-01	6.554E-01
14	1978	0.269	5.726E+01	5.745E+01	1.547E+01	1.547E+01	1.589E+01	1.259E+00	7.041E-01
15	1979	0.326	5.768E+01	5.628E+01	1.835E+01	1.835E+01	1.573E+01	1.525E+00	7.093E-01
16	1980	0.218	5.506E+01	5.678E+01	1.238E+01	1.238E+01	1.580E+01	1.020E+00	6.770E-01
17	1981	0.248	5.848E+01	5.919E+01	1.468E+01	1.468E+01	1.610E+01	1.160E+00	7.191E-01
18	1982	0.217	5.990E+01	6.143E+01	1.332E+01	1.332E+01	1.634E+01	1.014E+00	7.365E-01
19	1983	0.158	6.292E+01	6.612E+01	1.047E+01	1.047E+01	1.677E+01	7.409E-01	7.737E-01
20	1984	0.241	6.922E+01	6.935E+01	1.673E+01	1.673E+01	1.701E+01	1.129E+00	8.511E-01
21	1985	0.462	6.949E+01	6.272E+01	2.896E+01	2.896E+01	1.640E+01	2.160E+00	8.545E-01
22	1986	0.623	5.693E+01	4.842E+01	3.018E+01	3.018E+01	1.446E+01	2.915E+00	7.000E-01
23	1987	0.415	4.121E+01	3.932E+01	1.631E+01	1.631E+01	1.274E+01	1.941E+00	5.068E-01
24	1988	0.458	3.763E+01	3.531E+01	1.616E+01	1.616E+01	1.180E+01	2.141E+00	4.628E-01
25	1989	0.301	3.328E+01	3.390E+01	1.021E+01	1.021E+01	1.147E+01	1.408E+00	4.092E-01
26	1990	0.422	3.454E+01	3.311E+01	1.399E+01	1.399E+01	1.127E+01	1.976E+00	4.248E-01
27	1991	0.567	3.182E+01	2.857E+01	1.620E+01	1.620E+01	1.005E+01	2.653E+00	3.913E-01
28	1992	0.435	2.567E+01	2.473E+01	1.076E+01	1.076E+01	8.963E+00	2.035E+00	3.157E-01
29	1993	0.653	2.388E+01	2.076E+01	1.356E+01	1.356E+01	7.727E+00	3.056E+00	2.936E-01
30	1994	0.100	1.804E+01	2.076E+01	2.069E+00	2.069E+00	7.739E+00	4.661E-01	2.218E-01
31	1995	0.002	2.371E+01	2.845E+01	6.700E-02	6.700E-02	1.002E+01	1.101E-02	2.915E-01
32	1996	0.007	3.366E+01	3.969E+01	2.870E-01	2.870E-01	1.280E+01	3.382E-02	4.139E-01
33	1997	0.015	4.617E+01	5.324E+01	8.000E-01	8.000E-01	1.527E+01	7.028E-02	5.677E-01
34	1998	0.065	6.063E+01	6.684E+01	4.348E+00	4.348E+00	1.680E+01	3.043E-01	7.456E-01
35	1999	0.084	7.309E+01	7.852E+01	6.561E+00	6.561E+00	1.734E+01	3.908E-01	8.987E-01
36	2000	0.128	8.386E+01	8.703E+01	1.112E+01	1.112E+01	1.729E+01	5.977E-01	1.031E+00
37	2001	0.156	9.004E+01	9.150E+01	1.430E+01	1.430E+01	1.711E+01	7.310E-01	1.107E+00
38	2002		9.285E+01						1.142E+00

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 3

Table 12. ASPIC Model outputs for each time series.

RESULTS FOR DATA SERIES # 1 (NON-BOOTSTRAPPED) Canadian Campelen Survey

Data type CC: CPUE-catch series Series weight: 1.000

Obs	Year	Observed CPUE	Estimated CPUE	Estim F	Observed yield	Model yield	Resid in log scale	Resid in yield
1	1965	*	5.534E+02	0.0176	3.130E+00	3.130E+00	0.00000	0.000E+00
2	1966	*	5.232E+02	0.0419	7.026E+00	7.026E+00	0.00000	0.000E+00
3	1967	*	4.971E+02	0.0557	8.878E+00	8.878E+00	0.00000	0.000E+00
4	1968	*	4.714E+02	0.0882	1.334E+01	1.334E+01	0.00000	0.000E+00
5	1969	*	4.449E+02	0.1100	1.571E+01	1.571E+01	0.00000	0.000E+00
6	1970	*	4.071E+02	0.2023	2.643E+01	2.643E+01	0.00000	0.000E+00
7	1971	*	3.465E+02	0.3358	3.734E+01	3.734E+01	0.00000	0.000E+00
8	1972	*	2.768E+02	0.4420	3.926E+01	3.926E+01	0.00000	0.000E+00
9	1973	*	2.191E+02	0.4668	3.281E+01	3.281E+01	0.00000	0.000E+00
10	1974	*	1.822E+02	0.4158	2.431E+01	2.431E+01	0.00000	0.000E+00
11	1975	*	1.570E+02	0.4545	2.289E+01	2.289E+01	0.00000	0.000E+00
12	1976	*	1.556E+02	0.1614	8.057E+00	8.057E+00	0.00000	0.000E+00
13	1977	*	1.723E+02	0.2105	1.164E+01	1.164E+01	0.00000	0.000E+00
14	1978	*	1.791E+02	0.2692	1.547E+01	1.547E+01	0.00000	0.000E+00
15	1979	*	1.754E+02	0.3261	1.835E+01	1.835E+01	0.00000	0.000E+00
16	1980	*	1.770E+02	0.2180	1.238E+01	1.238E+01	0.00000	0.000E+00
17	1981	*	1.845E+02	0.2480	1.468E+01	1.468E+01	0.00000	0.000E+00
18	1982	*	1.914E+02	0.2168	1.332E+01	1.332E+01	0.00000	0.000E+00
19	1983	*	2.061E+02	0.1584	1.047E+01	1.047E+01	0.00000	0.000E+00
20	1984	2.177E+02	2.161E+02	0.2413	1.673E+01	1.673E+01	-0.00723	0.000E+00
21	1985	1.468E+02	1.955E+02	0.4618	2.896E+01	2.896E+01	0.28636	0.000E+00
22	1986	1.382E+02	1.509E+02	0.6232	3.018E+01	3.018E+01	0.08790	0.000E+00
23	1987	1.246E+02	1.225E+02	0.4149	1.631E+01	1.631E+01	-0.01669	0.000E+00
24	1988	8.100E+01	1.100E+02	0.4576	1.616E+01	1.616E+01	0.30638	0.000E+00
25	1989	1.038E+02	1.057E+02	0.3011	1.021E+01	1.021E+01	0.01775	0.000E+00
26	1990	1.031E+02	1.032E+02	0.4224	1.399E+01	1.399E+01	0.00082	0.000E+00
27	1991	9.340E+01	8.904E+01	0.5671	1.620E+01	1.620E+01	-0.04780	0.000E+00
28	1992	6.140E+01	7.707E+01	0.4352	1.076E+01	1.076E+01	0.22737	0.000E+00
29	1993	9.330E+01	6.471E+01	0.6533	1.356E+01	1.356E+01	-0.36594	0.000E+00
30	1994	5.560E+01	6.471E+01	0.0997	2.069E+00	2.069E+00	0.15167	0.000E+00
31	1995	7.060E+01	8.868E+01	0.0024	6.700E-02	6.700E-02	0.22798	0.000E+00
32	1996	1.756E+02	1.237E+02	0.0072	2.870E-01	2.870E-01	-0.35036	0.000E+00
33	1997	1.749E+02	1.659E+02	0.0150	8.000E-01	8.000E-01	-0.05268	0.000E+00
34	1998	2.022E+02	2.083E+02	0.0651	4.348E+00	4.348E+00	0.02977	0.000E+00
35	1999	3.657E+02	2.447E+02	0.0836	6.561E+00	6.561E+00	-0.40176	0.000E+00
36	2000	2.875E+02	2.712E+02	0.1278	1.112E+01	1.112E+01	-0.05827	0.000E+00
37	2001	*	2.852E+02	0.1563	1.430E+01	1.430E+01	0.00000	0.000E+00

* Asterisk indicates missing value(s).

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 4

UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 1

```
                   -1       -0.75     -0.5      -0.25       0        0.25      0.5       0.75       1
                    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |
Year   Residual    -------------------------------------------------------------------------------------
1965     0.0000                                             |
1966     0.0000                                             |
1967     0.0000                                             |
1968     0.0000                                             |
1969     0.0000                                             |
1970     0.0000                                             |
1971     0.0000                                             |
1972     0.0000                                             |
1973     0.0000                                             |
1974     0.0000                                             |
1975     0.0000                                             |
1976     0.0000                                             |
1977     0.0000                                             |
1978     0.0000                                             |
1979     0.0000                                             |
1980     0.0000                                             |
1981     0.0000                                             |
1982     0.0000                                             |
1983     0.0000                                             |
1984    -0.0072                                             |
1985     0.2864                                             |===========
1986     0.0879                                             |====
1987    -0.0167                                            =|
1988     0.3064                                             |============
1989     0.0178                                             |=
1990     0.0008                                             |
1991    -0.0478                                           ==|
1992     0.2274                                             |=========
1993    -0.3659                              ===============|
1994     0.1517                                             |======
1995     0.2280                                             |=========
1996    -0.3504                               ==============|
1997    -0.0527                                           ==|
1998     0.0298                                             |=
1999    -0.4018                             ================|
2000    -0.0583                                           ==|
2001     0.0000                                             |
                   -------------------------------------------------------------------------------------
```

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 5

Table 12 Cont'd.

RESULTS FOR DATA SERIES # 2 (NON-BOOTSTRAPPED)   Canadian Yankee Survey

Data type I1: Year-average biomass index   Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Resid in index
1	1965	0.000E+00	0.000E+00	0.0	*	1.428E+02	0.00000	0.0
2	1966	0.000E+00	0.000E+00	0.0	*	1.350E+02	0.00000	0.0
3	1967	0.000E+00	0.000E+00	0.0	*	1.282E+02	0.00000	0.0
4	1968	0.000E+00	0.000E+00	0.0	*	1.216E+02	0.00000	0.0
5	1969	0.000E+00	0.000E+00	0.0	*	1.148E+02	0.00000	0.0
6	1970	0.000E+00	0.000E+00	0.0	*	1.050E+02	0.00000	0.0
7	1971	1.000E+00	1.000E+00	0.0	9.690E+01	8.939E+01	0.08071	7.514E+00
8	1972	1.000E+00	1.000E+00	0.0	7.920E+01	7.141E+01	0.10355	7.791E+00
9	1973	1.000E+00	1.000E+00	0.0	5.170E+01	5.651E+01	-0.08901	-4.813E+00
10	1974	1.000E+00	1.000E+00	0.0	4.030E+01	4.701E+01	-0.15399	-6.709E+00
11	1975	1.000E+00	1.000E+00	0.0	3.740E+01	4.049E+01	-0.07946	-3.093E+00
12	1976	1.000E+00	1.000E+00	0.0	4.170E+01	4.014E+01	0.03816	1.561E+00
13	1977	1.000E+00	1.000E+00	0.0	6.500E+01	4.445E+01	0.37996	2.055E+01
14	1978	1.000E+00	1.000E+00	0.0	4.430E+01	4.619E+01	-0.04173	-1.888E+00
15	1979	1.000E+00	1.000E+00	0.0	3.850E+01	4.525E+01	-0.16144	-6.745E+00
16	1980	1.000E+00	1.000E+00	0.0	5.140E+01	4.565E+01	0.11864	5.750E+00
17	1981	1.000E+00	1.000E+00	0.0	4.500E+01	4.758E+01	-0.05578	-2.581E+00
18	1982	1.000E+00	1.000E+00	0.0	4.310E+01	4.938E+01	-0.13605	-6.282E+00
19	1983	0.000E+00	0.000E+00	0.0	*	5.316E+01	0.00000	0.0
20	1984	0.000E+00	0.000E+00	0.0	*	5.575E+01	0.00000	0.0
21	1985	0.000E+00	0.000E+00	0.0	*	5.042E+01	0.00000	0.0
22	1986	0.000E+00	0.000E+00	0.0	*	3.892E+01	0.00000	0.0
23	1987	0.000E+00	0.000E+00	0.0	*	3.161E+01	0.00000	0.0
24	1988	0.000E+00	0.000E+00	0.0	*	2.838E+01	0.00000	0.0
25	1989	0.000E+00	0.000E+00	0.0	*	2.725E+01	0.00000	0.0
26	1990	0.000E+00	0.000E+00	0.0	*	2.662E+01	0.00000	0.0
27	1991	0.000E+00	0.000E+00	0.0	*	2.297E+01	0.00000	0.0
28	1992	0.000E+00	0.000E+00	0.0	*	1.988E+01	0.00000	0.0
29	1993	0.000E+00	0.000E+00	0.0	*	1.669E+01	0.00000	0.0
30	1994	0.000E+00	0.000E+00	0.0	*	1.669E+01	0.00000	0.0
31	1995	0.000E+00	0.000E+00	0.0	*	2.287E+01	0.00000	0.0
32	1996	0.000E+00	0.000E+00	0.0	*	3.191E+01	0.00000	0.0
33	1997	0.000E+00	0.000E+00	0.0	*	4.280E+01	0.00000	0.0
34	1998	0.000E+00	0.000E+00	0.0	*	5.373E+01	0.00000	0.0
35	1999	0.000E+00	0.000E+00	0.0	*	6.312E+01	0.00000	0.0
36	2000	0.000E+00	0.000E+00	0.0	*	6.996E+01	0.00000	0.0
37	2001	0.000E+00	0.000E+00	0.0	*	7.356E+01	0.00000	0.0

* Asterisk indicates missing value(s).

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery   Page 6

UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 2

```
                   -1      -0.75     -0.5     -0.25      0       0.25      0.5      0.75      1
                    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |
Year   Residual    ---------------------------------------------------------------------------------
1965     0.0000                                          |
1966     0.0000                                          |
1967     0.0000                                          |
1968     0.0000                                          |
1969     0.0000                                          |
1970     0.0000                                          |
1971     0.0807                                          |===
1972     0.1035                                          |====
1973    -0.0890                                      ====|
1974    -0.1540                                    ======|
1975    -0.0795                                       ===|
1976     0.0382                                          |==
1977     0.3800                                          |===============
1978    -0.0417                                        ==|
1979    -0.1614                                    ======|
1980     0.1186                                          |=====
1981    -0.0558                                        ==|
1982    -0.1361                                     =====|
1983     0.0000                                          |
1984     0.0000                                          |
1985     0.0000                                          |
1986     0.0000                                          |
1987     0.0000                                          |
1988     0.0000                                          |
1989     0.0000                                          |
1990     0.0000                                          |
1991     0.0000                                          |
1992     0.0000                                          |
1993     0.0000                                          |
1994     0.0000                                          |
1995     0.0000                                          |
1996     0.0000                                          |
1997     0.0000                                          |
1998     0.0000                                          |
1999     0.0000                                          |
2000     0.0000                                          |
2001     0.0000                                          |
                   ---------------------------------------------------------------------------------
```

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery   Page 7

Table 12 Cont'd.

RESULTS FOR DATA SERIES # 3 (NON-BOOTSTRAPPED) Canadian Fall Survey

Data type I2: End-of-year biomass index Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Resid in index
1	1965	0.000E+00	0.000E+00	0.0	*	5.894E+02	0.00000	0.0
2	1966	0.000E+00	0.000E+00	0.0	*	5.575E+02	0.00000	0.0
3	1967	0.000E+00	0.000E+00	0.0	*	5.317E+02	0.00000	0.0
4	1968	0.000E+00	0.000E+00	0.0	*	5.016E+02	0.00000	0.0
5	1969	0.000E+00	0.000E+00	0.0	*	4.735E+02	0.00000	0.0
6	1970	0.000E+00	0.000E+00	0.0	*	4.208E+02	0.00000	0.0
7	1971	0.000E+00	0.000E+00	0.0	*	3.442E+02	0.00000	0.0
8	1972	0.000E+00	0.000E+00	0.0	*	2.685E+02	0.00000	0.0
9	1973	0.000E+00	0.000E+00	0.0	*	2.146E+02	0.00000	0.0
10	1974	0.000E+00	0.000E+00	0.0	*	1.861E+02	0.00000	0.0
11	1975	0.000E+00	0.000E+00	0.0	*	1.587E+02	0.00000	0.0
12	1976	0.000E+00	0.000E+00	0.0	*	1.816E+02	0.00000	0.0
13	1977	0.000E+00	0.000E+00	0.0	*	1.952E+02	0.00000	0.0
14	1978	0.000E+00	0.000E+00	0.0	*	1.966E+02	0.00000	0.0
15	1979	0.000E+00	0.000E+00	0.0	*	1.876E+02	0.00000	0.0
16	1980	0.000E+00	0.000E+00	0.0	*	1.993E+02	0.00000	0.0
17	1981	0.000E+00	0.000E+00	0.0	*	2.041E+02	0.00000	0.0
18	1982	0.000E+00	0.000E+00	0.0	*	2.144E+02	0.00000	0.0
19	1983	0.000E+00	0.000E+00	0.0	*	2.359E+02	0.00000	0.0
20	1984	0.000E+00	0.000E+00	0.0	*	2.368E+02	0.00000	0.0
21	1985	0.000E+00	0.000E+00	0.0	*	1.940E+02	0.00000	0.0
22	1986	0.000E+00	0.000E+00	0.0	*	1.405E+02	0.00000	0.0
23	1987	0.000E+00	0.000E+00	0.0	*	1.283E+02	0.00000	0.0
24	1988	0.000E+00	0.000E+00	0.0	*	1.134E+02	0.00000	0.0
25	1989	0.000E+00	0.000E+00	0.0	*	1.177E+02	0.00000	0.0
26	1990	1.000E+00	1.000E+00	0.0	6.640E+01	1.085E+02	-0.49070	-4.206E+01
27	1991	1.000E+00	1.000E+00	0.0	8.280E+01	8.750E+01	-0.05523	-4.702E+00
28	1992	1.000E+00	1.000E+00	0.0	6.420E+01	8.137E+01	-0.23700	-1.717E+01
29	1993	1.000E+00	1.000E+00	0.0	1.148E+02	6.147E+01	0.62461	5.333E+01
30	1994	1.000E+00	1.000E+00	0.0	1.068E+02	8.080E+01	0.27904	2.600E+01
31	1995	1.000E+00	1.000E+00	0.0	1.268E+02	1.147E+02	0.10026	1.210E+01
32	1996	1.000E+00	1.000E+00	0.0	1.360E+02	1.573E+02	-0.14572	-2.133E+01
33	1997	1.000E+00	1.000E+00	0.0	2.150E+02	2.066E+02	0.03966	8.360E+00
34	1998	1.000E+00	1.000E+00	0.0	2.316E+02	2.491E+02	-0.07277	-1.748E+01
35	1999	1.000E+00	1.000E+00	0.0	2.499E+02	2.858E+02	-0.13429	-3.592E+01
36	2000	1.000E+00	1.000E+00	0.0	3.350E+02	3.068E+02	0.08778	2.815E+01
37	2001	0.000E+00	0.000E+00	0.0	*	3.164E+02	0.00000	0.0

* Asterisk indicates missing value(s).

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 8

UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 3

```
                   -1       -0.75     -0.5      -0.25       0       0.25      0.5       0.75       1
                    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |
Year  Residual     ------------------------------------------------------------------------------------
1965     0.0000                                             |
1966     0.0000                                             |
1967     0.0000                                             |
1968     0.0000                                             |
1969     0.0000                                             |
1970     0.0000                                             |
1971     0.0000                                             |
1972     0.0000                                             |
1973     0.0000                                             |
1974     0.0000                                             |
1975     0.0000                                             |
1976     0.0000                                             |
1977     0.0000                                             |
1978     0.0000                                             |
1979     0.0000                                             |
1980     0.0000                                             |
1981     0.0000                                             |
1982     0.0000                                             |
1983     0.0000                                             |
1984     0.0000                                             |
1985     0.0000                                             |
1986     0.0000                                             |
1987     0.0000                                             |
1988     0.0000                                             |
1989     0.0000                                             |
1990    -0.4907                         ====================|
1991    -0.0552                                           ==|
1992    -0.2370                                    =========|
1993     0.6246                                             |=========================
1994     0.2790                                             |===========
1995     0.1003                                             |====
1996    -0.1457                                       ======|
1997     0.0397                                             |==
1998    -0.0728                                          ===|
1999    -0.1343                                        =====|
2000     0.0878                                             |====
2001     0.0000                                             |
                   ------------------------------------------------------------------------------------
```

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 9

Table 12 Cont'd.

RESULTS FOR DATA SERIES # 4 (NON-BOOTSTRAPPED) Russian Survey

Data type I1: Year-average biomass index Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Resid in index
1	1965	0.000E+00	0.000E+00	0.0	*	2.899E+02	0.00000	0.0
2	1966	0.000E+00	0.000E+00	0.0	*	2.740E+02	0.00000	0.0
3	1967	0.000E+00	0.000E+00	0.0	*	2.604E+02	0.00000	0.0
4	1968	0.000E+00	0.000E+00	0.0	*	2.469E+02	0.00000	0.0
5	1969	0.000E+00	0.000E+00	0.0	*	2.330E+02	0.00000	0.0
6	1970	0.000E+00	0.000E+00	0.0	*	2.132E+02	0.00000	0.0
7	1971	0.000E+00	0.000E+00	0.0	*	1.815E+02	0.00000	0.0
8	1972	1.000E+00	1.000E+00	0.0	1.060E+02	1.450E+02	-0.31322	-3.899E+01
9	1973	1.000E+00	1.000E+00	0.0	2.170E+02	1.147E+02	0.63719	1.023E+02
10	1974	1.000E+00	1.000E+00	0.0	1.290E+02	9.545E+01	0.30123	3.355E+01
11	1975	1.000E+00	1.000E+00	0.0	1.260E+02	8.222E+01	0.42692	4.378E+01
12	1976	1.000E+00	1.000E+00	0.0	1.310E+02	8.150E+01	0.47462	4.950E+01
13	1977	1.000E+00	1.000E+00	0.0	1.880E+02	9.026E+01	0.73378	9.774E+01
14	1978	1.000E+00	1.000E+00	0.0	1.100E+02	9.378E+01	0.15953	1.622E+01
15	1979	1.000E+00	1.000E+00	0.0	9.800E+01	9.187E+01	0.06464	6.134E+00
16	1980	1.000E+00	1.000E+00	0.0	1.640E+02	9.269E+01	0.57063	7.131E+01
17	1981	1.000E+00	1.000E+00	0.0	1.580E+02	9.661E+01	0.49192	6.139E+01
18	1982	1.000E+00	1.000E+00	0.0	1.250E+02	1.003E+02	0.22050	2.474E+01
19	1983	0.000E+00	0.000E+00	0.0	*	1.079E+02	0.00000	0.0
20	1984	1.000E+00	1.000E+00	0.0	1.320E+02	1.132E+02	0.15367	1.880E+01
21	1985	1.000E+00	1.000E+00	0.0	8.500E+01	1.024E+02	-0.18602	-1.738E+01
22	1986	1.000E+00	1.000E+00	0.0	4.200E+01	7.903E+01	-0.63218	-3.703E+01
23	1987	1.000E+00	1.000E+00	0.0	3.000E+01	6.418E+01	-0.76046	-3.418E+01
24	1988	1.000E+00	1.000E+00	0.0	2.300E+01	5.763E+01	-0.91858	-3.463E+01
25	1989	1.000E+00	1.000E+00	0.0	4.400E+01	5.534E+01	-0.22927	-1.134E+01
26	1990	1.000E+00	1.000E+00	0.0	2.700E+01	5.404E+01	-0.69392	-2.704E+01
27	1991	1.000E+00	1.000E+00	0.0	2.750E+01	4.663E+01	-0.52815	-1.913E+01
28	1992	0.000E+00	0.000E+00	0.0	*	4.037E+01	0.00000	0.0
29	1993	0.000E+00	0.000E+00	0.0	*	3.389E+01	0.00000	0.0
30	1994	0.000E+00	0.000E+00	0.0	*	3.389E+01	0.00000	0.0
31	1995	0.000E+00	0.000E+00	0.0	*	4.644E+01	0.00000	0.0
32	1996	0.000E+00	0.000E+00	0.0	*	6.479E+01	0.00000	0.0
33	1997	0.000E+00	0.000E+00	0.0	*	8.690E+01	0.00000	0.0
34	1998	0.000E+00	0.000E+00	0.0	*	1.091E+02	0.00000	0.0
35	1999	0.000E+00	0.000E+00	0.0	*	1.282E+02	0.00000	0.0
36	2000	0.000E+00	0.000E+00	0.0	*	1.421E+02	0.00000	0.0
37	2001	0.000E+00	0.000E+00	0.0	*	1.494E+02	0.00000	0.0

* Asterisk indicates missing value(s).

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page10

```
UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 4
                   -1       -0.75     -0.5      -0.25       0        0.25      0.5       0.75       1
                    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |
Year  Residual     ------------------------------------------------------------------------------------
1965    0.0000                                              |
1966    0.0000                                              |
1967    0.0000                                              |
1968    0.0000                                              |
1969    0.0000                                              |
1970    0.0000                                              |
1971    0.0000                                              |
1972   -0.3132                                 =============|
1973    0.6372                                              |=========================
1974    0.3012                                              |============
1975    0.4269                                              |=================
1976    0.4746                                              |===================
1977    0.7338                                              |=============================
1978    0.1595                                              |======
1979    0.0646                                              |===
1980    0.5706                                              |=======================
1981    0.4919                                              |====================
1982    0.2205                                              |=========
1983    0.0000                                              |
1984    0.1537                                              |======
1985   -0.1860                                       =======|
1986   -0.6322                     =========================|
1987   -0.7605                ==============================|
1988   -0.9186         =====================================|
1989   -0.2293                                     =========|
1990   -0.6939                  ============================|
1991   -0.5281                         =====================|
1992    0.0000                                              |
1993    0.0000                                              |
1994    0.0000                                              |
1995    0.0000                                              |
1996    0.0000                                              |
1997    0.0000                                              |
1998    0.0000                                              |
1999    0.0000                                              |
2000    0.0000                                              |
2001    0.0000                                              |
                   ------------------------------------------------------------------------------------
```

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page11

Table 12 Cont'd.

RESULTS FOR DATA SERIES # 5 (NON-BOOTSTRAPPED) Spanish Survey

Data type I1: Year-average biomass index Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Resid in index
1	1965	0.000E+00	0.000E+00	0.0	*	6.134E+02	0.00000	0.0
2	1966	0.000E+00	0.000E+00	0.0	*	5.799E+02	0.00000	0.0
3	1967	0.000E+00	0.000E+00	0.0	*	5.510E+02	0.00000	0.0
4	1968	0.000E+00	0.000E+00	0.0	*	5.226E+02	0.00000	0.0
5	1969	0.000E+00	0.000E+00	0.0	*	4.932E+02	0.00000	0.0
6	1970	0.000E+00	0.000E+00	0.0	*	4.512E+02	0.00000	0.0
7	1971	0.000E+00	0.000E+00	0.0	*	3.841E+02	0.00000	0.0
8	1972	0.000E+00	0.000E+00	0.0	*	3.068E+02	0.00000	0.0
9	1973	0.000E+00	0.000E+00	0.0	*	2.428E+02	0.00000	0.0
10	1974	0.000E+00	0.000E+00	0.0	*	2.020E+02	0.00000	0.0
11	1975	0.000E+00	0.000E+00	0.0	*	1.740E+02	0.00000	0.0
12	1976	0.000E+00	0.000E+00	0.0	*	1.725E+02	0.00000	0.0
13	1977	0.000E+00	0.000E+00	0.0	*	1.910E+02	0.00000	0.0
14	1978	0.000E+00	0.000E+00	0.0	*	1.985E+02	0.00000	0.0
15	1979	0.000E+00	0.000E+00	0.0	*	1.944E+02	0.00000	0.0
16	1980	0.000E+00	0.000E+00	0.0	*	1.962E+02	0.00000	0.0
17	1981	0.000E+00	0.000E+00	0.0	*	2.045E+02	0.00000	0.0
18	1982	0.000E+00	0.000E+00	0.0	*	2.122E+02	0.00000	0.0
19	1983	0.000E+00	0.000E+00	0.0	*	2.284E+02	0.00000	0.0
20	1984	0.000E+00	0.000E+00	0.0	*	2.396E+02	0.00000	0.0
21	1985	0.000E+00	0.000E+00	0.0	*	2.167E+02	0.00000	0.0
22	1986	0.000E+00	0.000E+00	0.0	*	1.673E+02	0.00000	0.0
23	1987	0.000E+00	0.000E+00	0.0	*	1.358E+02	0.00000	0.0
24	1988	0.000E+00	0.000E+00	0.0	*	1.220E+02	0.00000	0.0
25	1989	0.000E+00	0.000E+00	0.0	*	1.171E+02	0.00000	0.0
26	1990	0.000E+00	0.000E+00	0.0	*	1.144E+02	0.00000	0.0
27	1991	0.000E+00	0.000E+00	0.0	*	9.869E+01	0.00000	0.0
28	1992	0.000E+00	0.000E+00	0.0	*	8.543E+01	0.00000	0.0
29	1993	0.000E+00	0.000E+00	0.0	*	7.172E+01	0.00000	0.0
30	1994	0.000E+00	0.000E+00	0.0	*	7.172E+01	0.00000	0.0
31	1995	1.000E+00	1.000E+00	0.0	2.770E+01	9.829E+01	-1.26636	-7.059E+01
32	1996	1.000E+00	1.000E+00	0.0	1.296E+02	1.371E+02	-0.05600	-7.467E+00
33	1997	1.000E+00	1.000E+00	0.0	1.157E+02	1.839E+02	-0.46321	-6.818E+01
34	1998	1.000E+00	1.000E+00	0.0	4.254E+02	2.309E+02	0.61102	1.945E+02
35	1999	1.000E+00	1.000E+00	0.0	5.892E+02	2.712E+02	0.77579	3.180E+02
36	2000	1.000E+00	1.000E+00	0.0	4.474E+02	3.006E+02	0.39758	1.468E+02
37	2001	0.000E+00	0.000E+00	0.0	*	3.161E+02	0.00000	0.0

* Asterisk indicates missing value(s).

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page12

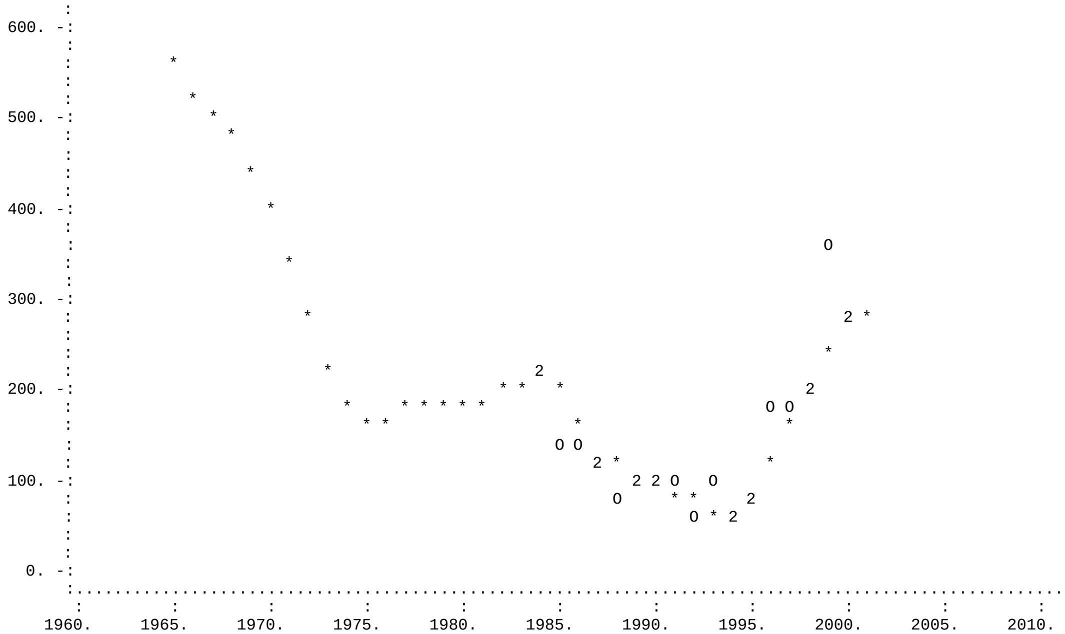
UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 5

```
                   -2       -1.5      -1       -0.5       0       0.5       1        1.5       2
                    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |    .    |
Year   Residual    ------------------------------------------------------------------------------------
1965     0.0000                                             |
1966     0.0000                                             |
1967     0.0000                                             |
1968     0.0000                                             |
1969     0.0000                                             |
1970     0.0000                                             |
1971     0.0000                                             |
1972     0.0000                                             |
1973     0.0000                                             |
1974     0.0000                                             |
1975     0.0000                                             |
1976     0.0000                                             |
1977     0.0000                                             |
1978     0.0000                                             |
1979     0.0000                                             |
1980     0.0000                                             |
1981     0.0000                                             |
1982     0.0000                                             |
1983     0.0000                                             |
1984     0.0000                                             |
1985     0.0000                                             |
1986     0.0000                                             |
1987     0.0000                                             |
1988     0.0000                                             |
1989     0.0000                                             |
1990     0.0000                                             |
1991     0.0000                                             |
1992     0.0000                                             |
1993     0.0000                                             |
1994     0.0000                                             |
1995    -1.2664                    =========================|
1996    -0.0560                                            =|
1997    -0.4632                                    =========|
1998     0.6110                                             |============
1999     0.7758                                             |================
2000     0.3976                                             |========
2001     0.0000                                             |
                   ------------------------------------------------------------------------------------
```

Table 12 Cont'd.

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery

Observed (O) and Estimated (*) CPUE for Data Series # 1 -- Canadian Campelen Survey



Observed (O) and Estimated (*) CPUE for Data Series # 2 -- Canadian Yankee Survey

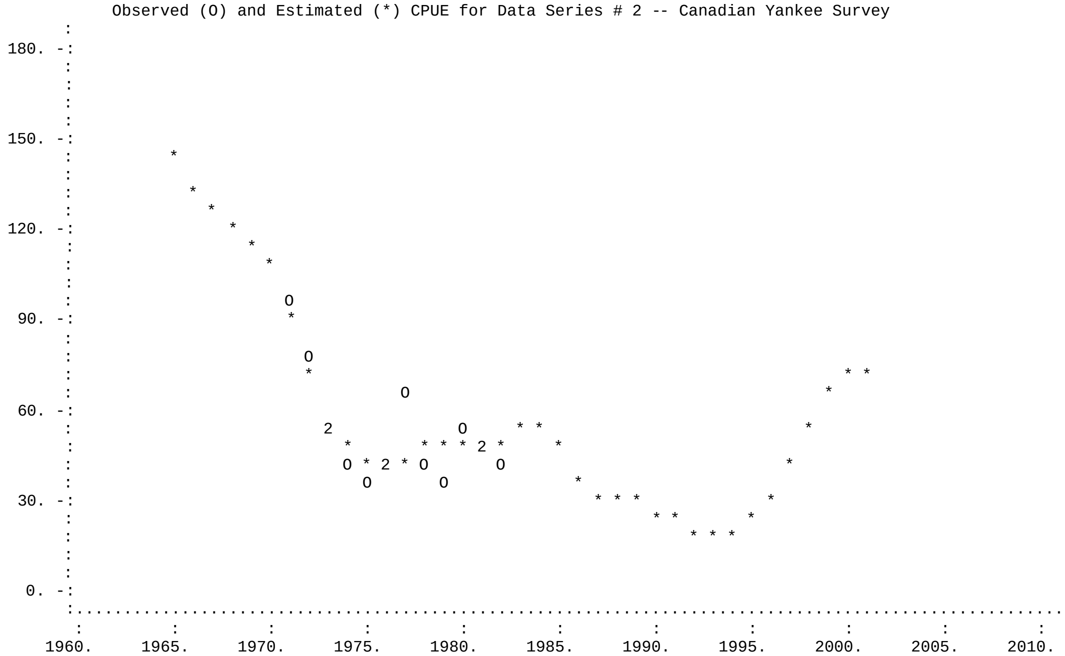
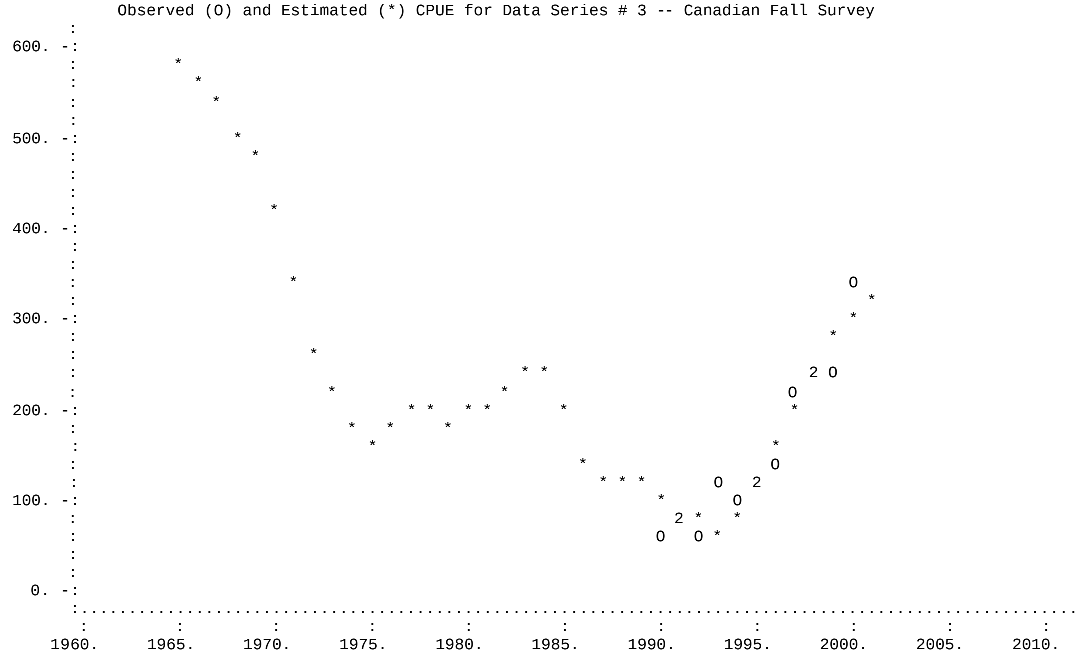


Table 12 Cont'd.

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery   Page 14

Observed (O) and Estimated (*) CPUE for Data Series # 3 -- Canadian Fall Survey



Observed (O) and Estimated (*) CPUE for Data Series # 4 -- Russian Survey

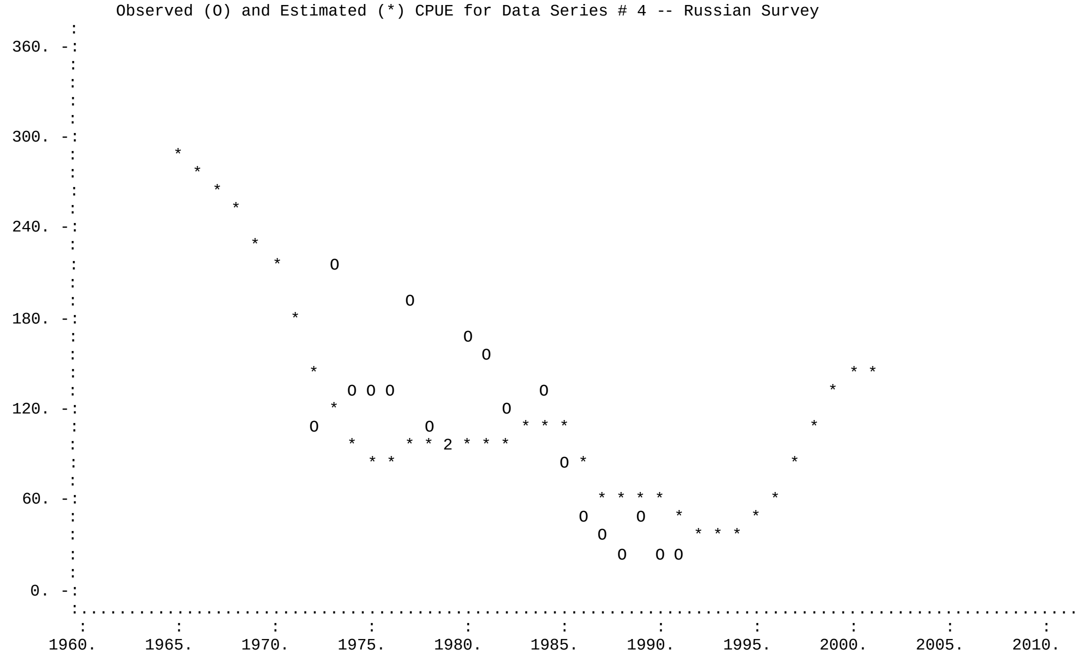
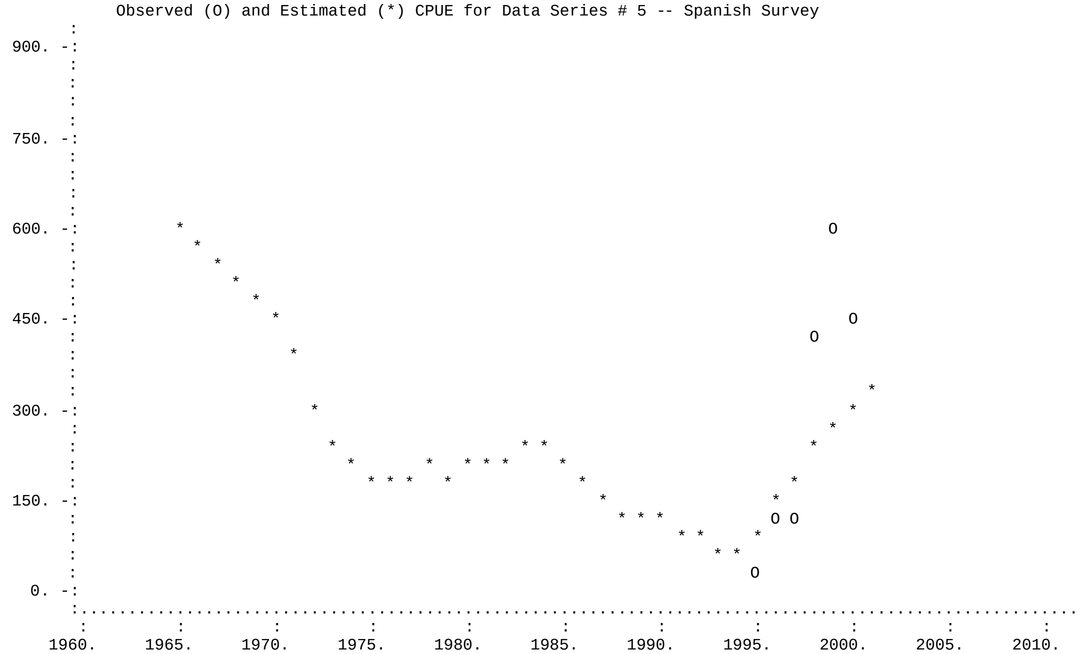


Table 12 Cont'd.

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 15

Observed (O) and Estimated (*) CPUE for Data Series # 5 -- Spanish Survey



Time Plot of Estimated F-Ratio and B-Ratio

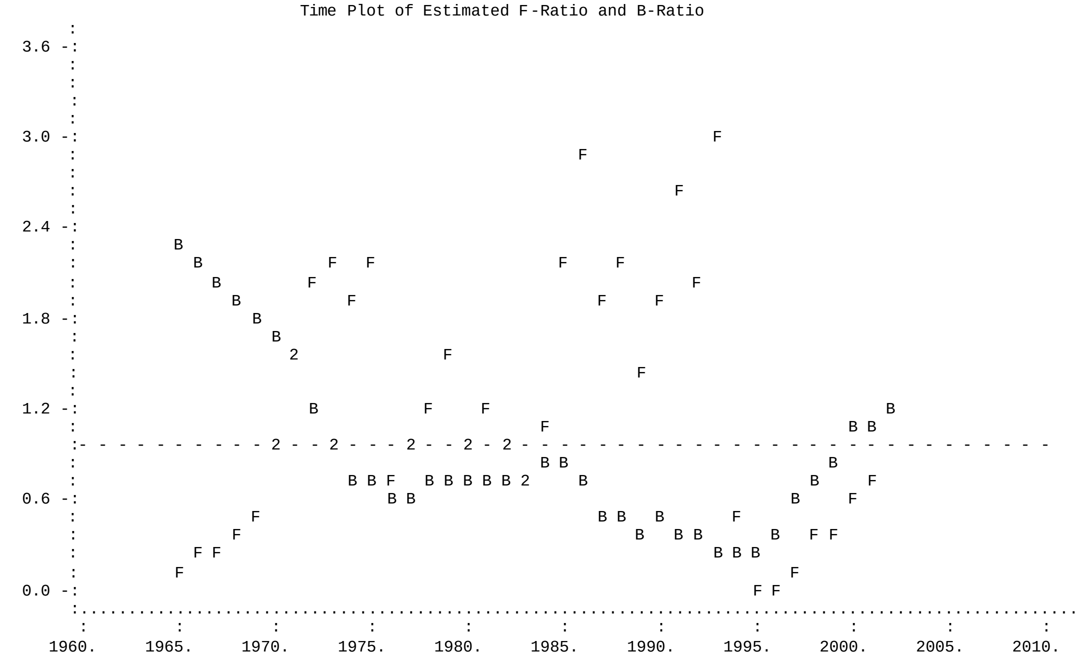


Table 13. Bias-corrected estimates from ASPIC production model derived from 500 boostrap iterations of survey residuals for Div. 3LNO yellowtail flounder.

3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page12

RESULTS OF BOOTSTRAPPED ANALYSIS

Param name	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
B1ratio	2.471E+00	2.251E+00	-8.89%	2.438E+00	2.759E+00	2.666E+00	2.759E+00	9.261E-02	0.037
K	1.620E+02	1.627E+02	0.42%	1.446E+02	1.869E+02	1.517E+02	1.701E+02	1.849E+01	0.114
r	4.213E-01	4.276E-01	1.49%	3.426E-01	5.053E-01	3.867E-01	4.679E-01	8.122E-02	0.193
q(1)	3.044E+00	3.117E+00	2.40%	2.423E+00	3.776E+00	2.734E+00	3.369E+00	6.353E-01	0.209
q(2)	7.835E-01	8.039E-01	2.60%	5.980E-01	9.859E-01	6.908E-01	8.800E-01	1.892E-01	0.241
q(3)	3.254E+00	3.408E+00	4.72%	2.314E+00	4.159E+00	2.749E+00	3.700E+00	9.511E-01	0.292
q(4)	1.600E+00	1.632E+00	2.04%	1.278E+00	1.961E+00	1.425E+00	1.802E+00	3.774E-01	0.236
q(5)	3.308E+00	3.454E+00	4.43%	2.416E+00	4.424E+00	2.790E+00	3.863E+00	1.073E+00	0.324
MSY	1.705E+01	1.739E+01	1.96%	1.587E+01	1.812E+01	1.634E+01	1.755E+01	1.216E+00	0.071
Ye(2002)	1.706E+01	1.704E+01	-0.12%	1.562E+01	1.790E+01	1.646E+01	1.747E+01	1.013E+00	0.059
Bmsy	8.098E+01	8.133E+01	0.42%	7.228E+01	9.343E+01	7.583E+01	8.507E+01	9.245E+00	0.114
Fmsy	2.107E-01	2.138E-01	1.49%	1.713E-01	2.526E-01	1.933E-01	2.340E-01	4.061E-02	0.193
fmsy(1)	6.882E-02	6.860E-02	-0.32%	5.572E-02	8.333E-02	6.143E-02	7.590E-02	1.446E-02	0.210
fmsy(2)	2.721E-01	2.659E-01	-2.25%	2.352E-01	3.202E-01	2.522E-01	2.990E-01	4.684E-02	0.172
fmsy(3)	6.465E-02	6.273E-02	-2.96%	5.014E-02	8.626E-02	5.730E-02	7.546E-02	1.816E-02	0.281
fmsy(4)	1.330E-01	1.310E-01	-1.51%	1.178E-01	1.504E-01	1.236E-01	1.418E-01	1.820E-02	0.137
fmsy(5)	6.383E-02	6.189E-02	-3.05%	4.406E-02	9.162E-02	5.259E-02	7.850E-02	2.591E-02	0.406
F(0.1)	1.896E-01	1.924E-01	1.34%	1.542E-01	2.274E-01	1.740E-01	2.106E-01	3.655E-02	0.193
Y(0.1)	1.688E+01	1.721E+01	1.94%	1.572E+01	1.794E+01	1.617E+01	1.738E+01	1.204E+00	0.071
B-ratio	1.158E+00	1.142E+00	-1.39%	8.808E-01	1.384E+00	1.020E+00	1.286E+00	2.661E-01	0.230
F-ratio	7.257E-01	7.310E-01	0.72%	5.635E-01	9.763E-01	6.255E-01	8.348E-01	2.094E-01	0.288
Y-ratio	9.869E-01	9.799E-01	-0.71%	9.129E-01	9.998E-01	9.583E-01	9.979E-01	3.963E-02	0.040
f0.1(1)	6.194E-02	6.174E-02	-0.29%	5.015E-02	7.499E-02	5.529E-02	6.831E-02	1.302E-02	0.210
f0.1(2)	2.449E-01	2.393E-01	-2.03%	2.117E-01	2.882E-01	2.270E-01	2.691E-01	4.215E-02	0.172
f0.1(3)	5.818E-02	5.646E-02	-2.67%	4.513E-02	7.763E-02	5.157E-02	6.791E-02	1.635E-02	0.281
f0.1(4)	1.197E-01	1.179E-01	-1.36%	1.060E-01	1.353E-01	1.112E-01	1.276E-01	1.638E-02	0.137
f0.1(5)	5.745E-02	5.570E-02	-2.74%	3.965E-02	8.246E-02	4.733E-02	7.065E-02	2.332E-02	0.406
q2/q1	2.542E-01	2.579E-01	1.49%	1.897E-01	3.213E-01	2.200E-01	2.891E-01	6.911E-02	0.272
q3/q1	1.068E+00	1.094E+00	2.40%	8.653E-01	1.322E+00	9.581E-01	1.205E+00	2.471E-01	0.231
q4/q1	5.229E-01	5.237E-01	0.15%	4.189E-01	6.532E-01	4.626E-01	5.907E-01	1.282E-01	0.245
q5/q1	1.074E+00	1.108E+00	3.21%	7.885E-01	1.386E+00	9.040E-01	1.228E+00	3.244E-01	0.302

NOTES ON BOOTSTRAPPED ESTIMATES

- The bootstrapped results shown were computed from 500 trials.
- These results are conditional on the constraints placed upon MSY and r in the input file (ASPIC.INP).
- All bootstrapped intervals are approximate. The statistical literature recommends using at least 1000 trials for accurate 95% intervals. The 80% intervals used by ASPIC should require fewer trials for equivalent accuracy. Using at least 500 trials is recommended.
- The bias corrections used here are based on medians. This is an accepted statistical procedure, but may estimate nonzero bias for unbiased, skewed estimators.

Trials replaced for lack of convergence: 12
Trials replaced for MSY out-of-bounds: 0
Trials replaced for r out-of-bounds: 0
Residual-adjustment factor: 1.0679

F multiplier	2002 F 5	25	50	75	95
1.0	0.133	0.146	0.158	0.172	0.206
0.9	0.120	0.131	0.142	0.155	0.185
0.8	0.106	0.117	0.126	0.138	0.165
0.6	0.080	0.087	0.095	0.103	0.124
0.4	0.053	0.058	0.063	0.069	0.082
Fmsy	0.164	0.199	0.217	0.237	0.266
2/3 Fmsy	0.108	0.131	0.143	0.156	0.175

F multiplier	2002 Yield 5	25	50	75	95
1.0	14.43	14.60	14.69	14.78	14.91
0.9	13.07	13.23	13.32	13.41	13.53
0.8	11.70	11.85	11.93	12.01	12.12
0.6	8.88	9.01	9.08	9.15	9.25
0.4	6.00	6.09	6.15	6.20	6.28

F multiplier	2003 Biomass 5	25	50	75	95
1.0	72.68	87.08	94.50	100.96	111.85
0.9	74.06	88.44	95.84	102.24	111.85
0.8	75.47	89.82	97.19	103.52	113.31
0.6	78.36	92.64	99.95	106.14	115.86
0.4	81.35	95.56	102.76	108.82	118.37

F multiplier	2003 Biomass / B msy 5	25	50	75	95
1.0	0.788	1.015	1.156	1.285	1.418
0.9	0.803	1.031	1.173	1.301	1.436
0.8	0.819	1.047	1.188	1.318	1.452
0.6	0.845	1.080	1.223	1.351	1.486
0.4	0.874	1.114	1.256	1.387	1.521

Table 14. Management option table for 2002 and 2003.

The percentiles of yield in 2002, biomass and biomass ratio in 2003 are based on F in 2002 calculated as the product of the F multiplier and F_{2001}.

The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 14,300 tonnes in 2001.

Table 15. Relative biomass and fishing mortality rates for the 2002 yield projections using a status quo F, i.e. $F_{2001} = F_{2002}$.

```
Results from ASPICP.EXE, version 2.31                                                       10 Jun 2001 at 23:01.26
3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery                                       Page 1
2002F=F2001

USER CONTROL INFORMATION (FROM INPUT FILE)
--------------------------------------------------
Name of biomass (BIO) file            aspic.bio
Name of output file (this file)       run2001v1.prj
Number of years of projections         1

Year          Input data          User data type
----          -----------         --------------
2002           1.000E+00           F/F(2001)
```

TRAJECTORY OF RELATIVE BIOMASS (BOOTSTRAPPED)

Year	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
1965	2.470E+00	2.251E+00	-8.87%	2.438E+00	2.759E+00	2.666E+00	2.759E+00	9.261E-02	0.037
1966	2.264E+00	2.127E+00	-6.06%	2.207E+00	2.437E+00	2.370E+00	2.437E+00	6.209E-02	0.027
1967	2.101E+00	2.012E+00	-4.26%	2.054E+00	2.190E+00	2.144E+00	2.190E+00	4.466E-02	0.021
1968	1.979E+00	1.918E+00	-3.05%	1.944E+00	2.023E+00	1.994E+00	2.023E+00	3.304E-02	0.017
1969	1.852E+00	1.810E+00	-2.28%	1.828E+00	1.879E+00	1.853E+00	1.879E+00	2.578E-02	0.014
1970	1.739E+00	1.708E+00	-1.78%	1.714E+00	1.755E+00	1.733E+00	1.755E+00	9.781E-03	0.006
1971	1.545E+00	1.518E+00	-1.72%	1.516E+00	1.585E+00	1.536E+00	1.565E+00	3.113E-02	0.020
1972	1.269E+00	1.242E+00	-2.13%	1.227E+00	1.323E+00	1.247E+00	1.296E+00	4.513E-02	0.036
1973	9.957E-01	9.687E-01	-2.70%	9.454E-01	1.053E+00	9.687E-01	1.028E+00	5.887E-02	0.059
1974	8.002E-01	7.742E-01	-3.24%	7.375E-01	8.693E-01	7.695E-01	8.422E-01	7.269E-02	0.091
1975	6.949E-01	6.716E-01	-3.35%	6.300E-01	7.679E-01	6.629E-01	7.458E-01	8.283E-02	0.119
1976	5.974E-01	5.726E-01	-4.15%	5.192E-01	6.816E-01	5.578E-01	6.480E-01	9.022E-02	0.151
1977	6.797E-01	6.554E-01	-3.58%	6.103E-01	7.548E-01	6.462E-01	7.314E-01	8.513E-02	0.125
1978	7.282E-01	7.041E-01	-3.31%	6.621E-01	7.929E-01	6.958E-01	7.698E-01	7.401E-02	0.102
1979	7.328E-01	7.093E-01	-3.21%	6.702E-01	7.924E-01	7.030E-01	7.704E-01	6.733E-02	0.092
1980	7.004E-01	6.770E-01	-3.34%	6.378E-01	7.605E-01	6.710E-01	7.375E-01	6.654E-02	0.095
1981	7.435E-01	7.191E-01	-3.29%	6.916E-01	7.910E-01	7.167E-01	7.707E-01	5.400E-02	0.073
1982	7.588E-01	7.365E-01	-2.94%	7.137E-01	7.974E-01	7.355E-01	7.778E-01	4.238E-02	0.056
1983	7.931E-01	7.737E-01	-2.45%	7.600E-01	8.197E-01	7.750E-01	8.113E-01	3.635E-02	0.046
1984	8.661E-01	8.511E-01	-1.73%	8.445E-01	8.903E-01	8.578E-01	8.857E-01	2.088E-02	0.024
1985	8.646E-01	8.545E-01	-1.17%	8.503E-01	8.838E-01	8.587E-01	8.838E-01	1.609E-02	0.019
1986	7.097E-01	7.000E-01	-1.36%	6.935E-01	7.382E-01	7.043E-01	7.256E-01	1.820E-02	0.026
1987	5.183E-01	5.068E-01	-2.22%	4.988E-01	5.484E-01	5.085E-01	5.360E-01	2.747E-02	0.053
1988	4.744E-01	4.628E-01	-2.45%	4.538E-01	5.085E-01	4.636E-01	4.934E-01	2.987E-02	0.063
1989	4.209E-01	4.092E-01	-2.78%	3.980E-01	4.633E-01	4.083E-01	4.455E-01	3.716E-02	0.088
1990	4.364E-01	4.248E-01	-2.66%	4.146E-01	4.796E-01	4.256E-01	4.604E-01	3.476E-02	0.080
1991	4.026E-01	3.913E-01	-2.80%	3.788E-01	4.571E-01	3.895E-01	4.303E-01	4.082E-02	0.101
1992	3.277E-01	3.157E-01	-3.66%	2.983E-01	3.924E-01	3.107E-01	3.642E-01	5.354E-02	0.163
1993	3.060E-01	2.936E-01	-4.06%	2.580E-01	3.931E-01	2.793E-01	3.453E-01	5.800E-02	0.190
1994	2.367E-01	2.218E-01	-6.29%	1.836E-01	3.361E-01	2.077E-01	2.780E-01	7.033E-02	0.297
1995	3.088E-01	2.915E-01	-5.61%	2.349E-01	4.169E-01	2.690E-01	3.619E-01	9.294E-02	0.301
1996	4.358E-01	4.139E-01	-5.03%	3.387E-01	5.722E-01	3.883E-01	5.076E-01	1.193E-01	0.274
1997	5.913E-01	5.677E-01	-3.99%	4.558E-01	7.616E-01	5.202E-01	6.732E-01	1.530E-01	0.259
1998	7.708E-01	7.456E-01	-3.27%	5.834E-01	9.803E-01	6.717E-01	8.658E-01	1.942E-01	0.252
1999	9.203E-01	8.987E-01	-2.35%	7.051E-01	1.159E+00	8.072E-01	1.041E+00	2.334E-01	0.254
2000	1.051E+00	1.031E+00	-1.91%	8.168E-01	1.299E+00	9.285E-01	1.188E+00	2.593E-01	0.247
2001	1.126E+00	1.107E+00	-1.65%	8.554E-01	1.361E+00	9.857E-01	1.252E+00	2.660E-01	0.236
2002	1.158E+00	1.142E+00	-1.39%	8.808E-01	1.384E+00	1.020E+00	1.286E+00	2.661E-01	0.230
2003	1.183E+00	1.170E+00	-1.09%	8.963E-01	1.398E+00	1.045E+00	1.312E+00	2.669E-01	0.226

NOTE: Printed BC confidence intervals are always approximate.
At least 500 trials are recommended when estimating confidence intervals.

Table 15 cont'd.

Results from ASPICP.EXE, version 2.31 10 Jun 2001 at 23:01.26
3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 2
2002F=F2001

TRAJECTORY OF RELATIVE FISHING MORTALITY RATE (BOOTSTRAPPED)

Year	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
1965	7.541E-02	8.245E-02	9.33%	7.047E-02	8.277E-02	7.047E-02	7.918E-02	8.711E-03	0.116
1966	1.855E-01	1.958E-01	5.50%	1.741E-01	2.022E-01	1.769E-01	1.940E-01	1.551E-02	0.084
1967	2.514E-01	2.603E-01	3.55%	2.401E-01	2.719E-01	2.445E-01	2.625E-01	1.798E-02	0.072
1968	4.035E-01	4.125E-01	2.24%	3.824E-01	4.316E-01	3.916E-01	4.193E-01	2.767E-02	0.069
1969	5.071E-01	5.146E-01	1.48%	4.788E-01	5.403E-01	4.891E-01	5.229E-01	3.383E-02	0.067
1970	9.365E-01	9.463E-01	1.05%	8.886E-01	9.965E-01	9.074E-01	9.649E-01	5.752E-02	0.061
1971	1.559E+00	1.571E+00	0.75%	1.492E+00	1.639E+00	1.519E+00	1.596E+00	7.631E-02	0.049
1972	2.057E+00	2.067E+00	0.50%	1.998E+00	2.114E+00	2.022E+00	2.077E+00	6.059E-02	0.029
1973	2.170E+00	2.183E+00	0.61%	2.106E+00	2.229E+00	2.134E+00	2.200E+00	5.705E-03	0.003
1974	1.918E+00	1.945E+00	1.39%	1.857E+00	1.980E+00	1.881E+00	1.942E+00	6.041E-02	0.031
1975	2.082E+00	2.126E+00	2.09%	1.965E+00	2.210E+00	2.015E+00	2.142E+00	1.268E-01	0.061
1976	7.380E-01	7.548E-01	2.27%	6.968E-01	7.874E-01	7.156E-01	7.617E-01	4.616E-02	0.063
1977	9.653E-01	9.844E-01	1.99%	9.290E-01	1.005E+00	9.460E-01	9.859E-01	3.462E-02	0.036
1978	1.239E+00	1.259E+00	1.64%	1.215E+00	1.275E+00	1.227E+00	1.258E+00	3.075E-02	0.025
1979	1.500E+00	1.525E+00	1.64%	1.468E+00	1.542E+00	1.487E+00	1.524E+00	3.610E-02	0.024
1980	1.003E+00	1.020E+00	1.60%	9.896E-01	1.025E+00	9.943E-01	1.016E+00	2.212E-02	0.022
1981	1.145E+00	1.160E+00	1.32%	1.130E+00	1.163E+00	1.130E+00	1.156E+00	1.949E-02	0.017
1982	1.005E+00	1.014E+00	0.87%	9.856E-01	1.033E+00	9.856E-01	1.016E+00	2.635E-02	0.026
1983	7.374E-01	7.409E-01	0.47%	7.116E-01	7.710E-01	7.237E-01	7.517E-01	2.661E-02	0.036
1984	1.127E+00	1.129E+00	0.17%	1.070E+00	1.217E+00	1.095E+00	1.163E+00	6.830E-02	0.061
1985	2.160E+00	2.160E+00	-0.02%	2.039E+00	2.342E+00	2.091E+00	2.235E+00	1.444E-01	0.067
1986	2.912E+00	2.915E+00	0.10%	2.788E+00	3.063E+00	2.838E+00	2.977E+00	1.391E-01	0.048
1987	1.935E+00	1.941E+00	0.30%	1.875E+00	2.005E+00	1.901E+00	1.970E+00	6.835E-02	0.035
1988	2.134E+00	2.141E+00	0.29%	2.065E+00	2.228E+00	2.101E+00	2.183E+00	8.179E-02	0.038
1989	1.403E+00	1.408E+00	0.35%	1.341E+00	1.479E+00	1.373E+00	1.442E+00	6.868E-02	0.049
1990	1.969E+00	1.976E+00	0.37%	1.848E+00	2.119E+00	1.909E+00	2.044E+00	1.347E-01	0.068
1991	2.629E+00	2.653E+00	0.90%	2.385E+00	2.853E+00	2.507E+00	2.745E+00	2.376E-01	0.090
1992	2.002E+00	2.035E+00	1.69%	1.743E+00	2.307E+00	1.868E+00	2.129E+00	2.613E-01	0.131
1993	2.956E+00	3.056E+00	3.38%	2.368E+00	3.607E+00	2.632E+00	3.269E+00	6.371E-01	0.216
1994	4.456E-01	4.661E-01	4.61%	3.327E-01	5.876E-01	3.832E-01	5.106E-01	1.273E-01	0.286
1995	1.058E-02	1.101E-02	4.15%	7.911E-03	1.412E-02	9.092E-03	1.228E-02	3.192E-03	0.302
1996	3.270E-02	3.382E-02	3.43%	2.470E-02	4.372E-02	2.857E-02	3.835E-02	9.778E-03	0.299
1997	6.897E-02	7.028E-02	1.91%	5.133E-02	9.224E-02	6.023E-02	8.092E-02	2.069E-02	0.300
1998	3.008E-01	3.043E-01	1.16%	2.251E-01	4.029E-01	2.593E-01	3.520E-01	9.272E-02	0.308
1999	3.868E-01	3.908E-01	1.04%	2.935E-01	5.216E-01	3.339E-01	4.547E-01	1.208E-01	0.312
2000	5.933E-01	5.977E-01	0.74%	4.564E-01	7.985E-01	5.081E-01	6.883E-01	1.802E-01	0.304
2001	7.257E-01	7.310E-01	0.72%	5.635E-01	9.763E-01	6.255E-01	8.348E-01	2.094E-01	0.288
2002	7.257E-01	7.310E-01	0.72%	5.635E-01	9.763E-01	6.255E-01	8.348E-01	2.094E-01	0.288

TABLE OF PROJECTED YIELDS

2002	1.470E+01	1.469E+01	-0.01%	1.449E+01	1.486E+01	1.460E+01	1.478E+01	1.826E-01	0.012

NOTE: Printed BC confidence intervals are always approximate.
At least 500 trials are recommended when estimating confidence intervals.

Table 16. Relative biomass and fishing mortality rates for the 2002 yield projections using a $F_{2001} = 2/3F_{msy}$

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Results from ASPICP.EXE, version 2.31                                                11 Jun 2001 at 21:21.17
3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery                                  Page 1
2002F=2/3F2001

USER CONTROL INFORMATION (FROM INPUT FILE)
-------------------------------------------------
Name of biomass (BIO) file           aspic.bio
Name of output file (this file)      run2001v2.prj
Number of years of projections        1

Year          Input data          User data type
----          -----------         --------------
2002           9.000E-01           F/F(2001)
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TRAJECTORY OF RELATIVE BIOMASS (BOOTSTRAPPED)

Year	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
1965	2.470E+00	2.251E+00	-8.87%	2.438E+00	2.759E+00	2.666E+00	2.759E+00	9.261E-02	0.037
1966	2.264E+00	2.127E+00	-6.06%	2.207E+00	2.437E+00	2.370E+00	2.437E+00	6.209E-02	0.027
1967	2.101E+00	2.012E+00	-4.26%	2.054E+00	2.190E+00	2.144E+00	2.190E+00	4.466E-02	0.021
1968	1.979E+00	1.918E+00	-3.05%	1.944E+00	2.023E+00	1.994E+00	2.023E+00	3.304E-02	0.017
1969	1.852E+00	1.810E+00	-2.28%	1.828E+00	1.879E+00	1.853E+00	1.879E+00	2.578E-02	0.014
1970	1.739E+00	1.708E+00	-1.78%	1.714E+00	1.755E+00	1.733E+00	1.755E+00	9.781E-03	0.006
1971	1.545E+00	1.518E+00	-1.72%	1.516E+00	1.585E+00	1.536E+00	1.565E+00	3.113E-02	0.020
1972	1.269E+00	1.242E+00	-2.13%	1.227E+00	1.323E+00	1.247E+00	1.296E+00	4.513E-02	0.036
1973	9.957E-01	9.687E-01	-2.70%	9.454E-01	1.053E+00	9.687E-01	1.028E+00	5.887E-02	0.059
1974	8.002E-01	7.742E-01	-3.24%	7.375E-01	8.693E-01	7.695E-01	8.422E-01	7.269E-02	0.091
1975	6.949E-01	6.716E-01	-3.35%	6.300E-01	7.679E-01	6.629E-01	7.458E-01	8.283E-02	0.119
1976	5.974E-01	5.726E-01	-4.15%	5.192E-01	6.816E-01	5.578E-01	6.480E-01	9.022E-02	0.151
1977	6.797E-01	6.554E-01	-3.58%	6.103E-01	7.548E-01	6.462E-01	7.314E-01	8.513E-02	0.125
1978	7.282E-01	7.041E-01	-3.31%	6.621E-01	7.929E-01	6.958E-01	7.698E-01	7.401E-02	0.102
1979	7.328E-01	7.093E-01	-3.21%	6.702E-01	7.924E-01	7.030E-01	7.704E-01	6.733E-02	0.092
1980	7.004E-01	6.770E-01	-3.34%	6.378E-01	7.605E-01	6.710E-01	7.375E-01	6.654E-02	0.095
1981	7.435E-01	7.191E-01	-3.29%	6.916E-01	7.910E-01	7.167E-01	7.707E-01	5.400E-02	0.073
1982	7.588E-01	7.365E-01	-2.94%	7.137E-01	7.974E-01	7.355E-01	7.778E-01	4.238E-02	0.056
1983	7.931E-01	7.737E-01	-2.45%	7.600E-01	8.197E-01	7.750E-01	8.113E-01	3.635E-02	0.046
1984	8.661E-01	8.511E-01	-1.73%	8.445E-01	8.903E-01	8.578E-01	8.857E-01	2.088E-02	0.024
1985	8.646E-01	8.545E-01	-1.17%	8.503E-01	8.838E-01	8.587E-01	8.838E-01	1.609E-02	0.019
1986	7.097E-01	7.000E-01	-1.36%	6.935E-01	7.382E-01	7.043E-01	7.256E-01	1.820E-02	0.026
1987	5.183E-01	5.068E-01	-2.22%	4.988E-01	5.484E-01	5.085E-01	5.360E-01	2.747E-02	0.053
1988	4.744E-01	4.628E-01	-2.45%	4.538E-01	5.085E-01	4.636E-01	4.934E-01	2.987E-02	0.063
1989	4.209E-01	4.092E-01	-2.78%	3.980E-01	4.633E-01	4.083E-01	4.455E-01	3.716E-02	0.088
1990	4.364E-01	4.248E-01	-2.66%	4.146E-01	4.796E-01	4.256E-01	4.604E-01	3.476E-02	0.080
1991	4.026E-01	3.913E-01	-2.80%	3.788E-01	4.571E-01	3.895E-01	4.303E-01	4.082E-02	0.101
1992	3.277E-01	3.157E-01	-3.66%	2.983E-01	3.924E-01	3.107E-01	3.642E-01	5.354E-02	0.163
1993	3.060E-01	2.936E-01	-4.06%	2.580E-01	3.931E-01	2.793E-01	3.453E-01	5.800E-02	0.190
1994	2.367E-01	2.218E-01	-6.29%	1.836E-01	3.361E-01	2.077E-01	2.780E-01	7.033E-02	0.297
1995	3.088E-01	2.915E-01	-5.61%	2.349E-01	4.169E-01	2.690E-01	3.619E-01	9.294E-02	0.301
1996	4.358E-01	4.139E-01	-5.03%	3.387E-01	5.722E-01	3.883E-01	5.076E-01	1.193E-01	0.274
1997	5.913E-01	5.677E-01	-3.99%	4.558E-01	7.616E-01	5.202E-01	6.732E-01	1.530E-01	0.259
1998	7.708E-01	7.456E-01	-3.27%	5.834E-01	9.803E-01	6.717E-01	8.658E-01	1.942E-01	0.252
1999	9.203E-01	8.987E-01	-2.35%	7.051E-01	1.159E+00	8.072E-01	1.041E+00	2.334E-01	0.254
2000	1.051E+00	1.031E+00	-1.91%	8.168E-01	1.299E+00	9.285E-01	1.188E+00	2.593E-01	0.247
2001	1.126E+00	1.107E+00	-1.65%	8.554E-01	1.361E+00	9.857E-01	1.252E+00	2.660E-01	0.236
2002	1.158E+00	1.142E+00	-1.39%	8.808E-01	1.384E+00	1.020E+00	1.286E+00	2.661E-01	0.230
2003	1.199E+00	1.186E+00	-1.07%	9.138E-01	1.417E+00	1.065E+00	1.330E+00	2.645E-01	0.221

NOTE: Printed BC confidence intervals are always approximate.
At least 500 trials are recommended when estimating confidence intervals.

Table 16 cont'd.

Results from ASPICP.EXE, version 2.31 11 Jun 2001 at 21:21.17
3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 2
2002F=2/3F2001

TRAJECTORY OF RELATIVE FISHING MORTALITY RATE (BOOTSTRAPPED)

Year	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
1965	7.541E-02	8.245E-02	9.33%	7.047E-02	8.277E-02	7.047E-02	7.918E-02	8.711E-03	0.116
1966	1.855E-01	1.958E-01	5.50%	1.741E-01	2.022E-01	1.769E-01	1.940E-01	1.551E-02	0.084
1967	2.514E-01	2.603E-01	3.55%	2.401E-01	2.719E-01	2.445E-01	2.625E-01	1.798E-02	0.072
1968	4.035E-01	4.125E-01	2.24%	3.824E-01	4.316E-01	3.916E-01	4.193E-01	2.767E-02	0.069
1969	5.071E-01	5.146E-01	1.48%	4.788E-01	5.403E-01	4.891E-01	5.229E-01	3.383E-02	0.067
1970	9.365E-01	9.463E-01	1.05%	8.886E-01	9.965E-01	9.074E-01	9.649E-01	5.752E-02	0.061
1971	1.559E+00	1.571E+00	0.75%	1.492E+00	1.639E+00	1.519E+00	1.596E+00	7.631E-02	0.049
1972	2.057E+00	2.067E+00	0.50%	1.998E+00	2.114E+00	2.022E+00	2.077E+00	6.059E-02	0.029
1973	2.170E+00	2.183E+00	0.61%	2.106E+00	2.229E+00	2.134E+00	2.200E+00	5.705E-03	0.003
1974	1.918E+00	1.945E+00	1.39%	1.857E+00	1.980E+00	1.881E+00	1.942E+00	6.041E-02	0.031
1975	2.082E+00	2.126E+00	2.09%	1.965E+00	2.210E+00	2.015E+00	2.142E+00	1.268E-01	0.061
1976	7.380E-01	7.548E-01	2.27%	6.968E-01	7.874E-01	7.156E-01	7.617E-01	4.616E-02	0.063
1977	9.653E-01	9.844E-01	1.99%	9.290E-01	1.005E+00	9.460E-01	9.859E-01	3.462E-02	0.036
1978	1.239E+00	1.259E+00	1.64%	1.215E+00	1.275E+00	1.227E+00	1.258E+00	3.075E-02	0.025
1979	1.500E+00	1.525E+00	1.64%	1.468E+00	1.542E+00	1.487E+00	1.524E+00	3.610E-02	0.024
1980	1.003E+00	1.020E+00	1.60%	9.896E-01	1.025E+00	9.943E-01	1.016E+00	2.212E-02	0.022
1981	1.145E+00	1.160E+00	1.32%	1.130E+00	1.163E+00	1.130E+00	1.156E+00	1.949E-02	0.017
1982	1.005E+00	1.014E+00	0.87%	9.856E-01	1.033E+00	9.856E-01	1.016E+00	2.635E-02	0.026
1983	7.374E-01	7.409E-01	0.47%	7.116E-01	7.710E-01	7.237E-01	7.517E-01	2.661E-02	0.036
1984	1.127E+00	1.129E+00	0.17%	1.070E+00	1.217E+00	1.095E+00	1.163E+00	6.830E-02	0.061
1985	2.160E+00	2.160E+00	-0.02%	2.039E+00	2.342E+00	2.091E+00	2.235E+00	1.444E-01	0.067
1986	2.912E+00	2.915E+00	0.10%	2.788E+00	3.063E+00	2.838E+00	2.977E+00	1.391E-01	0.048
1987	1.935E+00	1.941E+00	0.30%	1.875E+00	2.005E+00	1.901E+00	1.970E+00	6.835E-02	0.035
1988	2.134E+00	2.141E+00	0.29%	2.065E+00	2.228E+00	2.101E+00	2.183E+00	8.179E-02	0.038
1989	1.403E+00	1.408E+00	0.35%	1.341E+00	1.479E+00	1.373E+00	1.442E+00	6.868E-02	0.049
1990	1.969E+00	1.976E+00	0.37%	1.848E+00	2.119E+00	1.909E+00	2.044E+00	1.347E-01	0.068
1991	2.629E+00	2.653E+00	0.90%	2.385E+00	2.853E+00	2.507E+00	2.745E+00	2.376E-01	0.090
1992	2.002E+00	2.035E+00	1.69%	1.743E+00	2.307E+00	1.868E+00	2.129E+00	2.613E-01	0.131
1993	2.956E+00	3.056E+00	3.38%	2.368E+00	3.607E+00	2.632E+00	3.269E+00	6.371E-01	0.216
1994	4.456E-01	4.661E-01	4.61%	3.327E-01	5.876E-01	3.832E-01	5.106E-01	1.273E-01	0.286
1995	1.058E-02	1.101E-02	4.15%	7.911E-03	1.412E-02	9.092E-03	1.228E-02	3.192E-03	0.302
1996	3.270E-02	3.382E-02	3.43%	2.470E-02	4.372E-02	2.857E-02	3.835E-02	9.778E-03	0.299
1997	6.897E-02	7.028E-02	1.91%	5.133E-02	9.224E-02	6.023E-02	8.092E-02	2.069E-02	0.300
1998	3.008E-01	3.043E-01	1.16%	2.251E-01	4.029E-01	2.593E-01	3.520E-01	9.272E-02	0.308
1999	3.868E-01	3.908E-01	1.04%	2.935E-01	5.216E-01	3.339E-01	4.547E-01	1.208E-01	0.312
2000	5.933E-01	5.977E-01	0.74%	4.564E-01	7.985E-01	5.081E-01	6.883E-01	1.802E-01	0.304
2001	7.257E-01	7.310E-01	0.72%	5.635E-01	9.763E-01	6.255E-01	8.348E-01	2.094E-01	0.288
2002	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288

TABLE OF PROJECTED YIELDS

2002	1.332E+01	1.332E+01	0.00%	1.312E+01	1.348E+01	1.323E+01	1.341E+01	1.783E-01	0.013

NOTE: Printed BC confidence intervals are always approximate.
At least 500 trials are recommended when estimating confidence intervals.

Table 17. Relative biomass and fishing mortality rates for the 2002 to 2011 (10 yr) yield projections using a $F_{2002-2011} = 2/3F_{msy.}$

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Results from ASPICP.EXE, version 2.31                                                   11 Jun 2001 at 21:28.01
3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery                                     Page 1
2002-2011 F projections
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USER CONTROL INFORMATION (FROM INPUT FILE)

Name of biomass (BIO) file	aspic.bio
Name of output file (this file)	run2001v3.prj
Number of years of projections	10

Year	Input data	User data type
2002	9.000E-01	F/F(2001)
2003	9.000E-01	F/F(2001)
2004	9.000E-01	F/F(2001)
2005	9.000E-01	F/F(2001)
2006	9.000E-01	F/F(2001)
2007	9.000E-01	F/F(2001)
2008	9.000E-01	F/F(2001)
2009	9.000E-01	F/F(2001)
2010	9.000E-01	F/F(2001)
2011	9.000E-01	F/F(2001)

TRAJECTORY OF RELATIVE BIOMASS (BOOTSTRAPPED)

Year	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
1965	2.470E+00	2.251E+00	-8.87%	2.438E+00	2.759E+00	2.666E+00	2.759E+00	9.261E-02	0.037
1966	2.264E+00	2.127E+00	-6.06%	2.207E+00	2.437E+00	2.370E+00	2.437E+00	6.209E-02	0.027
1967	2.101E+00	2.012E+00	-4.26%	2.054E+00	2.190E+00	2.144E+00	2.190E+00	4.466E-02	0.021
1968	1.979E+00	1.918E+00	-3.05%	1.944E+00	2.023E+00	1.994E+00	2.023E+00	3.304E-02	0.017
1969	1.852E+00	1.810E+00	-2.28%	1.828E+00	1.879E+00	1.853E+00	1.879E+00	2.578E-02	0.014
1970	1.739E+00	1.708E+00	-1.78%	1.714E+00	1.755E+00	1.733E+00	1.755E+00	9.781E-03	0.006
1971	1.545E+00	1.518E+00	-1.72%	1.516E+00	1.585E+00	1.536E+00	1.565E+00	3.113E-02	0.020
1972	1.269E+00	1.242E+00	-2.13%	1.227E+00	1.323E+00	1.247E+00	1.296E+00	4.513E-02	0.036
1973	9.957E-01	9.687E-01	-2.70%	9.454E-01	1.053E+00	9.687E-01	1.028E+00	5.887E-02	0.059
1974	8.002E-01	7.742E-01	-3.24%	7.375E-01	8.693E-01	7.695E-01	8.422E-01	7.269E-02	0.091
1975	6.949E-01	6.716E-01	-3.35%	6.300E-01	7.679E-01	6.629E-01	7.458E-01	8.283E-02	0.119
1976	5.974E-01	5.726E-01	-4.15%	5.192E-01	6.816E-01	5.578E-01	6.480E-01	9.022E-02	0.151
1977	6.797E-01	6.554E-01	-3.58%	6.103E-01	7.548E-01	6.462E-01	7.314E-01	8.513E-02	0.125
1978	7.282E-01	7.041E-01	-3.31%	6.621E-01	7.929E-01	6.958E-01	7.698E-01	7.401E-02	0.102
1979	7.328E-01	7.093E-01	-3.21%	6.702E-01	7.924E-01	7.030E-01	7.704E-01	6.733E-02	0.092
1980	7.004E-01	6.770E-01	-3.34%	6.378E-01	7.605E-01	6.710E-01	7.375E-01	6.654E-02	0.095
1981	7.435E-01	7.191E-01	-3.29%	6.916E-01	7.910E-01	7.167E-01	7.707E-01	5.400E-02	0.073
1982	7.588E-01	7.365E-01	-2.94%	7.137E-01	7.974E-01	7.355E-01	7.778E-01	4.238E-02	0.056
1983	7.931E-01	7.737E-01	-2.45%	7.600E-01	8.197E-01	7.750E-01	8.113E-01	3.635E-02	0.046
1984	8.661E-01	8.511E-01	-1.73%	8.445E-01	8.903E-01	8.578E-01	8.857E-01	2.088E-02	0.024
1985	8.646E-01	8.545E-01	-1.17%	8.503E-01	8.838E-01	8.587E-01	8.838E-01	1.609E-02	0.019
1986	7.097E-01	7.000E-01	-1.36%	6.935E-01	7.382E-01	7.043E-01	7.256E-01	1.820E-02	0.026
1987	5.183E-01	5.068E-01	-2.22%	4.988E-01	5.484E-01	5.085E-01	5.360E-01	2.747E-02	0.053
1988	4.744E-01	4.628E-01	-2.45%	4.538E-01	5.085E-01	4.636E-01	4.934E-01	2.987E-02	0.063
1989	4.209E-01	4.092E-01	-2.78%	3.980E-01	4.633E-01	4.083E-01	4.455E-01	3.716E-02	0.088
1990	4.364E-01	4.248E-01	-2.66%	4.146E-01	4.796E-01	4.256E-01	4.604E-01	3.476E-02	0.080
1991	4.026E-01	3.913E-01	-2.80%	3.788E-01	4.571E-01	3.895E-01	4.303E-01	4.082E-02	0.101
1992	3.277E-01	3.157E-01	-3.66%	2.983E-01	3.924E-01	3.107E-01	3.642E-01	5.354E-02	0.163
1993	3.060E-01	2.936E-01	-4.06%	2.580E-01	3.931E-01	2.793E-01	3.453E-01	5.800E-02	0.190
1994	2.367E-01	2.218E-01	-6.29%	1.836E-01	3.361E-01	2.077E-01	2.780E-01	7.033E-02	0.297
1995	3.088E-01	2.915E-01	-5.61%	2.349E-01	4.169E-01	2.690E-01	3.619E-01	9.294E-02	0.301
1996	4.358E-01	4.139E-01	-5.03%	3.387E-01	5.722E-01	3.883E-01	5.076E-01	1.193E-01	0.274
1997	5.913E-01	5.677E-01	-3.99%	4.558E-01	7.616E-01	5.202E-01	6.732E-01	1.530E-01	0.259
1998	7.708E-01	7.456E-01	-3.27%	5.834E-01	9.803E-01	6.717E-01	8.658E-01	1.942E-01	0.252
1999	9.203E-01	8.987E-01	-2.35%	7.051E-01	1.159E+00	8.072E-01	1.041E+00	2.334E-01	0.254
2000	1.051E+00	1.031E+00	-1.91%	8.168E-01	1.299E+00	9.285E-01	1.188E+00	2.593E-01	0.247
2001	1.126E+00	1.107E+00	-1.65%	8.554E-01	1.361E+00	9.857E-01	1.252E+00	2.660E-01	0.236
2002	1.158E+00	1.142E+00	-1.39%	8.808E-01	1.384E+00	1.020E+00	1.286E+00	2.661E-01	0.230
2003	1.199E+00	1.186E+00	-1.07%	9.138E-01	1.417E+00	1.065E+00	1.330E+00	2.645E-01	0.221
2004	1.233E+00	1.221E+00	-0.98%	9.374E-01	1.438E+00	1.098E+00	1.356E+00	2.580E-01	0.209
2005	1.260E+00	1.249E+00	-0.86%	9.676E-01	1.454E+00	1.127E+00	1.379E+00	2.527E-01	0.201
2006	1.281E+00	1.271E+00	-0.78%	9.968E-01	1.466E+00	1.153E+00	1.395E+00	2.418E-01	0.189
2007	1.298E+00	1.288E+00	-0.75%	1.020E+00	1.476E+00	1.177E+00	1.410E+00	2.322E-01	0.179
2008	1.311E+00	1.301E+00	-0.75%	1.038E+00	1.483E+00	1.192E+00	1.419E+00	2.264E-01	0.173
2009	1.321E+00	1.311E+00	-0.70%	1.052E+00	1.487E+00	1.205E+00	1.425E+00	2.195E-01	0.166
2010	1.328E+00	1.319E+00	-0.67%	1.064E+00	1.490E+00	1.215E+00	1.430E+00	2.147E-01	0.162
2011	1.333E+00	1.325E+00	-0.62%	1.074E+00	1.492E+00	1.224E+00	1.433E+00	2.099E-01	0.158
2012	1.336E+00	1.329E+00	-0.54%	1.082E+00	1.493E+00	1.230E+00	1.436E+00	2.058E-01	0.154

NOTE: Printed BC confidence intervals are always approximate.
At least 500 trials are recommended when estimating confidence intervals.

Table 17. cont'd.

Results from ASPICP.EXE, version 2.31 11 Jun 2001 at 21:28.01
3LNO yellowtail flounder (biomass in kt) 10% overrun in 2001 fishery Page 2
2002-2011 F projections

TRAJECTORY OF RELATIVE FISHING MORTALITY RATE (BOOTSTRAPPED)

Year	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
1965	7.541E-02	8.245E-02	9.33%	7.047E-02	8.277E-02	7.047E-02	7.918E-02	8.711E-03	0.116
1966	1.855E-01	1.958E-01	5.50%	1.741E-01	2.022E-01	1.769E-01	1.940E-01	1.551E-02	0.084
1967	2.514E-01	2.603E-01	3.55%	2.401E-01	2.719E-01	2.445E-01	2.625E-01	1.798E-02	0.072
1968	4.035E-01	4.125E-01	2.24%	3.824E-01	4.316E-01	3.916E-01	4.193E-01	2.767E-02	0.069
1969	5.071E-01	5.146E-01	1.48%	4.788E-01	5.403E-01	4.891E-01	5.229E-01	3.383E-02	0.067
1970	9.365E-01	9.463E-01	1.05%	8.886E-01	9.965E-01	9.074E-01	9.649E-01	5.752E-02	0.061
1971	1.559E+00	1.571E+00	0.75%	1.492E+00	1.639E+00	1.519E+00	1.596E+00	7.631E-02	0.049
1972	2.057E+00	2.067E+00	0.50%	1.998E+00	2.114E+00	2.022E+00	2.077E+00	6.059E-02	0.029
1973	2.170E+00	2.183E+00	0.61%	2.106E+00	2.229E+00	2.134E+00	2.200E+00	5.705E-03	0.003
1974	1.918E+00	1.945E+00	1.39%	1.857E+00	1.980E+00	1.881E+00	1.942E+00	6.041E-02	0.031
1975	2.082E+00	2.126E+00	2.09%	1.965E+00	2.210E+00	2.015E+00	2.142E+00	1.268E-01	0.061
1976	7.380E-01	7.548E-01	2.27%	6.968E-01	7.874E-01	7.156E-01	7.617E-01	4.616E-02	0.063
1977	9.653E-01	9.844E-01	1.99%	9.290E-01	1.005E+00	9.460E-01	9.859E-01	3.462E-02	0.036
1978	1.239E+00	1.259E+00	1.64%	1.215E+00	1.275E+00	1.227E+00	1.258E+00	3.075E-02	0.025
1979	1.500E+00	1.525E+00	1.64%	1.468E+00	1.542E+00	1.487E+00	1.524E+00	3.610E-02	0.024
1980	1.003E+00	1.020E+00	1.60%	9.896E-01	1.025E+00	9.943E-01	1.016E+00	2.212E-02	0.022
1981	1.145E+00	1.160E+00	1.32%	1.130E+00	1.163E+00	1.130E+00	1.156E+00	1.949E-02	0.017
1982	1.005E+00	1.014E+00	0.87%	9.856E-01	1.033E+00	9.856E-01	1.016E+00	2.635E-02	0.026
1983	7.374E-01	7.409E-01	0.47%	7.116E-01	7.710E-01	7.237E-01	7.517E-01	2.661E-02	0.036
1984	1.127E+00	1.129E+00	0.17%	1.070E+00	1.217E+00	1.095E+00	1.163E+00	6.830E-02	0.061
1985	2.160E+00	2.160E+00	-0.02%	2.039E+00	2.342E+00	2.091E+00	2.235E+00	1.444E-01	0.067
1986	2.912E+00	2.915E+00	0.10%	2.788E+00	3.063E+00	2.838E+00	2.977E+00	1.391E-01	0.048
1987	1.935E+00	1.941E+00	0.30%	1.875E+00	2.005E+00	1.901E+00	1.970E+00	6.835E-02	0.035
1988	2.134E+00	2.141E+00	0.29%	2.065E+00	2.228E+00	2.101E+00	2.183E+00	8.179E-02	0.038
1989	1.403E+00	1.408E+00	0.35%	1.341E+00	1.479E+00	1.373E+00	1.442E+00	6.868E-02	0.049
1990	1.969E+00	1.976E+00	0.37%	1.848E+00	2.119E+00	1.909E+00	2.044E+00	1.347E-01	0.068
1991	2.629E+00	2.653E+00	0.90%	2.385E+00	2.853E+00	2.507E+00	2.745E+00	2.376E-01	0.090
1992	2.002E+00	2.035E+00	1.69%	1.743E+00	2.307E+00	1.868E+00	2.129E+00	2.613E-01	0.131
1993	2.956E+00	3.056E+00	3.38%	2.368E+00	3.607E+00	2.632E+00	3.269E+00	6.371E-01	0.216
1994	4.456E-01	4.661E-01	4.61%	3.327E-01	5.876E-01	3.832E-01	5.106E-01	1.273E-01	0.286
1995	1.058E-02	1.101E-02	4.15%	7.911E-03	1.412E-02	9.092E-03	1.228E-02	3.192E-03	0.302
1996	3.270E-02	3.382E-02	3.43%	2.470E-02	4.372E-02	2.857E-02	3.835E-02	9.778E-03	0.299
1997	6.897E-02	7.028E-02	1.91%	5.133E-02	9.224E-02	6.023E-02	8.092E-02	2.069E-02	0.300
1998	3.008E-01	3.043E-01	1.16%	2.251E-01	4.029E-01	2.593E-01	3.520E-01	9.272E-02	0.308
1999	3.868E-01	3.908E-01	1.04%	2.935E-01	5.216E-01	3.339E-01	4.547E-01	1.208E-01	0.312
2000	5.933E-01	5.977E-01	0.74%	4.564E-01	7.985E-01	5.081E-01	6.883E-01	1.802E-01	0.304
2001	7.257E-01	7.310E-01	0.72%	5.635E-01	9.763E-01	6.255E-01	8.348E-01	2.094E-01	0.288
2002	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2003	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2004	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2005	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2006	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2007	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2008	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2009	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2010	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288
2011	6.532E-01	6.579E-01	0.72%	5.071E-01	8.787E-01	5.629E-01	7.513E-01	1.884E-01	0.288

TABLE OF PROJECTED YIELDS

2002	1.332E+01	1.332E+01	0.00%	1.312E+01	1.348E+01	1.323E+01	1.341E+01	1.783E-01	0.013
2003	1.377E+01	1.378E+01	0.05%	1.338E+01	1.410E+01	1.358E+01	1.394E+01	3.592E-01	0.026
2004	1.412E+01	1.414E+01	0.10%	1.358E+01	1.462E+01	1.386E+01	1.438E+01	5.191E-01	0.037
2005	1.440E+01	1.442E+01	0.17%	1.367E+01	1.500E+01	1.404E+01	1.470E+01	6.530E-01	0.045
2006	1.460E+01	1.464E+01	0.33%	1.375E+01	1.531E+01	1.420E+01	1.495E+01	7.526E-01	0.052
2007	1.475E+01	1.481E+01	0.46%	1.381E+01	1.559E+01	1.432E+01	1.518E+01	8.654E-01	0.059
2008	1.488E+01	1.494E+01	0.46%	1.382E+01	1.579E+01	1.440E+01	1.534E+01	9.441E-01	0.063
2009	1.497E+01	1.504E+01	0.52%	1.385E+01	1.595E+01	1.441E+01	1.546E+01	1.047E+00	0.070
2010	1.504E+01	1.512E+01	0.54%	1.388E+01	1.610E+01	1.447E+01	1.560E+01	1.121E+00	0.075
2011	1.509E+01	1.518E+01	0.60%	1.390E+01	1.622E+01	1.448E+01	1.567E+01	1.189E+00	0.079

NOTE: Printed BC confidence intervals are always approximate.
At least 500 trials are recommended when estimating confidence intervals.

F	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
5	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
25	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131
50	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142
75	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155
95	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185
Fmsy	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217
2/3Fmsy	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145

B	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
5	70.23	74.06	76.77	79.13	81.01	82.70	84.14	85.34	86.35	87.21
25	84.58	88.44	91.61	94.27	96.40	98.11	99.42	100.48	101.16	101.67
50	92.06	95.84	98.80	101.02	102.64	103.96	104.81	105.45	106.03	106.48
75	99.14	102.24	104.36	106.25	107.74	108.99	109.80	110.28	110.79	111.12
95	108.36	111.85	113.31	115.55	117.36	118.98	119.83	120.44	120.96	121.81

Y	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
5	13.07	13.30	13.46	13.58	13.67	13.72	13.76	13.79	13.82	13.83
25	13.23	13.61	13.90	14.10	14.28	14.41	14.52	14.59	14.65	14.69
50	13.32	13.78	14.15	14.45	14.69	14.88	15.01	15.12	15.20	15.27
75	13.41	13.95	14.40	14.77	15.07	15.30	15.49	15.64	15.77	15.86
95	13.53	14.18	14.74	15.20	15.62	15.91	16.19	16.38	16.59	16.76

Br	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
5	0.77	0.80	0.83	0.86	0.88	0.90	0.92	0.94	0.95	0.96
25	0.98	1.03	1.07	1.10	1.12	1.14	1.16	1.17	1.18	1.19
50	1.13	1.17	1.21	1.24	1.26	1.28	1.29	1.30	1.31	1.32
75	1.25	1.30	1.34	1.36	1.38	1.40	1.41	1.41	1.42	1.42
95	1.40	1.44	1.46	1.47	1.48	1.49	1.49	1.50	1.50	1.50

Yr	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
5	0.83	0.81	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.75
25	0.93	0.91	0.89	0.87	0.85	0.84	0.83	0.83	0.82	0.82
50	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.91	0.90	0.90
75	0.99	0.99	0.99	0.98	0.98	0.97	0.97	0.96	0.96	0.96
95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 18. Medium term projections for Yellowtail flounder. The 5,25,50,75 & 95th percentiles of fishing mortality yield, yield / MSY, biomass and biomass / Bmsy for a fishing mortality of 2/3 Fmsy using a F multiplier of 0.9.
The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 14,300 tonnes in 2001.

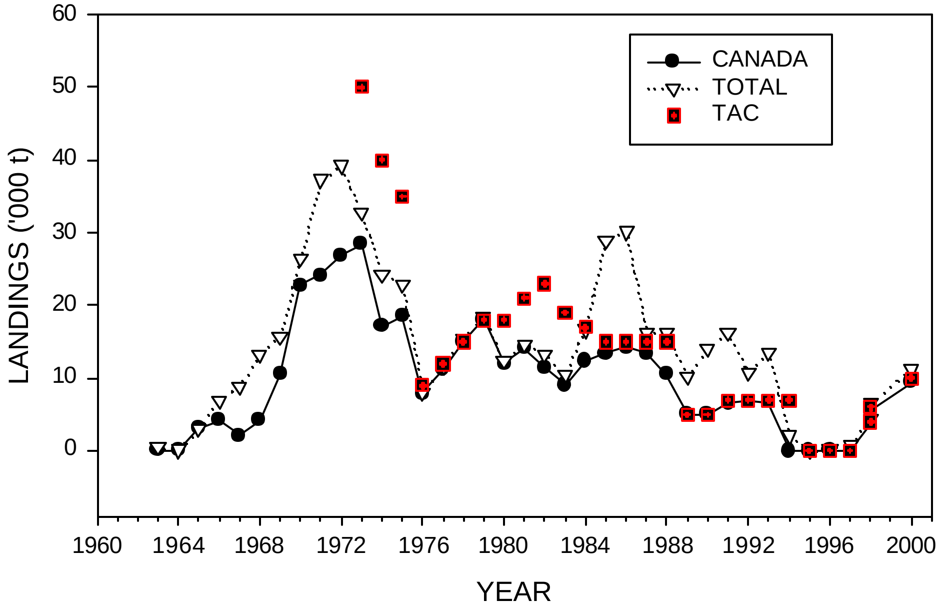


Fig. 1 Landings and TACs of yellowtail flounder in Division 3LNO

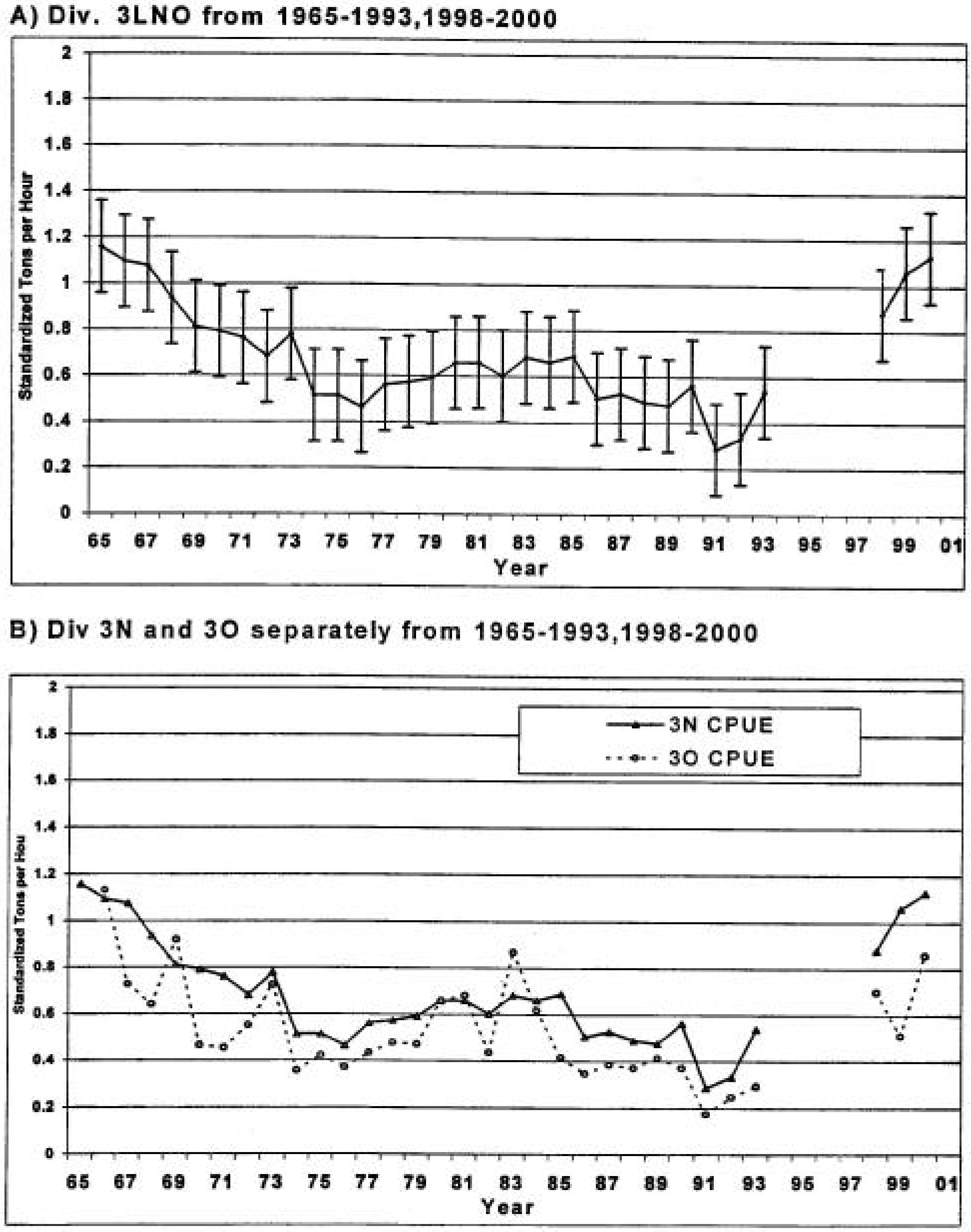


Fig. 2. Standardized CPUE with ± 2 S.E. for yellowtail flounder in Div 3LNO from 1965-1993 and 1998-2000 under different treatments for the database. From 1991-1993 the fishery was a mixed fishery with American plaice. There was no directed fishery from 1994-1997.

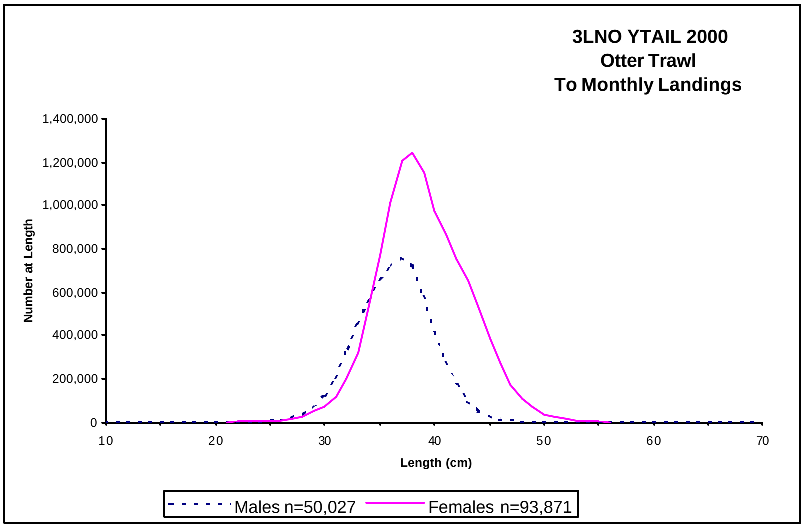


Fig. 3. Length frequency of otter trawl catches in the 2000 Canadian fishery.

2000 Fisheries in the NAFO Regulatory Area of Div. 3NO

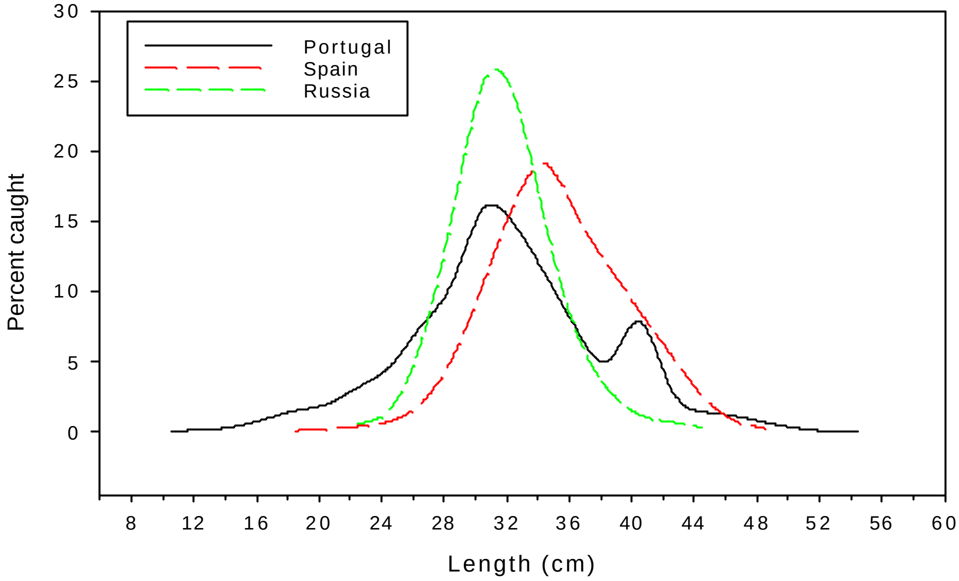
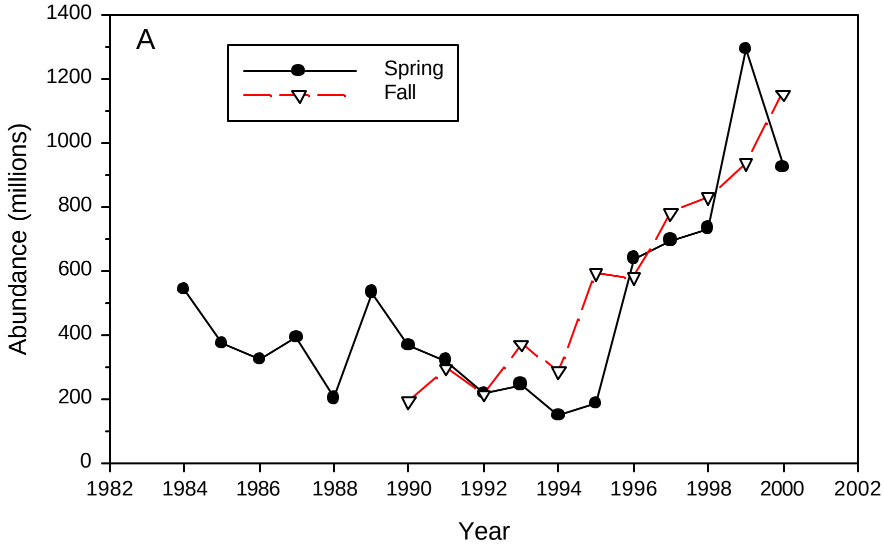


Fig. 4 Length frequency of yellowtail flounder in the 2000 fisheries in the NAFO Regulatory Area.



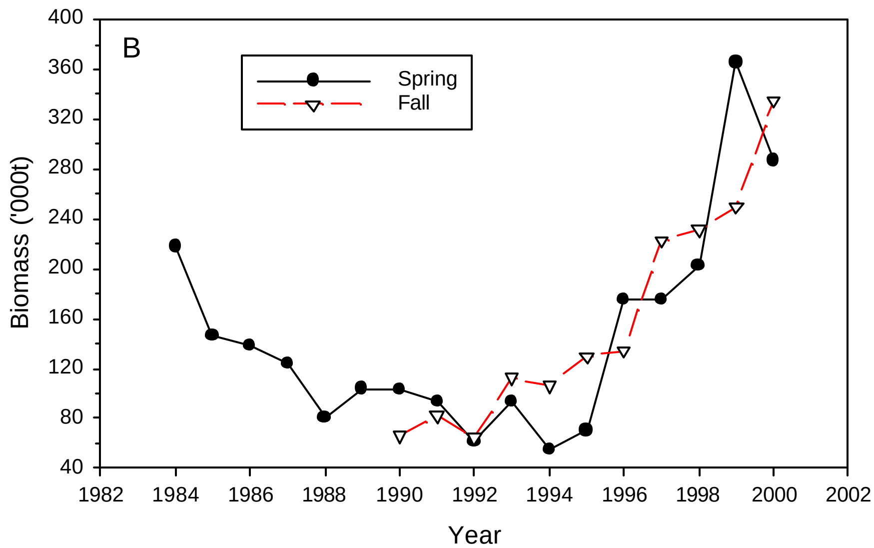


Fig.5 . **A**. The abundance and (**B**) biomass of yellowtail flounder estimated from annual bottom trawl surveys by Canada, 1984-2000

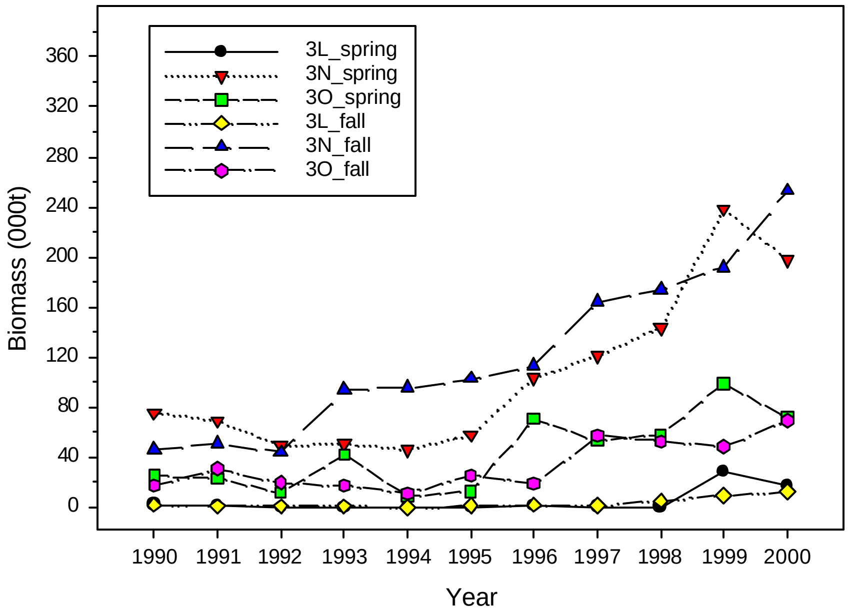


Fig.6 . Comparison of spring and fall biomass estimates of yellowtail flounder for 1990-2000 surveys by division.

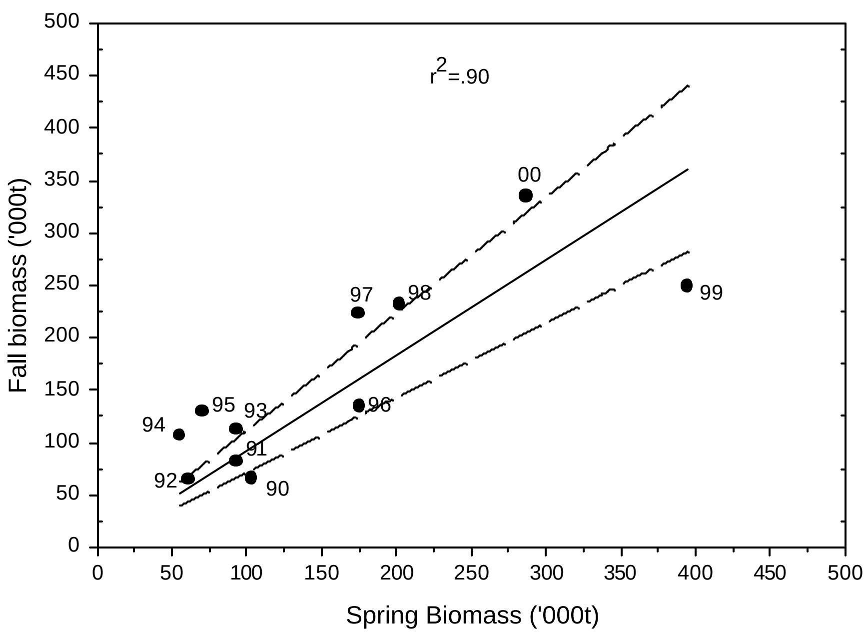


Fig. 7. Regression of fall and spring biomass estimates from annual bottom trawl surveys for yellowtail flounder on the Grand Bank, 1990-2000.

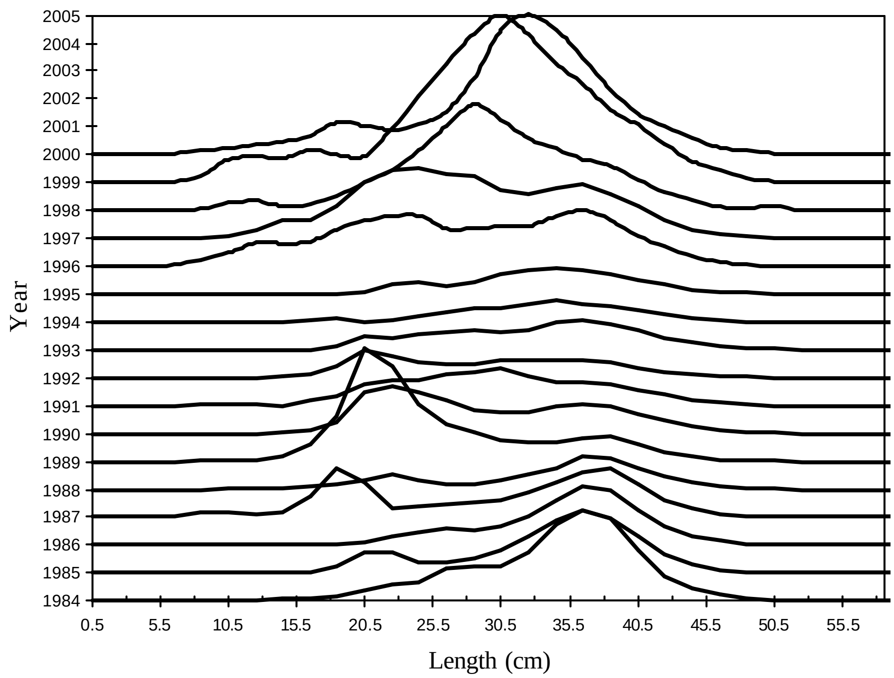


Fig. 8. Length frequency of yellowtail flounder in the spring surveys of Div. 3LNO, 1984-2000.

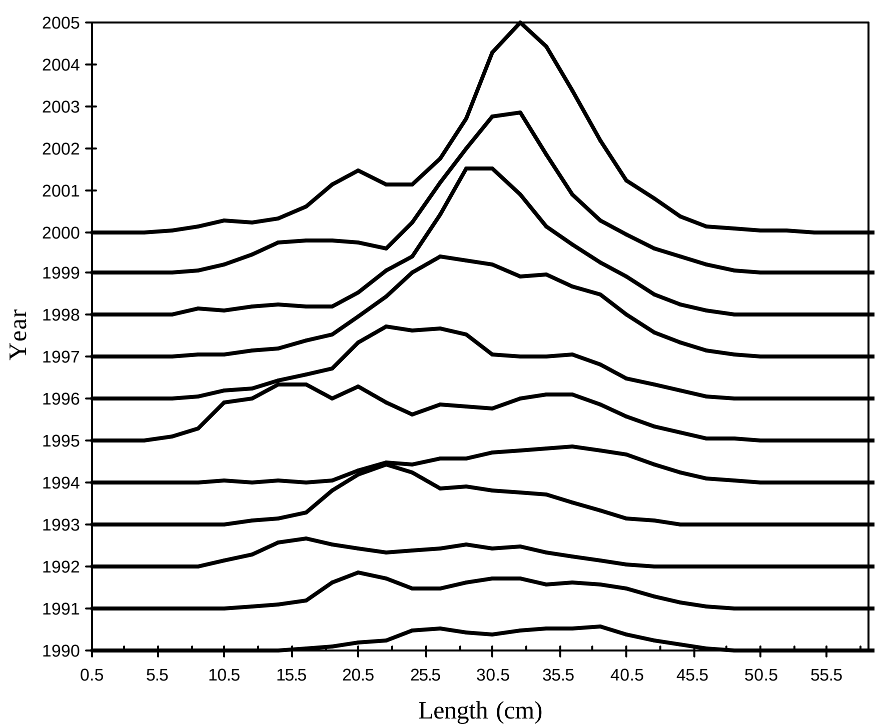


Fig. 9. Length frequency of yellowtail flounder in the fall surveys of Div. 3LNO, 1990-2000.

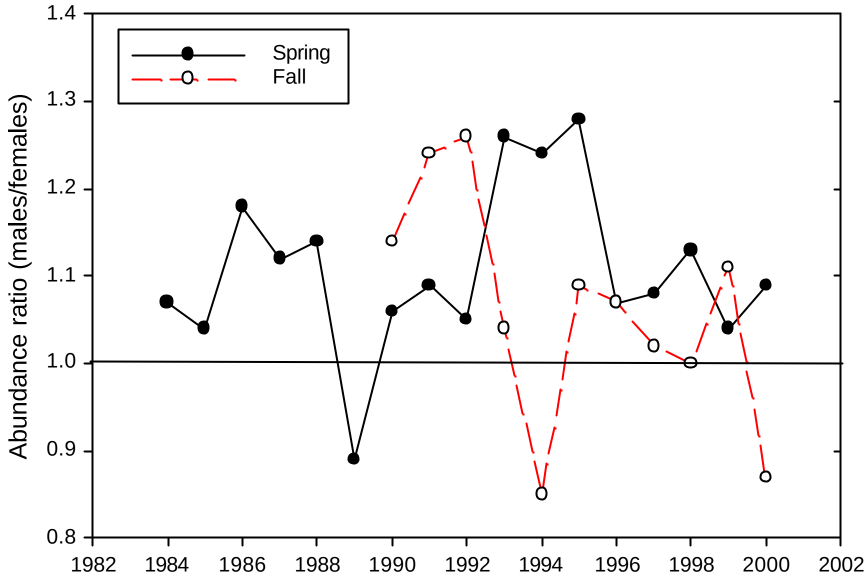


Fig. 10 Ratio of male to female yellowtail flounder from the 1984-2000 spring and 1990-99 fall surveys of Div. 3LNO.

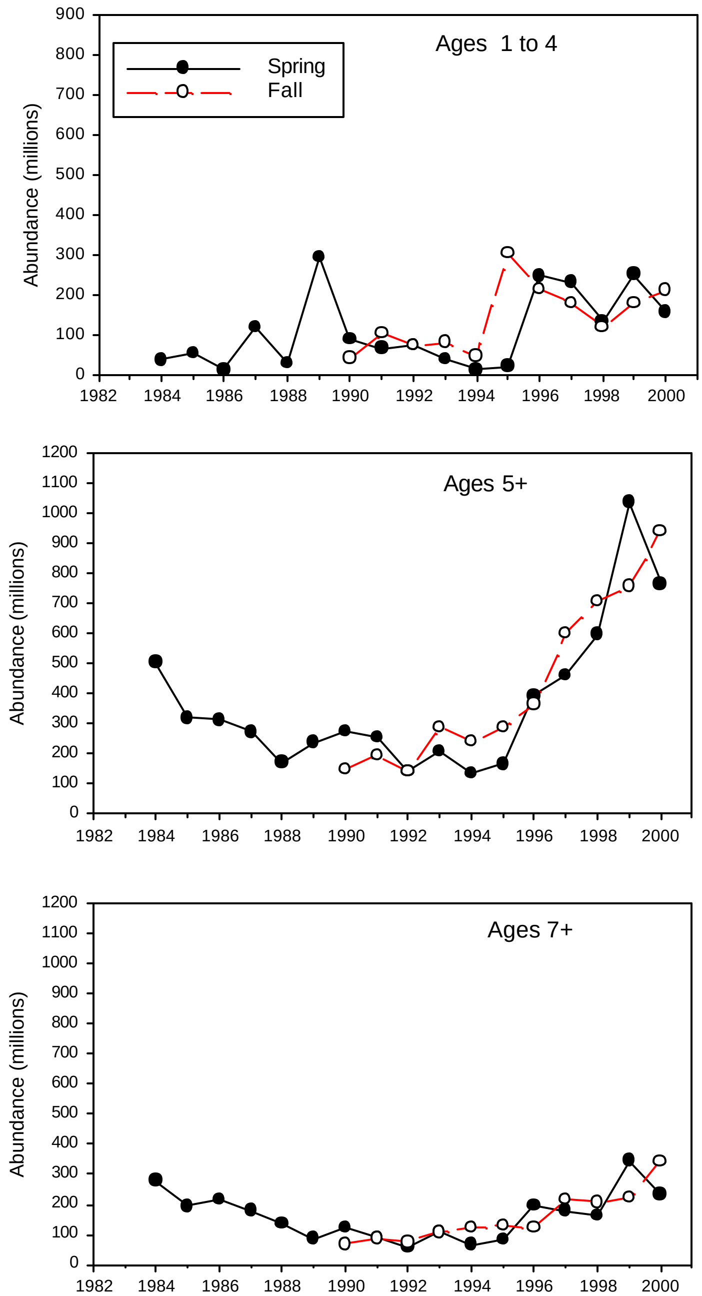
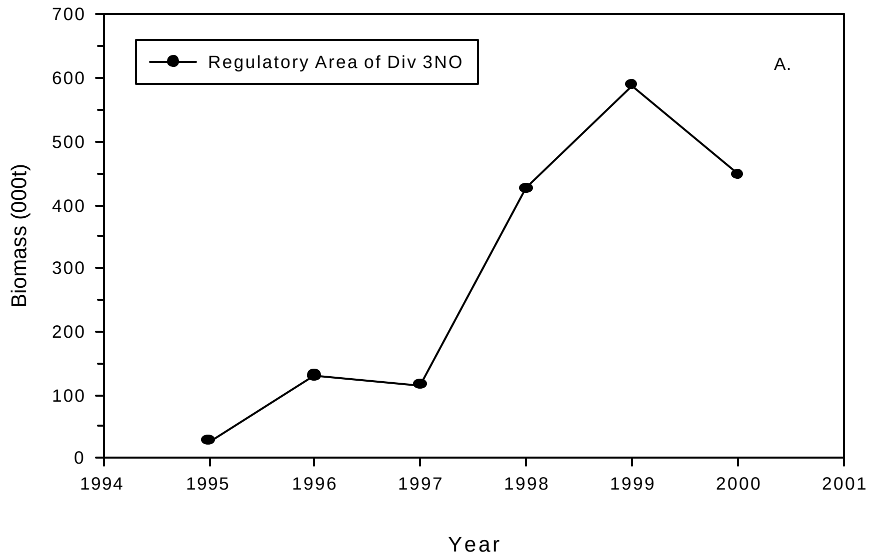


Fig.11 . Comparison of 1984-2000 spring and fall survey estimates of pre-recruit, partially recruited and fully recruited ages of yellowtail flounder from Div. 3LNO.



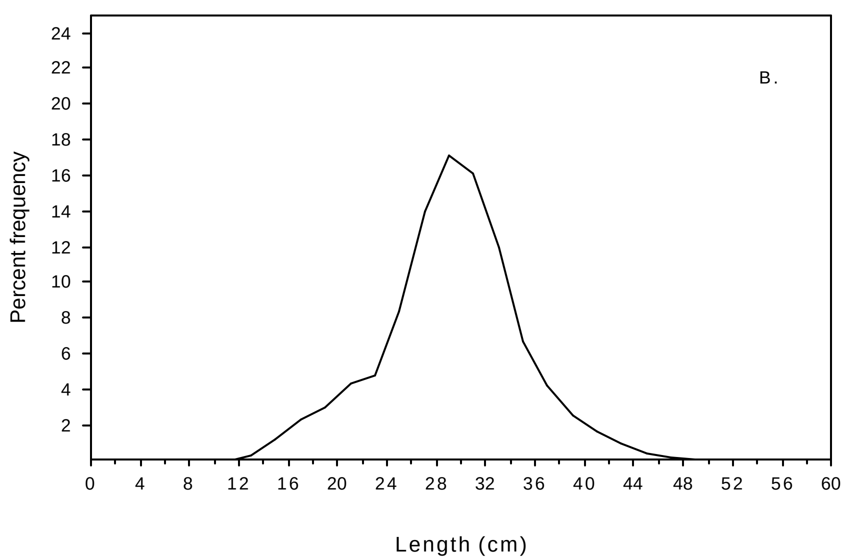


Fig. 12. A. Biomass of yellowtail flounder from the Spanish surveys in the Regulatory Area of Div.3
B. Length frequency of yellowtail flounder in the 2000 Spanish survey in the
Regulatory Area of Div. 3LNO

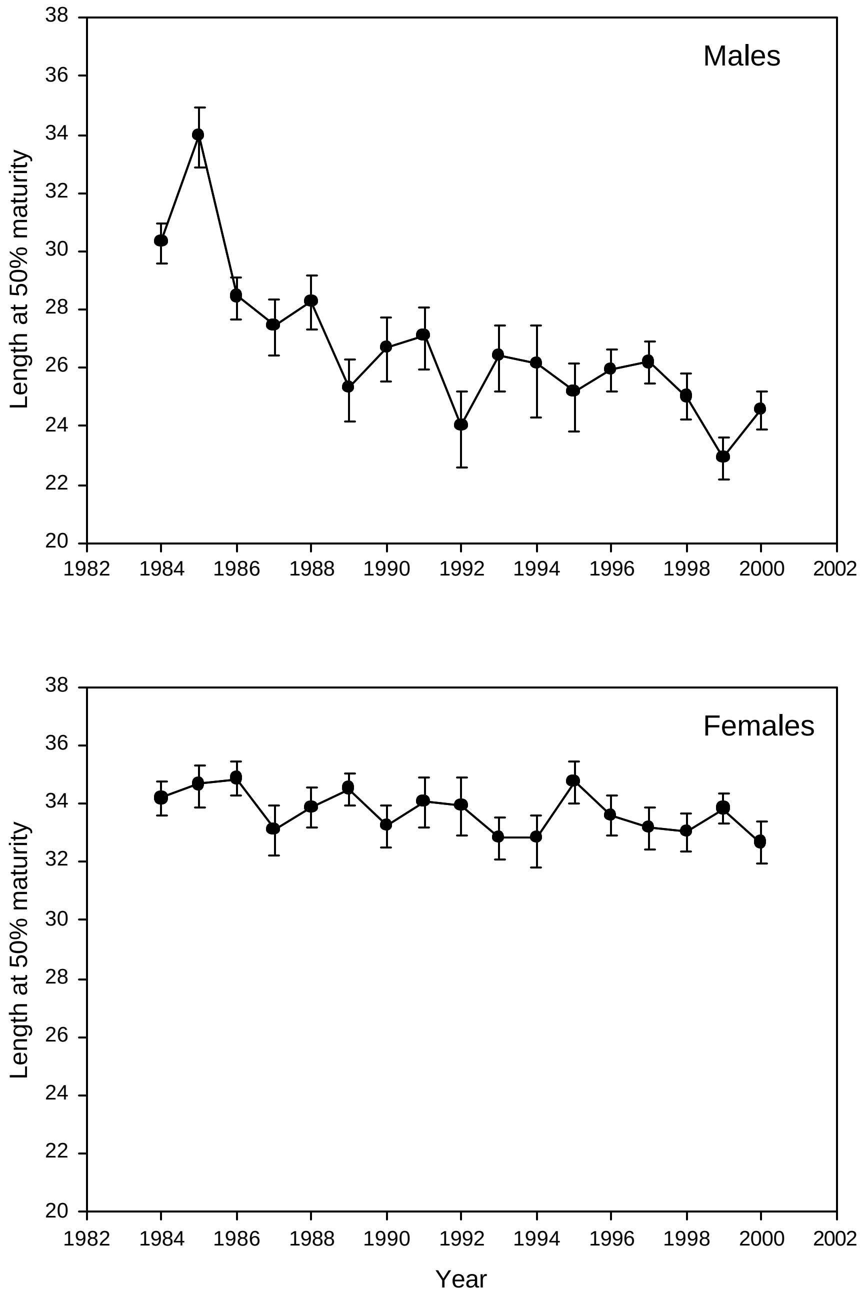


Fig 13. Length at 50% maturity of male and female yellowtail flounder from annual spring surveys of Div. 3LNO from 1984-2000.

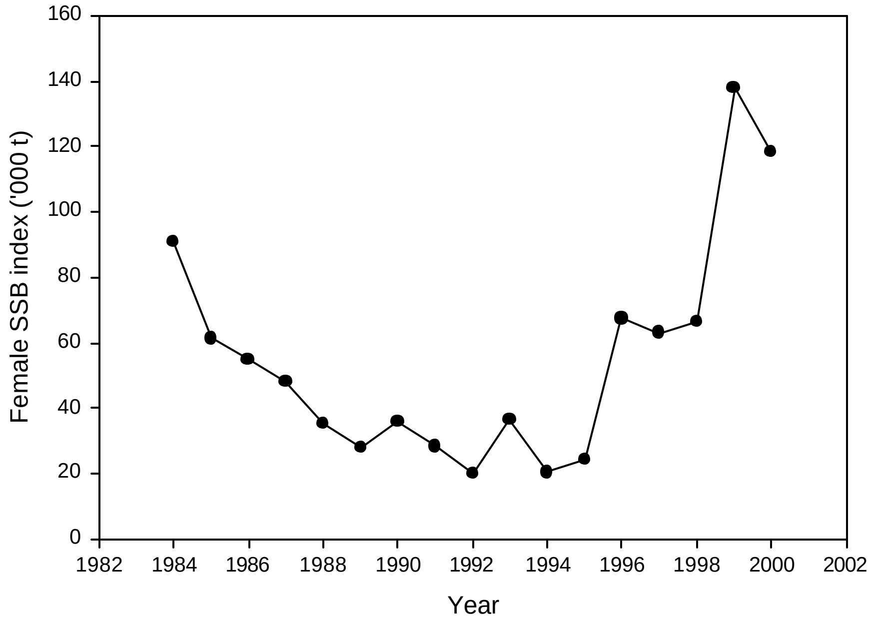


Fig 14. Index of female spawning stock biomass ('000 t) as calculated from Canadian spring research vessel surveys.

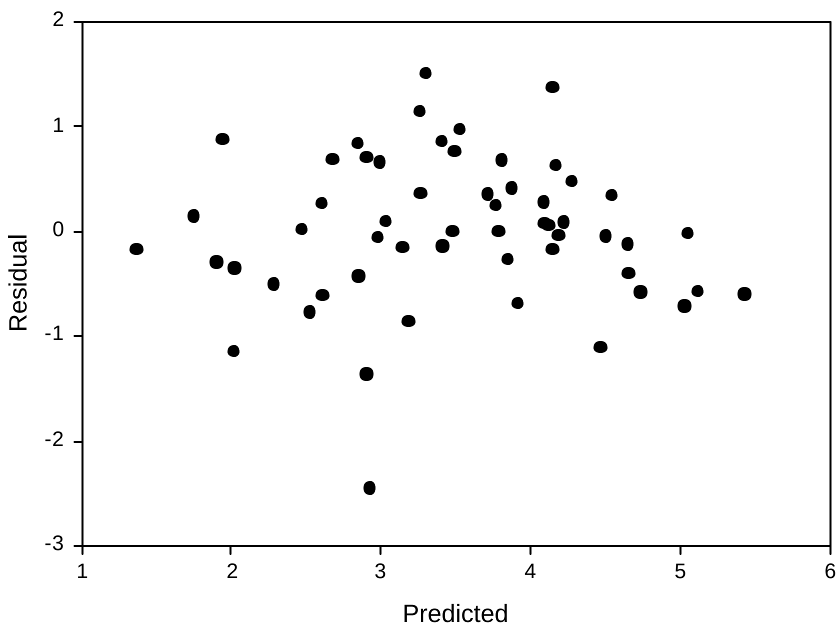


Fig 15 . Residual plot from relative cohort strength model for yellowtail flounder. A separate survey effect was estimated.

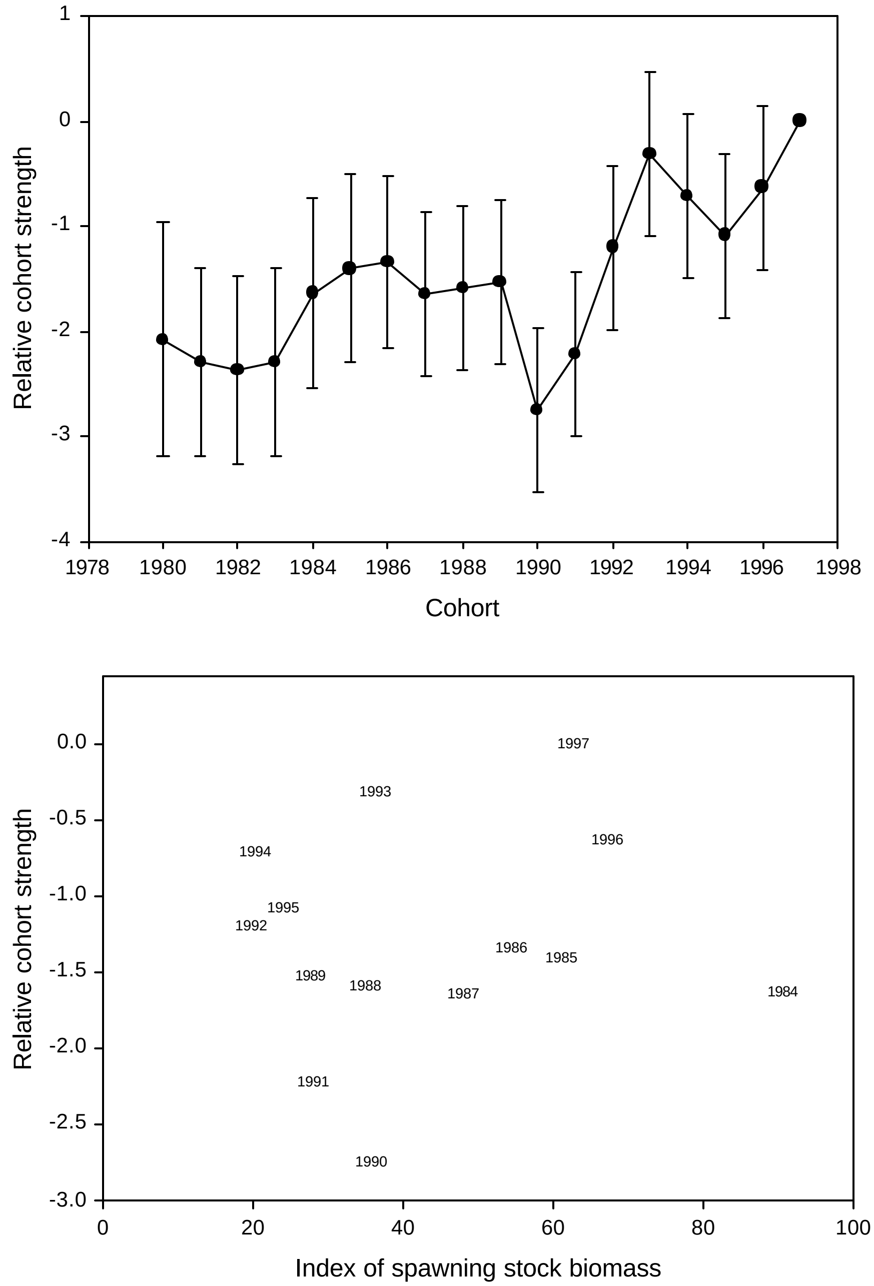
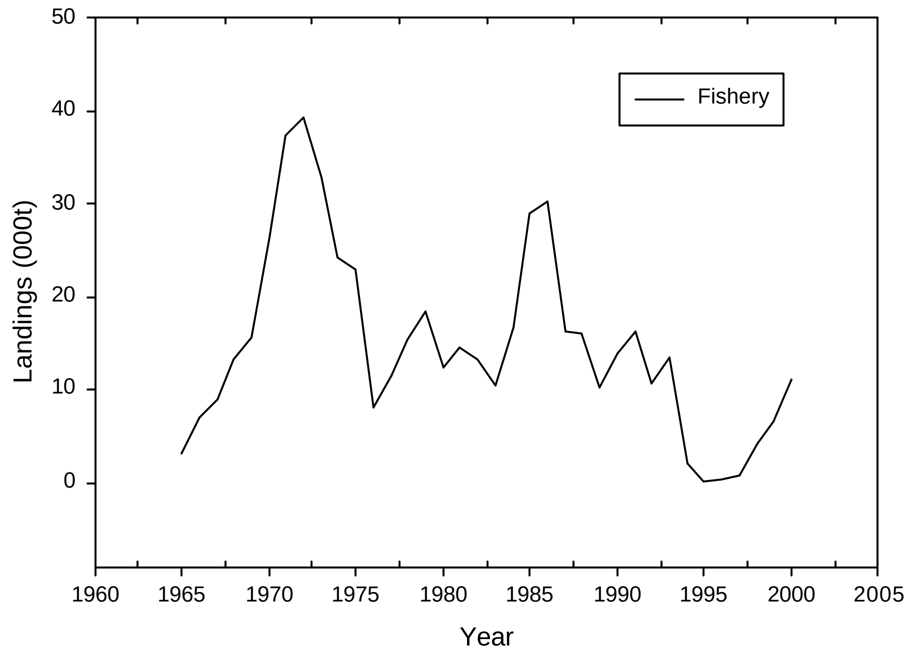


Fig.16. Relative cohort strength as estimated from a multiplicative model (top) and relative cohort strength vs. an index of female spawning stock biomass ('000 t) from the Canadian spring survey for Div. 3LNO yellowtail flounder (bottom).



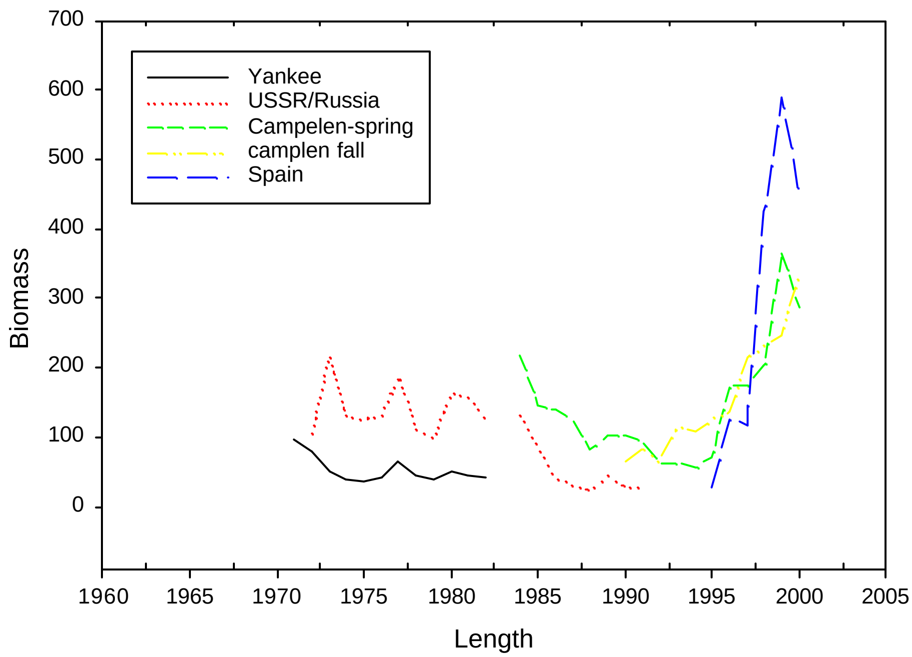


Fig. 17 Nominal landings (top panel) from the yellowtail fishery and the survey times series used in ASPIC production model.

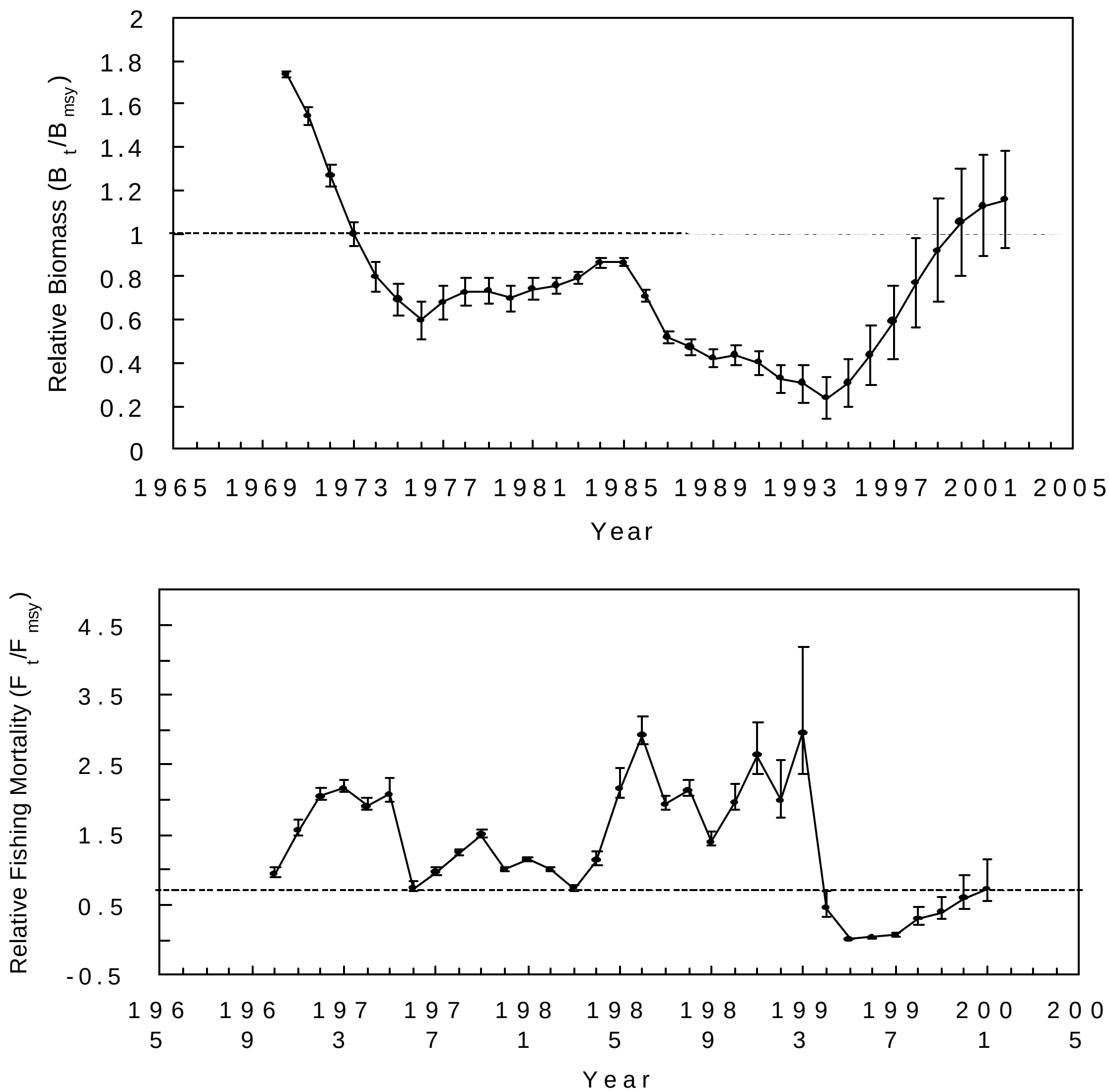


Fig. 18. Bias corrected relative biomass (Top panel) and fishing mortality trends with 80% confidence intervals for Div. 3LNO yellowtail flounder.

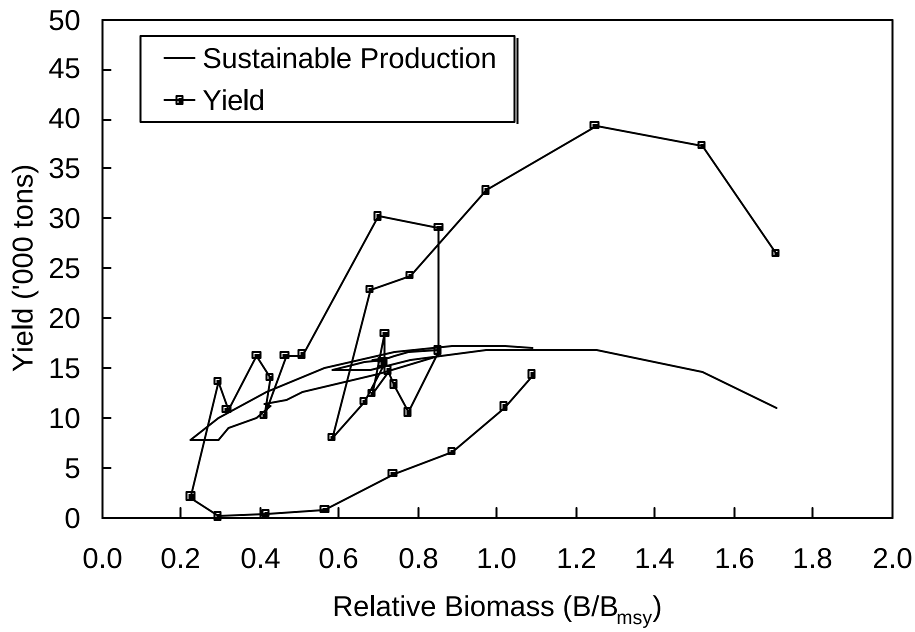


Fig. 19.Yield trajectory and sustainable production from ASPIC production model with catch in 2001 assumed to be taken with a 10% overrun, i.e. 14, 300 t

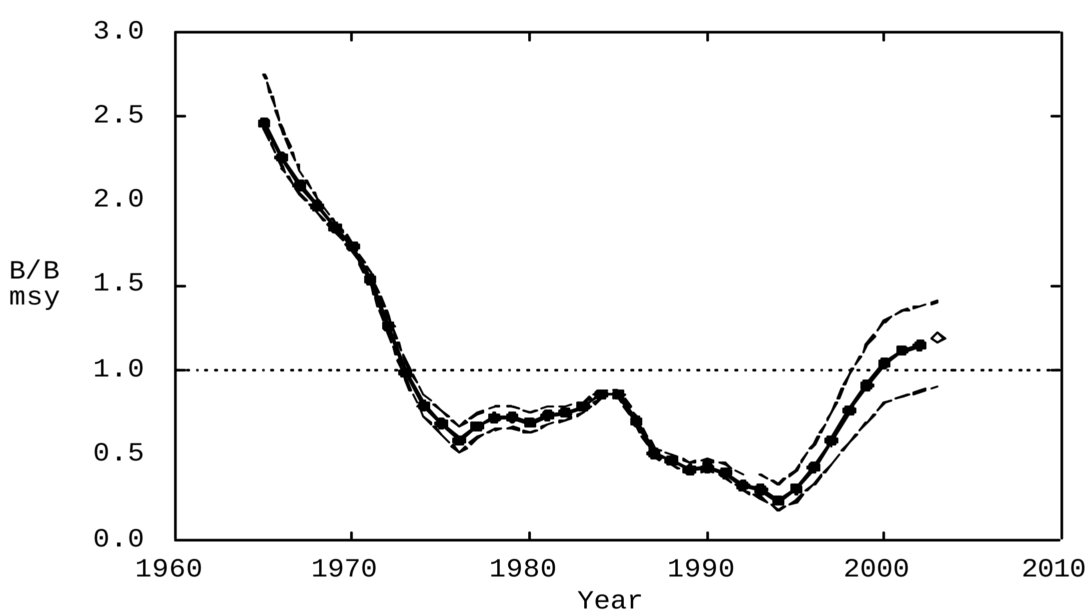


Fig. 20. Relative biomass with 80% CI for 2002 yield projections using status quo $F_{2001} = F_{2001}$

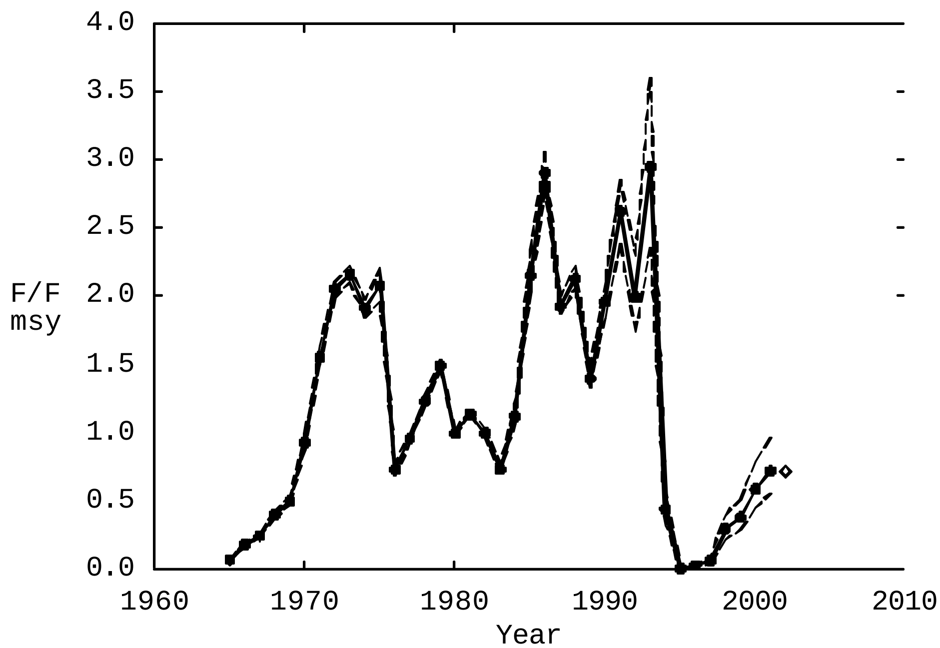


Fig. 21. Relative fishing mortality trends with 80% CI for 2002 yield projections using status quo $F_{2001} = F_{2001}$

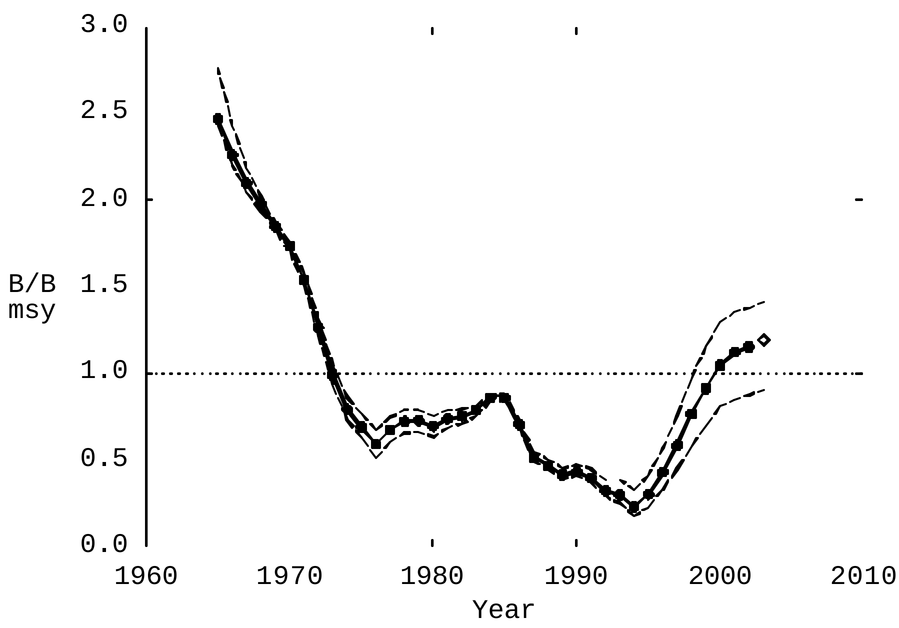


Fig. 22. Relative biomass with 80% CI for 2002 yield projections using $F_{2001} = 2/3F_{msy}$

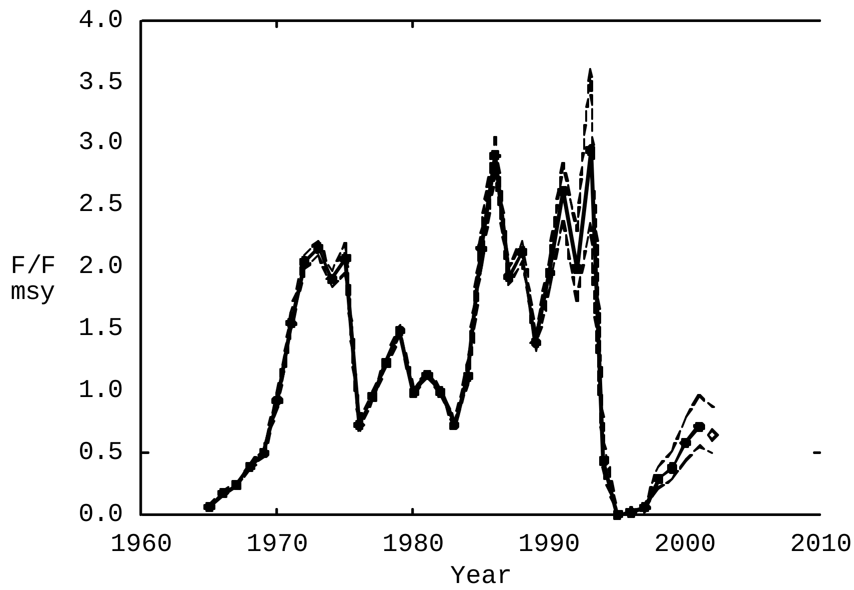


Fig. 23. Relative fishing mortality trend with 80% CI for 2002 yield projections using $F_{2001} = 2/3F_{msy}$.

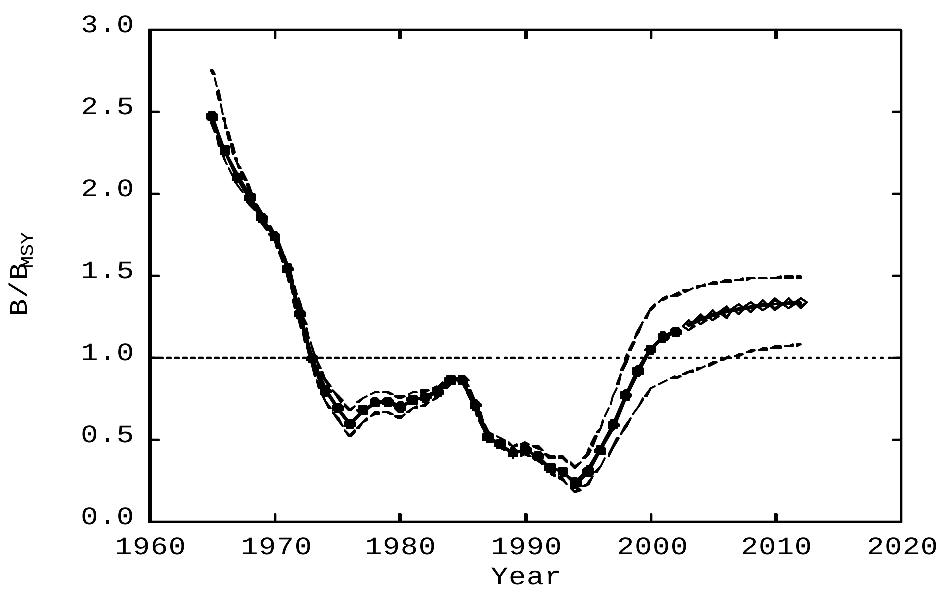


Fig. 24. Relative fishing mortality trend with 80% CI for 2002-2011 yield projections using $F_{2001} = 2/3F_{msy}$.

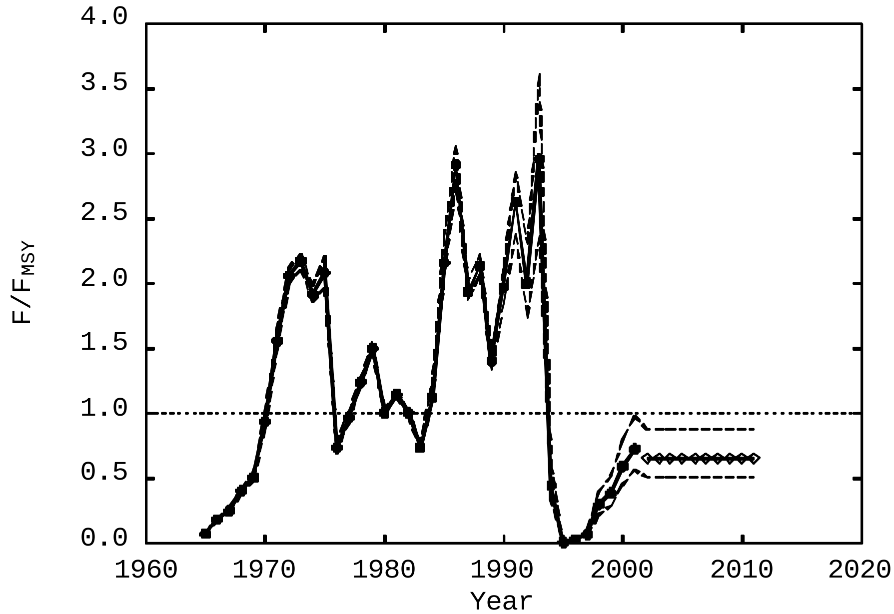


Fig. 25. Relative fishing mortality trend with 80% CI for 2002–2011 yield projections using $F_{2001} = 2/3F_{msy}$.

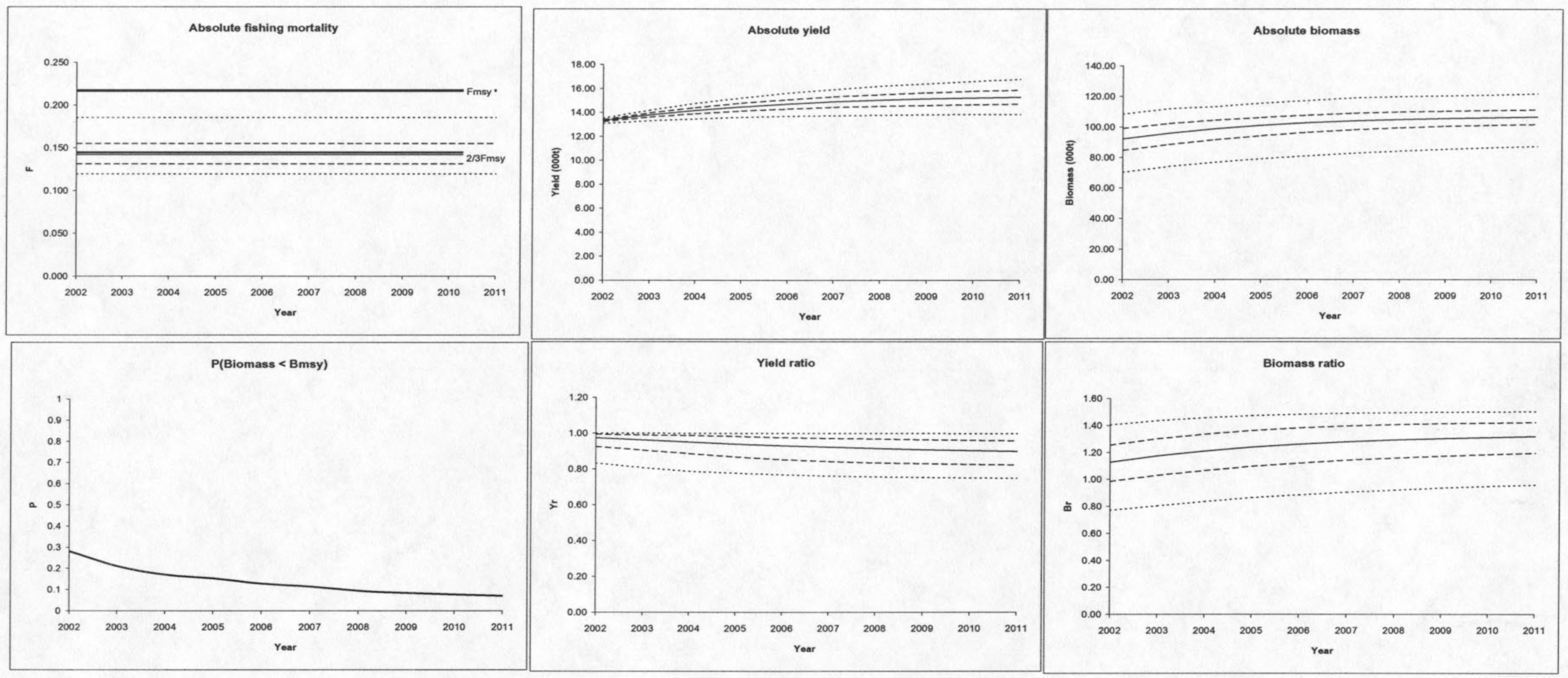


Fig 26. Medium term projections for yellowtail flounder at a constant fishing mortality of 2/3 F_{msy} using a F multiplier (Table 14) of 0.9. The figures show the 5, 25, 50, 75 and 95 oercentiles of fishing mortality, yield, potential yield/MSY, biomass and biomass/B_{msy}. The probability of biomass being less than B_{msy} is also given. The results are derived from an ASPIC bootstrap run (500 iterations) with a cacth constraint of 14, 300 tons in 2001.

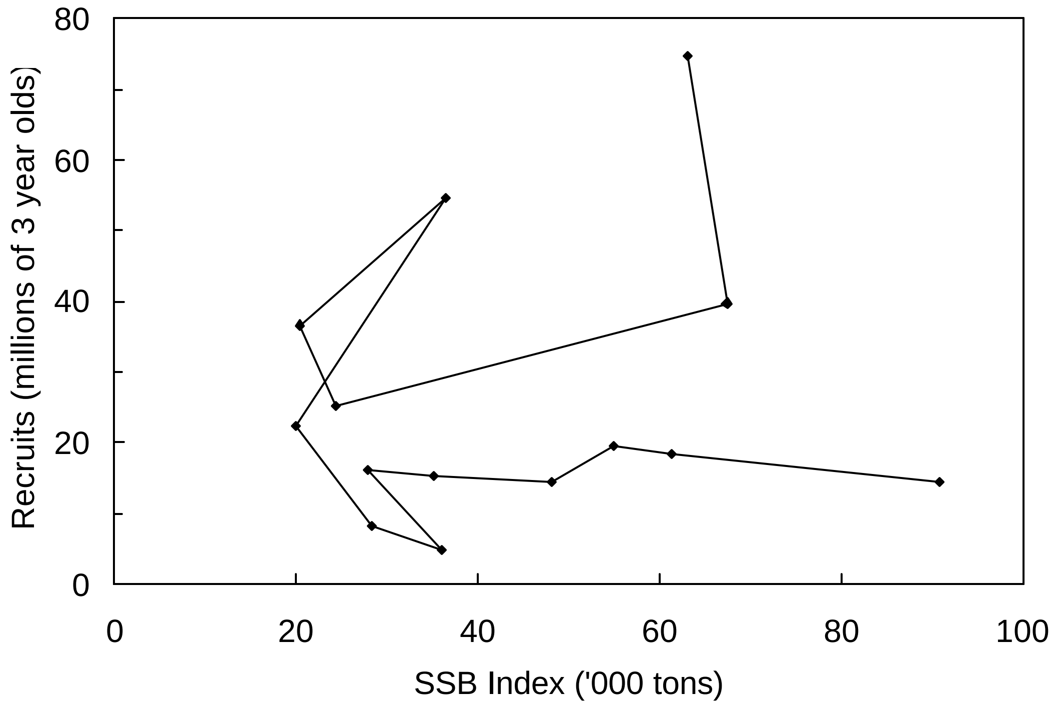


Fig. 27. Stock-recruitment plot for Div. 3LNO yellowtail flounder.

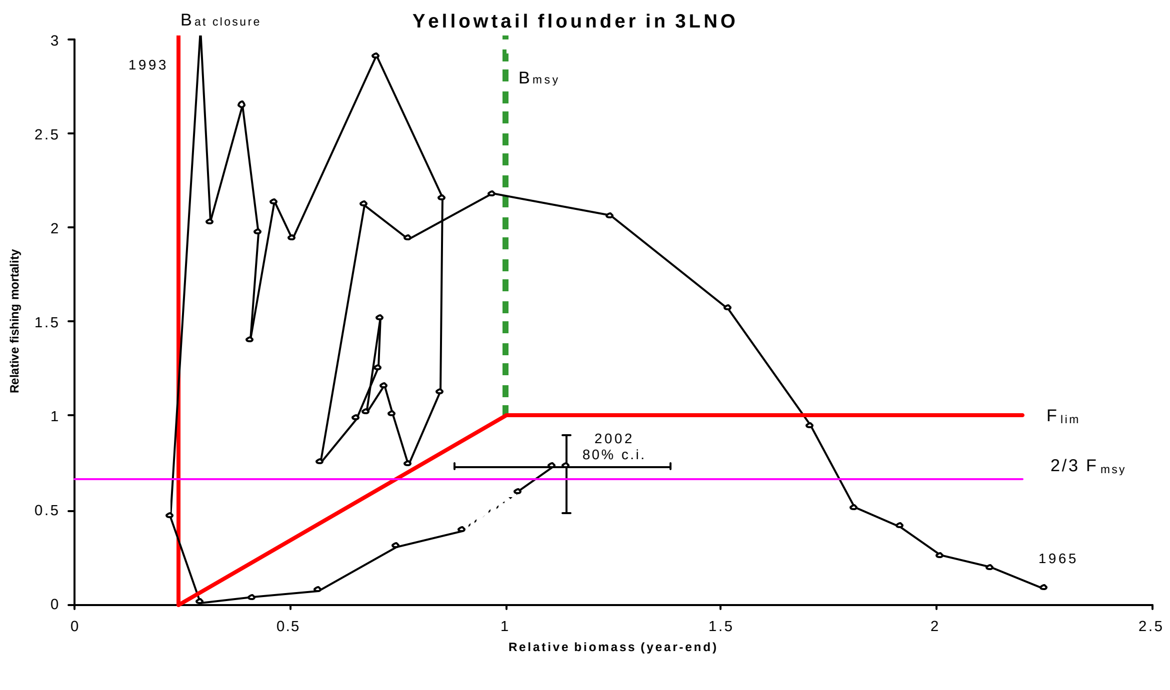


Fig. 28. Yellowtail flounder in Div. 3LNO: stock trajectory estimated in a surplus production analysis under the precautionary framework.