6 GREENLAND HALIBUT IN SUBAREAS V AND XIV

6.1 Landings, Fisheries, Fleet and Stock Perception

Landings

Total annual landings in Divisions Va, Vb, and Subareas XII and XIV are presented for the years 1981–2003 in Tables 6.1.1–6.1.5 and since 1961 in Figure 6.1.1. Landings during the decade prior to the extension of the EEZ to 200 nm by coastal nations in 1976 were in the order of 20-35 000 t. From 1976 landings increased from a low of 5 000 t to above 30 000 t after 1982. In the years 1987–1989, landings increased further to a record high of about 61 000 t. Since 1989 catches have decreased to 20 000 t in 1998-99, followed by an increase in the past 5 years to about 30 000 t in 2003. Landings not officially reported to ICES have been included in the assessment.

Catches in Icelandic waters have historically predominated the total catches in areas V+XIV. In the year 1989 with record high catches Iceland took 97% of the total catch. Since then fisheries developed in Div. XIVb and Vb and these areas have increased their share of the total catches and have in the past decade varied from about 20% to 50%.

Fisheries and fleets

In the Greenland EEZ, the Greenland fleet was only capable of catching about 60% of the quota, while the foreign fleets nearly fulfilled their quotas. In Iceland EEZ the fleets caught the quota and in Faroese EEZ only by-catch regulations is limiting the individual trawlers.

Most of the fishery for Greenland halibut in Divisions Va, Vb and XIVb is a directed fishery only minor catches in Va by Iceland, and in XIVb by Germany and the UK comes partly from a redfish fishery and south of Iceland No major changes were observed in 2003. Table 6.1.6 describes the Working Group's best landing estimates for the year 2003 with respect to area and gear.

The major fishing grounds in Icelandic waters are located west of Iceland (64º30-66ºN, 27º-29ºW), where approximately 75% of the annual trawl catch in Icelandic waters has been taken in recent years. The Icelandic trawlers moved to deeper waters around 1988, but the average depth of fishing on the western grounds has remained at approximately 900 meters since 1990. A fishery also occurs north of Iceland (67º-68ºN, 19º-24ºW, at approximately 500 m), and along the narrow continental slope northeast and east of Iceland (63º30-66ºN, 11º–16ºW, between 400 and 700 meter depth). The main fishing season in Division Va formerly occurred during the spawning season in spring, but in recent years, the fishing season has expanded and the present fishery is conducted in late winter to early summer, with the bulk of the catches taken in April through June.

The trawlers (single trawlers > 1000 Hp) fishing in Division Vb operate on relatively shallow parts of the continental slope, mainly in summer. The gillnet fishery in Division Vb started in 1993, and since then the fishing grounds have expanded. This fishery is carried out during the whole year with a peak activity in the spring.

The fishing grounds in Division XIVb are found on the continental slopes (61ºN-65ºN, 36º-41ºW). Trawling was formerly concentrated in a narrow belt of the continental slope at depths of 500–1000 meters in the north-easternmost area of XIVb, but has in 1997 expanded to a southerly area between 61°40-62°30N, 40°00-40°30W at depths of 1000–1400 meters, where longliners are also fishing. The main fishing season is from April to November for both longliners and trawlers with the bulk of the catches taken in July. Both freezer trawlers and fresh fish trawlers operate in the area.

Since 1994 a longline fishery developed on new fishing grounds along the western slope of the Reykjanes Ridge (60ºN-62ºN, 27º-29ºW), both inside and outside the 200 mile EEZ (XIVb and XII). This fishery has ceased since 2000. The same fleet has continued as a gillnet fleet since, only accounting for small catches.

Bycatch and discard

Bycatches in the Greenland halibut trawl fisheries is mainly redfish, sharks and cod. Southeast of Iceland the cod fishery and Greenland halibut fishery are coinciding spatially.

Previous reports based on measurements from a Greenlandic shrimp trawler operating in Denmark Strait (XIVb), indicated that Greenland halibut, mainly pre recruits below 40 cm, did constitute a significant bycatch. (0.48 kg and 0.81 individuals of Greenland halibut were caught per 1 kg shrimp).

Only little information is presently available on discard in the fisheries. Discard records from logbooks that suggest discard less than 1% of the catches are considered incomplete.

Stock perception

The current definition of the Greenland halibut in East Greenland, Iceland, and Faroe waters as one stock, specified by ICES in 1976 was "based on a strong probability that the spawning grounds [for Greenland halibut in these waters] are the same". A summary of the current state of knowledge on Greenland halibut in the above-mentioned waters shows that key information on the life cycle is lacking (Woll 2000). Information on the spawning location and spawning time of the stock is very limited. It is hypothesised, based on information from one scientific bottom trawl cruise in 1977, that the major spawning grounds are located on the continental slopes west of Iceland at depths around and below 1000 m (Magnusson 1977; Sigurdsson 1977; Sigurdsson and Magnusson 1980). In recent years (1995 and 2000), some spawning has been observed in East Greenland waters (62°N and 64°N) in August (Gundersen *et al*. 1997; Fossen and Gundersen 2000).

Standard 0-group fish surveys have been carried out annually in late summer (mainly in August) in Icelandic and in East Greenland waters since 1970. Larvae are mainly observed along the shelf region off East Greenland and are in some years abundant all over the shelf area south to 60° N, which is the southernmost limit of the survey area. Highest abundance is observed on the continental shelf north of 64° N and just east off the continental shelf south of 64° N. 0-group larvae are only occasionally observed on the Icelandic shelf in very limited numbers. Nursery grounds for young Greenland halibut (ages 1-3, fish less than 45 cm long) are well known in West Greenland waters, where they are most abundant from Store Hellefiske Bank to Disko and in Disko Bay between 66^{o}-69^{o} latitude at depths of about 200 m (Riget and Boje, 1988). When it comes to knowledge on young fish in East Greenland and Icelandic waters, information is very sparse. A gillnet survey targeting young Greenland halibut, modelling of advection of eggs and larvae with currents from assumed spawning areas in Icelandic and East Greenland waters (Woll 2000), and results of historic Greenland ichtyoplankton surveys (Boje 1997), indicated that larvae were transported to Southwest Greenland waters before settling, mixing with specimens from the Greenland-Canadian stock complex. Analyses of shrimp surveys in Icelandic and Greenland waters (Boje and Hjørleifsson 2000) concluded that nursery grounds were neither to be found in Icelandic nor in East Greenland waters.

The highest aggregation of commercial-sized Greenland halibut is found just south of the Greenland-Iceland ridge. In this area the major portion of the annual catch in the past 10 to 15 years has been taken mainly at depths between 500 and 1000 meters. Other locations of Greenland halibut in exploitable densities (for trawl fisheries) are found along the north and east coast of Iceland, mainly at depths between 500 to 700 meters, in waters of Faroe Islands, as well as along the continental slope off East Greenland. The sizes of the Greenland halibut in the trawl fisheries depend largely on location and depth, and to some extent on the season. In Icelandic waters, smaller fish are found along the east and north coast, with somewhat larger fish in the deeper waters south of the Faroe-Iceland ridge. The largest fish are, however, always found on the main fishing grounds between Iceland and Greenland.

6.2 Trends in Effort and CPUE

Division Va

Indices of CPUE for the Icelandic trawl fleet directed at Greenland halibut for the period 1985–2003 (Table 6.2.1, Fig. 6.2.1) were estimated from a GLIM multiplicative model, taking into account changes in the Icelandic trawl catch due to vessel, statistical square, month, and year effects. All hauls with Greenland halibut exceeding 50% of the total catch were included in the CPUE estimation. The CPUE indices from the trawling fleets in Divisions Va, Vb and XIVb were used to estimate the total effort for each year (y) for each of the divisions according to:

$$E_{y,div} = Y_{y,div} / CPUE_{y,div}$$

where E is the total effort and Y is the total reported landings (Table 6.2.1).

Catch rates of Icelandic bottom trawlers decreased for all fishing grounds during 1990–1995, but stabilised in 1995–1997. In 1998, an increase of 60% in CPUE was observed for all fishing grounds coinciding with a drastic (60%) reduction in effort (Table 6.2.1, Figure 6.2.1). In 1999 to 2001 CPUE increases annually between 4 – 15% until 2002

and 2003 when CPUE decreased by 24% and 30%, respectively. The total effort increased up to 1995, decreased significantly until 2001, but increased again in 2002 and 2003 by 54 % and 47%, respectively. Since 1994 CPUE's have been stable and effort has thus followed the development of the catches (Fig. 6.2.1). CPUE trends are equal for the areas west, north, east and south of Iceland, but recent development into 2003 differs; but for the most important fishing grounds west of Iceland, where over 75% of the Va catch is taken, CPUE decreased markedly (Fig. 6.2.2).

Division Vb

Information from logbooks from the Faroese otterboard trawl fleet (>1000 hp) was available for the years 1991-2003 (Table 6.2.1). It is a rather new fishery and the location of the bulk of fishery has changed from the eastern side of the islands in 1995-1998, to the western side since 2000. Therefore, the fishery is assumed to have been in the process of learning. Only hauls where G.halibut consisted of more than 50% of the catches and conducted on depths more than 450 meters were selected for the analyses. The logbooks were standardised in the same way (GLM) as the Va fleet. Also effort is estimated as described for the Va fleet. The fishery has increased from about 1500 t in 1991 to more than 6000 t mostly mainly due to gillnetters. CPUE decreased in the early period by about 10% coinciding with a significant increase in effort.

Division XIVb

For Division XIVb, logbook data was available from German, Norwegian, Faroese, Russian, Japanese, U.K., Spanish and Greenland fleets. Hauls where targeted species was G.halibut and where catch weight exceeds 100 kg were selected, as no information on other species caught was available. CPUE from logbooks in the years 1991–2003 were standardised in the same way as described for fleets in Va and so was effort (Table 6.2.1, Fig.6.2.1). CPUE increased significantly from 1992 to 1993, where after it remains relatively stable. Effort has thus since 1993 followed the development in catches. However, the fishery in XIVb is relatively new and catches have increased from below 500 tons annually before 1991 to about 7000 t in the past three years. The fishery was therefore assumed to be in the process of learning in the beginning of the CPUE series. A breakdown of the CPUE series into fleet components, shows various signals for the fleets, but for the German fleet, CPUE is decreasing in 2003 after a stable period since 1997 (Fig. 6.2.3). The German fleet comprised about 40% of the catches in that Division and is the only series in the entire year span. The Greenland fleet, also being one of the major components in the fishery, do have status quo CPUE in 2003.

The CPUE series from Divisions Va, Vb and XIVb show contradictory trends in the period 1991 to 2003 (Fig.6.2.1). CPUE's in Vb and XIVb are stable for the period 1994 to 2002, while those series shows contradicting trends prior to 1994; in XIVb CPUE's increased from 1993 to 1994, while CPUE's decreased for Div. Vb in the same period. The Icelandic CPUE's (Va) have decreased since the late 1980'ies until 1996. From 1996 to 2001 CPUE's increased somewhat, but decline again after 2001. This might indicate different stock developments in the areas, but could also be artefacts, i.e. due to different behaviour of the fleets, fish migration between areas or difference in availability.

6.3 Catch-at-age

Otoliths have been sampled from the Icelandic fishery in 2003 but due to changes in the age-reading staff at MRI no readings were available at the time the WG met. The only available aged otoliths were from the Greenland survey in East Greenland. As this survey mainly catches younger fish than the commercial fishery, i.e. below age 8-9 and as length composition by age in the survey is expected to differ from the commercial fishery, attempts were not made to establish catch-at-age for the total catches. Since 2000 no age-disaggregated assessment have been conducted for Greenland halibut and the lack of a catch-at-age matrix do thus not prevent an update of stock assessment. When the otoliths sampled by Iceland is age-read, the catch-at-age matrix will be updated accordingly.

Length compositions of catches from the commercial trawl fishery in Div. Va are incredibly stable from year to year. In Fig. 6.3 is shown length distributions since 1985 from the western area of Iceland, comprising the most important fishing grounds. For all the years catches were in the range 40 – 100 cm with a mode at about 60 cm. The 2003 distribution do obviously not differ form the long-term average. A similar pattern has been observed for other areas within SA V and XIV although more noisy.

6.4 Weight-at-age

Due to lack of age-readings as described in Section 6.3 no weight-at-age is provided.

6.5 Maturity-at-age

Due to lack of age-readings as described in Sec. 6.3 no maturity-at-age is provided.

6.6 Survey information

Division Va

An October groundfish survey in Icelandic waters, covering the distributional area of Greenland halibut within the Icelandic EEZ, was started in 1996. The survey is a fixed station stratified random survey consisting of 300 stations on the continental shelf and slope down to a depth of 1300 m. An increase in the fishable biomass of Greenland halibut (fish of length equal to or greater than 50 cm) is observed from 1996 to 2001 (Figure 6.6.1b). Abundance indices of smaller fish (<50 cm) indicate signs of improved recruitment in 1998 and 1999 that may account for the increase in the estimated fishable biomass over the period. Since 2002 abundance fish between 40 and 60 cm decreased significantly below that observed in 2001. In the same period biomass indices decreased markedly for 40-60 cm fish Figure 6.6.1a.

Division Vb

Since 1995, a Faroese Greenland halibut survey has been carried out on the southern and eastern slope on the Faroe Plateau at depths of 400-600 m. In 1995, the survey was conducted in the first week of July and since then it has been conducted during the first two weeks in June. Usually the total number of hauls has been around 40, except in 1995 and 2003 when only about 24 stations were taken. The stations are not fixed; the skipper decides where and when the hauls are going to be taken and for how long time. Usually the whole area has been covered, except in 1995 and 1996 when only the southern and eastern part, respectively, were covered. Occasionally a few tows in shallower depths are taken. The majority of the catch consists of immature females (about 80 %). From that survey are selected hauls deeper than 450 m (all stations in 2003) to cover the areas where the commercial fishery takes place. Catch rates have generally been low in the survey, but the tendency since the start of the series is a gradual decline in catch rates (Fig. 6.6.3).

Division XIVb

Since 1998, a Greenland survey for Greenland halibut has been carried out in East Greenland waters from 60°N to 67°N at the main commercial fishing grounds at depths of 400-1500 m in late June/early July. No survey took place in 2001. In 2003 a total of 40 of the planned 70 stations were hauled. Total estimated biomass in 2003 was estimated at 14 000 t, which is a 7% decrease (not significant at the 95% level) from the 2002 biomass estimate (Fig. 6.6.2). Compared to the period 1999-2001, biomass estimates for the period 2002-2003 is somewhat lower, although not significant at the 5% level.

Also other indices have been made available from surveys not aimed at Greenland halibut. These surveys cover only very limited range of the total distribution of the Greenland halibut. The Icelandic groundfish spring survey has been conducted since 1985 mainly for cod, but has occasional catches of Greenland halibut in the deeper stations. Catch rates vary considerably, but generally decreases until recent years, where the index seems stable at very low values (Fig. 6.6.4). A shrimp survey has been conducted in northern waters of Iceland since 1987 and catch rates from this survey coincide with the trend from the spring groundfish survey, i.e. a decline throughout the time series to a minimum in recent years (Fig. 6.6.4).

Survey	No hauls in 2003	Depth range (m)	Coverage (km^2)
Va	150 (150)	500-1300	130 000
Vb	24 (40)	450-550	3 300
XIVb	40 (70)	400-1500	43 000

6.7 Stock Assessment

6.7.1 Age-based assessement

Age-disaggregated CPUE values for age groups 7–12 from the Icelandic trawling fleet operating in Division Va have previously been used in the XSA tuning assessments. Since 2000 the XSA assessment has been considered unreliable due to poor diagnostics mainly caused by inconsistent sampling and age readings (see section 6.9), and was thus

rejected as a basis for advice. No attempt was made this year to run an age-based assessment due to lack of age readings. In the 2002 NWWG report is given the historic trends in log(q) residuals and the retrospective pattern of F. Based on those plots the Working Group in 2002 decided that an XSA model was not a reliable estimator of recent stock history.

6.7.2 Stock production model

A stock-production model approach, ASPIC, have been performed since 2000, when the age-disaggregated assessment was considered unreliable. ASPIC requires series of catch data and indices of stock biomass, either corresponding effort, CPUE, or survey catch rates. Corresponding catch and effort data is available for Div. Va, (formerly used as a tuning fleet in the XSA), Vb and XIVb, and in addition several survey series (Figure 6.2.1 and Figure 6.6.4) were available:

Fleet and index	Period	Division
Icelandic trawler CPUE from GLIM	1973-2003	Va
Icelandic fall groundfish survey	1996-2003	Va
Icelandic shrimp fishery	1986-1994	Va
Icelandic shrimp survey	1987-2003	Va
Greenland trawler CPUE from GLIM	1991-2003	XIVb
Greenland spring deepwater bottom-trawl survey	1997-2000, 2002-3	XIVb
Faroese trawler CPUE from GLIM	1991-2003	Vb
Faroese deep-water survey	1995-2003	Vb

The Icelandic shrimp fishery no longer exploits Greenland halibut, because of implementation of sorting grids in recent years. It does thus not provide indices of recent stock trends and was thus not included in the model. Since the shrimp survey covers a relatively limited area, the index was also excluded as an input candidate into the model. The Greenland deepwater survey only consist of a short time series with lack of a 2001 survey and was therefore not used. A run using the remaining four indices failed due to conflicting trends for the CPUE series in Divs. XIVb and Vb in the early 1990'ies. For the two remaining indices — Icelandic trawler standardized CPUE and Icelandic groundfish survey — ASPIC was run with a reduced commercial time-series from 1985-2003, the fall groundfish survey from 1996-2003. The decision of using only a reduced time series is because the CPUE index from 1973 to 1985 may not be reliable as it is based on limited logbook material and may cover a learning period at the beginning of the fishery.

ASPIC was run fitting a logistic model conditioned on catch as in previous years. Initially ASPIC was run with different starting guesses of MSY, B ratio and r to explore stability of parameter estimation. For an appropriate range of input values, ASPIC results were stable. However, when comparing the estimates to previous years estimates, the perception of stock productivity, and biomass and fishery related to MSY are changing over the time (text table below).

Parameter\Year of assessment	**2000**	**2001**	**2002**	**2003**	**2004**
B85/K	0.67	0.72	0.71	0.75	0.51
K	179	210	204	228	272
MSY	38	36	36	35	36
Bmsy	89	105	102	114	136
Fmsy	0.42	0.34	0.36	0.3	0.26

Observed and estimated CPUE's are provided in Fig. 6.7.2.1 and Table 6.7.2.1. For both indices the modelled CPUE do not entirely reflect the short-term dynamics in the observed CPUE's each year. The low of the commercial CPUE's in 1996 is hardly detected and similar with the observed increase until 2001 followed by the decrease to 2003. For the survey indices the decrease in observed values since 2001 is only moderately reflected by the model. The state of the stock relative to F_{msy} and B_{msy} is given in Fig 6.7.2.2 and Table 6.7.2.1. Compared to the 2003 assessment, the perception of the stock and fishery is changed considerably. Biomass has since the start of the period decreased, and was already in 1989 below Bmsy. For the past 5-7 years the biomass has been stable at about 40% of B_{msy}. F has in nearly the entire time series been above Fmsy and in the last decade increased dramatically being in 2003 about twice Fmsy.

Retrospective analyses were carried out in the 2002 NWWG report for both B/Bmsy and F/Fmsy in order to exploit the consistency of ASPIC with the currently used CPUE series. ASPIC then behaved consistent when contrasting data were available, e.g. back to about 1997. However, with the addition of this year's observation, ASPIC changes the modelled indices and CPUE's substantially compared to previous years. This is illustrated in the historic performance of ASPIC

as given in Fig. 6.7.2.3. From the upper figures in Fig. 6.7.2.3. It is obvious that ASPIC reacts relatively strong to the decrease from 2002 to 2003 although the decrease already began a year before. This change in modelled indices results in a different historical perception of F and B in relation to MSY as seen from the lower part of Fig. 6.7.2.3. Therefore ASPIC most be considered a poor performer of the recent biomass dynamics that the CPUE and survey indices are considered to reflect.

6.7.3 Summary of the various observation data

A number of indices from the commercial fishery and from surveys are available as indicators for the biomass development. Although the indices are of different quality and are of different time length they indicate that stock dynamics may have been different in different areas in the most recent years:

- **Div. Va:** Icelandic trawl cpue (1985-2003) show that catch rates in 1993-2003 are less than half that observed in 1985-1989. In recent years catch rates increased from 1999 to 2001 but they have declined in the last three years and are currently 1/3 of that in 1985. The fall groundfish survey in Va (1996-2003) also indicate a decline in biomass in 2003 compared with previous years. A shrimp survey in the northern waters off Iceland (1987-2003), covering a limited area of whole distributional range of Greenland halibut indicate that the biomass in that area has been relatively low in recent years.

- **Div. Vb and XIVb:** The time series of the commercial indices as well as surveys from both Div. XIVb and Vb are relative short (approximately the last ten years) compared to the Icelandic trawler fleet and the Icelandic shrimp survey. None of these fleets show any clear trends over this period.

6.7.4 State of the stock

The present state of the stock is not known. Indices from Div. Va suggest a low biomass in recent years compared to the mid 1980'ies and a declining trend in the past two years. For the remaining areas, Divisions Vb and XIVb, the state of the stock in relation to a longer time perspective is unknown, but indices for the past decade point to stable stock components.

6.7.5 Stock projection

From calculated stock parameters and considered fishing regimes, ASPIC can project forward trajectories of population biomass and fishing mortality including uncertainty estimates based on bootstrapping. In all forward projections it was assumed that the catch in 2004 would be maintained at 30 000 t. This is based on a TAC in Icelandic waters that is maintained at 20 000 t and expected to be caught. Given that the landings in Vb and XIV will be the same as in recent years and that the Icelandic fleet will catch all its quota, it is anticipated that total landings in the year 2004 also will be in the order of 30 000 t. Three different trajectories were produced using the following options:

1) $F(2004\text{-}13)=2/3\mathbf{F}_{MSY}\sim\mathbf{F}_{pa}$,
2) $F(2004\text{-}13)=\mathbf{F}_{sq}$,
3) Catch(2004-2013)=30 000 t.

Plots of B-ratios ($B/\mathbf{B}_{MSY}$) are given in Figure 6.7.5 and biomass trajectory for option 1 only is given in Table 6.7.5. By fishing at $\mathbf{F}_{pa}$ ($2/3\mathbf{F}_{MSY}$) it is expected that the biomass will increase slowly above $\mathbf{B}_{MSY}$ by 2012 with a risk being below. Fishing at $\mathbf{F}_{sq}$ will result in a stock collapse within the next 5-6 years. Fishing at 30 000 t annually will also likely result in a stock collapse with a probability that stock biomass will remain very low. Landings in 2005 associated with the trajectories are 8 000 t at $\mathbf{F}_{pa}$ and 37 000 t at $\mathbf{F}_{sq}$. Compared to previous assessments, none of the projections in 2003 did result in a stock collapse.

6.7.6 Biological reference points

Defined reference points for Greenland halibut have previously been defined on the basis of an age-based analytical assessment. The Working Group considers it appropriate to define $\mathbf{F}_{pa}$ as 2/3 of $\mathbf{F}_{MSY}$ estimated from the stock-production model. Using 2/3 as $\mathbf{F}_{pa}$, $\mathbf{F}_{lim}$ could be calculated using $\mathbf{F}_{lim}=\mathbf{F}_{pa}*e^{1.645\sigma}$, where σ could be 0.30.

6.8 Management Considerations

No formal agreement on the management of the Greenland halibut exists among the three coastal states, Greenland, Iceland, and the Faroe Islands. The regulation schemes of those states have previously resulted in catches well in excess of TAC's advised by ICES.

Although the overall status of Greenland halibut in the assessment area is unknown, there are clear decreases in the CPUE from the Icelandic fishery from 1985. Normally, if a reduction in abundance of this magnitude is caused by high fishing mortality, larger fish would be expected to become progressively less abundant over time. In the Greenland halibut case, however, the size composition of the Icelandic catch on the principal fishing ground off the west coast have remained stable from 1985-2003 suggesting that fishing mortality is not affecting markedly the size composition of Greenland halibut in the area of the fishery. Such a discrepancy could be explained if the Icelandic fishing ground were regularly re-supplied by fish from neighbouring areas that are more lightly fished. Under this hypothesis, the decrease in abundance could be the result of the removal rate on the Icelandic ground being in excess of the re-supplying rate. If this hypothesis were true, the decrease in the survey index and in the CPUE would not necessarily cause concern for the conservation of the resource, but from a management perspective, however, there could be advantages in reducing fishing mortality to better match it with the hypothesised re-supplying rates from neighbouring areas. Given the uncertainties about overall stock size, stock structure, and abundance in the area of the fishery, a better mean to reduce fishing mortality could be through effort reductions rather than through TAC reductions.

6.9 Comments on the Assessment

It is noteworthy that even though there has been a substantial fluctuation in the commercial CPUE from Icelandic waters, the catch distribution from that area has kept relatively stable. This could be due to a limited availability of Greenland halibut to the fishery in combination with slow growth of the species, i.e. harvest occur on a relatively limited number of age groups in relation to the age range in the stock

The stock production model used to assess the status of the stock relies on the same trawler CPUE series as previously used in the XSA. This years output estimates of biomass and fishing mortality of the production model differs significantly from previous years ASPIC output and it is doubtful whether they represents the state of the stock in relation to MSY parameters. The lower biomass and higher exploitation as indicated by the model is driven by the most recent data points observed in 2003. Given the inertia of the ASPIC model it is not able to respond to the dynamics in observation data in recent year. This means that the observed biomass index decrease in recent years is not only considered due to fishing mortality but also other factors such as availability to fishery, migration etc.

Therefore, applying ASPIC bootstrap to the point estimates for catch projections as a basis for advice, will inevitability result in a considerable year to year variation in perception of stock production and thus also in expected catch for the forthcoming year. A stabilizer is therefore required …..

Use of other indices than the currently Icelandic (Va) CPUE series and survey series in the stock production model (ASPIC) should have been explored. CPUE series from XIVb and Vb are presently available, but due to 0 different trends than the Icelandic series it impedes inclusion in the ASPIC. Neither did they perform alone with catch related to their area, due to too short time series or to little contrast in data.

Table 6.1.1 GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Sub-areas V, XII and XIV 1981-2003, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	767	1,532	1,146	2,502	1,052	853	1,096	1,378	2,319
France	8	27	236	489	845	52	19	25	-
Germany	3,007	2,581	1,142	936	863	858	565	637	493
Greenland	+	1	5	15	81	177	154	37	11
Iceland	15,457	28,300	28,360	30,080	29,231	31,044	44,780	49,040	58,330
Norway	-	-	2	2	3	+	2	1	3
Russia	-	-	-	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	19,239	32,441	30,891	34,024	32,075	32,984	46,622	51,118	61,156
Working Group estimate	-	-	-	-	-	-	-	-	61,396

Country	1990	1991	1992	1993	1994	1995	1996 [1]	1997 [1]	1998 [1]
Denmark	-	-	-	-	-	-	1	-	
Faroe Islands	1,803	1,566	2,128	4,405	6,241	3,763	6,148	4,971	3,817
France	-	-	3	2	-	-	29	11	8
Germany	336	303	382	415	648	811	3,368	3,342	3,056
Greenland	40	66	437	288	867	533	1,162	1,129	747
Iceland	36,557	34,883	31,955	33,987	27,778	27,383	22,055	18,569	10,728
Norway	50	34	221	846	1,173 [1]	1,810	2,164	1,939	1,367
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	109	811	513	1,436	386	218	190
UK (Scotland)	-	-	19	26	84	232	25	26	43
United Kingdom									
Total	38,813	36,890	35,259	40,780	37,305	36,006	35,762	30,242	20,360
Working Group estimate	39,326	37,950	35,423	40,817	36,958	36,300	35,825	30,267	-

Country	1999 [1]	2000 [1]	2001 [1]	2002 [1]	2003 [1]
Denmark		-	0	0	0
Faroe Islands	3,884	-	0	0	0
France	-	21	25	20	33
Germany	3,082	3,271	2,807	2,148	2,948
Greenland	200	1,740	1,553		
Iceland	11,180	14,537	16,590	2,277	20,371
Ireland		-	7		
Norway	1,187	1,272	1,483	1,328	1,114
Portugal			6		
Russia	138	183	186	44	
Spain		8	10		
UK (Engl. and Wales)	261	370	227		
UK (Scotland)	69	121	130		
United Kingdom	-	-		239	1,205
Total	20,001	21,523	23,024	6,284	25,671
Working Group estimate	20,371	26,839	28,021	29,260	30,858

Table 6.1.2 GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Division Va 1981-2002, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	325	669	33	46			15	379	719
Germany									
Greenland									
Iceland	15,455	28,300	28,359	30,078	29,195	31,027	44,644	49,000	58,330
Norway			+	+	2				
Total	15,780	28,969	28,392	30,124	29,197	31,027	44,659	49,379	59,049
Working Group estimate									59,272 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Faroe Islands	739	273	23	166	910	13	14	26	6
Germany					1	2	4		9
Greenland					1				[1]
Iceland	36,557	34,883	31,955	33,968	27,696	27,376	22,055	16,766	10,580
Norway								[1]	[1]
Total	37,296	35,156	31,978	34,134	28,608	27,391	22,073	16,792	10,595
Working Group estimate	37,308 [2]	35,413 [2]							

Country	1999	2000	2001	2002	2003 [1]
Faroe Islands	9				
Germany	13	22	50	31	23
Greenland	[1]				
Iceland	11,087	14,507	2,310 [4]	2,277	20,371
Norway			6		
UK (E/W/I)	26	73	50	21	
UK Scottland	3	5	12	16	
UK				37	21
Total	11,138	14,607	2,428	2,382	20,415
Working Group estimate		14,519 [3]	16,752	19,714	

1) Provisional data

2) Includes 223 t catch by Norway.

3) Includes 12 t catch by Norway.

4) 14280 t fished in Icelandic EEZ, previously reported in Va, are in 2002 moved to ICES XIV b.

Table 6.1.3 GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Division Vb 1981-2003 as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	442	863	1,112	2,456	1,052	775	907	901	1,513
France	8	27	236	489	845	52	19	25	...
Germany	114	142	86	118	227	113	109	42	73
Greenland	-	-	-	-	-	-	-	-	-
Norway	2	+	2	2	2	+	2	1	3
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	566	1,032	1,436	3,065	2,126	940	1,043	969	1,589
Working Group estimate	-	-	-	-	-	-	-	-	1,606 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	-	-	
Faroe Islands	1,064	1,293	2,105	4,058	5,163	3,603	6,004	4750	3660
France [6]	...	...	3 [1]	2	1	28	29	11	8 [1]
Germany	43	24	71	24	8	1	21	41	
Greenland	-	-	-	-	-	-	-	-	
Norway	42	16	25	335	53	142	281	42 [1]	114 [1]
UK (Engl. and Wales)	-	-	1	15	-	31	122		
UK (Scotland)	-	-	1	-	-	27	12	26	43
United Kingdom	-	-	-	-	-				
Total	1,149	1,333	2,206	4,434	5,225	3,832	6,469	4,870	3825
Working Group estimate	1,282 [2]	1,662 [2]	2,269 [2]	-	-		-	-	0

Country	1999	2000 [1]	2001 [1]	2002 [1]	2003 [1]
Denmark					
Faroe Islands	3873				
France		21	25 [1]	20	33
Germany	22	6	7		
Iceland					
Ireland			+		
Norway	87	110 [1]	53 [1]	48	2
UK (Engl. and Wales)	9	35	77	50	
UK (Scotland)	66	116	118	141	
United Kingdom					197
Total	4057	288	280 2	259	232
Working Group estimate	2694 [2]	5092 [3]	3,951	2,694	2,426

1) Provisional data
2) WG estimate includes additional catches as described in Working Group reports for each year and in the report from 2001.

Table 6.1.4 GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Sub-area XIV 1981-2002, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	-	-	-	-	-	78	74	98	87
Germany	2,893	2,439	1,054	818	636	745	456	595	420
Greenland	+	1	5	15	81	177	154	37	11
Iceland	-	-	1	2	36	17	136	40	+
Norway	-	-	-	+	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	+
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	2,893	2,440	1,060	835	753	1,017	820	770	518
Working Group estimate	-	-	-	-	-	-	-	-	-

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	1	+	+
Faroe Islands	-	-	-	181	168	147	130	148	151
Germany	293	279	311	391	639	808	3,343	3,301	3,399
Greenland	40	66	437	288	866	533	1,162	1,129	747 [1,7]
Iceland	-	-	-	19	82	7	-	1,803	148
Norway	8	18	196	511	1,120	1,668	1,881	1,897 [1]	1,253 [1]
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	108	796	513	1405	264	218	190
UK (Scotland)	-	-	18	26	84	205	13		
United Kingdom	-	-	-	-	-	-	-		
Total	368	401	1,075	2,212	3,472	4,783	7,218	8,533	5940
Working Group estimate	736 [2]	875 [3]	1,176 [4]	2,249 [5]	3,125 [6]	5,077 [7]	7,283 [8]	8,558 [9]	

Country	1999	2000	2001 [1]	2002 [1]	2003 [1]
Denmark					
Faroe Islands	2				
Germany	3047	3243	2,750	2,117	2,925
Greenland	200 [1,4]	1740 [8]	1,553 [9]		
Iceland	93	30	14,280		
Ireland			7		
Norway	1100	1162 [1]	1,424	1,280	1,112
Portugal			6		
Russia	138	183	186	44	
Spain		8	10		
UK (Engl. and Wales)	226	262	100		
UK (Scotland)					
United Kingdom				202	987
Total	4806	6628	20,316	3,643 0	5,024
Working Group estimate	5376 [11]	6588 [5]	6,588 [6]	6,750 #	8,017 [10]

1) Provisional data

2)WG estimate includes additional catches as described in working Group reports for each year and in the report from 2001.

3) Includes 125 t by Faroe Islands and 206 t by Greenland.

4) Excluding 4732 t reported as area unknown.

5) Includes 1523 t by Norway, 102 t by Faroe Islands, 3343 t by Germany, 1910 t by Greenland, 180 t by Russia, as reported to Greenland authorities.

6) Includes 2849 t by Greenland, 142 t by Norway, 2750 t by Germany. Does not include 14280 t by Iceland as those are included in WG estimate of Va.

7) Excluding 138 t reported as area unknown.

8) Excluding 16 t reported as area unknown.

9) Excluding 20 t reported as area unknown

10) Includes 3370 t by Greenland, 3552 t as total for Germany and 959 t for Norway.

Table 6.1.5 GREENLAND HALIBUT. Nominal catches (tonnes) by countries in Sub-area XII, as officially reported to the ICES.

Country	1996	1997	1998	1999	2000	2001	2002	2003 [1]
Faroe Islands		47						
Norway	2							
Total	2	47	-	-	-			
WG estimate							102 [1]	

[1] 102t by Faroe Islands as reported to Faroe Island authorities

Table 6.1.6. 2003 Catch statistics for Greenland halibut in V and XIV.
Working Groups best estimates.

Va	Long line	Trawl	Gill Net	Unknown	SUM	"Official"
Faroe Islands					0	
Germany, Fed. Rep.		23			23	23
Greenland					0	
Iceland	65	18,905	1,383		20,353	20371
Norway					0	
UK (E/W/NI)					0	
UK (Scotland)					0	
UK					21	21
Total	65	18,928	1,383	0	20,376	20,415

Vb	Long line	Trawl	Gill Net	Unknown	SUM	"Official"
Faroe Islands				2,194	2,194	
France					33	33
Germany Fed. Rep.					0	
Norway					2	2
UK (England & Wales)					0	
UK (Scotland)					0	
United Kingdom					197	197
Total	0	0	0	2,194	2,194	232

XII	Long line	Trawl	Gill Net	Unknown	SUM	SUM
Faroe Islands					0	
Total	0	0	0	0	0	0

XIV	Long line	Trawl	Gill Net	Unknown	SUM	"Official"
Denmark					0	
Faroe Islands		136			136	
EU (GER)		3,552			3,552	2,925
Greenland		3,370			3,370	
Iceland (outside 200 EEZ)					0	
Norway (inside 200 EEZ)	423	536			959	1,112
Norway (outside 200 EEZ)					0	
Russia					0	
Ireland					0	
UK (England & Wales)					0	
UK (Scotland)					0	
United Kingdom					0	987
Total	423	7,594	0	0	8,017	5,024

Summary of catch by gear	Long line	Trawl	Gill Net	Unknown	SUM	SUM
	488	26,522	1,383	2,194	**30,587**	25,671

Table 6.2.1. CPUE indices oftrawl fleets in Div Va, Vb and XIVb as derived from GLM multiplicative models.

area	year	cpue	% change in CPUE between years	landings	effort	% change in effort between years
Iceland Va	1985	1.00		29,197	29	
	1986	0.91	-9	31,027	34	16
	1987	0.88	-3	44,659	51	49
	1988	0.96	9	49,379	51	2
	1989	0.91	-5	59,049	65	26
	1990	0.74	-19	37,308	50	-22
	1991	0.76	2	35,413	47	-7
	1992	0.65	-14	31,978	49	5
	1993	0.51	-23	34,134	68	38
	1994	0.41	-19	28,608	70	3
	1995	0.31	-24	27,391	88	26
	1996	0.26	-17	22,073	85	-3
	1997	0.29	11	16,792	58	-32
	1998	0.47	62	10,595	23	-61
	1999	0.54	15	11,138	21	-8
	2000	0.59	10	14,607	25	19
	2001	0.61	4	16,755	27	11
	2002	0.47	-24	19,714	42	54
	2003	0.33	-30	20,415	62	47
Greenland, XIVb	1991	1.00		875	1	
	1992	0.99	-1	1,176	1	36
	1993	1.18	19	2,249	2	60
	1994	1.27	7	3,125	2	30
	1995	1.23	-3	5,077	4	68
	1996	1.24	1	7,283	6	42
	1997	1.27	3	8,558	7	14
	1998	1.29	1	5,940	5	-31
	1999	1.24	-4	5,376	4	-6
	2000	1.26	1	6,958	6	28
	2001	1.23	-2	7,216	6	6
	2002	1.23	0	6,750	5	-7
	2003	1.25	1	8,017	6	17
Faroe Islands, Vb	1991	1.00		1,662	2	
	1992	1.01	1	2,269	2	35
	1993	0.95	-6	4,434	5	108
	1994	0.90	-6	5,225	6	25
	1995	0.88	-1	3,832	4	-26
	1996	0.88	0	6,469	7	70
	1997	0.86	-2	4,870	6	-23
	1998	0.88	3	3,825	4	-23
	1999	0.87	-1	4,265	5	13
	2000	0.87	0	5,079	6	20
	2001	0.88	1	3,245	4	-37
	2002	0.89	1	2,694	3	-18
	2003	0.92	4	2,426	3	-28

Table 6.7.2.1. Output from ASPIC model on CPUE series in Div. Va, total catches in Va, Vb and XIV and Icelandic fall survey indices.

```
ASPIC -- A Surplus-Production Model Including Covariates (Ver. 3.82)
FIT Mode

CONTROL PARAMETERS USED (FROM INPUT FILE)
-------------------------------------------------------------------------------------------------------
--------------------
Number of years analyzed:                          19            Number of bootstrap trials:
0
Number of data series:                              2            Lower bound on MSY:
2.000E+04
Objective function computed:                in effort            Upper bound on MSY:
1.800E+07
Relative conv. criterion (simplex):        1.000E-08            Lower bound on r:
2.000E-02
Relative conv. criterion (restart):        3.000E-08            Upper bound on r:
1.000E+01
Relative conv. criterion (effort):         1.000E-04            Random number seed:
5930561
Maximum F allowed in fitting:                  8.000            Monte Carlo search mode, trials:
1     10000


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

CORRELATION AMONG INPUT SERIES EXPRESSED AS CPUE (NUMBER OF PAIRWISE OBSERVATIONS BELOW)
-------------------------------------------------------------------------------------------------------
--------------------
                                      |
 1  cc va                             |   1.000
                                      |      19
                                      |
 2  survey va                         |   0.675   1.000
                                      |       8       8
                                      ------------------------------------------------
                                              1       2


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                      0.000E+00    1           N/A    0.000E+00
N/A
Loss( 1)  cc va                                    1.089E+00   19     6.404E-02    1.000E+00
9.760E-01        0.772
Loss( 2)  survey va                                3.548E-01    8     5.913E-02    1.000E+00
1.057E+00        0.273
TOTAL OBJECTIVE FUNCTION:                     1.44352199E+00

Number of restarts required for convergence:              51
Est. B-ratio coverage index (0 worst, 2 best):        0.7494               < 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 1985        1.130E+00         1.000E+00           1            1
MSY       Maximum sustainable yield                3.606E+04         6.000E+05           1            1
r         Intrinsic rate of increase               5.298E-01         6.000E-01           1            1
........  Catchability coefficients by fishery:
q( 1)     cc va                                    6.377E-03         5.000E-03           1            1
q( 2)     survey va                                6.575E-03         5.000E-03           1            1
```

Table 6.7.2.1 (Cont'd)

MANAGEMENT PARAMETER ESTIMATES (NON-BOOTSTRAPPED)

Parameter quantity		Estimate	Formula	Related
MSY	Maximum sustainable yield	3.606E+04	Kr/4	
K	Maximum stock biomass	2.722E+05		
Bmsy	Stock biomass at MSY	1.361E+05	K/2	
Fmsy	Fishing mortality at MSY	2.649E-01	r/2	
F(0.1)	Management benchmark	2.384E-01	0.9*Fmsy	
Y(0.1)	Equilibrium yield at F(0.1)	3.570E+04	0.99*MSY	
B-ratio	Ratio of B(2004) to Bmsy	4.109E-01		
F-ratio	Ratio of F(2003) to Fmsy	1.974E+00		
F01-mult	Ratio of F(0.1) to F(2003)	4.559E-01		
Y-ratio	Proportion of MSY avail in 2004	6.529E-01	2*Br-Br^2	Ye(2004) = 2.355E+04
.....	Fishing effort at MSY in units of each fishery:			
fmsy(1)	cc va	4.154E+01	r/2q(1)	f(0.1) = 3.739E+01

Page 2

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	1985	0.206	1.539E+05	1.556E+05	3.208E+04	3.208E+04	3.532E+04	7.782E-01	1.130E+00
2	1986	0.208	1.571E+05	1.582E+05	3.298E+04	3.298E+04	3.511E+04	7.868E-01	1.154E+00
3	1987	0.304	1.593E+05	1.533E+05	4.662E+04	4.662E+04	3.546E+04	1.148E+00	1.170E+00
4	1988	0.365	1.481E+05	1.401E+05	5.112E+04	5.112E+04	3.599E+04	1.378E+00	1.088E+00
5	1989	0.516	1.330E+05	1.190E+05	6.140E+04	6.140E+04	3.538E+04	1.948E+00	9.768E-01
6	1990	0.377	1.070E+05	1.042E+05	3.933E+04	3.933E+04	3.408E+04	1.424E+00	7.857E-01
7	1991	0.382	1.017E+05	9.936E+04	3.795E+04	3.795E+04	3.343E+04	1.442E+00	7.472E-01
8	1992	0.369	9.719E+04	9.589E+04	3.542E+04	3.542E+04	3.291E+04	1.394E+00	7.140E-01
9	1993	0.453	9.467E+04	9.002E+04	4.082E+04	4.082E+04	3.191E+04	1.712E+00	6.955E-01
10	1994	0.449	8.577E+04	8.237E+04	3.696E+04	3.696E+04	3.043E+04	1.694E+00	6.301E-01
11	1995	0.482	7.924E+04	7.537E+04	3.630E+04	3.630E+04	2.887E+04	1.818E+00	5.821E-01
12	1996	0.534	7.181E+04	6.708E+04	3.583E+04	3.583E+04	2.677E+04	2.016E+00	5.276E-01
13	1997	0.505	6.276E+04	5.990E+04	3.027E+04	3.027E+04	2.475E+04	1.907E+00	4.610E-01
14	1998	0.343	5.724E+04	5.938E+04	2.036E+04	2.036E+04	2.460E+04	1.294E+00	4.205E-01
15	1999	0.317	6.148E+04	6.432E+04	2.037E+04	2.037E+04	2.602E+04	1.195E+00	4.516E-01
16	2000	0.400	6.713E+04	6.711E+04	2.684E+04	2.684E+04	2.679E+04	1.510E+00	4.932E-01
17	2001	0.422	6.708E+04	6.635E+04	2.802E+04	2.802E+04	2.659E+04	1.594E+00	4.928E-01
18	2002	0.458	6.565E+04	6.393E+04	2.926E+04	2.926E+04	2.592E+04	1.728E+00	4.823E-01
19	2003	0.523	6.231E+04	5.900E+04	3.086E+04	3.086E+04	2.448E+04	1.974E+00	4.577E-01
20	2004		5.593E+04						4.109E-01

RESULTS FOR DATA SERIES # 1 (NON-BOOTSTRAPPED) cc va

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	1985	1.000E+03	9.922E+02	0.2062	3.208E+04	3.208E+04	-0.00781	0.000E+00
2	1986	9.140E+02	1.009E+03	0.2084	3.298E+04	3.298E+04	0.09907	0.000E+00
3	1987	8.820E+02	9.779E+02	0.3041	4.662E+04	4.662E+04	0.10317	0.000E+00
4	1988	9.600E+02	8.932E+02	0.3650	5.112E+04	5.112E+04	-0.07212	0.000E+00
5	1989	9.130E+02	7.589E+02	0.5160	6.140E+04	6.140E+04	-0.18488	0.000E+00
6	1990	7.440E+02	6.647E+02	0.3773	3.933E+04	3.933E+04	-0.11272	0.000E+00
7	1991	7.570E+02	6.337E+02	0.3820	3.795E+04	3.795E+04	-0.17786	0.000E+00
8	1992	6.530E+02	6.115E+02	0.3694	3.542E+04	3.542E+04	-0.06564	0.000E+00
9	1993	5.060E+02	5.741E+02	0.4534	4.082E+04	4.082E+04	0.12623	0.000E+00
10	1994	4.110E+02	5.253E+02	0.4487	3.696E+04	3.696E+04	0.24544	0.000E+00
11	1995	3.130E+02	4.807E+02	0.4816	3.630E+04	3.630E+04	0.42903	0.000E+00
12	1996	2.590E+02	4.278E+02	0.5340	3.583E+04	3.583E+04	0.50190	0.000E+00
13	1997	2.880E+02	3.820E+02	0.5053	3.027E+04	3.027E+04	0.28256	0.000E+00
14	1998	4.660E+02	3.787E+02	0.3429	2.036E+04	2.036E+04	-0.20752	0.000E+00
15	1999	5.350E+02	4.102E+02	0.3167	2.037E+04	2.037E+04	-0.26557	0.000E+00
16	2000	5.890E+02	4.280E+02	0.3999	2.684E+04	2.684E+04	-0.31935	0.000E+00
17	2001	6.120E+02	4.231E+02	0.4223	2.802E+04	2.802E+04	-0.36901	0.000E+00
18	2002	4.670E+02	4.077E+02	0.4577	2.926E+04	2.926E+04	-0.13577	0.000E+00
19	2003	3.290E+02	3.763E+02	0.5230	3.086E+04	3.086E+04	0.13423	0.000E+00

Table 6.7.2.1.cont'd

```
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    ----------------------------------------------------------------------------------
---
1985    -0.0078                                          |
1986     0.0991                                          |====
1987     0.1032                                          |====
1988    -0.0721                                      ===|
1989    -0.1849                                  =======|
1990    -0.1127                                    =====|
1991    -0.1779                                  =======|
1992    -0.0656                                      ===|
1993     0.1262                                          |=====
1994     0.2454                                          |==========
1995     0.4290                                          |==================
1996     0.5019                                          |====================
1997     0.2826                                          |==========
1998    -0.2075                                  ========|
1999    -0.2656                                ==========|
2000    -0.3194                              ============|
2001    -0.3690                            ==============|
2002    -0.1358                                    =====|
2003     0.1342                                          |=====
                  ----------------------------------------------------------------------------------
RESULTS FOR DATA SERIES # 2 (NON-BOOTSTRAPPED)                                 survey va
--------------------------------------------------------------------------------------------------------
--------------------
Data type I2: End-of-year biomass index                                        Series weight:  1.000

                Observed    Estimated    Estim     Observed        Model    Resid in     Resid in
Obs    Year       effort       effort        F        index        index   log index        index

  1    1985    0.000E+00    0.000E+00      0.0     *           1.033E+03     0.00000    0.0
  2    1986    0.000E+00    0.000E+00      0.0     *           1.047E+03     0.00000    0.0
  3    1987    0.000E+00    0.000E+00      0.0     *           9.737E+02     0.00000    0.0
  4    1988    0.000E+00    0.000E+00      0.0     *           8.743E+02     0.00000    0.0
  5    1989    0.000E+00    0.000E+00      0.0     *           7.032E+02     0.00000    0.0
  6    1990    0.000E+00    0.000E+00      0.0     *           6.687E+02     0.00000    0.0
  7    1991    0.000E+00    0.000E+00      0.0     *           6.390E+02     0.00000    0.0
  8    1992    0.000E+00    0.000E+00      0.0     *           6.225E+02     0.00000    0.0
  9    1993    0.000E+00    0.000E+00      0.0     *           5.639E+02     0.00000    0.0
 10    1994    0.000E+00    0.000E+00      0.0     *           5.210E+02     0.00000    0.0
 11    1995    0.000E+00    0.000E+00      0.0     *           4.721E+02     0.00000    0.0
 12    1996    1.000E+00    1.000E+00      0.0    3.440E+02    4.126E+02    -0.18190   -6.863E+01
 13    1997    1.000E+00    1.000E+00      0.0    4.200E+02    3.764E+02     0.10971    4.364E+01
 14    1998    1.000E+00    1.000E+00      0.0    4.200E+02    4.042E+02     0.03832    1.579E+01
 15    1999    1.000E+00    1.000E+00      0.0    5.240E+02    4.414E+02     0.17160    8.263E+01
 16    2000    1.000E+00    1.000E+00      0.0    3.960E+02    4.411E+02    -0.10778   -4.506E+01
 17    2001    1.000E+00    1.000E+00      0.0    5.570E+02    4.316E+02     0.25498    1.254E+02
 18    2002    1.000E+00    1.000E+00      0.0    4.720E+02    4.097E+02     0.14166    6.234E+01
 19    2003    1.000E+00    1.000E+00      0.0    2.400E+02    3.677E+02    -0.42667   -1.277E+02

* Asterisk indicates missing value(s).
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    ----------------------------------------------------------------------------------
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    -0.1819                                  ========|
1997     0.1097                                          |====
1998     0.0383                                          |==
1999     0.1716                                          |=======
2000    -0.1078                                     =====|
2001     0.2550                                          |==========
2002     0.1417                                          |======
2003    -0.4267                            ==============|
```

Table 6.7.5. Trajectories from ASPIC assuming Catch = 30,000 t in 2004 and F2005-2013 =Fpa (~2/3Fmsy).

```
USER CONTROL INFORMATION (FROM INPUT FILE)
--------------------------------------------------
Name of biomass (BIO) file             ghl8503.bio
Name of output file (this file)        ghlboot_catc
Number of years of projections         10

CAUTION: ASPIC-P is designed for SHORT-TERM projections.  Projections longer than 5 years are increasingly
uncertain.
```

Year	Input data	User data type
2004	3.000E+04	TAC
2005	3.050E-01	F/F(2003)
2006	3.050E-01	F/F(2003)
2007	3.050E-01	F/F(2003)
2008	3.050E-01	F/F(2003)
2009	3.050E-01	F/F(2003)
2010	3.050E-01	F/F(2003)
2011	3.050E-01	F/F(2003)
2012	3.050E-01	F/F(2003)
2013	3.050E-01	F/F(2003)

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
1985	9.440E-01	1.058E+00	12.10%	3.807E-01	2.081E+00	6.046E-01	1.426E+00	8.210E-01	0.870
1986	1.004E+00	1.097E+00	9.24%	4.033E-01	1.848E+00	6.480E-01	1.382E+00	7.341E-01	0.731
1987	1.039E+00	1.127E+00	8.40%	4.518E-01	1.684E+00	7.111E-01	1.352E+00	6.406E-01	0.616
1988	9.827E-01	1.053E+00	7.17%	4.504E-01	1.503E+00	6.940E-01	1.225E+00	5.312E-01	0.541
1989	8.929E-01	9.468E-01	6.04%	4.260E-01	1.303E+00	6.405E-01	1.078E+00	4.376E-01	0.490
1990	7.191E-01	7.536E-01	4.81%	3.867E-01	1.146E+00	5.571E-01	8.912E-01	3.341E-01	0.465
1991	6.857E-01	7.181E-01	4.73%	3.714E-01	1.072E+00	5.322E-01	8.409E-01	3.087E-01	0.450
1992	6.565E-01	6.880E-01	4.79%	3.598E-01	1.006E+00	5.119E-01	7.945E-01	2.826E-01	0.430
1993	6.412E-01	6.733E-01	5.01%	3.430E-01	9.258E-01	4.823E-01	7.574E-01	2.751E-01	0.429
1994	5.811E-01	6.092E-01	4.83%	3.197E-01	8.529E-01	4.529E-01	6.883E-01	2.355E-01	0.405
1995	5.369E-01	5.625E-01	4.77%	2.994E-01	8.009E-01	4.239E-01	6.355E-01	2.116E-01	0.394
1996	4.870E-01	5.081E-01	4.33%	2.734E-01	7.449E-01	3.841E-01	5.758E-01	1.916E-01	0.393
1997	4.206E-01	4.396E-01	4.51%	2.549E-01	7.266E-01	3.410E-01	5.263E-01	1.853E-01	0.441
1998	3.871E-01	3.963E-01	2.40%	2.273E-01	7.244E-01	3.075E-01	5.136E-01	2.061E-01	0.532
1999	4.143E-01	4.277E-01	3.23%	2.461E-01	7.472E-01	3.292E-01	5.398E-01	2.105E-01	0.508
2000	4.550E-01	4.712E-01	3.55%	2.679E-01	7.559E-01	3.622E-01	5.560E-01	1.938E-01	0.426
2001	4.557E-01	4.717E-01	3.50%	2.704E-01	7.427E-01	3.652E-01	5.635E-01	1.983E-01	0.435
2002	4.463E-01	4.616E-01	3.45%	2.653E-01	7.327E-01	3.581E-01	5.614E-01	2.033E-01	0.456
2003	4.258E-01	4.365E-01	2.50%	2.444E-01	7.067E-01	3.269E-01	5.429E-01	2.161E-01	0.507
2004	3.600E-01	3.719E-01	3.30%	1.877E-01	6.842E-01	2.620E-01	5.086E-01	2.467E-01	0.685
2005	2.814E-01	3.010E-01	6.98%	6.061E-02	6.322E-01	1.476E-01	4.493E-01	3.017E-01	1.072
2006	3.838E-01	4.005E-01	4.36%	8.638E-02	7.602E-01	2.117E-01	5.848E-01	3.731E-01	0.972
2007	5.096E-01	5.166E-01	1.37%	1.312E-01	9.165E-01	2.977E-01	7.401E-01	4.424E-01	0.868
2008	6.429E-01	6.433E-01	0.07%	1.862E-01	1.041E+00	3.986E-01	8.688E-01	4.702E-01	0.731
2009	7.905E-01	7.721E-01	-2.32%	2.726E-01	1.181E+00	5.386E-01	1.022E+00	4.836E-01	0.612
2010	9.270E-01	8.938E-01	-3.59%	3.845E-01	1.300E+00	6.751E-01	1.161E+00	4.854E-01	0.524
2011	1.052E+00	1.001E+00	-4.82%	5.009E-01	1.383E+00	8.114E-01	1.259E+00	4.477E-01	0.426
2012	1.140E+00	1.090E+00	-4.44%	5.796E-01	1.434E+00	9.063E-01	1.323E+00	4.166E-01	0.365
2013	1.210E+00	1.160E+00	-4.13%	6.627E-01	1.464E+00	9.785E-01	1.370E+00	3.917E-01	0.324
2014	1.259E+00	1.213E+00	-3.70%	7.475E-01	1.491E+00	1.048E+00	1.404E+00	3.558E-01	0.283

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

Table 6.7.5 cont'd

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
1985	8.154E-01	7.965E-01	-2.33%	5.544E-01	1.192E+00	6.549E-01	1.004E+00	3.495E-01	0.429
1986	8.032E-01	7.939E-01	-1.15%	6.134E-01	1.099E+00	6.909E-01	9.427E-01	2.518E-01	0.313
1987	1.156E+00	1.148E+00	-0.72%	9.526E-01	1.492E+00	1.030E+00	1.315E+00	2.846E-01	0.246
1988	1.382E+00	1.374E+00	-0.58%	1.191E+00	1.726E+00	1.262E+00	1.532E+00	2.700E-01	0.195
1989	1.967E+00	1.951E+00	-0.81%	1.720E+00	2.378E+00	1.816E+00	2.167E+00	3.501E-01	0.178
1990	1.442E+00	1.433E+00	-0.63%	1.260E+00	1.723E+00	1.344E+00	1.571E+00	2.266E-01	0.157
1991	1.456E+00	1.447E+00	-0.61%	1.294E+00	1.715E+00	1.361E+00	1.577E+00	2.163E-01	0.149
1992	1.403E+00	1.394E+00	-0.62%	1.270E+00	1.646E+00	1.321E+00	1.512E+00	1.910E-01	0.136
1993	1.716E+00	1.709E+00	-0.42%	1.565E+00	1.974E+00	1.622E+00	1.825E+00	2.034E-01	0.119
1994	1.704E+00	1.692E+00	-0.71%	1.560E+00	1.965E+00	1.620E+00	1.822E+00	2.026E-01	0.119
1995	1.838E+00	1.820E+00	-0.96%	1.688E+00	2.131E+00	1.753E+00	1.962E+00	2.095E-01	0.114
1996	2.048E+00	2.032E+00	-0.79%	1.740E+00	2.320E+00	1.904E+00	2.162E+00	2.030E-01	0.099
1997	1.929E+00	1.943E+00	0.72%	1.506E+00	2.160E+00	1.747E+00	2.052E+00	3.051E-01	0.158
1998	1.311E+00	1.323E+00	0.89%	9.953E-01	1.490E+00	1.168E+00	1.409E+00	2.414E-01	0.184
1999	1.201E+00	1.214E+00	1.08%	9.294E-01	1.361E+00	1.087E+00	1.281E+00	1.946E-01	0.162
2000	1.515E+00	1.525E+00	0.63%	1.237E+00	1.742E+00	1.397E+00	1.622E+00	2.253E-01	0.149
2001	1.594E+00	1.609E+00	0.89%	1.272E+00	1.870E+00	1.436E+00	1.715E+00	2.788E-01	0.175
2002	1.728E+00	1.747E+00	1.08%	1.338E+00	2.109E+00	1.532E+00	1.914E+00	3.826E-01	0.221
2003	2.124E+00	2.154E+00	1.41%	1.512E+00	3.374E+00	1.794E+00	2.602E+00	6.871E-01	0.323
2004	2.382E+00	2.401E+00	0.78%	1.485E+00	4.659E+00	1.868E+00	3.196E+00	1.328E+00	0.558
2005	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2006	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2007	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2008	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2009	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2010	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2011	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2012	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323
2013	6.480E-01	6.571E-01	1.41%	4.610E-01	8.678E-01	5.471E-01	7.567E-01	2.096E-01	0.323

TABLE OF PROJECTED YIELDS

2004	3.000E+04	3.000E+04	0.00%	3.000E+04	3.000E+04	3.000E+04	3.000E+04	0.000E+00	0.000
2005	**8.323E+03**	8.569E+03	2.95%	3.070E+03	1.013E+04	6.093E+03	9.501E+03	3.408E+03	0.409
2006	1.203E+04	1.122E+04	-6.74%	9.113E+03	1.572E+04	1.050E+04	1.389E+04	3.384E+03	0.281
2007	1.598E+04	1.422E+04	-11.03%	1.154E+04	2.117E+04	1.352E+04	1.907E+04	5.556E+03	0.348
2008	2.011E+04	1.737E+04	-13.61%	1.358E+04	2.629E+04	1.641E+04	2.372E+04	7.314E+03	0.364
2009	2.392E+04	2.046E+04	-14.47%	1.575E+04	3.117E+04	1.961E+04	2.760E+04	7.987E+03	0.334
2010	2.721E+04	2.328E+04	-14.46%	1.740E+04	3.591E+04	2.229E+04	3.133E+04	9.036E+03	0.332
2011	2.983E+04	2.569E+04	-13.88%	1.812E+04	4.004E+04	2.378E+04	3.339E+04	9.606E+03	0.322
2012	3.187E+04	2.763E+04	-13.30%	1.976E+04	4.321E+04	2.577E+04	3.578E+04	1.001E+04	0.314
2013	3.364E+04	2.914E+04	-13.39%	2.133E+04	4.717E+04	2.763E+04	3.866E+04	1.103E+04	0.328

TRAJECTORY OF ABSOLUTE 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
1985	1.196E+05	1.375E+05	14.94%	7.210E+04	3.284E+05	8.826E+04	1.976E+05	1.093E+05	0.914
1986	1.309E+05	1.425E+05	8.85%	8.195E+04	3.141E+05	9.952E+04	1.996E+05	1.001E+05	0.764
1987	1.388E+05	1.464E+05	5.48%	9.662E+04	3.083E+05	1.106E+05	2.084E+05	9.775E+04	0.704
1988	1.309E+05	1.368E+05	4.56%	9.451E+04	2.809E+05	1.060E+05	1.919E+05	8.590E+04	0.656
1989	1.182E+05	1.230E+05	4.07%	8.767E+04	2.504E+05	9.668E+04	1.713E+05	7.464E+04	0.632
1990	9.359E+04	9.791E+04	4.62%	6.641E+04	2.168E+05	7.465E+04	1.426E+05	6.791E+04	0.726
1991	8.893E+04	9.330E+04	4.91%	6.389E+04	2.052E+05	7.190E+04	1.341E+05	6.224E+04	0.700
1992	8.506E+04	8.938E+04	5.08%	6.194E+04	1.922E+05	6.940E+04	1.270E+05	5.759E+04	0.677
1993	8.345E+04	8.749E+04	4.84%	6.206E+04	1.810E+05	6.924E+04	1.211E+05	5.190E+04	0.622
1994	7.544E+04	7.915E+04	4.91%	5.587E+04	1.660E+05	6.240E+04	1.086E+05	4.615E+04	0.612
1995	6.954E+04	7.309E+04	5.11%	5.191E+04	1.549E+05	5.789E+04	1.011E+05	4.316E+04	0.621
1996	6.268E+04	6.602E+04	5.32%	4.642E+04	1.441E+05	5.196E+04	9.163E+04	3.967E+04	0.633
1997	5.382E+04	5.711E+04	6.12%	3.846E+04	1.334E+05	4.373E+04	8.298E+04	3.926E+04	0.729
1998	4.807E+04	5.150E+04	7.12%	3.257E+04	1.273E+05	3.782E+04	7.782E+04	3.999E+04	0.832
1999	5.211E+04	5.557E+04	6.64%	3.594E+04	1.319E+05	4.151E+04	8.253E+04	4.102E+04	0.787
2000	5.792E+04	6.122E+04	5.69%	4.146E+04	1.379E+05	4.744E+04	8.805E+04	4.061E+04	0.701
2001	5.836E+04	6.129E+04	5.02%	4.223E+04	1.352E+05	4.797E+04	8.702E+04	3.905E+04	0.669
2002	5.709E+04	5.998E+04	5.05%	4.172E+04	1.307E+05	4.684E+04	8.397E+04	3.713E+04	0.650
2003	5.377E+04	5.671E+04	5.46%	3.886E+04	1.287E+05	4.400E+04	8.210E+04	3.810E+04	0.709
2004	4.485E+04	4.832E+04	7.74%	2.806E+04	1.160E+05	3.343E+04	7.120E+04	3.777E+04	0.842
2005	3.357E+04	3.911E+04	16.52%	6.034E+03	9.802E+04	1.711E+04	5.673E+04	3.963E+04	1.181
2006	4.463E+04	5.204E+04	16.61%	6.421E+03	1.079E+05	2.264E+04	6.872E+04	4.608E+04	1.033
2007	5.848E+04	6.712E+04	14.78%	7.188E+03	1.169E+05	2.861E+04	8.320E+04	5.459E+04	0.933
2008	7.506E+04	8.359E+04	11.37%	9.805E+03	1.324E+05	3.950E+04	1.008E+05	6.127E+04	0.816
2009	9.215E+04	1.003E+05	8.87%	2.023E+04	1.528E+05	5.641E+04	1.208E+05	6.439E+04	0.699
2010	1.097E+05	1.161E+05	5.83%	3.445E+04	1.694E+05	7.335E+04	1.377E+05	6.435E+04	0.586
2011	1.263E+05	1.301E+05	2.97%	5.448E+04	1.894E+05	9.475E+04	1.567E+05	6.192E+04	0.490
2012	1.394E+05	1.416E+05	1.57%	7.524E+04	2.072E+05	1.115E+05	1.715E+05	5.996E+04	0.430
2013	1.492E+05	1.507E+05	0.99%	8.995E+04	2.198E+05	1.223E+05	1.821E+05	5.989E+04	0.401
2014	1.562E+05	1.576E+05	0.87%	1.052E+05	2.307E+05	1.304E+05	1.909E+05	6.053E+04	0.387

Table 6.7.5 cont'd

TRAJECTORY OF ABSOLUTE 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
1985	2.511E-01	2.289E-01	-8.85%	1.001E-01	4.157E-01	1.599E-01	3.408E-01	1.809E-01	0.720
1986	2.420E-01	2.282E-01	-5.73%	1.061E-01	3.690E-01	1.600E-01	3.136E-01	1.536E-01	0.635
1987	3.443E-01	3.299E-01	-4.18%	1.577E-01	4.881E-01	2.331E-01	4.320E-01	1.989E-01	0.578
1988	4.094E-01	3.948E-01	-3.55%	1.939E-01	5.607E-01	2.856E-01	5.064E-01	2.208E-01	0.539
1989	5.832E-01	5.608E-01	-3.85%	2.649E-01	8.066E-01	3.954E-01	7.250E-01	3.296E-01	0.565
1990	4.303E-01	4.117E-01	-4.30%	1.898E-01	6.049E-01	2.886E-01	5.365E-01	2.479E-01	0.576
1991	4.344E-01	4.158E-01	-4.27%	1.933E-01	6.041E-01	2.918E-01	5.369E-01	2.451E-01	0.564
1992	4.175E-01	4.007E-01	-4.03%	1.905E-01	5.711E-01	2.860E-01	5.107E-01	2.247E-01	0.538
1993	5.132E-01	4.911E-01	-4.31%	2.366E-01	6.943E-01	3.595E-01	6.223E-01	2.629E-01	0.512
1994	5.079E-01	4.863E-01	-4.24%	2.313E-01	6.867E-01	3.539E-01	6.154E-01	2.615E-01	0.515
1995	5.483E-01	5.231E-01	-4.61%	2.431E-01	7.408E-01	3.783E-01	6.624E-01	2.841E-01	0.518
1996	6.146E-01	5.839E-01	-5.00%	2.597E-01	8.491E-01	4.136E-01	7.524E-01	3.388E-01	0.551
1997	5.904E-01	5.584E-01	-5.42%	2.319E-01	8.540E-01	3.768E-01	7.435E-01	3.667E-01	0.621
1998	4.031E-01	3.802E-01	-5.67%	1.570E-01	5.964E-01	2.551E-01	5.132E-01	2.581E-01	0.640
1999	3.680E-01	3.488E-01	-5.24%	1.504E-01	5.237E-01	2.375E-01	4.565E-01	2.190E-01	0.595
2000	4.599E-01	4.382E-01	-4.73%	1.958E-01	6.413E-01	3.082E-01	5.608E-01	2.526E-01	0.549
2001	4.822E-01	4.623E-01	-4.12%	2.108E-01	6.669E-01	3.302E-01	5.886E-01	2.584E-01	0.536
2002	5.249E-01	5.019E-01	-4.37%	2.220E-01	7.215E-01	3.446E-01	6.364E-01	2.918E-01	0.556
2003	6.528E-01	6.191E-01	-5.15%	2.652E-01	1.324E+00	4.290E-01	9.281E-01	4.202E-01	0.644
2004	7.505E-01	6.900E-01	-8.07%	2.845E-01	2.014E+00	4.776E-01	1.224E+00	7.466E-01	0.995
2005	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2006	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2007	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2008	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2009	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2010	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2011	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2012	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644
2013	1.991E-01	1.888E-01	-5.15%	8.087E-02	2.970E-01	1.308E-01	2.590E-01	1.282E-01	0.644

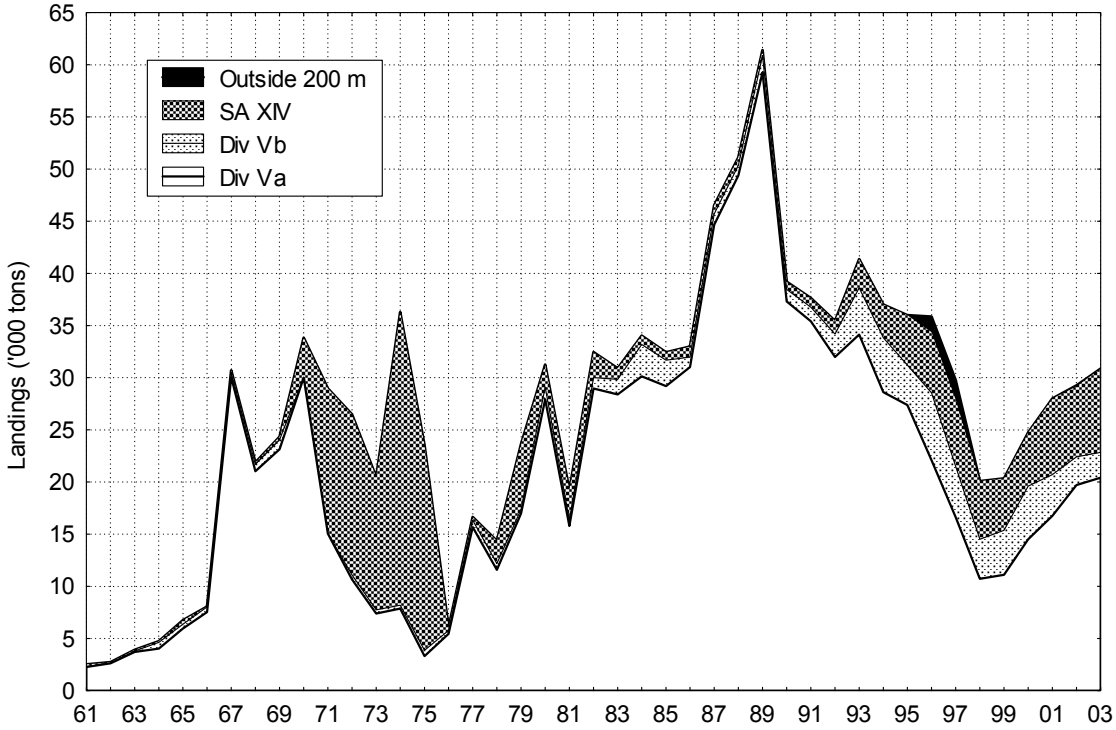


Figure 6.1.1 Landings of Greenland halibut in Divisions Va, Vb, and Subarea XIV. As the landings within Icelandic waters, since 1976, have not officially been separated and reported according to the defined ICES statistical areas, they are set under area Va by the North Western Working Group.

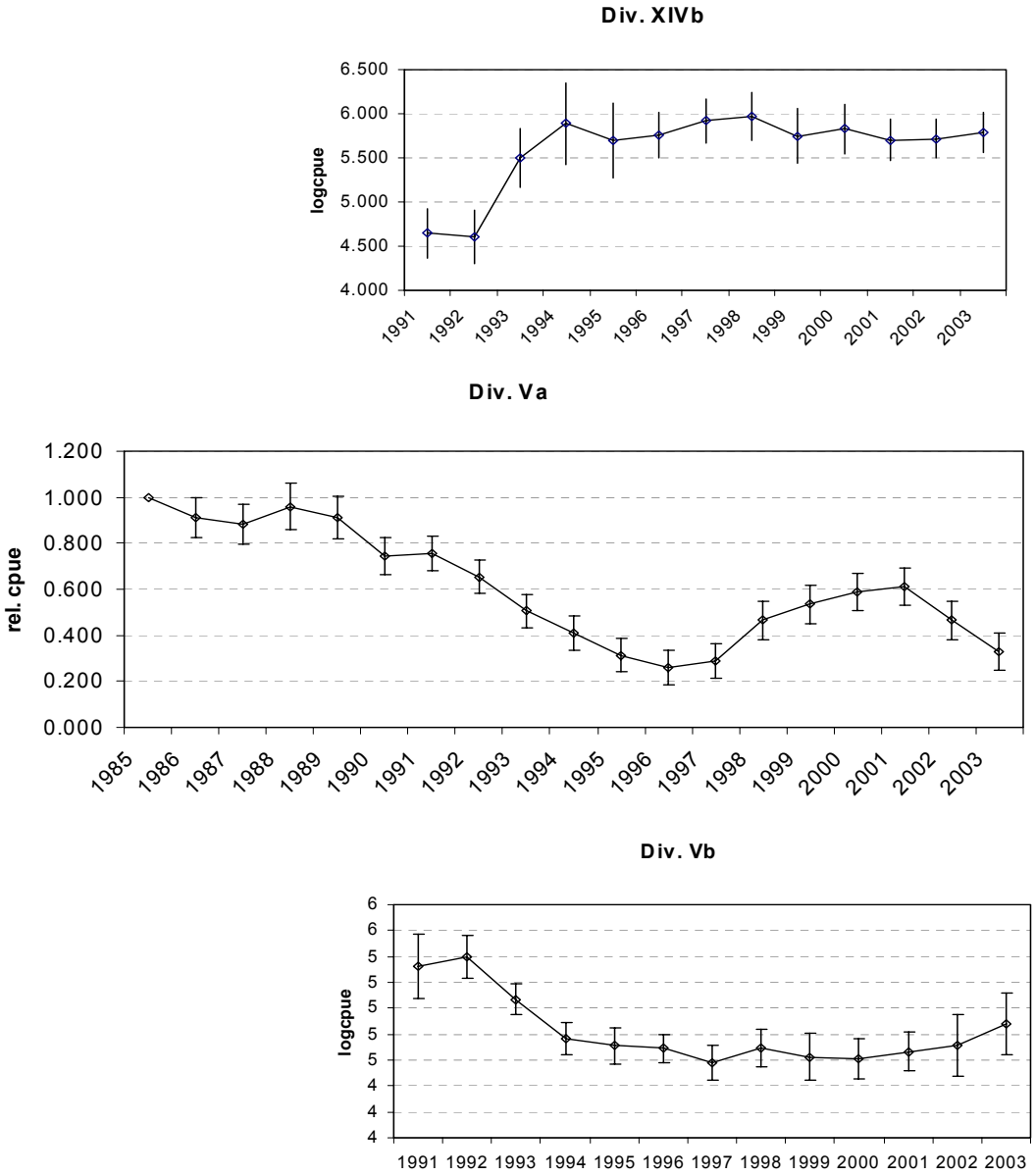


Figure 6.2.1. Standardised CPUE series from fleets in Divisions XIVb, Va and Vb with indication of 95% CI.

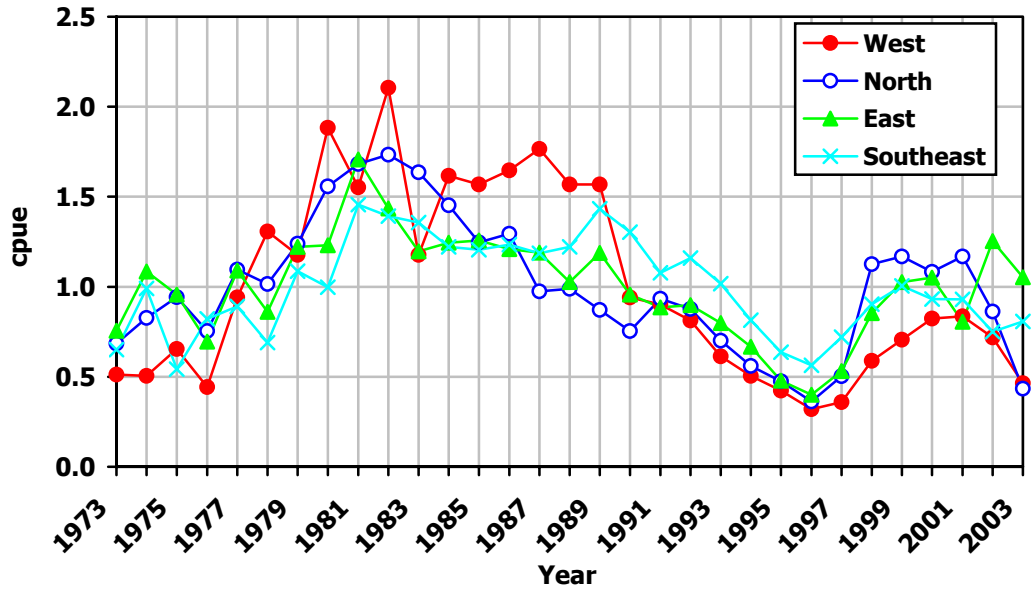


Figure. 6.2.2. Standardised CPUE from Icelandic trawlers from four areas around Iceland.

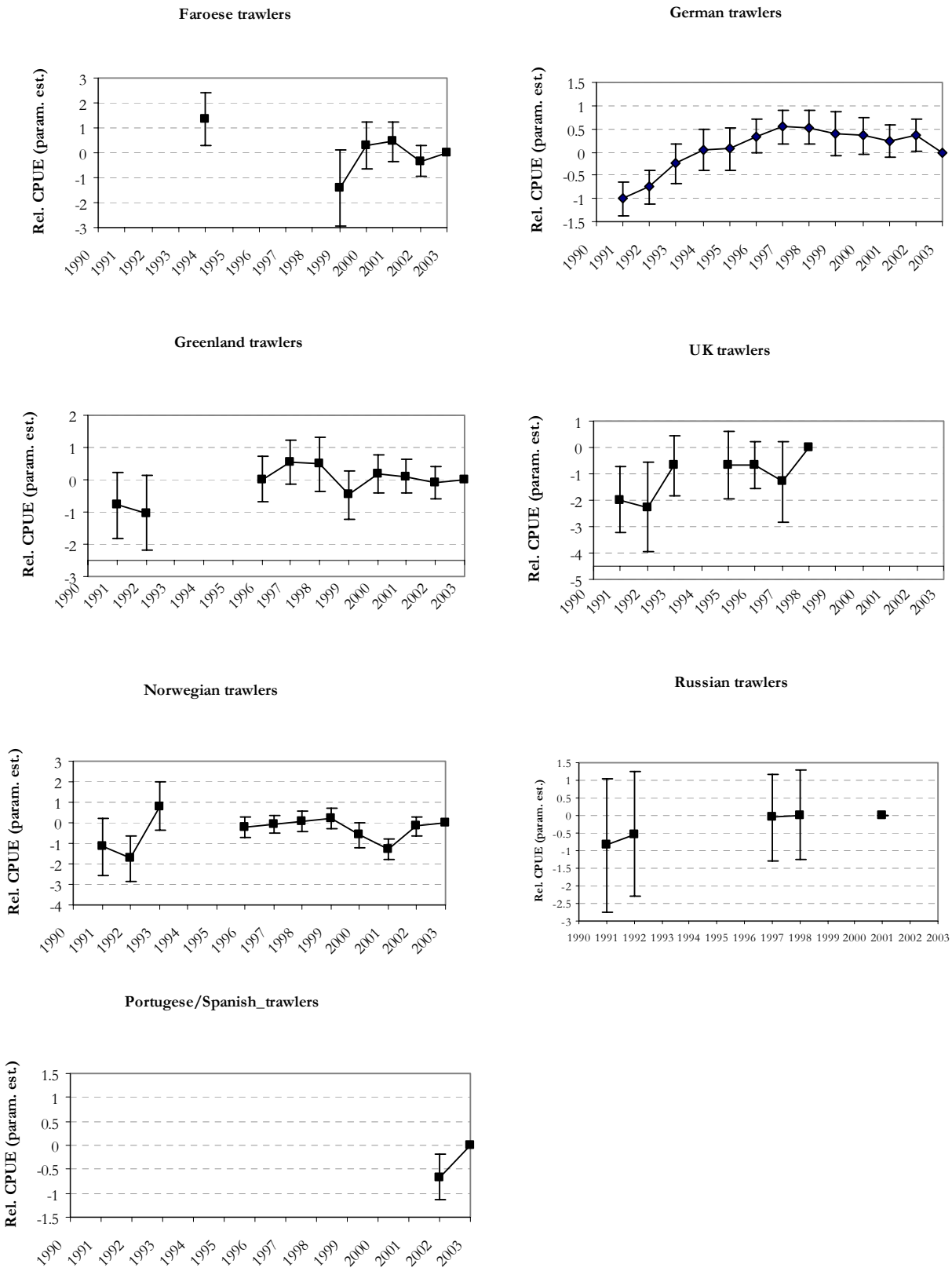


Figure. 6.2.3. Standardised CPUE series from individual fleets in Div. XIVb.

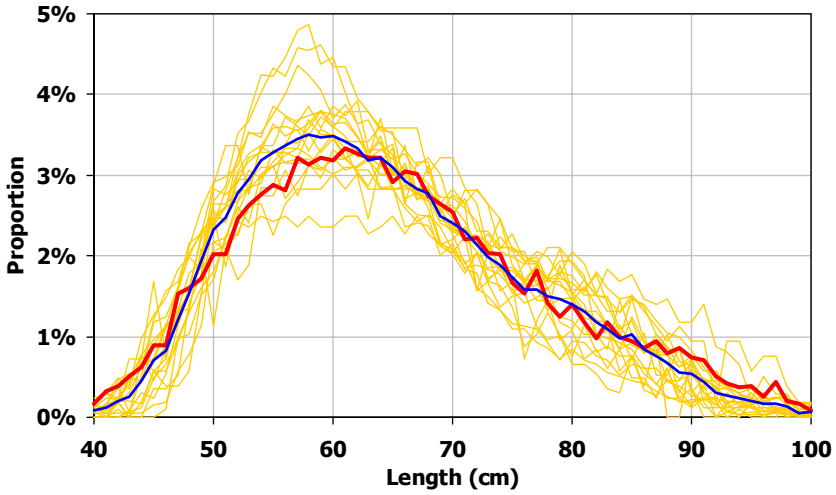


Figure 6.3 Length distributions from the commercial trawlfishery in the western fishing grounds of Iceland (Va) in the years 1985 – 2003. The thin solid line is average of 1985-2003 and the thick solid line is 2003 distribution.

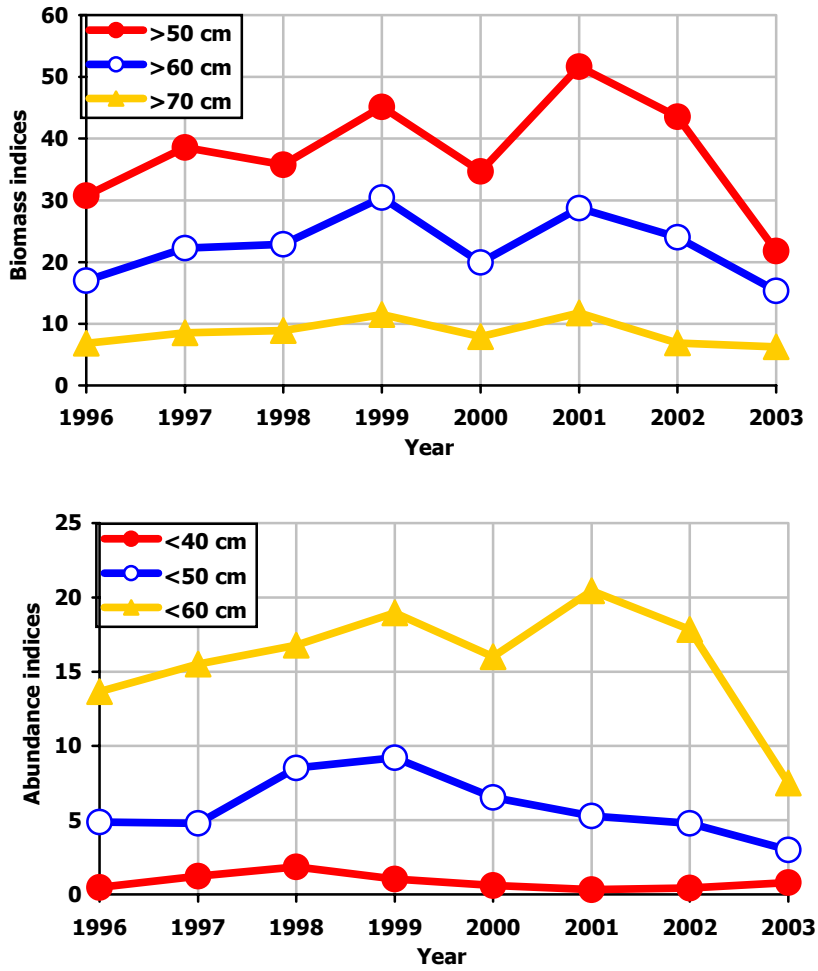


Figure 6.6.1. Greenland halibut in Icelandic fall groundfish survey; a) upper: biomass indices of lengths larger than indicated and b) lower: abundance indices by lengths smaller than indicated.

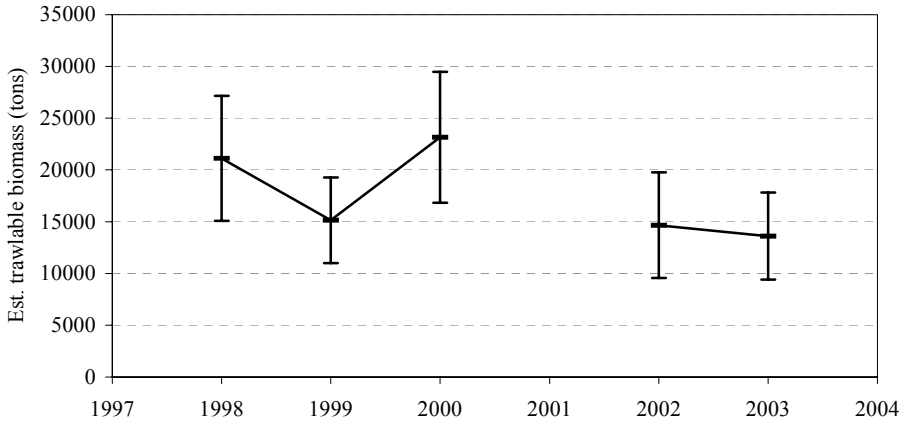


Figure 6.6.2. Estimated trawlable biomass in Div. XIVb from the Greenland deep-water trawl survey with 95% CI indicated.

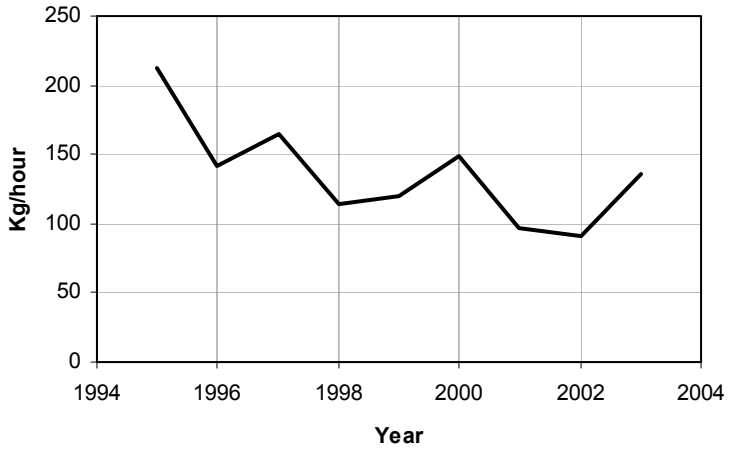


Figure 6.6.3. Catch rates from a Faroese deep-water survey in Div. Vb.

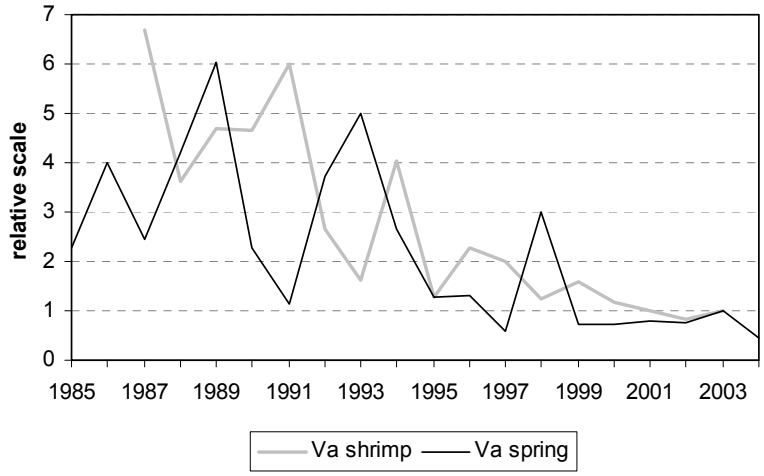


Figure 6.6.4. Comparison of catch rates from various surveys in Divisions Va, Vb and XIVb. Catch rates are scaled relative to the values of 2003.

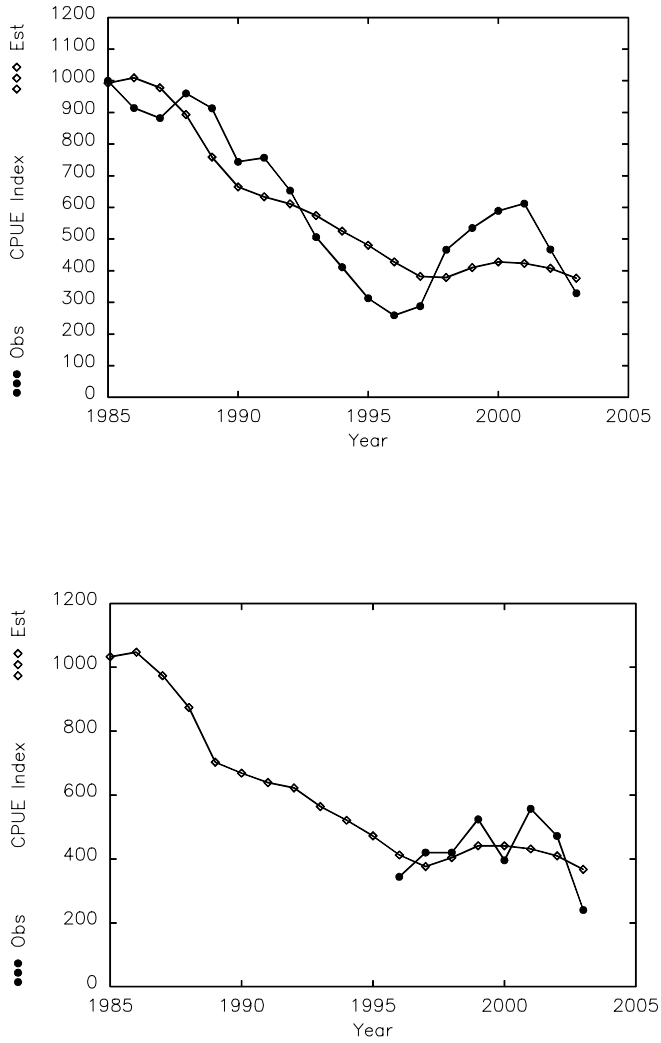


Figure 6.7.2.1. Observed and predicted CPUE's from ASPIC. Upper: Icelandic trawler CPUE, Lower: Icelandic groundfish survey.

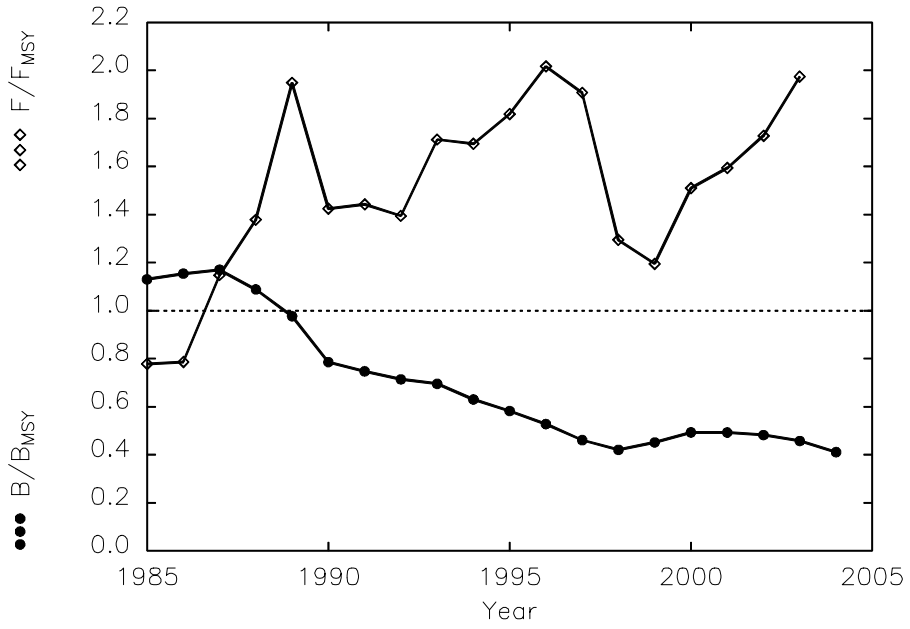
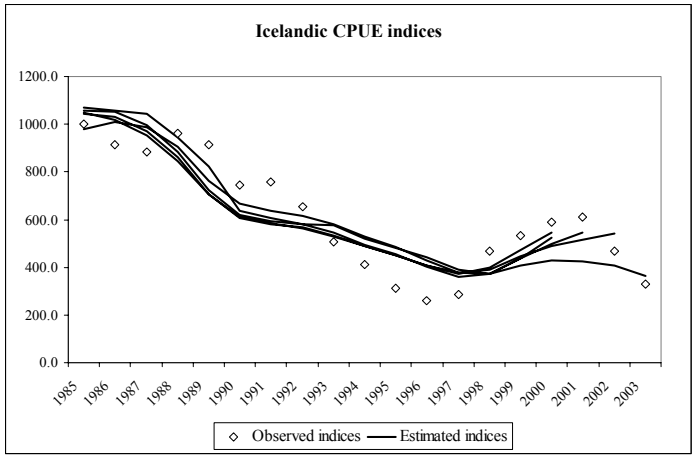
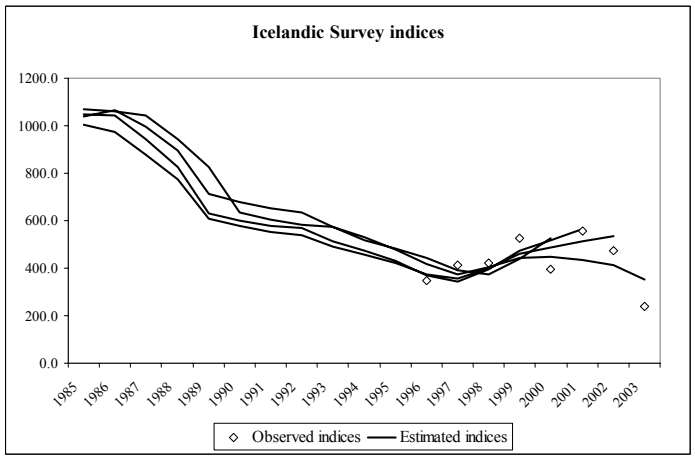


Figure 6.7.2.2 Greenland halibut V+XIV**.** Relative state of biomass and fishing mortality from ASPIC (Table 6.7.2.1).





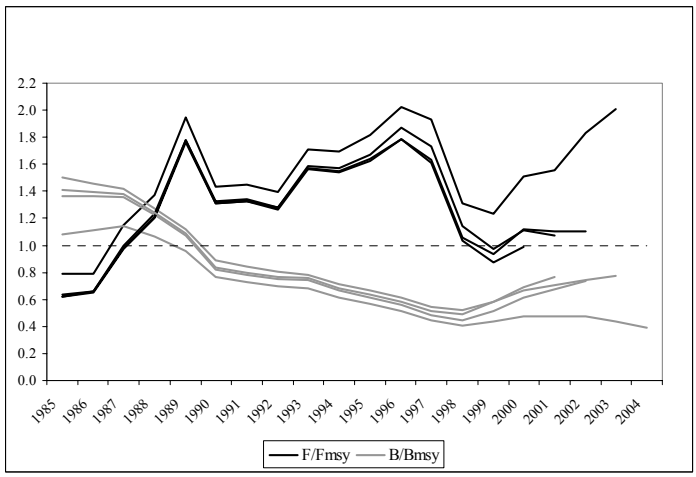


Figure 6.7.2.3. Historical plots of observed versus modelled indices from ASPIC (upper two) and relative state of biomass and fishing mortality (lower).

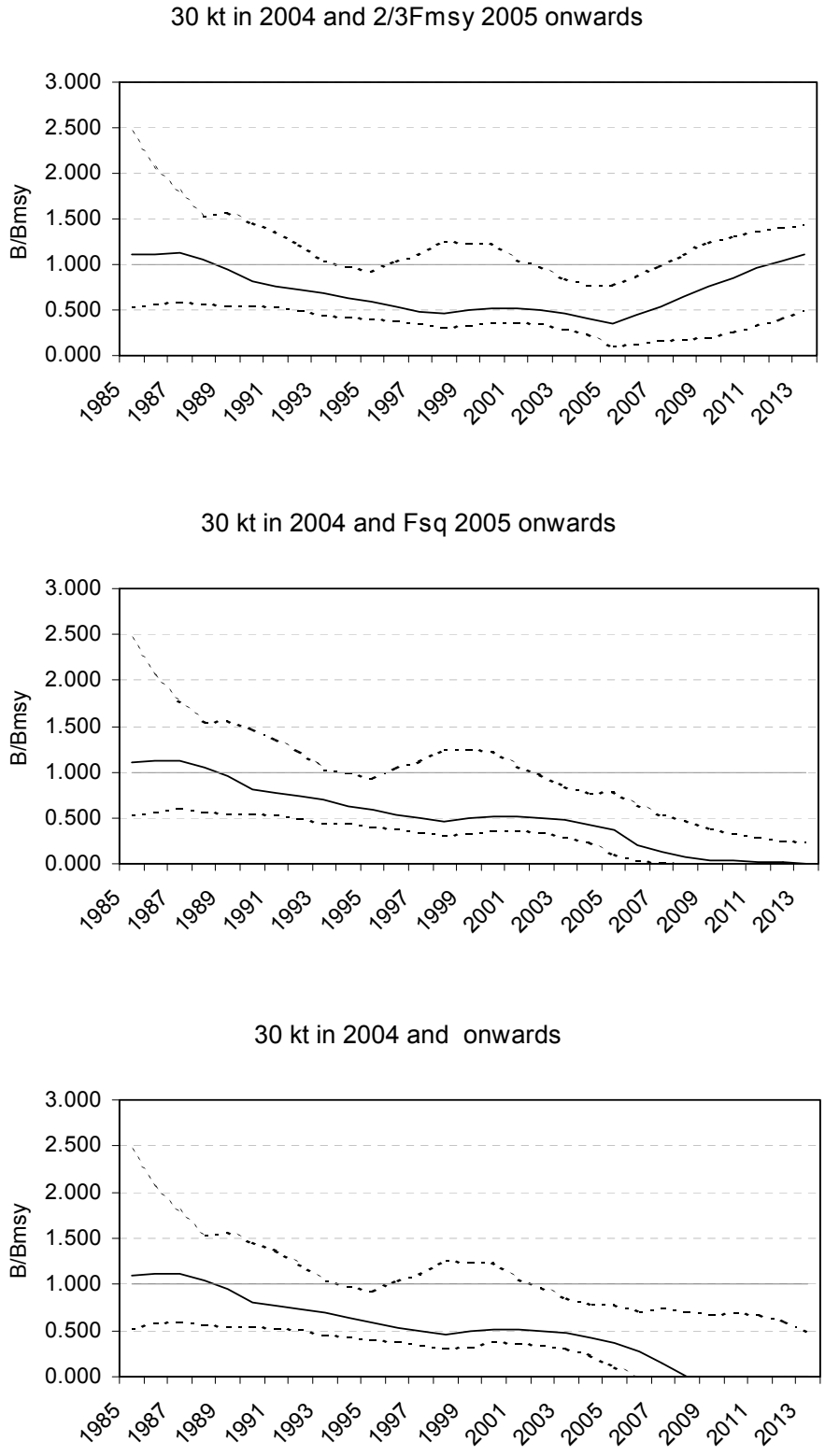


Figure 6.7.5. Biomass (B/Bmsy) trajectories under different options as derived from ASPIC-P.