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# Ageing inconsistencies and sensitivity analysis for 4WX herring

# Incohérence dans la détermination de l'âge et analyse de sensibilité du hareng de 4WX

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## Abstract

The assessment of 4WX herring has been hampered in recent years by uncertainty in ageing. Recent exchanges of herring otoliths amongst research institutes indicated inconsistencies in reader assigned ages that are both significantly different and biased. This paper looks at the divergence, when it may have occurred and the potential effects on the assessment model. Several approaches were examined to investigate the sensitivity of VPA estimates of fishing mortality and biomass to ageing errors. Age length keys (ALK) were compared and then used to generate a new Catch at Age (CAA) and age disaggregated indices of abundance from 1999 to 2006 for the VPA input.   An iterative process to fit a new ALK based on the length distribution of samples from another year's data to investigated to examine the sensitivity of the VPA to the input ALK data. The model did not perform very well and the resulting CAA and VPA outputs were unrealistic. Alternatively, the ALK's from several selected years were applied directly to the length frequency data from 1999-2006 to generate a revised CAA and an index of abundance for these years.  Comparison of these VPA results indicated that slight changes in the age structure can have a profound impact on the final output.  Estimates of F and biomass from the VPA analyses were found vary by a factor of 2 or 3 based solely on the different growth model inputs. It was concluded that within the range of age differences examined for the sensitivity analysis, accurate ageing is critical in the estimate F and stock biomass. It was also concluded , that regardless of the scenario , the 4WX herring stock remains at a historically low level with little signs of recent improvement. Fishing mortality is still well above $F_{0.1}$ even with a substantial decrease in catches over the past 2 years and the acoustic index of abundance shows only a slight upward trend in 2006.

**Résumé**

L’évaluation du hareng de 4WX a été ralentie ces dernières années par l’incertitude qui entoure la détermination de l’âge. De récents échanges d’otolites de hareng entre les établissements de recherche ont révélé des incohérences dans les âges assignés par les lecteurs d’otolites, qui sont à la fois largement différents et faussés. Les auteurs du présent document examinent l’écart, le moment où il se serait produit et ses effets possibles sur le modèle d’évaluation. Plusieurs approches ont été étudiées en vue de mesurer la sensibilité aux erreurs de détermination de l’âge des estimations par APV du taux de mortalité par pêche et de la biomasse. Les clés âge-longueur (CAL) ont été comparées, puis utilisées pour produire de nouveaux indices des prises selon l’âge (PSA) et de l’abondance, non regroupés par âge de 1999 à 2006, pour l’APV. Un processus itératif permettant d’intégrer une nouvelle CAL, basée sur la répartition selon la longueur des échantillons à l’aide des données d’une autre année, a servi à examiner la sensibilité de l’APV aux données de la CAL. Le modèle n’a pas été très efficace et les résultats obtenus au plan des PSA et de l’APV étaient peu réalistes. Par ailleurs, la CAL de plusieurs années choisies a été appliquée directement aux données des fréquences de longueur de 1999 à 2006 pour produire un indice de PSA révisé et un indice d’abondance pour ces années. La comparaison des résultats de ces APV a indiqué que de légers changements apportés à la structure d’âge pouvaient avoir des conséquences profondes sur le résultat final. L’estimation de F et de la biomasse d’après les APV variait d’un facteur de 2 ou 3 en fonction uniquement des différents intrants du modèle de croissance. On a conclu que dans l’échelle des différences d’âge examinée pour l’analyse de sensibilité, la détermination exacte de l’âge est cruciale pour l’estimation de F et de la biomasse du stock. On a aussi conclu que, quel que soit le scénario, le stock de hareng de 4WX demeure à un faible niveau historique, sans grands signes d’amélioration récente. La mortalité par pêche est encore bien au-dessus de $F_{0,1}$ malgré la diminution substantielle des prises au cours des deux dernières années, et l’indice d’abondance obtenu par méthode acoustique affiche une très légère tendance à la hausse en 2006.

## Introduction

Assessment of the 4WX herring stock utilizes an aged based assessment model and is therefore dependent upon an accurate and consistent ageing (Power et al, 2006). Over the past couple of years concern has been expressed about the consistency and inter-reader comparability of herring otolith ages (Melvin, 2006). A number of otolith exchanges have been undertaken amongst Canadian and American research institutes to evaluate these inconsistencies and the results were presented at the first herring framework review meeting in October of 2006 (TRAC, 2006). Overall there was poor performance for both the inter and intra-reader tests, although the intra reader differences were not considered to be as problematic. Neither the source of the problem, nor the point in time when it started, could be identified. Given the importance of ages to the current and future assessment methodologies, it was recommended that these issues be resolved before the final framework meeting on data models. In particular, it was requested that historical data be examined to explore the possible timing of the difference or divergence in ageing and to provide an estimate of the time required to correct the problem. The purpose of the study was to investigate: 1) when the ageing inconsistencies began and what if possible might have contributed to the observed difference/divergence; and, 2) to evaluate the implications of these ageing errors by reconstructing the catch-at-age (CAA) using a growth model from years when ageing is assumed to be correct (i.e., sensitivity analysis).

## Investigation of Inconsistencies in Ageing

A major stumbling block in the database was the lack of identification of the otolith reader. The ages were input into the database without reader identification, even though reader name fields are available and the information was recorded on the hardcopy datasheet. To ascertain when, and if, observable changes could be identified, we needed to be able to identify what otoliths were read by which reader and when a change in reader occurred. Shortly after the first framework meeting the primary and secondary readers were identified and these data incorporated into the database for the years 1974 to 2005 (Table 1). No ageing was undertaken in 2006 due to the unresolved issues and uncertainty with ageing herring. Table 2 serves to illustrate the number of otoliths read annually by each reader from 1991 to 2005 and identifies years where changes in the otolith readers occurred in the most recent 15 years. In 1995 the responsibility switched from JBS to MJP, while 1998 represented shared responsibility between MJP and FJF. Prior to 1993 it was common practice for the primary and secondary to compare several hundred otoliths annually for quality control. Since 1999 FJF has been the primary reader for herring, reading 98+ % of the 6,000 to 8,500 otoliths read annually.

Identification of when the problem began is even more difficult to discern given the lack of a bench mark and the potential for mixed percent aged during the introduction of a new reader (e.g., 1998). One source of information for evaluating if a change has occurred is the length at age from the biological samples and the continuity of the observations. Major deviations or a sudden discontinuity in the annual size trend of a specific age group could indicate either a real growth change or if this corresponds to a change in readers, a time window may be identified for the ageing problem. Although possible, it is unlikely that the inconsistencies currently being observed occurred during a period when two readers were available for a significant portion of the age assignments. Comparative aging and consensus on age differences were assumed to act as quality control and to maintain consistency in reading methodology. Consequently, it is probable that any divergence from the standard protocols or practices occurred after 1994 when, for the majority of the subsequent years, a single reader was involved.

## Results

The initial stage of the data analysis involved the examination of the historical data for trends or discontinuities in the size at age of herring. Length at age data for the years 1980 to 2005 were examined using box whisker plots to illustrate the median, 25 and 75 percentiles, the 95% confidence interval, and outliers for all gear types within 4X (Appendix 1). The same data for seine and weir samples which were explored independently during the assessment review showed similar trends, but are not illustrated in this document. Examination of box plots of herring lengths (combined gear) by year for each age between 1980 and 2005 indicates several problem areas. For ages 3and 4 there is an obvious discontinuity in size and length distribution that occurs between 1999 and 2000. This change in trend or abrupt shift disappears after age 5 and age 6. However, a different shift seems to begin about age 6 between 1994 and 1995 and persists through until age 10. For the older ages there has also been a progressive increase that in mean length at age since 1999. This is particularly true for age 10 and older. Another observation in the plots is the narrowing of the error bars around the mean, indicating that the size of the fish for a given age is becoming more constant. Break points in the plots approximately correspond to a change in otolith readers. Separating the age data into gear type for 4X shows a consistent pattern and serves to accentuate the zones of discontinuity in some years.

The overall data tend to suggest a gradual decrease in the size of age 2 fish since 2000 which appears to be more extreme in the purse seine collected samples, but is not apparent in the weir samples, and does not carry through to age 3. This may reflect a change in fishery toward harvesting more juvenile fish earlier in the year. Conversely, it would be expected that the weir samples should show a slight increase in length, which they do not, given that more catches from this fishery have been occurring later in the season during the past 6 years. For the older ages (e.g., 5 and older) there also appears to be a contracting of the size distribution associated with a specific age since about 2001. This is reflected in the narrowing of the confidence intervals about the mean and is observed in the entire dataset especially age 6 and older. It would be expected that the 95% confidence interval would broaden given the reduction in number of fish 6 years and older in recent years. There are also fewer outliers than in the past for all ages. Unfortunately, no herring aged 9 or older have been collected in samples since 2003, with very few fish (<5 fish) between 1998-2003. No age 10 fish or older have been observed in herring samples since 1998 in 4X.

In summary, there is an indication that the observed inconsistencies in ageing may have began sometime between 1999 and 2000 for the younger ages and perhaps between 1994 and 1995 for ages 6 and older. Whether or not the differences are the result of an abrupt change or a gradual drift from standard ageing protocols or a change in growth is unknown. Although the cause of the inconsistencies are unknown, it is evident that there are significant and biased differences between readers. There is also indirect evidence to suggest that the availability of fish length at the time of reading may have a influence on the assigned age. It is believed that multiple readers and consensus will improve the consistency in assigned ages.

Currently two studies are underway to investigate the sources of error and inconsistencies with herring ageing. The first study involves the selection of ~ 100 otoliths for bomb radio carbon assay to determine the actual (within 6 months) age. The second study will utilize a dominant year class (~2000 otoliths) and the ability of readers to track the appropriate cohort as it moves through the fishery. The four institutes involved in the current (both the bomb radio carbon and dominant year tracking) and previous otolith exchanges are, the National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR), the Department of Fisheries and Oceans St. Andrews (SABS) and the Department of Fisheries and Oceans, Moncton (Gulf).

**Sensitivity Analysis**

The terms of reference for the 2007 assessment of Nova Scotia / Bay of Fundy herring spawning component include an evaluation of the implications of the aging errors reported in 2006 on the current VPA-based assessment formulation (DFO, 2007). It was assumed that a growth model which utilized the age-length key (ALK) from one or more years where a broad age structure was observed, and the ageing was assumed to be correct, could be used to reconstruct the CAA. Unfortunately, the direct application of an ALK from one year to the length frequency of a different year is known to produce a biased age distribution (year-effect). To overcome this problem we explored the Iterative Age-Length Key (IALK) of Kimura and Chikuni (1987) which is amenable to applying the age-length data sampled from one population to the length frequency data of another (Gavaris and Van Eeckhaute, 1993). The model utilizes the length frequency and ALK of the source year to fit the distribution of the target year to generate a new length at age key (LAK) which is then applied using an iterative process to the numbers at length for the target year.

For 4WX herring it is not a simple task to modify the historical CAA and the age disaggregated acoustic index to reflect variation in the age-length key (ALK) required for a sensitivity analysis. Much of the data for the early years are available in hardcopy only and not easily adjusted to investigate the proposed sensitivities. Adjustment to the VPA input parameters is limited to the most recent portion of the time series. Consequently, based on the analysis above, which suggests that the most significant discontinuity occurred between 1999 and 2000, the sensitivity analysis was restricted to modifications in CAA and the acoustic index of abundance for the 1999 to 2006 period. The CAA from all previous years remained unchanged from the assessment. It should however be noted that the extent of the ageing problem is unknown and will remain so until completion of the on going studies.

CAA Modification

In the current assessment, ALK’s are generated monthly for each year and applied to the fishery catch weighted length frequency samples to produce a CAA for each fishery. The monthly CAA data are summed for the total CAA then used as input for the assessment. Constructing a new monthly ALK for each scenario evaluated in the sensitivity analysis would require an enormous amount of time as the current CAA software is not geared for batch processing. Consequently, the analysis was restricted to an annual ALK extracted from biological samples collected in NAFO unit areas 4Xq, 4Xr, and 4Xs, respectively. These are the areas where currently and historically the majority of the fishery occurs. The ALK for each year from 1999 to 2006 was applied to the same year’s numbers at length data and a new CAA constructed for the period 1999 to 2006. If no detailed samples were available for a specific size interval in a given year the ages for the length interval from the 1992 ALK were substituted. This occasionally occurred for the small and larger length intervals and varied slightly from year to year. The overall result was that the total number of fish caught in a given year did not change from the current CAA , only the number of fish for a given age within a year changed.

The original ALK’s constructed from the monthly age length data were compared with the annual ALK to evaluate if they would produce similar patterns in CAA for 1999 to 2006 (Figure 1). For all years examined, the catch at age constructed from the monthly ALK was very similar in magnitude and trend to the CAA developed from a single annual ALK. The greatest differences appear to occur in the younger years (ages 2-3) where the monthly ALK’s tend to reflect more of the size changes associated with the rapidly growing fish than the annual ALK. Beyond age 4 the numbers at age are almost identical. Based on these comparisons, it was concluded that the annual ALK’s could be used in conjunction with the annual catch in numbers at length to develop a CAA for evaluation of the ageing error sensitivity.

For the sensitivity analysis we selected the ALK's from 3 years (1992, 1998, and 2002) representing various stock conditions to apply the iterative procedure (IALK) and construct a new CAA. The year 1992 represents a period when stock abundance was around average, 1999 the year the ageing problem may have started, and 2002 a recent year with a relatively broad age distribution. The ALK and length frequency data from each of these years, and the length frequencies from 1999 to 2006 were input into the iterative program to construct a new CAA. Unlike the Expert Opinion (Melvin and Power, 2006) which modified the CAA based on a degrading difference between two otolith readers, this analysis applied the ALK’s from 1992, 1998, and 2002 to the catch at length data to create the modified CAA's for evaluating the impact of different growth models on the VPA.

A similar approach was adopted for the age disaggregated acoustic abundance index. The same yearly ALK’s and the length frequency data for each survey were then used to apportion the acoustic backscatter into an estimate of biomass by age for each survey. The surveys were then summed for the individual spawning grounds to determine a spawning stock biomass for each of the main spawning grounds in Southwest Nova Scotia/Bay of Fundy region (Scots Bay and German Bank).

**Analysis**

The IALK method utilizes an iterative approach based on the length distribution and the ALK of the source year to minimize the error and create a new ALK. This ALK was then applied to the length frequencies from years of interest and the CAA revised. In theory this should overcome year effect. Unfortunately, the method does not always produce realistic results. In cases (years) where the length distribution of the source are very different from the target, the IALK method was unable to correctly discriminate year-class strengths when there was substantial overlap in the length at age amongst age groups. For the herring data this occurred when the 1992 IALK was applied to the annual length frequencies from 1999 to 2006. Examination of the length frequencies for the three growth model years (1992, 1999 and 2002) indicates a marked difference in their distributions (Figure 2). The main feature is the bi and tri-modal distribution of 1999 and 2002 compared to the single peak in 1992. Comparison of the all years (1999-2006) shows similar distinct and different distributions. The result is that the IALK model has difficulty fitting the target years based on the 1992 distribution. In fact, the revised CAA indicated the complete absent of several age groups (e.g., 2000 and 2003 age 4) (Table 3). As such, it was felt that the 1992 model would not provide a realistic estimate of the CAA and it was not included in subsequent VPA analysis. Only the CAA from 1999 and the 2002 data were used with the IALK method and in the following VPA analysis.

As an alternative approach to the IALK method, acknowledging the year effects bias, we directly applied the ALK from 1987, 1992, 1999 and 2002 to the numbers at length from the 1999 to 2006 data to modify the CAA and to examine the effects when a broad age distribution was available. This in essence equates to a period of slow growth (1987), before the ageing problem is believed to have begun (1992), the year in which the problem may have started (1999) and a year (2002) after the problem may have begun. The revised CAA based on this alternative approach is shown Table 4, the acoustic index of abundance overall in Table 5 and the acoustic index of abundance for German Bank in Table 6, all using the same approach. In the most recent VPA formulation only the German Bank acoustic index of abundance was used for tuning due to the poor performance of other spawning areas(Power et al 2006).The revised CAA's and indices of abundance were then used as input to the VPA and the results compared to complete the sensitivity analysis.

**VPA Results**

The output from the IALK method and applying ALK's from previous years to the CAA and age-disaggregated indices of abundance were used as input parameters for a VPA. Eleven scenarios were investigated:

- IALK method using ALKs from 1999 and 2002 to modify the CAA and overall index of abundance 1999-2006 (two VPA trials)

- ALK from 1987, 1992, 1999 and 2002 to modify the CAA and overall index of abundance for 1999-2006 (four VPA trials).
- ALK from 1987, 1992, 1999 and 2002 to modify the CAA and German Bank index of abundance for 1999-2006 (four VPA trials).
- ALK from 2005 to modify the CAA and overall index of abundance for 2006 (one VPA trials). No ageing was undertaken in 2006.

The VPA formulation was consistent with the 2005 herring assessment and used the following input parameters:

- M= 0.2
- Fully recruited age 6
- PR age 2 = 0.2, age 3 =0.4, age 4= 0.7, age 5= 0.9
- Estimate ages 7, 2007
- Acoustic index for ages 4 to 8
- 2006 and 2007 age 1 set at 1,000,000

<u>VPA Analysis</u>

Output results from the VPA runs which utilized the IALK approach to generate a revised CAA and acoustic index of abundance were discouraging in that they did not provide realistic output. The 1992 data set was excluded even before the VPA analysis and the two other years, 1999 and 2002, produced unrealistic estimates of F and mean square residuals that would result in the formulations being rejected outright (Appendix II). In fact, the 1999 source year completely eliminated several year-classes before they could move through the fishery, estimating biomass at 0. The 2002 source year performed better in that year-classes were not lost, but the error estimates were so high the run would be rejected at an assessment review. Estimated F for the 1999 and 2002 growth model are shown to be extremely high and the biomass for some age groups produced a negative value (Figure 4). . The IALK approach may work well when there are clearly separated length modes; however, for cases such as herring with multiple overlapping length at age modes the model fails. Gavaris and Van Eechaute (1993) made a similar observation. It was thus concluded that the IALK growth models could not fit the data and could not be used for an ageing sensitivity analysis.

The use of an ALK from one year applied to the length frequency of another year is generally considered an invalid approach due to loss of the year effect. However, it may provide some indication of the changes that could be due to ageing error. Given the inability of the IALK growth model to provide realistic modification to the CAA and the indices of abundance, we applied the ALK's from 1987, 1992, 1999, and 2002 to the length frequency distribution of catches from 1999 to 2006 to generate a new CAA and index of abundance. These data were then used as inputs to the same VPA formulations as examined in the IALK sensitivity analysis. Both the overall and German Bank modified indices were explored and applied to 1999 to 2006 data. The mean square residuals and relative errors for all runs were generally within acceptable levels. The VPA output for the 2002 ALK scenario is presented in Appendix III.

The VPA results using inputs derived with the ALK method to generate a CAA and acoustic index of abundance indicates that fishing mortality over the last 5 years remains high ranging from 1.1 to 2.5 in 2006 for the model using the overall index and 0.8 to 2.5 with the German Bank index depending upon the source year (Figure 5 and 6) . Using the 1987 and 1992 ALK's would suggest a decrease in F over the last couple of years while 1999 and 2002 imply an increase even with the reduced catches (TAC). A similar pattern was observed for total biomass and SSB except that the 1992 ALK method showed an increase since 2005. For the other 3 scenarios (1987, 1992 and 1999 ALK's), the biomass continued to decline with the SSB and total biomass estimated at or below 100,000t.

The final analysis involved examination of the VPA analysis used for the 2006 Expert Opinion (Melvin and Power, 2006). In this case the difference between readers was scaled down over the 1999 to 2006 period such that the CAA and the index of abundance shifted from one reader's ages to the other over the 7 years. Details of one of the VPA runs for Reader 1 vs external reader are shown in Appendix IV. Results for the 3 scenarios comparing the three agers with one another indicate that the Fs are substantially below the current assessment and although high, range from 0.4 to 0.8 in 2005. Biomass (both total and SSB) estimates are higher than the ALK method based runs ranging between 80,000 and 220,000 t, and are stable or increasing slightly (Figure 7). Mean square residuals and relative errors are also within acceptable limits.

**Summary**

It is not possible, from this analysis to determine which, if any, of the above analytical procedures reflect the true state of the 4WX herring stock. Evident from the analysis is that our perception of stock status using an age based assessment model is highly dependent upon correct ageing. Slight changes such as those observed between readers or the use of a different ALK can have a profound impact on the final output. Depending upon the approach taken, estimates of F and biomass from a VPA analysis could be off by a factor of 2 or 3, highlighting the need for consistent within and between reader ageing. Despite this it is also evident, regardless of the scenario, that the 4WX herring stock is at a historically low level and showed little sign of improvement in 2006. Fishing mortality is still well above $F_{0.1}$ even with a substantial decrease in catches over the past 2 years and the acoustic index of abundance shows only a slight upward trend in 2006. The biomass estimates also remain at a very low level. Finally, a proper evaluation of stock status using an age based assessment model can not be undertaken until the ageing problem is resolved.

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Table 1. Historical overview of the number of herring otoliths read and the primary and secondary readers at the St. Andrews Biological Station since 1974.

| Year | Number | Primary Reader | Secondary Reader | Year | Number | Primary Reader | Secondary Reader |
|---|---|---|---|---|---|---|---|
| 1974 | 23,933 | JH | | 1990 | 11,426 | MJP | JBS |
| 1975 | 18,507 | PS | | 1991 | 10,826 | MJP | JBS |
| 1976 | 25,355 | PS | | 1992 | 5,975 | JBS | MJP |
| 1977 | 21,343 | PS | | 1993 | 4,508 | JBS | MJP |
| 1978 | 14,330 | CM | | 1994 | 6,233 | JBS | MJP |
| 1979 | 13,470 | CM | | 1995 | 4,344 | MJP | FJF |
| 1980 | 13,452 | CM | | 1996 | 6,505 | MJP | |
| 1981 | 10,709 | CM | | 1997 | 6,223 | MJP | |
| 1982 | 16,338 | MJP | | 1998 | 7,236 | MJP | FJF |
| 1983 | 13,371 | BB | MJP | 1999 | 7,499 | FJF | MJP |
| 1984 | 18,692 | BB | MJP | 2000 | 5,267 | FJF | MJP |
| 1985 | 13,101 | BB | MJP | 2001 | 7,558 | FJF | MJP |
| 1986 | 12,591 | MJP | | 2002 | 7,654 | FJF | MJP |
| 1987 | 13,522 | MJP | | 2003 | 8,681 | FJF | MJP |
| 1988 | 11,738 | MJP | JBS | 2004 | 5,817 | FJF | MJP |
| 1989 | 10,606 | MJP | JBS | 2005 | 5,825 | FJF | MJP |

Otolith Readers

| Name | Initial | Name | Initial |
|---|---|---|---|
| Billie Burnett | BB | Mike Power | MJP |
| Jack Fife | FJF | Jeff Sochasky | JBS |
| Joe Hunt | JH | Peggy Stewart | PS |
| Collin MacDougall | CM | | |

Table 2. Summary of the number of herring otoliths read each year from1991 to 2005 by individual reader. No otoliths were read from the 2006 samples.

| | Reader | | | |
|---|---|---|---|---|
| Year | FJF | JBS | MJP | Total |
| 1991 | | 10,022 | 804 | 10,826 |
| 1992 | | 5,210 | 765 | 5,975 |
| 1993 | 227 | 3,500 | 781 | 4,508 |
| 1994 | 201 | 6,032 | | 6,233 |
| 1995 | 180 | 554 | 3,610 | 4,344 |
| 1996 | | | 6,504 | 6,504 |
| 1997 | | | 6,223 | 6,223 |
| 1998 | 3,372 | | 3,864 | 7,236 |
| 1999 | 7,320 | | 179 | 7,499 |
| 2000 | 5,141 | | 126 | 5,267 |
| 2001 | 7,592 | | 6 | 7,598 |
| 2002 | 7,654 | | | 7,654 |
| 2003 | 8,658 | | 23 | 8,681 |
| 2004 | 5,817 | | | 5,817 |
| 2005 | 5,825 | | | 5,825 |
| 2006 | | | | |
| Total | 51,987 | 25,318 | 22,885 | 100,190 |

Table 3. Revised catch at age (numbers in 000's) for 1999-2006 based on the IALK model using ALKs from 1992, 1999 and 2002. The first series of years represents the original CAA used in previous assessments.

| | Age | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11+** | **Total** |
| 1999 | 2,694 | 117,014 | 233,700 | 152,777 | 127,331 | 54,321 | 9,338 | 589 | 191 | 69 | 8 | 698,033 |
| 2000 | 847 | 376,448 | 78,917 | 110,874 | 121,344 | 58,100 | 24,650 | 4,292 | 245 | 37 | 14 | 775,768 |
| 2001 | 51 | 75,685 | 330,502 | 56,217 | 58,982 | 30,286 | 14,483 | 2,053 | 263 | 9 | 4 | 568,536 |
| 2002 | 16,965 | 309,549 | 100,839 | 209,395 | 74,601 | 27,812 | 12,739 | 1,548 | 59 | 22 | 3 | 753,532 |
| 2003 | 510 | 488,925 | 274,124 | 101,442 | 86,242 | 11,816 | 6,894 | 381 | 19 | 0 | 0 | 970,353 |
| 2004 | 3,142 | 319,530 | 282,611 | 124,226 | 79,305 | 9,081 | 3,205 | 328 | 35 | 1 | 0 | 821,464 |
| 2005 | 135 | 71,812 | 147,691 | 172,642 | 26,829 | 4,193 | 1,046 | 47 | 2 | 2 | | 424,399 |
| 1992 Growth Model | | | | | | | | | | | | |
| 1999 | 0 | 67,771 | 457,267 | 12,266 | 138,922 | 14,990 | 6,570 | 0 | 0 | 0 | 246 | 698,033 |
| 2000 | 0 | 29,782 | 502,751 | 0 | 195,818 | 33,228 | 14,103 | 0 | 0 | 0 | 86 | 775,769 |
| 2001 | 0 | 985 | 389,777 | 77,806 | 47,571 | 43,856 | 8,537 | 0 | 0 | 0 | 0 | 568,532 |
| 2002 | 2,330 | 172,908 | 257,713 | 167,313 | 122,083 | 25,502 | 5,677 | 0 | 0 | 0 | 0 | 753,526 |
| 2003 | 0 | 247,646 | 557,740 | 0 | 161,666 | 0 | 3,300 | 0 | 0 | 0 | 0 | 970,353 |
| 2004 | 0 | 204,824 | 440,554 | 77,155 | 83,876 | 14,892 | 0 | 0 | 163 | 0 | 0 | 821,464 |
| 2005 | 0 | 26,865 | 227,631 | 146,203 | 15,394 | 8,253 | 0 | 54 | 0 | 0 | 0 | 424,399 |
| 2006 | 0 | 17,995 | 236,795 | 63,552 | 94,656 | 0 | 523 | 0 | 0 | 0 | 0 | 413,521 |
| 1999 Growth Model | | | | | | | | | | | | |
| 1999 | 2,603 | 118,061 | 228,941 | 158,249 | 127,473 | 51,324 | 10,131 | 1,011 | 182 | 42 | 17 | 698,033 |
| 2000 | 879 | 79,556 | 324,771 | 91,956 | 170,117 | 85,235 | 21,732 | 1,403 | 0 | 0 | 121 | 775,768 |
| 2001 | 0 | 26,016 | 111,349 | 288,594 | 69,359 | 56,862 | 14,581 | 1,771 | 0 | 0 | 4 | 568,536 |
| 2002 | 3,570 | 253,981 | 88,912 | 98,300 | 240,435 | 55,554 | 12,314 | 447 | 0 | 16 | 3 | 753,532 |
| 2003 | 158 | 477,466 | 117,619 | 191,816 | 132,593 | 47,202 | 2,946 | 552 | 0 | 0 | 0 | 970,353 |
| 2004 | 8,009 | 372,548 | 30,988 | 252,186 | 108,728 | 48,364 | 115 | 526 | 0 | 0 | 0 | 821,464 |
| 2005 | 1,603 | 94,260 | 27,345 | 176,589 | 109,183 | 14,150 | 1,262 | 6 | 0 | 0 | 0 | 424,399 |
| 2006 | 6 | 53,812 | 102,509 | 101,058 | 131,555 | 24,226 | 201 | 153 | 0 | 0 | 9 | 413,530 |
| 2002 Growth Model | | | | | | | | | | | | |
| 1999 | 24,542 | 115,030 | 381,299 | 52,673 | 91,480 | 15,394 | 16,365 | 614 | 622 | 0 | 13 | 698,033 |
| 2000 | 0 | 157,868 | 367,531 | 54,838 | 138,513 | 24,384 | 29,620 | 2,788 | 61 | 133 | 32 | 775,768 |
| 2001 | 0 | 23,298 | 399,580 | 37,903 | 66,074 | 20,719 | 17,657 | 3,240 | 62 | 0 | 4 | 568,536 |
| 2002 | 28,106 | 258,243 | 132,695 | 212,922 | 78,124 | 28,343 | 13,478 | 1,550 | 64 | 4 | 3 | 753,532 |
| 2003 | 15,966 | 468,618 | 304,499 | 52,683 | 111,925 | 6,886 | 9,380 | 346 | 49 | 0 | 0 | 970,353 |
| 2004 | 68,122 | 278,850 | 294,209 | 96,063 | 61,470 | 19,368 | 3,002 | 340 | 41 | 0 | 0 | 821,464 |
| 2005 | 6,537 | 79,236 | 179,464 | 129,456 | 18,691 | 9,424 | 1,508 | 82 | 0 | 0 | 0 | 424,399 |
| 2006 | 635 | 63,410 | 192,579 | 82,177 | 67,186 | 4,814 | 2,677 | 34 | 11 | 0 | 9 | 413,530 |

Table 4. Revised catch at age (numbers in 000's) for 1999-2006 using the ALK method based on the 1987, 1992, 1999 and 2002 ALKs. The first series of years represent the original CAA used in previous assessments.

| Original Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 2,694 | 117,014 | 233,700 | 152,777 | 127,331 | 54,321 | 9,338 | 589 | 191 | 69 | 8 | 698,033 |
| 2000 | 847 | 376,448 | 78,917 | 110,874 | 121,344 | 58,100 | 24,650 | 4,292 | 245 | 37 | 14 | 775,768 |
| 2001 | 51 | 75,685 | 330,502 | 56,217 | 58,982 | 30,286 | 14,483 | 2,053 | 263 | 9 | 4 | 568,536 |
| 2002 | 16,965 | 309,549 | 100,839 | 209,395 | 74,601 | 27,812 | 12,739 | 1,548 | 59 | 22 | 3 | 753,532 |
| 2003 | 510 | 488,925 | 274,124 | 101,442 | 86,242 | 11,816 | 6,894 | 381 | 19 | - | - | 970,353 |
| 2004 | 3,142 | 319,530 | 282,611 | 124,226 | 79,305 | 9,081 | 3,205 | 328 | 35 | 1 | - | 821,464 |
| 2005 | 135 | 71,812 | 147,691 | 172,642 | 26,829 | 4,193 | 1,046 | 47 | 2 | 2 | | 424,399 |
| 2006 | | | | | | | | | | | | |
| 1992 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | 753 | 166,100 | 272,803 | 149,405 | 65,239 | 29,326 | 7,595 | 3,575 | 2,252 | 793 | 193 | 698,033 |
| 2000 | 1,786 | 288,532 | 278,586 | 132,530 | 56,545 | 7,650 | 7,226 | 2,708 | 139 | 43 | 23 | 775,768 |
| 2001 | 300 | 115,328 | 326,824 | 78,638 | 34,929 | 5,138 | 5,157 | 2,107 | 106 | 8 | 1 | 568,536 |
| 2002 | 9,865 | 288,435 | 262,026 | 139,742 | 42,946 | 4,955 | 4,094 | 1,407 | 52 | 7 | 2 | 753,532 |
| 2003 | 10,399 | 512,678 | 305,721 | 106,236 | 29,841 | 2,760 | 2,068 | 624 | 26 | 1 | - | 970,353 |
| 2004 | 12,157 | 379,605 | 310,286 | 88,280 | 26,938 | 2,469 | 1,387 | 323 | 19 | 1 | - | 821,464 |
| 2005 | 2,097 | 118,983 | 225,438 | 63,549 | 12,431 | 1,121 | 639 | 137 | 3 | 0 | - | 424,399 |
| 2006 | 1,169 | 122,172 | 186,918 | 82,625 | 18,499 | 1,283 | 702 | 148 | 5 | 3 | 7 | 413,530 |
| 1999 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | 969 | 112,472 | 234,710 | 158,298 | 127,900 | 52,560 | 10,346 | 538 | 200 | 23 | 15 | 698,033 |
| 2000 | 531 | 100,315 | 290,539 | 118,303 | 160,011 | 85,727 | 19,329 | 771 | 190 | 30 | 9 | 775,755 |
| 2001 | 7 | 32,112 | 123,950 | 246,542 | 98,733 | 52,914 | 13,518 | 648 | 108 | 2 | 2 | 568,536 |
| 2002 | 3,766 | 186,013 | 159,249 | 120,478 | 206,074 | 65,999 | 11,504 | 372 | 72 | 2 | 4 | 753,532 |
| 2003 | 2,133 | 328,994 | 275,520 | 177,274 | 133,059 | 47,006 | 6,134 | 209 | 24 | - | - | 970,353 |
| 2004 | 3,432 | 282,156 | 152,475 | 209,640 | 124,405 | 44,578 | 4,627 | 130 | 21 | - | - | 821,464 |
| 2005 | 560 | 73,219 | 69,857 | 148,610 | 110,955 | 19,041 | 2,115 | 41 | - | - | - | 424,399 |
| 2006 | 210 | 50,061 | 108,923 | 103,779 | 118,178 | 29,978 | 2,337 | 52 | 3 | - | 9 | 413,530 |
| 2002 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | 16,138 | 218,919 | 217,656 | 149,250 | 58,600 | 23,150 | 12,477 | 1,578 | 229 | 33 | 2 | 698,033 |
| 2000 | 6,031 | 255,518 | 203,495 | 159,952 | 87,088 | 37,586 | 22,857 | 3,011 | 189 | 40 | - | 775,768 |
| 2001 | 1,304 | 89,710 | 222,338 | 164,258 | 48,697 | 24,167 | 15,558 | 2,395 | 101 | 7 | 1 | 568,536 |
| 2002 | 28,106 | 258,243 | 132,695 | 212,922 | 78,124 | 28,343 | 13,478 | 1,550 | 64 | 5 | 2 | 753,532 |
| 2003 | 34,936 | 463,576 | 226,469 | 153,752 | 66,331 | 17,513 | 7,034 | 718 | 25 | 1 | - | 970,353 |
| 2004 | 41,554 | 329,327 | 198,940 | 175,073 | 52,825 | 18,097 | 5,216 | 411 | 22 | 1 | - | 821,464 |
| 2005 | 7,390 | 98,598 | 129,595 | 149,399 | 29,031 | 7,745 | 2,480 | 158 | 2 | 0 | - | 424,399 |
| 2006 | 4,073 | 104,347 | 116,608 | 127,401 | 48,101 | 10,146 | 2,658 | 182 | 5 | 0 | 9 | 413,530 |
| 1987 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | 4,285 | 225,721 | 217,579 | 163,688 | 71,260 | 11,856 | 2,679 | 598 | 208 | 133 | 26 | 698,033 |
| 2000 | 1,581 | 250,440 | 206,751 | 181,588 | 107,955 | 20,874 | 5,156 | 958 | 291 | 139 | 34 | 775,768 |
| 2001 | 829 | 90,748 | 208,336 | 185,492 | 64,251 | 13,927 | 3,721 | 921 | 223 | 71 | 17 | 568,536 |
| 2002 | 10,117 | 268,236 | 128,931 | 235,715 | 93,136 | 13,694 | 2,990 | 522 | 129 | 49 | 13 | 753,532 |
| 2003 | 10,013 | 479,014 | 229,777 | 170,915 | 70,751 | 7,910 | 1,523 | 379 | 51 | 16 | 3 | 970,353 |
| 2004 | 11,755 | 354,462 | 190,322 | 196,195 | 60,393 | 6,890 | 1,121 | 279 | 32 | 12 | 2 | 821,464 |
| 2005 | 2,227 | 104,431 | 118,921 | 162,065 | 33,042 | 3,069 | 485 | 148 | 8 | 3 | 0 | 424,399 |
| 2006 | 1,078 | 105,612 | 113,041 | 139,929 | 49,242 | 3,904 | 574 | 127 | 10 | 4 | 9 | 413,530 |

Table 5. Overall acoustic index of abundance for the combined German Bank, Scots Bay and Trinity Ledge age disaggregated based on the ALK method using the ALK's from 1987, 1992, 1999, and 2002. The first series of years represent the index used in previous assessments.

| Original<br>Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | - | 22 | 11,837 | 466,939 | 1,259,696 | 724,815 | 173,021 | 5,775 | 6,645 | 941 | 1,091 | 2,650,782 |
| 2000 | 179 | 160,418 | 170,220 | 687,340 | 930,573 | 496,803 | 213,924 | 37,273 | 2,019 | 175 | 1,000 | 2,699,924 |
| 2001 | - | 87,170 | 1,499,796 | 457,975 | 467,332 | 279,943 | 142,956 | 25,436 | 2,178 | - | - | 2,962,785 |
| 2002 | 2,376 | 81,122 | 453,103 | 1,938,353 | 592,580 | 217,955 | 121,346 | 17,362 | 799 | 385 | - | 3,425,381 |
| 2003 | - | 136,238 | 1,528,559 | 926,469 | 796,381 | 104,841 | 59,548 | 2,081 | 1 | - | - | 3,554,118 |
| 2004 | - | 25,675 | 1,103,423 | 1,193,644 | 759,611 | 117,403 | 47,312 | 3,275 | 2,271 | - | - | 3,252,614 |
| 2005 | - | 3,705 | 213,306 | 966,885 | 264,704 | 50,696 | 15,687 | 629 | - | 4 | | 1,515,617 |
| 2006 | | | | | | | | | | | | |
| 1992 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 288 | 201,128 | 1,058,025 | 720,368 | 444,874 | 106,900 | 56,559 | 43,852 | 15,416 | 3,374 | 2,650,782 |
| 2000 | - | 72,122 | 374,335 | 1,038,991 | 632,294 | 403,307 | 91,766 | 44,464 | 31,575 | 9,843 | 1,224 | 2,699,924 |
| 2001 | - | 42,583 | 778,964 | 1,245,851 | 445,868 | 284,734 | 75,804 | 43,979 | 33,000 | 10,586 | 1,416 | 2,962,785 |
| 2002 | 31 | 43,478 | 417,934 | 1,711,513 | 773,533 | 338,964 | 70,028 | 34,820 | 25,872 | 8,272 | 936 | 3,425,381 |
| 2003 | 18 | 83,454 | 1,025,807 | 1,469,470 | 639,638 | 266,347 | 40,575 | 16,071 | 9,342 | 3,115 | 281 | 3,554,118 |
| 2004 | - | 21,480 | 799,360 | 1,513,948 | 560,213 | 275,995 | 49,655 | 17,836 | 9,646 | 3,736 | 745 | 3,252,614 |
| 2005 | - | 5,357 | 267,020 | 769,237 | 308,829 | 130,992 | 21,129 | 7,758 | 3,960 | 1,276 | 59 | 1,515,617 |
| 2006 | - | 3,134 | 199,691 | 768,574 | 462,415 | 186,265 | 22,965 | 6,999 | 2,856 | 939 | 45 | 1,653,883 |
| 1999 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 37 | 9,334 | 443,430 | 1,278,134 | 725,051 | 178,513 | 9,595 | 5,596 | - | 1,091 | 2,650,782 |
| 2000 | - | 35,811 | 131,572 | 445,848 | 1,081,136 | 774,342 | 217,682 | 10,651 | 1,853 | 547 | 274 | 2,699,716 |
| 2001 | - | 20,547 | 155,586 | 1,340,411 | 829,930 | 471,596 | 136,961 | 5,977 | 1,777 | - | - | 2,962,785 |
| 2002 | 25 | 26,243 | 64,632 | 544,199 | 1,927,567 | 681,075 | 168,273 | 9,277 | 3,887 | 183 | 110 | 3,425,470 |
| 2003 | 5 | 70,046 | 225,458 | 1,512,057 | 1,262,356 | 431,084 | 52,175 | 936 | 1 | - | - | 3,554,118 |
| 2004 | - | 7,324 | 153,479 | 1,370,015 | 1,195,936 | 463,865 | 58,595 | 3,400 | - | - | - | 3,252,614 |
| 2005 | - | 3,046 | 40,695 | 503,126 | 734,868 | 207,097 | 26,110 | 674 | - | - | - | 1,515,617 |
| 2006 | - | 1,255 | 31,061 | 362,610 | 928,469 | 306,754 | 23,291 | 442 | - | - | - | 1,653,883 |
| 2002 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 790 | 243,846 | 1,129,929 | 690,818 | 335,794 | 208,982 | 35,977 | 3,298 | 623 | 727 | 2,650,782 |
| 2000 | - | 110,855 | 297,174 | 958,908 | 680,908 | 358,288 | 251,542 | 39,386 | 1,922 | 814 | 127 | 2,699,924 |
| 2001 | - | 85,806 | 887,292 | 1,183,713 | 395,542 | 230,517 | 153,137 | 25,764 | 996 | 20 | - | 2,962,785 |
| 2002 | 766 | 67,882 | 479,641 | 1,852,715 | 648,263 | 217,557 | 138,575 | 19,127 | 804 | 51 | - | 3,425,381 |
| 2003 | 763 | 137,741 | 1,133,348 | 1,440,651 | 616,110 | 157,766 | 62,607 | 5,110 | 23 | 0 | - | 3,554,118 |
| 2004 | - | 49,734 | 923,701 | 1,498,856 | 498,988 | 201,946 | 72,027 | 6,009 | 1,288 | 63 | - | 3,252,614 |
| 2005 | - | 13,102 | 313,548 | 803,697 | 264,086 | 87,100 | 31,826 | 2,223 | 34 | 0 | - | 1,515,617 |
| 2006 | - | 7,593 | 231,814 | 824,781 | 456,891 | 105,366 | 25,917 | 1,515 | 7 | - | - | 1,653,883 |
| 1987 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 3,884 | 187,301 | 1,305,881 | 896,808 | 188,406 | 50,374 | 10,431 | 4,289 | 1,984 | 1,424 | 2,650,782 |
| 2000 | 45 | 124,069 | 329,726 | 1,240,742 | 796,857 | 159,994 | 39,256 | 6,205 | 1,776 | 821 | 433 | 2,699,924 |
| 2001 | - | 97,278 | 758,549 | 1,366,021 | 555,583 | 134,430 | 39,394 | 8,375 | 2,314 | 696 | 145 | 2,962,785 |
| 2002 | 480 | 71,370 | 376,409 | 2,038,485 | 775,141 | 125,485 | 29,652 | 5,761 | 1,873 | 571 | 153 | 3,425,381 |
| 2003 | 781 | 168,219 | 1,027,959 | 1,617,045 | 652,500 | 70,815 | 13,353 | 3,122 | 232 | 84 | 8 | 3,554,118 |
| 2004 | - | 69,346 | 781,159 | 1,696,823 | 603,787 | 83,226 | 13,775 | 2,790 | 939 | 642 | 126 | 3,252,614 |
| 2005 | - | 18,901 | 254,124 | 893,669 | 305,641 | 36,252 | 5,938 | 913 | 141 | 26 | 11 | 1,515,617 |
| 2006 | - | 12,489 | 193,316 | 934,593 | 467,782 | 39,532 | 5,417 | 681 | 54 | 15 | 5 | 1,653,883 |

Table 6. German Bank acoustic index of abundance age disaggregated based on the ALK method using the ALK's from 1987, 1992, 1999, and 2002. The first series of years represent the index used in previous assessments.

| Original Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | - | - | 9,924 | 428,280 | 1,131,660 | 664,725 | 163,298 | 5,561 | 6,599 | 934 | 1,079 | 2,412,061 |
| 2000 | 179 | 159,866 | 146,724 | 524,346 | 740,919 | 360,915 | 155,853 | 26,263 | 1,631 | 175 | 996 | 2,117,866 |
| 2001 | - | 85,238 | 685,939 | 185,393 | 167,059 | 112,396 | 61,752 | 12,400 | 1,753 | - | - | 1,311,930 |
| 2002 | 2,366 | 78,824 | 334,785 | 1,370,159 | 440,402 | 166,919 | 90,875 | 13,560 | 758 | 380 | - | 2,499,028 |
| 2003 | - | 119,130 | 1,172,040 | 590,615 | 494,790 | 71,925 | 36,656 | 1,717 | - | - | - | 2,486,873 |
| 2004 | - | 22,502 | 785,706 | 967,910 | 571,000 | 96,778 | 37,007 | 2,586 | 2,271 | - | - | 2,485,760 |
| 2005 | - | 3,489 | 182,737 | 874,175 | 243,815 | 46,493 | 14,539 | 597 | - | - | | 1,365,846 |
| 2006 | - | - | | | | | | | | | | |
| 1992 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 177 | 182,426 | 958,511 | 649,033 | 407,085 | 100,099 | 54,011 | 42,467 | 14,922 | 3,332 | 2,412,061 |
| 2000 | - | 61,593 | 252,808 | 710,449 | 524,889 | 358,849 | 93,715 | 55,356 | 43,327 | 14,397 | 2,483 | 2,117,866 |
| 2001 | - | 41,431 | 393,050 | 516,277 | 173,762 | 115,323 | 32,606 | 19,382 | 14,779 | 4,715 | 606 | 1,311,930 |
| 2002 | 31 | 42,485 | 322,225 | 1,206,380 | 566,323 | 254,452 | 53,123 | 27,267 | 19,749 | 6,267 | 727 | 2,499,028 |
| 2003 | - | 71,152 | 777,909 | 1,022,869 | 400,136 | 169,456 | 26,443 | 10,736 | 5,902 | 2,049 | 220 | 2,486,873 |
| 2004 | - | 17,604 | 592,660 | 1,174,792 | 427,703 | 208,331 | 39,138 | 13,939 | 7,666 | 3,210 | 717 | 2,485,760 |
| 2005 | - | 4,949 | 231,769 | 692,330 | 285,028 | 120,499 | 19,330 | 7,065 | 3,639 | 1,182 | 54 | 1,365,846 |
| 2006 | - | 2,941 | 173,119 | 657,212 | 405,061 | 165,358 | 20,583 | 6,222 | 2,490 | 806 | 28 | 1,433,819 |
| 1999 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 21 | 7,344 | 405,926 | 1,149,246 | 663,578 | 169,882 | 9,422 | 5,563 | - | 1,079 | 2,412,061 |
| 2000 | - | 35,798 | 129,569 | 349,288 | 825,799 | 591,332 | 173,802 | 9,410 | 1,844 | 545 | 273 | 2,117,660 |
| 2001 | - | 20,285 | 128,515 | 586,842 | 322,702 | 188,914 | 60,482 | 2,733 | 1,458 | - | - | 1,311,930 |
| 2002 | 25 | 25,902 | 61,181 | 410,493 | 1,351,378 | 512,001 | 128,100 | 6,671 | 3,077 | 181 | 109 | 2,499,117 |
| 2003 | - | 60,885 | 163,214 | 1,163,926 | 786,040 | 278,004 | 34,179 | 625 | - | - | - | 2,486,873 |
| 2004 | - | 6,082 | 108,559 | 1,039,444 | 935,219 | 347,773 | 45,577 | 3,107 | - | - | - | 2,485,760 |
| 2005 | - | 2,856 | 36,529 | 435,221 | 676,773 | 189,987 | 23,858 | 622 | - | - | - | 1,365,846 |
| 2006 | - | 1,194 | 28,027 | 309,739 | 800,321 | 273,300 | 20,865 | 375 | - | - | - | 1,433,819 |
| 2002 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 555 | 241,360 | 1,009,376 | 633,595 | 302,934 | 189,362 | 32,051 | 542 | 784 | 1,501 | 2,412,061 |
| 2000 | - | 128,363 | 246,018 | 709,362 | 549,248 | 262,718 | 190,117 | 30,194 | 424 | 745 | 678 | 2,117,866 |
| 2001 | - | 97,670 | 454,641 | 434,339 | 154,961 | 94,189 | 65,389 | 10,742 | - | - | - | 1,311,930 |
| 2002 | 228 | 73,127 | 383,670 | 1,286,072 | 478,806 | 162,943 | 101,152 | 12,630 | 132 | 171 | 97 | 2,499,028 |
| 2003 | - | 122,577 | 963,254 | 875,273 | 385,048 | 101,046 | 36,615 | 3,060 | - | - | - | 2,486,873 |
| 2004 | - | 46,965 | 753,588 | 1,100,219 | 375,589 | 150,173 | 53,886 | 3,206 | 1,032 | 551 | 551 | 2,485,760 |
| 2005 | - | 14,412 | 294,433 | 707,299 | 245,064 | 75,778 | 27,136 | 1,724 | - | - | - | 1,365,846 |
| 2006 | - | 8,192 | 217,937 | 690,480 | 407,378 | 87,542 | 21,400 | 890 | - | - | - | 1,433,819 |
| 1987 ALK | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| 1999 | - | 3,123 | 169,809 | 1,181,724 | 814,363 | 176,757 | 48,457 | 10,200 | 4,251 | 1,967 | 1,410 | 2,412,061 |
| 2000 | - | 106,999 | 209,110 | 868,210 | 698,993 | 169,040 | 49,699 | 10,168 | 3,785 | 1,231 | 630 | 2,117,866 |
| 2001 | - | 85,996 | 370,554 | 553,876 | 220,968 | 58,006 | 17,351 | 3,731 | 1,028 | 372 | 50 | 1,311,930 |
| 2002 | 477 | 68,562 | 290,540 | 1,437,157 | 577,532 | 95,630 | 22,617 | 4,488 | 1,427 | 483 | 115 | 2,499,028 |
| 2003 | 457 | 135,489 | 777,646 | 1,104,998 | 411,208 | 45,729 | 8,821 | 2,275 | 179 | 66 | 5 | 2,486,873 |
| 2004 | - | 51,300 | 576,871 | 1,322,152 | 455,841 | 65,084 | 10,563 | 2,292 | 903 | 633 | 122 | 2,485,760 |
| 2005 | - | 17,164 | 219,870 | 807,182 | 282,006 | 33,226 | 5,417 | 813 | 133 | 23 | 10 | 1,365,846 |
| 2006 | - | 11,282 | 168,081 | 800,188 | 413,539 | 35,422 | 4,715 | 568 | 16 | 8 | - | 1,433,819 |

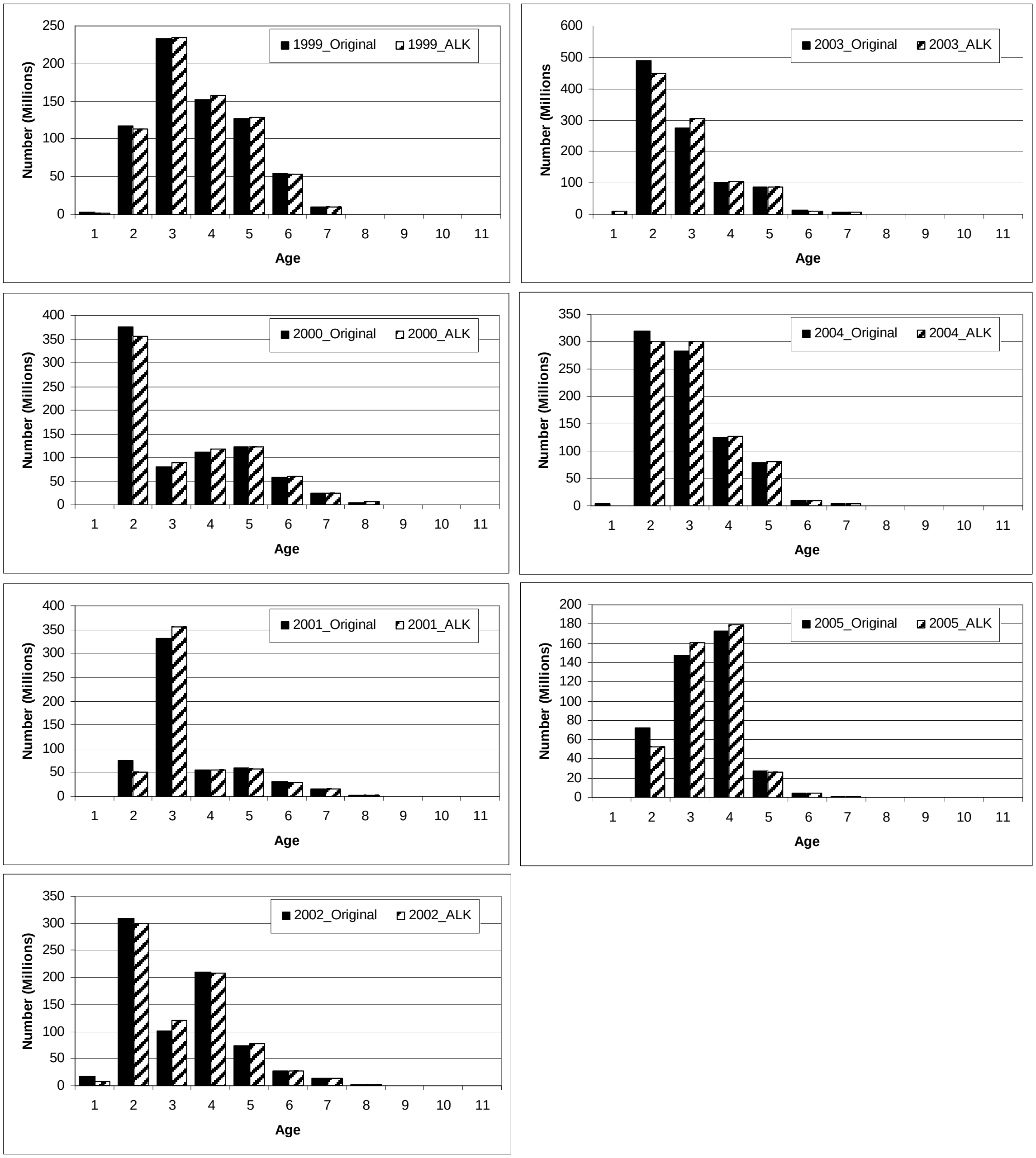



Figure 1. Comparison of the original (previously reported) catch at age in numbers based on monthly ALKs and yearly ALKs from 1999 to 2005 for herring in 4Xqrs.

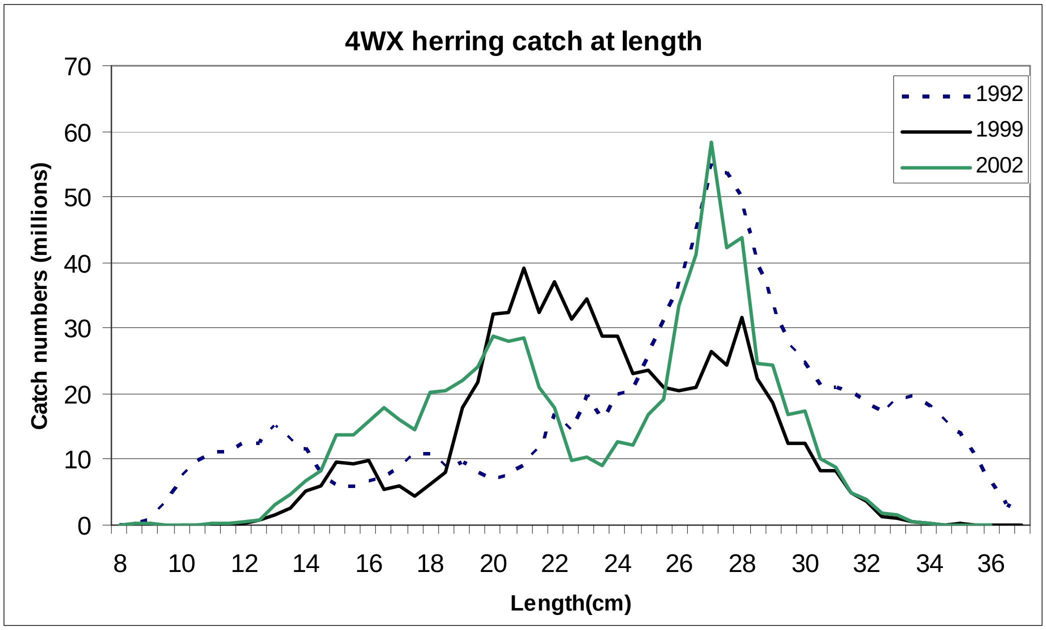



Figure 2. Herring catch at length frequencies for 1992, 1999 and 2002 used as growth model source years for the IALK method.

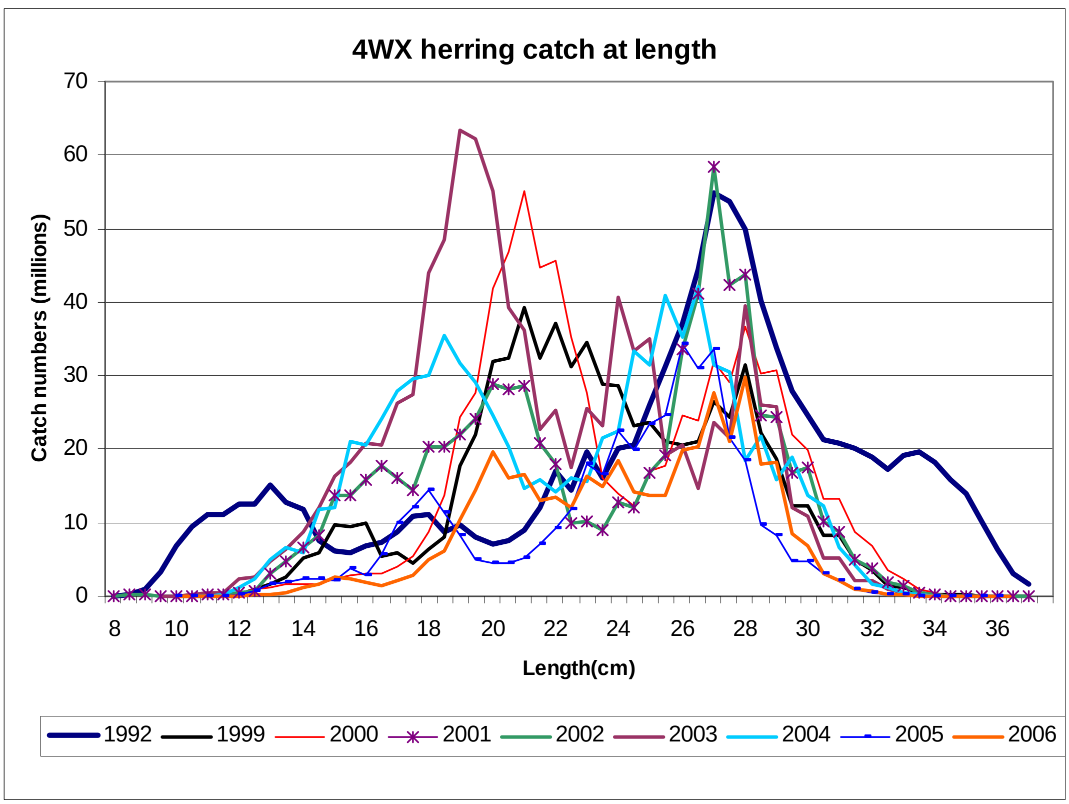



Figure 3. Herring length frequencies for ALK source years (1992, 1999 and 2002) and CAA target year modifications (1999 to 2006).

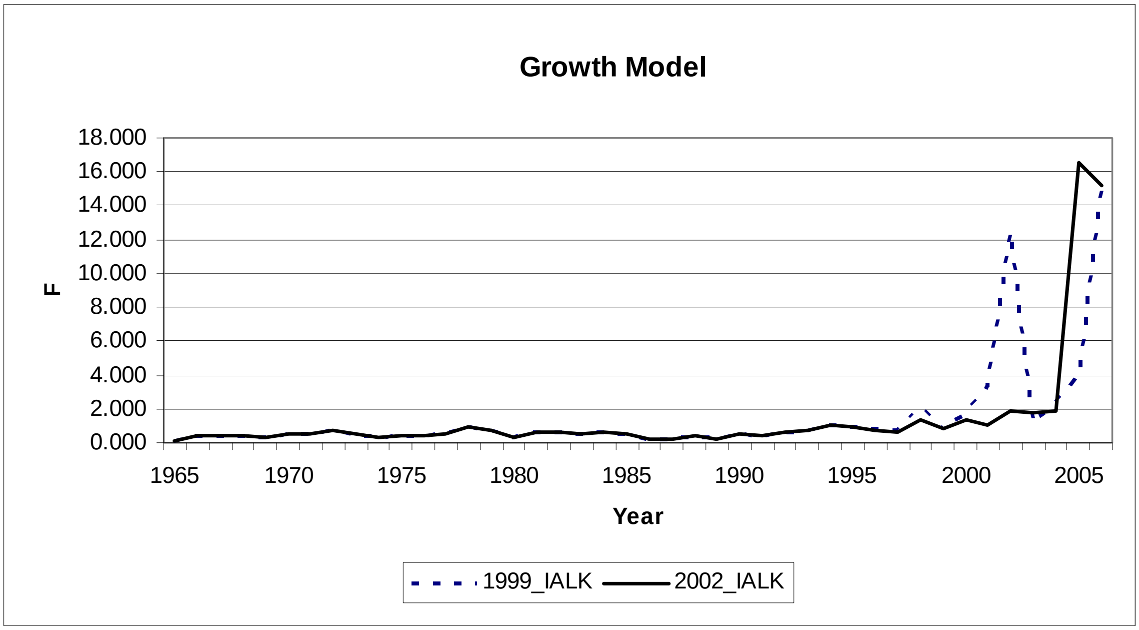



Figure 4. Fishing mortality (F) for the 4X herring stock from a sensitivity analysis using the 1999 and 2002 growth model and the IALK method to modify the CAA.

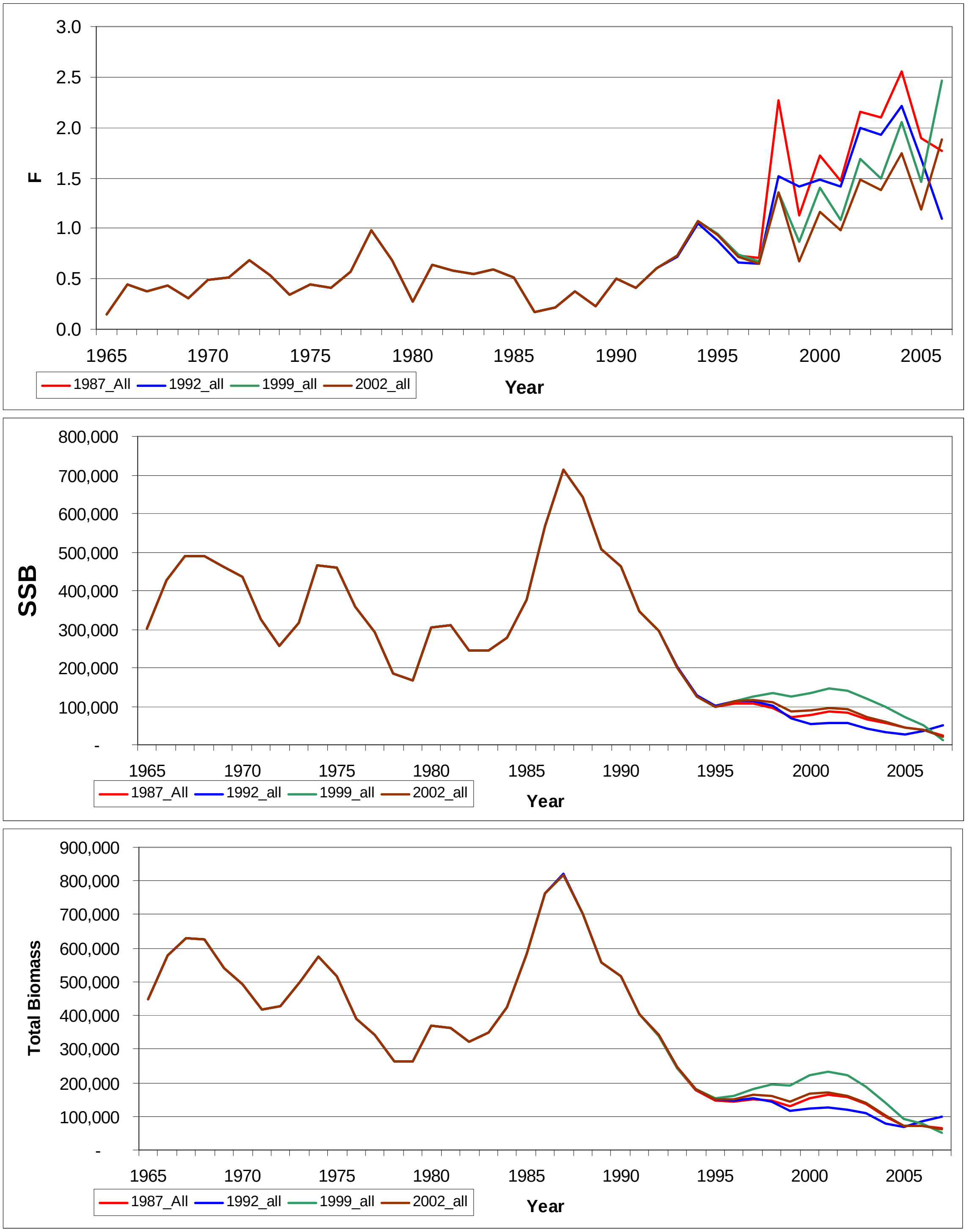



Figure 5. Fishing mortality (F), spawning stock biomass (SSB) and total biomass for the 4X herring stock (ALK method) using the 1987, 1992, 1999 and 2002 ALKs to modify the CAA and <u>overall</u> acoustic index of abundance in the VPA formulation.

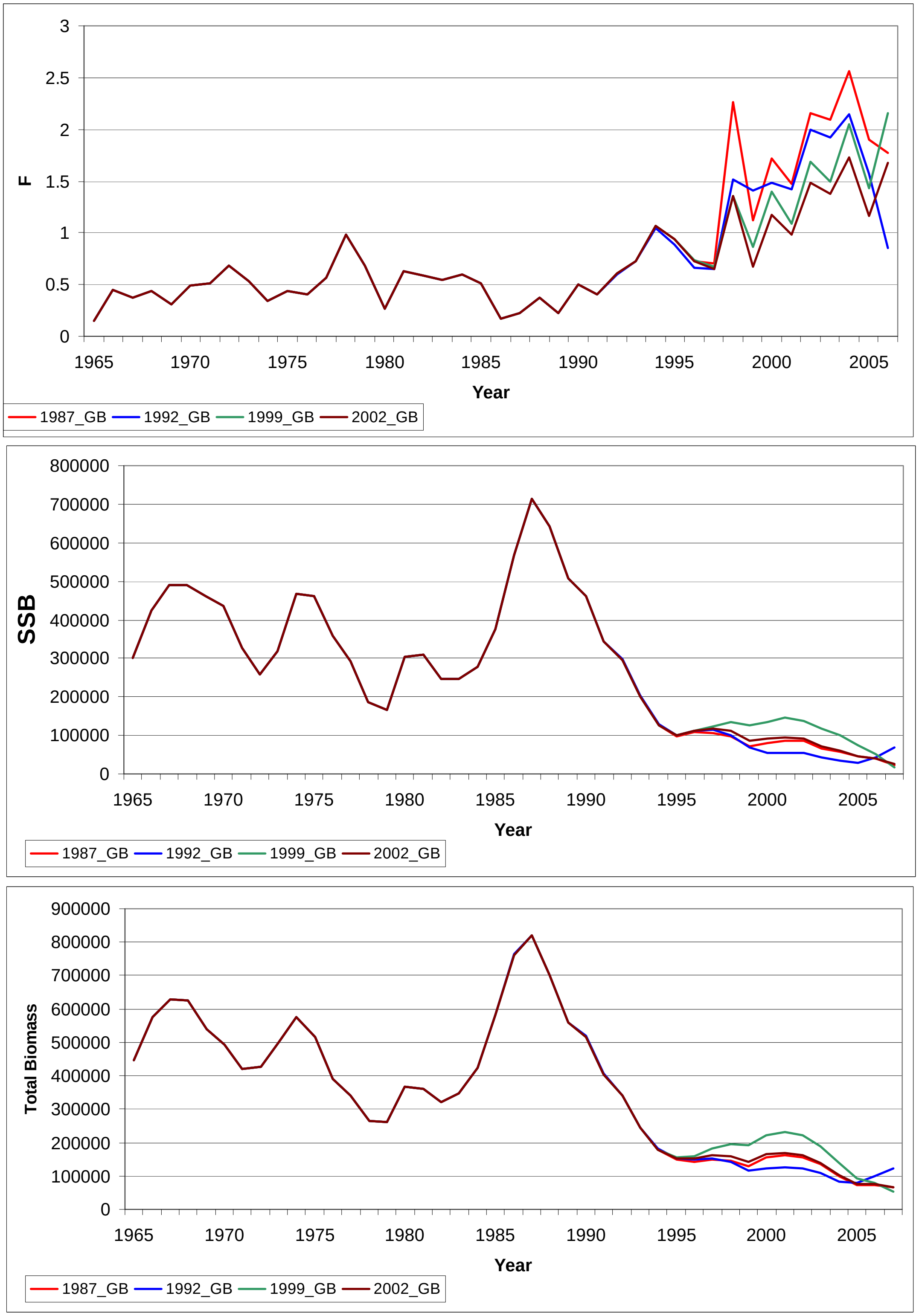



Figure 6. Fishing mortality (F), spawning stock biomass (SSB) and total biomass for the 4X herring stock (ALK method) using the 1987, 1992, 1999 and 2002 ALKs to modify the CAA and German Bank acoustic index of abundance in the VPA formulation.

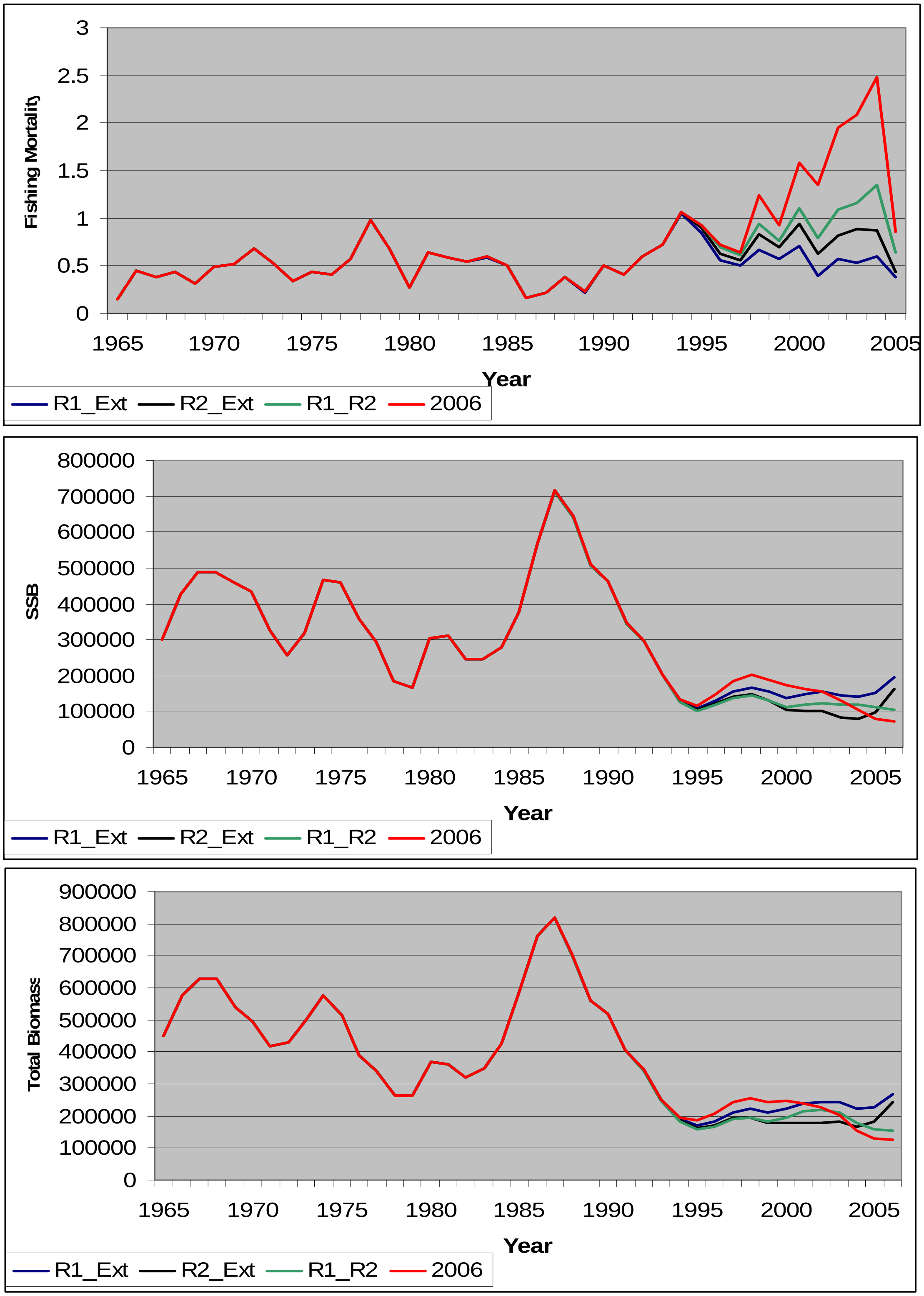
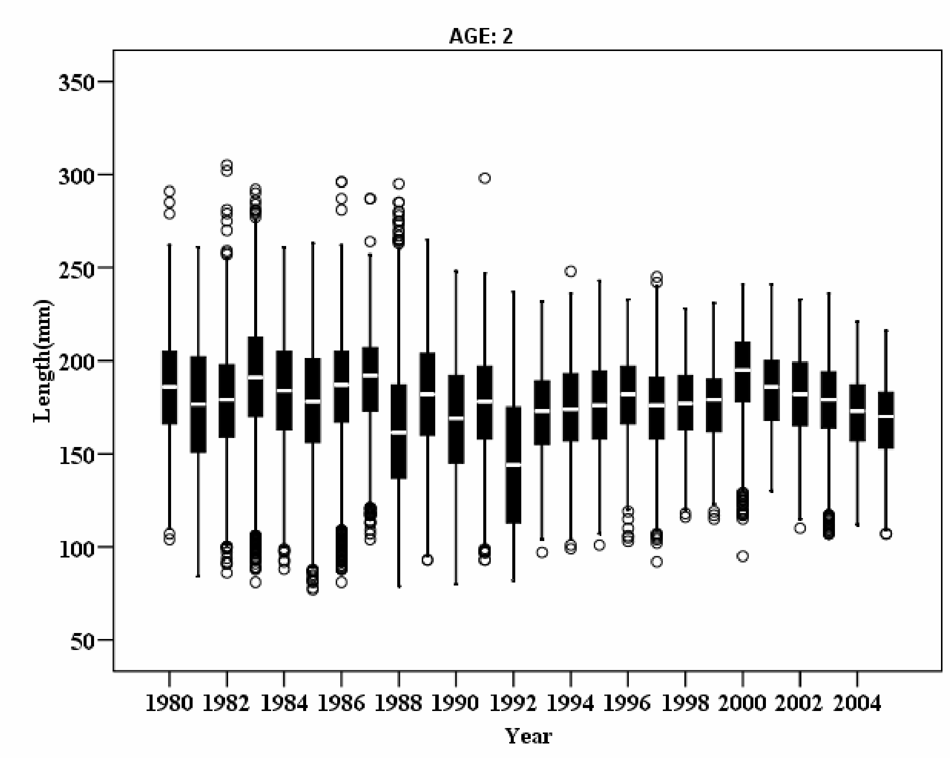
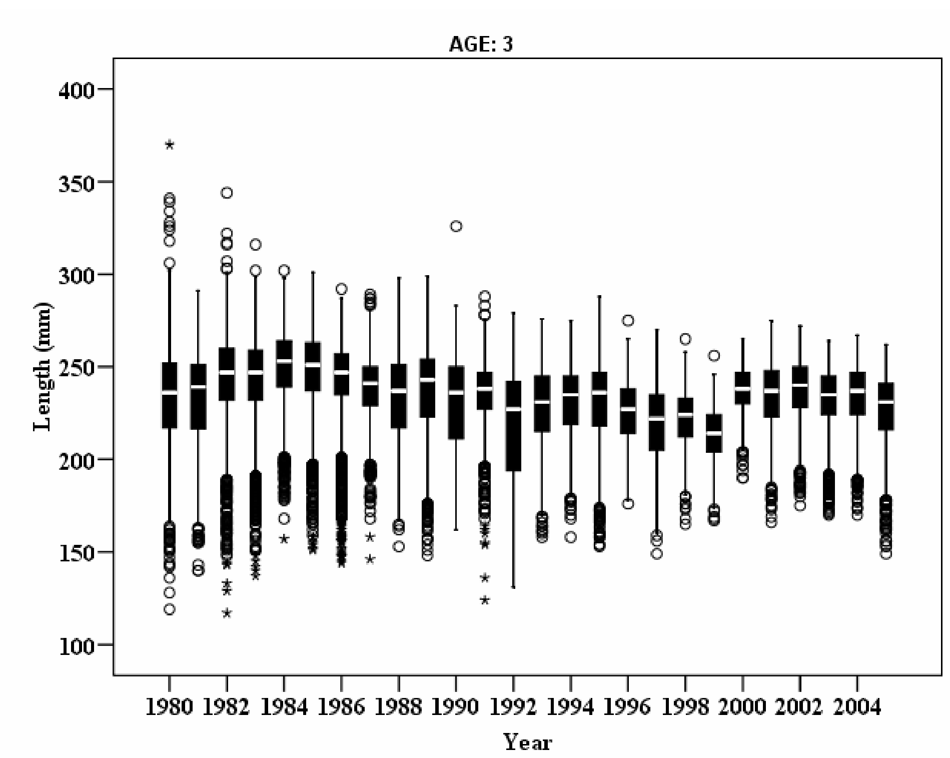


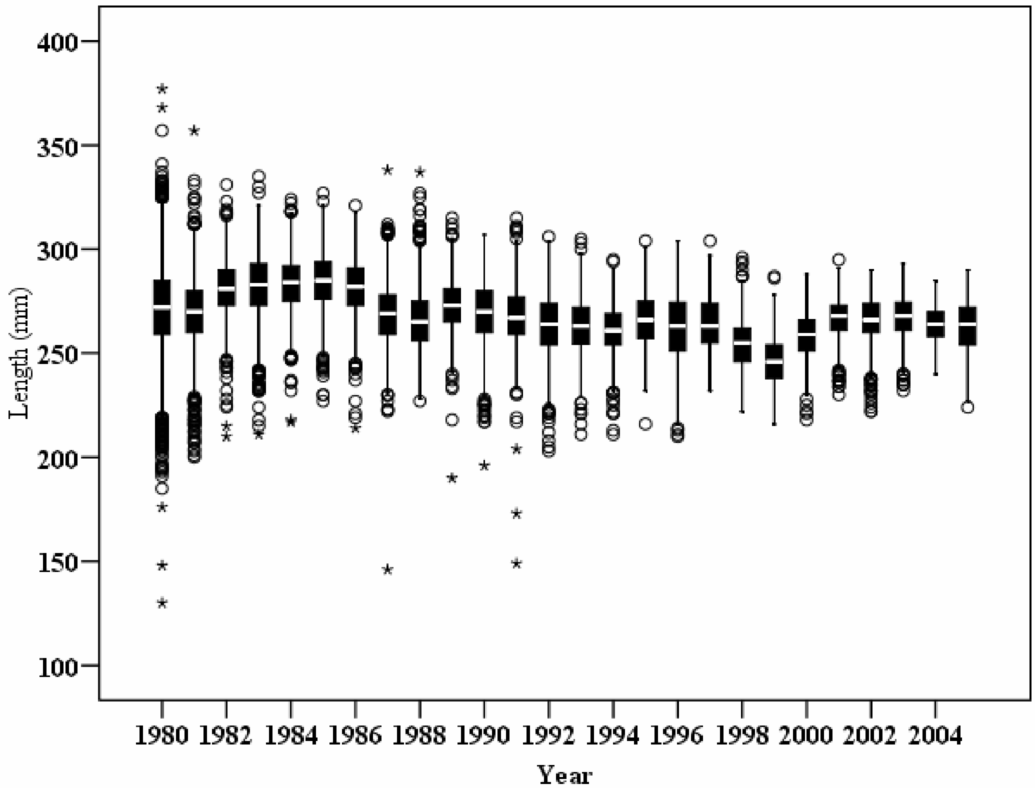

Figure 7. Fishing mortality (F), spawning stock biomass (SSB) and total biomass for the 4X herring stock using the decaying aging from one reader to another between 1999 and 2006 (Melvin and Power, 2006). The 2006 line represents the last analytical assessment.

Appendix I. Length at age box plots of herring sampled in 4X for all gear types and months combined for 1980 to 2005 showing the median, 25 and 75 percentiles, the 95% confidence interval, and outliers.



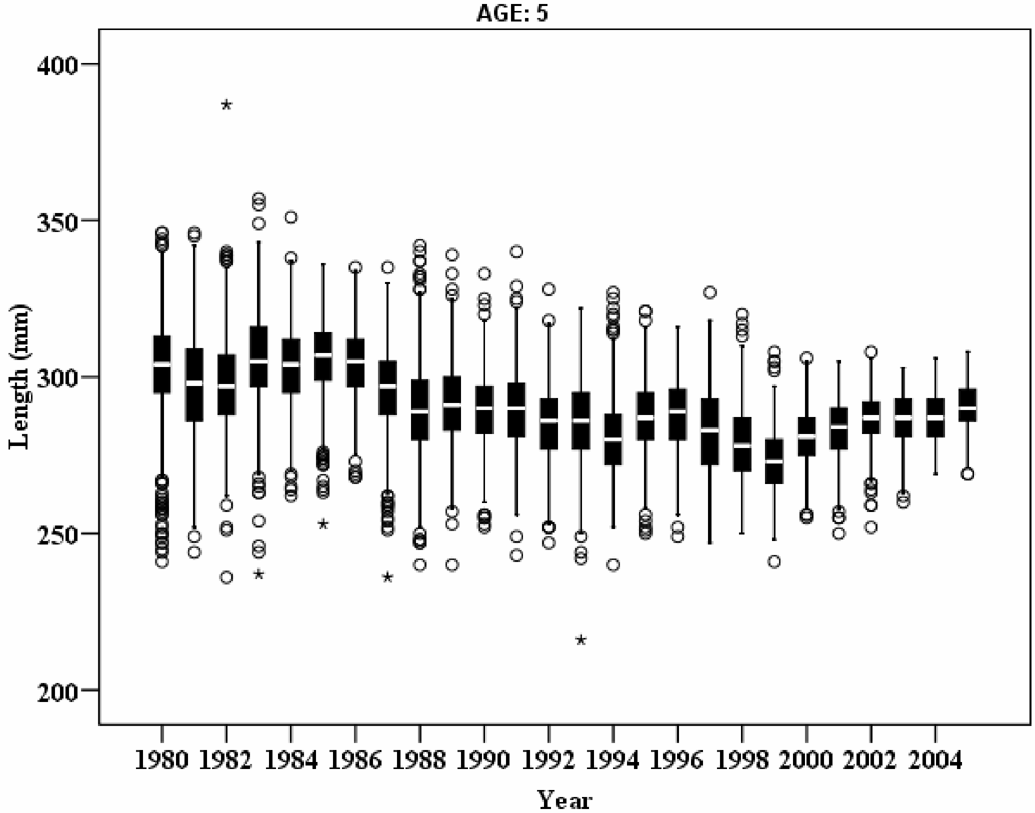



AGE: 4

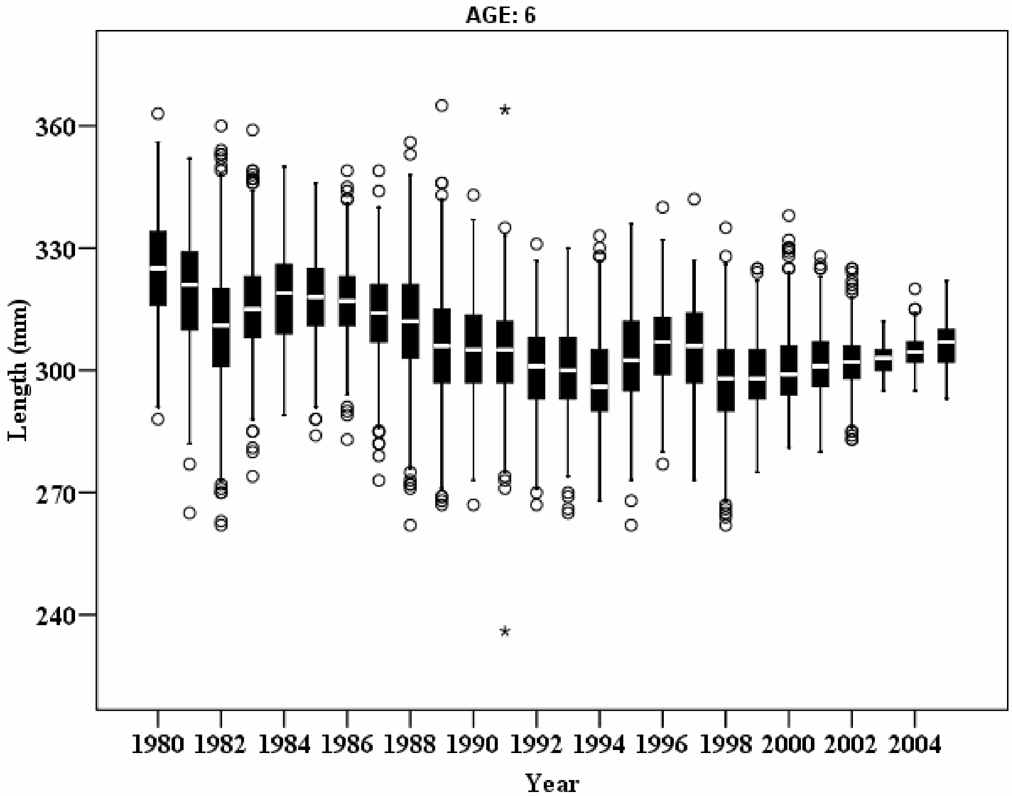


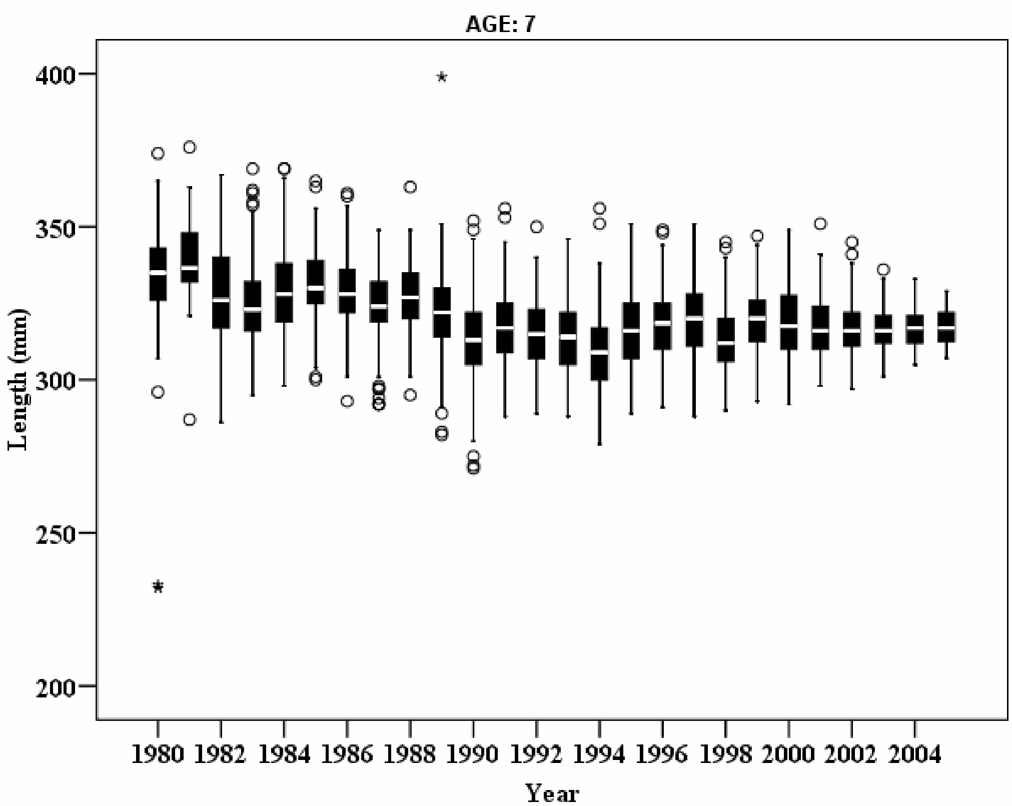
Length (mm)
400
350
300
250
200
150
100
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Year

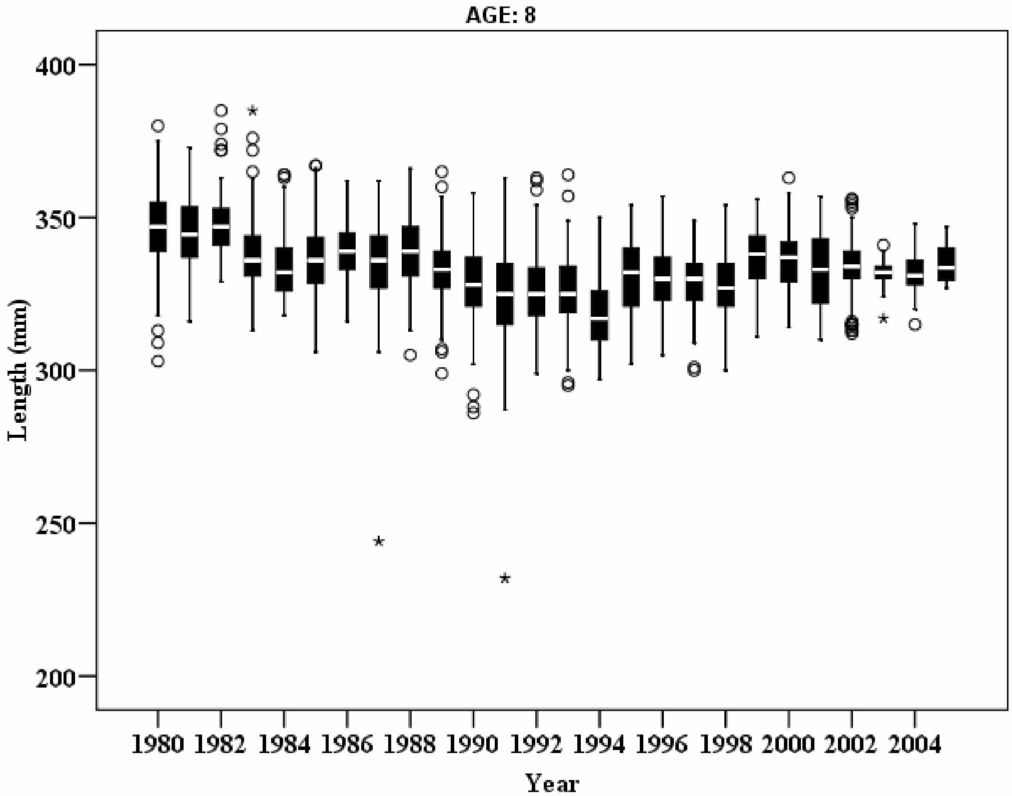

AGE: 5

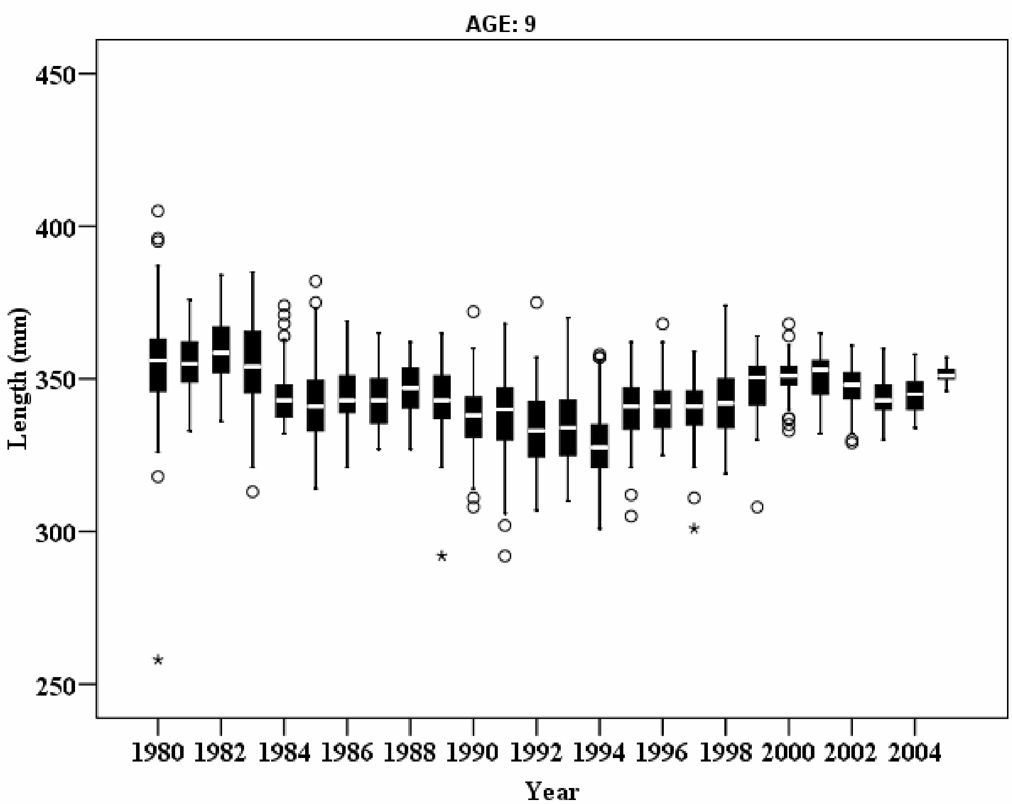


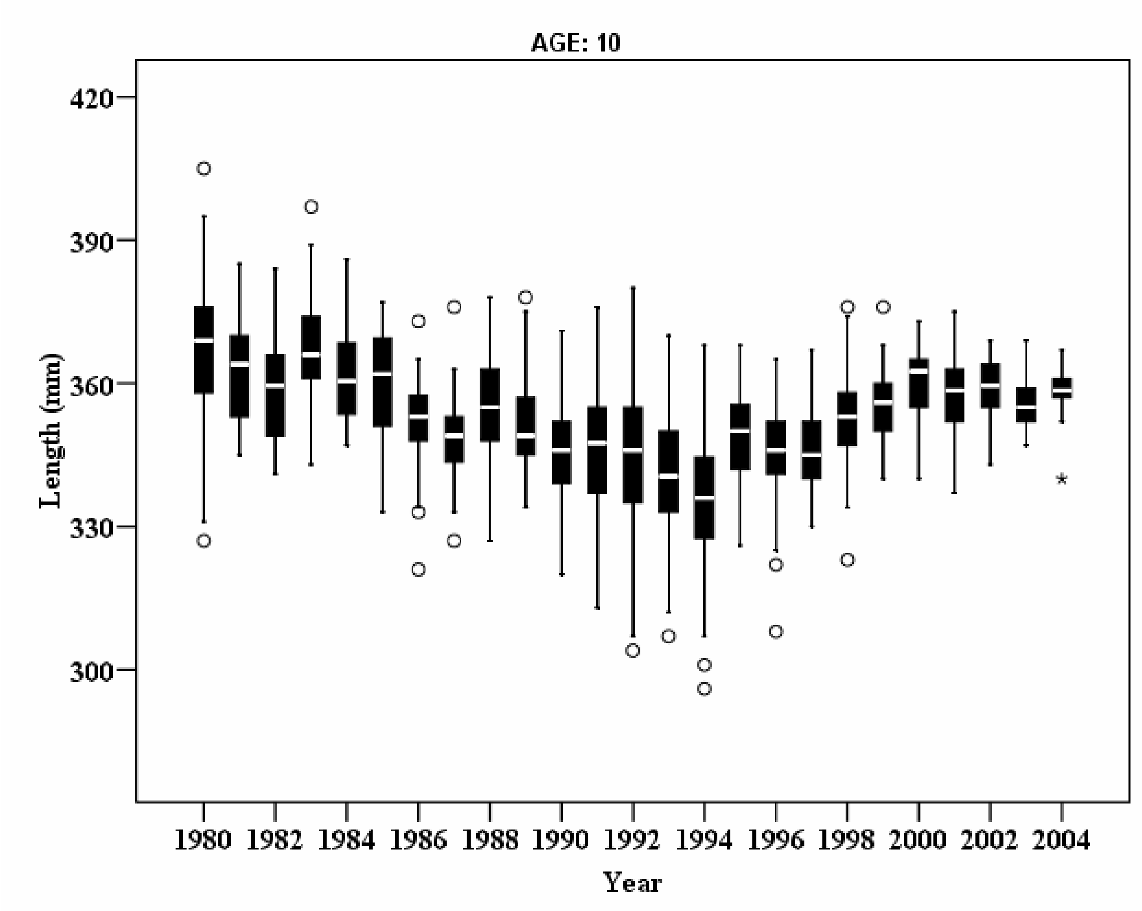
Length (mm)
400
350
300
250
200
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Year


AGE: 6
360
330
300
270
240
Length (mm)
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Year


AGE: 7
400
350
300
250
200
Length (mm)
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Year


AGE: 8
400
350
300
250
200
Length (mm)
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Year


AGE: 9
450
400
350
300
250
Length (mm)
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Year


AGE: 10
420
390
360
330
300
Length (mm)
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year

Appendix II. ADAPT VPA Run using 2002 IALK results to modify the CAA and index of abundance for 1999 to 2006.

Revised Catch at Age Using IALK with 2002 as basis run (numbers in thousands)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 270378 | 1084719 | 34835 | 234383 | 49925 | 10592 | 1693 | 561 | 54 | 37 | 1 |
| 1966.00 | 154323 | 914093 | 448940 | 73382 | 321857 | 45916 | 13970 | 7722 | 1690 | 215 | 1 |
| 1967.00 | 722208 | 613970 | 153626 | 266454 | 110051 | 159203 | 57948 | 4497 | 409 | 296 | 148 |
| 1968.00 | 164703 | 2389061 | 224956 | 83109 | 290285 | 73087 | 90617 | 31977 | 15441 | 5668 | 1175 |
| 1969.00 | 108875 | 290329 | 531812 | 132319 | 162439 | 112631 | 62506 | 22595 | 6345 | 2693 | 722 |
| 1970.00 | 699720 | 576896 | 76532 | 286278 | 201215 | 120280 | 111937 | 41257 | 21271 | 7039 | 2674 |
| 1971.00 | 87570 | 404224 | 183896 | 106630 | 113566 | 75593 | 93620 | 50022 | 36618 | 7536 | 5695 |
| 1972.00 | 0 | 649254 | 71984 | 148516 | 77207 | 75384 | 49065 | 48700 | 26055 | 13792 | 11679 |
| 1973.00 | 1018 | 167454 | 781061 | 130851 | 40128 | 30334 | 22046 | 20249 | 23871 | 11630 | 13386 |
| 1974.00 | 18411 | 766064 | 93606 | 803651 | 68276 | 19093 | 10232 | 6565 | 12786 | 7102 | 9031 |
| 1975.00 | 3199 | 317641 | 239827 | 124599 | 514605 | 66302 | 12298 | 4409 | 4778 | 3847 | 6225 |
| 1976.00 | 240 | 55596 | 206535 | 153782 | 68804 | 268839 | 21460 | 5571 | 3951 | 2059 | 3446 |
| 1977.00 | 1170 | 153921 | 31572 | 218478 | 119234 | 51173 | 177247 | 13977 | 3170 | 1415 | 3894 |
| 1978.00 | 35381 | 383611 | 40887 | 12906 | 122108 | 68410 | 31088 | 108975 | 11082 | 2425 | 1676 |
| 1979.00 | 342 | 183982 | 250393 | 54620 | 5430 | 23142 | 18255 | 11836 | 41389 | 4527 | 2411 |
| 1980.00 | 2339 | 12503 | 80518 | 474091 | 27930 | 4373 | 4692 | 6560 | 2985 | 10641 | 2739 |
| 1981.00 | 0 | 103051 | 50883 | 102743 | 451482 | 32978 | 2418 | 2767 | 1917 | 538 | 2149 |
| 1982.00 | 3589 | 102133 | 150764 | 22640 | 98206 | 211043 | 14627 | 2080 | 1354 | 1250 | 1014 |
| 1983.00 | 5488 | 191682 | 150328 | 244007 | 24483 | 60678 | 89982 | 10352 | 1728 | 642 | 1324 |
| 1984.00 | 0 | 88433 | 243542 | 224354 | 146096 | 22716 | 21654 | 28299 | 9515 | 2183 | 9000 |
| 1985.00 | 9022 | 216740 | 337591 | 302782 | 147670 | 42404 | 14075 | 18178 | 7997 | 1201 | 470 |
| 1986.00 | 63 | 125300 | 275903 | 292792 | 56937 | 31599 | 10770 | 4320 | 2942 | 1356 | 349 |
| 1987.00 | 2300 | 82940 | 126436 | 527443 | 242597 | 45933 | 19481 | 7292 | 3361 | 3120 | 650 |
| 1988.00 | 151 | 148399 | 113208 | 195096 | 434192 | 236089 | 42533 | 21208 | 4186 | 3797 | 2845 |
| 1989.00 | 8 | 101788 | 114095 | 61842 | 79451 | 169023 | 76684 | 18303 | 8270 | 3814 | 3057 |
| 1990.00 | 0 | 178532 | 130176 | 171560 | 89922 | 101066 | 201901 | 116788 | 31466 | 10572 | 6848 |
| 1991.00 | 0 | 96960 | 179463 | 183647 | 88431 | 41352 | 50380 | 80732 | 45516 | 18291 | 13524 |
| 1992.00 | 9 | 168561 | 132642 | 286923 | 126510 | 75473 | 34458 | 35369 | 59136 | 34558 | 20653 |
| 1993.00 | 166 | 76405 | 43766 | 194198 | 130713 | 67708 | 33820 | 21481 | 21893 | 20684 | 11175 |
| 1994.00 | 151 | 103885 | 142260 | 53700 | 118015 | 72512 | 36059 | 14889 | 8706 | 10447 | 15533 |
| 1995.00 | 1831 | 113457 | 219777 | 112245 | 36784 | 36402 | 22127 | 6474 | 4217 | 2957 | 3566 |
| 1996.00 | 0 | 37496 | 37715 | 256063 | 54534 | 16862 | 9151 | 3300 | 1782 | 1310 | 1605 |
| 1997.00 | 356 | 56561 | 87395 | 78098 | 131062 | 18917 | 5131 | 3636 | 894 | 620 | 874 |
| 1998.00 | 137 | 264901 | 62322 | 138751 | 97065 | 97464 | 20679 | 3856 | 1730 | 1288 | 398 |
| 1999.00 | 24542 | 115030 | 381299 | 52673 | 91480 | 15394 | 16365 | 614 | 622 | 0 | 13 |
| 2000.00 | 0 | 157868 | 367531 | 54838 | 138513 | 24384 | 29620 | 2788 | 61 | 133 | 32 |
| 2001.00 | 0 | 23298 | 399580 | 37903 | 66074 | 20719 | 17657 | 3240 | 62 | 0 | 4 |
| 2002.00 | 28106 | 258243 | 132695 | 212922 | 78124 | 28343 | 13478 | 1550 | 64 | 4 | 3 |
| 2003.00 | 15966 | 468618 | 304499 | 52683 | 111925 | 6886 | 9380 | 346 | 49 | 0 | 0 |
| 2004.00 | 68122 | 278850 | 294209 | 96063 | 61470 | 19368 | 3002 | 340 | 41 | 0 | 0 |
| 2005.00 | 6537 | 79236 | 179464 | 129456 | 18691 | 9424 | 1508 | 82 | 0 | 0 | 0 |
| 2006.00 | 635 | 63410 | 192579 | 82177 | 67186 | 4814 | 2677 | 34 | 11 | 0 | 9 |
| 2007.00 | | | | | | | | | | | |

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET......... 0.000499
MEAN SQUARE RESIDUALS ....... 8.001859

| Parameter | Est. | Std. Err. | Rel. Err. | Bias | Rel. Bias |
|---|---|---|---|---|---|
| N[2007 7] | 1.37E3 | 2.61E3 | 1.902 | 2.20E3 | 1.599 |
| q ID#[3] | 4.06E3 | 4.17E3 | 1.026 | 1.94E3 | 0.478 |
| q ID#[4] | 1.79E4 | 1.84E4 | 1.026 | 8.79E3 | 0.490 |
| q ID#[5] | 1.77E4 | 1.81E4 | 1.025 | 8.88E3 | 0.502 |
| q ID#[6] | 4.49E4 | 4.60E4 | 1.025 | 2.25E4 | 0.502 |
| q ID#[7] | 1.39E4 | 1.42E4 | 1.024 | 7.00E3 | 0.504 |

VPA using analytical bias adjusted parameters (linear scale)
Population Numbers

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 3503534 | 3848688 | 995990 | 1312007 | 348049 | 92556 | 44658 | 4104 | 1354 | 406 | 500 |
| 1966.00 | 2737874 | 2624572 | 2177169 | 784001 | 863223 | 239988 | 66231 | 35035 | 2855 | 1060 | 707 |
| 1967.00 | 6078739 | 2102325 | 1329624 | 1378701 | 575717 | 418512 | 155171 | 41661 | 21740 | 836 | 1253 |
| 1968.00 | 1286168 | 4325977 | 1170158 | 950142 | 889042 | 372334 | 200109 | 75150 | 30056 | 17430 | 1311 |
| 1969.00 | 1754254 | 904620 | 1415817 | 755635 | 702962 | 467578 | 239085 | 82892 | 32938 | 10845 | 9244 |
| 1970.00 | 2304087 | 1338027 | 480252 | 682955 | 499558 | 429512 | 281595 | 139599 | 47575 | 21258 | 13377 |
| 1971.00 | 7460417 | 1258574 | 579796 | 324285 | 303152 | 228973 | 243661 | 130382 | 77266 | 19947 | 19640 |
| 1972.00 | 1138007 | 6028985 | 667899 | 309749 | 169889 | 146502 | 119687 | 115682 | 61966 | 30575 | 20551 |
| 1973.00 | 2336523 | 931722 | 4350855 | 481941 | 121063 | 70132 | 52761 | 54102 | 51165 | 27434 | 19153 |
| 1974.00 | 1625829 | 1912063 | 612115 | 2859196 | 277069 | 63139 | 30305 | 23481 | 26162 | 20577 | 15920 |
| 1975.00 | 247148 | 1314489 | 880008 | 416859 | 1619372 | 165491 | 34561 | 15639 | 13330 | 10013 | 15485 |
| 1976.00 | 721821 | 199459 | 790742 | 505119 | 229479 | 864256 | 76167 | 17278 | 8846 | 6633 | 11862 |
| 1977.00 | 4140082 | 590760 | 113384 | 461878 | 275572 | 126138 | 466414 | 43093 | 9149 | 3712 | 10202 |
| 1978.00 | 1346540 | 3388555 | 345406 | 64483 | 183136 | 119041 | 57492 | 223170 | 22748 | 4650 | 6640 |
| 1979.00 | 449150 | 1070509 | 2428553 | 245946 | 41184 | 41880 | 36645 | 19392 | 85497 | 8737 | 5577 |
| 1980.00 | 1572601 | 367424 | 710839 | 1762597 | 152252 | 28826 | 13695 | 13722 | 5372 | 33069 | 5530 |
| 1981.00 | 1669565 | 1285424 | 289534 | 509413 | 1017308 | 99518 | 19663 | 7007 | 5380 | 1742 | 19616 |
| 1982.00 | 2302841 | 1366924 | 959470 | 191250 | 324646 | 429491 | 51910 | 13919 | 3261 | 2687 | 15067 |
| 1983.00 | 4078615 | 1882165 | 1027015 | 649787 | 136178 | 177676 | 163382 | 29368 | 9523 | 1459 | 12505 |
| 1984.00 | 5027338 | 3334330 | 1368177 | 705449 | 313500 | 89458 | 91080 | 53687 | 14768 | 6242 | 9665 |
| 1985.00 | 1831408 | 4116036 | 2650074 | 900964 | 376340 | 126232 | 52833 | 55107 | 18747 | 3661 | 3339 |
| 1986.00 | 1059599 | 1491281 | 3174332 | 1865506 | 466205 | 175955 | 65335 | 30614 | 28818 | 8199 | 4231 |
| 1987.00 | 1397556 | 867469 | 1107953 | 2350109 | 1263691 | 330387 | 115620 | 43795 | 21173 | 20942 | 8641 |
| 1988.00 | 1401939 | 1142145 | 635440 | 793156 | 1449885 | 816339 | 229120 | 77124 | 29291 | 14309 | 20825 |
| 1989.00 | 1744644 | 1147674 | 801399 | 418360 | 474063 | 797425 | 456440 | 149311 | 44099 | 20211 | 22792 |
| 1990.00 | 1184504 | 1428387 | 847845 | 553356 | 286825 | 316602 | 500863 | 304665 | 105752 | 28664 | 29022 |
| 1991.00 | 583346 | 969790 | 1008587 | 576926 | 299137 | 154168 | 168565 | 229430 | 144883 | 58344 | 31604 |
| 1992.00 | 822696 | 477604 | 706579 | 664233 | 307627 | 165547 | 89083 | 92798 | 115498 | 77791 | 45145 |
| 1993.00 | 1684072 | 673558 | 239988 | 459138 | 287354 | 138704 | 68129 | 42089 | 44310 | 41852 | 51328 |
| 1994.00 | 770563 | 1378652 | 482597 | 157097 | 202270 | 118514 | 53156 | 25617 | 15312 | 16751 | 47791 |
| 1995.00 | 835010 | 630747 | 1035037 | 267438 | 80486 | 60727 | 32677 | 11632 | 7741 | 4794 | 29647 |
| 1996.00 | 726637 | 681994 | 414297 | 649760 | 118586 | 33044 | 17394 | 7184 | 3763 | 2584 | 22361 |
| 1997.00 | 1360697 | 594920 | 524534 | 305189 | 302812 | 48390 | 12023 | 6089 | 2935 | 1491 | 17807 |
| 1998.00 | 1042082 | 1113723 | 436080 | 350770 | 179704 | 130771 | 22686 | 5257 | 1756 | 1601 | 14456 |
| 1999.00 | 1641612 | 853061 | 673746 | 300894 | 163016 | 60709 | 21252 | 730 | 906 | 0 | 11658 |
| 2000.00 | 536662 | 1321874 | 594794 | 212501 | 198939 | 52090 | 35874 | 3018 | 62 | 192 | 9534 |
| 2001.00 | ******** | 439382 | 939986 | 160891 | 124718 | 40515 | 20878 | 3477 | 72 | 0 | 7816 |
| 2002.00 | 1542891 | ******** | 338711 | 412339 | 97657 | 43258 | 14703 | 1693 | 65 | 5 | 6396 |
| 2003.00 | 832501 | 1237832 | ******** | 158548 | 147843 | 11483 | 10318 | 421 | 50 | 0 | 5235 |
| 2004.00 | 478488 | 667176 | 593858 | ******** | 82573 | 22585 | 3286 | 349 | 42 | 0 | 4286 |
| 2005.00 | 93111 | 330391 | 296866 | 223808 | ******** | 13479 | 1624 | 101 | 0 | 0 | 3509 |
| 2006.00 | 1000000 | 70336 | 199287 | 83723 | 68168 | ******** | 2712 | 34 | 11 | 0 | 2873 |
| 2007.00 | 1000000 | 818157 | 2755 | 373 | 2 | 0 | ý824 | 0 | 0 | 0 | 2344 |

Fishing Mortality

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 0.089 | 0.370 | 0.039 | 0.219 | 0.172 | 0.135 | 0.043 | 0.163 | 0.045 | 0.106 | 0.002 |
| 1966.00 | 0.064 | 0.480 | 0.257 | 0.109 | 0.524 | 0.236 | 0.264 | 0.277 | 1.028 | 0.252 | 0.002 |
| 1967.00 | 0.140 | 0.386 | 0.136 | 0.239 | 0.236 | 0.538 | 0.525 | 0.127 | 0.021 | 0.490 | 0.139 |
| 1968.00 | 0.152 | 0.917 | 0.237 | 0.101 | 0.443 | 0.243 | 0.681 | 0.625 | 0.819 | 0.440 | 2.943 |
| 1969.00 | 0.071 | 0.433 | 0.529 | 0.214 | 0.293 | 0.307 | 0.338 | 0.355 | 0.238 | 0.318 | 0.090 |
| 1970.00 | 0.405 | 0.636 | 0.193 | 0.612 | 0.580 | 0.367 | 0.570 | 0.392 | 0.669 | 0.450 | 0.248 |
| 1971.00 | 0.013 | 0.434 | 0.427 | 0.446 | 0.527 | 0.449 | 0.545 | 0.544 | 0.727 | 0.533 | 0.383 |
| 1972.00 | 0.000 | 0.126 | 0.126 | 0.739 | 0.685 | 0.821 | 0.594 | 0.616 | 0.615 | 0.678 | 0.960 |
| 1973.00 | 0.000 | 0.220 | 0.220 | 0.354 | 0.451 | 0.639 | 0.610 | 0.527 | 0.711 | 0.622 | 1.402 |
| 1974.00 | 0.013 | 0.576 | 0.184 | 0.369 | 0.315 | 0.403 | 0.462 | 0.366 | 0.760 | 0.475 | 0.958 |
| 1975.00 | 0.014 | 0.308 | 0.355 | 0.397 | 0.428 | 0.576 | 0.493 | 0.370 | 0.498 | 0.545 | 0.579 |
| 1976.00 | 0.000 | 0.365 | 0.338 | 0.406 | 0.398 | 0.417 | 0.370 | 0.436 | 0.668 | 0.416 | 0.383 |
| 1977.00 | 0.000 | 0.337 | 0.364 | 0.725 | 0.639 | 0.586 | 0.537 | 0.439 | 0.477 | 0.539 | 0.540 |
| 1978.00 | 0.029 | 0.133 | 0.140 | 0.248 | 1.275 | 0.978 | 0.887 | 0.759 | 0.757 | 0.838 | 0.324 |
| 1979.00 | 0.001 | 0.209 | 0.121 | 0.280 | 0.157 | 0.918 | 0.782 | 1.084 | 0.750 | 0.830 | 0.639 |
| 1980.00 | 0.002 | 0.038 | 0.133 | 0.350 | 0.225 | 0.183 | 0.470 | 0.736 | 0.926 | 0.435 | 0.775 |
| 1981.00 | 0.000 | 0.092 | 0.215 | 0.251 | 0.662 | 0.451 | 0.145 | 0.565 | 0.494 | 0.413 | 0.129 |
| 1982.00 | 0.002 | 0.086 | 0.190 | 0.140 | 0.403 | 0.767 | 0.370 | 0.180 | 0.604 | 0.708 | 0.077 |
| 1983.00 | 0.001 | 0.119 | 0.176 | 0.529 | 0.220 | 0.468 | 0.913 | 0.487 | 0.222 | 0.655 | 0.124 |
| 1984.00 | 0.000 | 0.030 | 0.218 | 0.428 | 0.710 | 0.327 | 0.302 | 0.852 | 1.195 | 0.483 | 3.753 |
| 1985.00 | 0.005 | 0.060 | 0.151 | 0.459 | 0.560 | 0.459 | 0.346 | 0.448 | 0.627 | 0.445 | 0.168 |
| 1986.00 | 0.000 | 0.097 | 0.101 | 0.189 | 0.144 | 0.220 | 0.200 | 0.169 | 0.119 | 0.201 | 0.095 |
| 1987.00 | 0.002 | 0.111 | 0.134 | 0.283 | 0.237 | 0.166 | 0.205 | 0.202 | 0.192 | 0.179 | 0.086 |
| 1988.00 | 0.000 | 0.154 | 0.218 | 0.315 | 0.398 | 0.381 | 0.228 | 0.359 | 0.171 | 0.344 | 0.163 |
| 1989.00 | 0.000 | 0.103 | 0.170 | 0.177 | 0.204 | 0.265 | 0.204 | 0.145 | 0.231 | 0.232 | 0.160 |
| 1990.00 | 0.000 | 0.148 | 0.185 | 0.415 | 0.421 | 0.430 | 0.581 | 0.543 | 0.395 | 0.517 | 0.300 |
| 1991.00 | 0.000 | 0.117 | 0.218 | 0.429 | 0.392 | 0.348 | 0.397 | 0.486 | 0.422 | 0.421 | 0.630 |
| 1992.00 | 0.000 | 0.488 | 0.231 | 0.638 | 0.597 | 0.688 | 0.550 | 0.539 | 0.815 | 0.663 | 0.691 |
| 1993.00 | 0.000 | 0.133 | 0.224 | 0.620 | 0.686 | 0.759 | 0.778 | 0.811 | 0.773 | 0.773 | 0.273 |
| 1994.00 | 0.000 | 0.087 | 0.390 | 0.469 | 1.003 | 1.088 | 1.319 | 0.997 | 0.961 | 1.126 | 0.440 |
| 1995.00 | 0.002 | 0.220 | 0.266 | 0.613 | 0.690 | 1.050 | 1.315 | 0.928 | 0.897 | 1.104 | 0.142 |
| 1996.00 | 0.000 | 0.063 | 0.106 | 0.563 | 0.696 | 0.811 | 0.850 | 0.695 | 0.726 | 0.803 | 0.082 |
| 1997.00 | 0.000 | 0.111 | 0.202 | 0.330 | 0.640 | 0.558 | 0.627 | 1.044 | 0.406 | 0.606 | 0.056 |
| 1998.00 | 0.000 | 0.303 | 0.171 | 0.566 | 0.885 | 1.617 | 3.237 | 1.558 | 13.422 | 1.973 | 0.031 |
| 1999.00 | 0.017 | 0.161 | 0.954 | 0.214 | 0.941 | 0.326 | 1.752 | 2.269 | 1.351 | 0.717 | 0.001 |
| 2000.00 | 0.000 | 0.141 | 1.107 | 0.333 | 1.391 | 0.714 | 2.134 | 3.533 | 10.491 | 1.374 | 0.004 |
| 2001.00 | 0.000 | 0.060 | 0.624 | 0.299 | 0.859 | 0.814 | 2.312 | 3.774 | 2.418 | 1.456 | 0.001 |
| 2002.00 | 0.020 | 19.180 | 0.559 | 0.826 | 1.941 | 1.233 | 3.354 | 3.321 | 10.688 | 1.825 | 0.000 |
| 2003.00 | 0.021 | 0.534 | 19.344 | 0.452 | 1.679 | 1.051 | 3.186 | 2.099 | 10.485 | 2.081 | 0.000 |
| 2004.00 | 0.170 | 0.610 | 0.776 | 18.191 | 1.613 | 2.432 | 3.279 | 7.237 | 10.165 | 2.614 | 0.000 |
| 2005.00 | 0.081 | 0.306 | 1.066 | 0.989 | 16.556 | 1.403 | 3.667 | 2.028 | 5.113 | 1.650 | 0.000 |
| 2006.00 | 0.001 | 3.040 | 6.080 | 10.640 | 13.680 | 15.200 | 15.200 | 15.200 | 15.200 | 15.200 | 0.003 |

Appendix III: ADAPT VPA Run using 2002 ALK results to modify the CAA and the German Bank acoustic index of abundance from 1999 to 2006.

Annual Catch at Age (000's) using 2002 age length applied to 99-06

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 270378 | 1084719 | 34835 | 234383 | 49925 | 10592 | 1693 | 561 | 54 | 37 | 1 |
| 1966.00 | 154323 | 914093 | 448940 | 73382 | 321857 | 45916 | 13970 | 7722 | 1690 | 215 | 1 |
| 1967.00 | 722208 | 613970 | 153626 | 266454 | 110051 | 159203 | 57948 | 4497 | 409 | 296 | 148 |
| 1968.00 | 164703 | 2389061 | 224956 | 83109 | 290285 | 73087 | 90617 | 31977 | 15441 | 5668 | 1175 |
| 1969.00 | 108875 | 290329 | 531812 | 132319 | 162439 | 112631 | 62506 | 22595 | 6345 | 2693 | 722 |
| 1970.00 | 699720 | 576896 | 76532 | 286278 | 201215 | 120280 | 111937 | 41257 | 21271 | 7039 | 2674 |
| 1971.00 | 87570 | 404224 | 183896 | 106630 | 113566 | 75593 | 93620 | 50022 | 36618 | 7536 | 5695 |
| 1972.00 | 0 | 649254 | 71984 | 148516 | 77207 | 75384 | 49065 | 48700 | 26055 | 13792 | 11679 |
| 1973.00 | 1018 | 167454 | 781061 | 130851 | 40128 | 30334 | 22046 | 20249 | 23871 | 11630 | 13386 |
| 1974.00 | 18411 | 766064 | 93606 | 803651 | 68276 | 19093 | 10232 | 6565 | 12786 | 7102 | 9031 |
| 1975.00 | 3199 | 317641 | 239827 | 124599 | 514605 | 66302 | 12298 | 4409 | 4778 | 3847 | 6225 |
| 1976.00 | 240 | 55596 | 206535 | 153782 | 68804 | 268839 | 21460 | 5571 | 3951 | 2059 | 3446 |
| 1977.00 | 1170 | 153921 | 31572 | 218478 | 119234 | 51173 | 177247 | 13977 | 3170 | 1415 | 3894 |
| 1978.00 | 35381 | 383611 | 40887 | 12906 | 122108 | 68410 | 31088 | 108975 | 11082 | 2425 | 1676 |
| 1979.00 | 342 | 183982 | 250393 | 54620 | 5430 | 23142 | 18255 | 11836 | 41389 | 4527 | 2411 |
| 1980.00 | 2339 | 12503 | 80518 | 474091 | 27930 | 4373 | 4692 | 6560 | 2985 | 10641 | 2739 |
| 1981.00 | 0 | 103051 | 50883 | 102743 | 451482 | 32978 | 2418 | 2767 | 1917 | 538 | 2149 |
| 1982.00 | 3589 | 102133 | 150764 | 22640 | 98206 | 211043 | 14627 | 2080 | 1354 | 1250 | 1014 |
| 1983.00 | 5488 | 191682 | 150328 | 244007 | 24483 | 60678 | 89982 | 10352 | 1728 | 642 | 1324 |
| 1984.00 | 0 | 88433 | 243542 | 224354 | 146096 | 22716 | 21654 | 28299 | 9515 | 2183 | 9000 |
| 1985.00 | 9022 | 216740 | 337591 | 302782 | 147670 | 42404 | 14075 | 18178 | 7997 | 1201 | 470 |
| 1986.00 | 63 | 125300 | 275903 | 292792 | 56937 | 31599 | 10770 | 4320 | 2942 | 1356 | 349 |
| 1987.00 | 2300 | 82940 | 126436 | 527443 | 242597 | 45933 | 19481 | 7292 | 3361 | 3120 | 650 |
| 1988.00 | 151 | 148399 | 113208 | 195096 | 434192 | 236089 | 42533 | 21208 | 4186 | 3797 | 2845 |
| 1989.00 | 8 | 101788 | 114095 | 61842 | 79451 | 169023 | 76684 | 18303 | 8270 | 3814 | 3057 |
| 1990.00 | 0 | 178532 | 130176 | 171560 | 89922 | 101066 | 201901 | 116788 | 31466 | 10572 | 6848 |
| 1991.00 | 0 | 96960 | 179463 | 183647 | 88431 | 41352 | 50380 | 80732 | 45516 | 18291 | 13524 |
| 1992.00 | 9 | 168561 | 132642 | 286923 | 126510 | 75473 | 34458 | 35369 | 59136 | 34558 | 20653 |
| 1993.00 | 166 | 76405 | 43766 | 194198 | 130713 | 67708 | 33820 | 21481 | 21893 | 20684 | 11175 |
| 1994.00 | 151 | 103885 | 142260 | 53700 | 118015 | 72512 | 36059 | 14889 | 8706 | 10447 | 15533 |
| 1995.00 | 1831 | 113457 | 219777 | 112245 | 36784 | 36402 | 22127 | 6474 | 4217 | 2957 | 3566 |
| 1996.00 | 0 | 37496 | 37715 | 256063 | 54534 | 16862 | 9151 | 3300 | 1782 | 1310 | 1605 |
| 1997.00 | 356 | 56561 | 87395 | 78098 | 131062 | 18917 | 5131 | 3636 | 894 | 620 | 874 |
| 1998.00 | 137 | 264901 | 62322 | 138751 | 97065 | 97464 | 20679 | 3856 | 1730 | 1288 | 398 |
| 1999.00 | 16138 | 218919 | 217656 | 149250 | 58600 | 23150 | 12477 | 1578 | 229 | 33 | 2 |
| 2000.00 | 6031 | 255518 | 203495 | 159952 | 87088 | 37586 | 22857 | 3011 | 189 | 40 | 0 |
| 2001.00 | 1304 | 89710 | 222338 | 164258 | 48697 | 24167 | 15558 | 2395 | 101 | 7 | 1 |
| 2002.00 | 28106 | 258243 | 132695 | 212922 | 78124 | 28343 | 13478 | 1550 | 64 | 5 | 2 |
| 2003.00 | 34936 | 463576 | 226469 | 153752 | 66331 | 17513 | 7034 | 718 | 25 | 1 | 0 |
| 2004.00 | 41554 | 329327 | 198940 | 175073 | 52825 | 18097 | 5216 | 411 | 22 | 1 | 0 |
| 2005.00 | 7390 | 98598 | 129595 | 149399 | 29031 | 7745 | 2480 | 158 | 2 | 0 | 0 |
| 2006.00 | 4073 | 104347 | 116608 | 127401 | 48101 | 10146 | 2658 | 182 | 5 | 0 | 9 |
| 2007.00 | | | | | | | | | | | |

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET......... 0.000239
MEAN SQUARE RESIDUALS ....... 0.377112

| Parameter | Est. | Std. Err. | Rel. Err. | Bias | Rel. Bias |
|---|---|---|---|---|---|
| N[2007 7] | 1.88E3 | 8.11E2 | 0.432 | 1.60E2 | 0.085 |
| q ID#[3] | 6.51E0 | 1.44E0 | 0.222 | 1.46Eý1 | 0.022 |
| q ID#[4] | 9.56E0 | 2.12E0 | 0.222 | 2.20Eý1 | 0.023 |
| q ID#[5] | 1.16E1 | 2.57E0 | 0.222 | 2.73Eý1 | 0.024 |
| q ID#[6] | 3.51E1 | 7.79E0 | 0.222 | 8.32Eý1 | 0.024 |
| q ID#[7] | 6.26E1 | 1.39E1 | 0.222 | 1.48E0 | 0.024 |

VPA using analytical bias adjusted parameters (linear scale)
Population Numbers

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 3503534 | 3848688 | 995990 | 1312007 | 348049 | 92556 | 44658 | 4104 | 1354 | 406 | 500 |
| 1966.00 | 2737874 | 2624572 | 2177169 | 784001 | 863223 | 239988 | 66231 | 35035 | 2855 | 1060 | 707 |
| 1967.00 | 6078739 | 2102325 | 1329624 | 1378701 | 575717 | 418512 | 155171 | 41661 | 21740 | 836 | 1253 |
| 1968.00 | 1286168 | 4325977 | 1170158 | 950142 | 889042 | 372334 | 200109 | 75150 | 30056 | 17430 | 1311 |
| 1969.00 | 1754254 | 904620 | 1415817 | 755635 | 702962 | 467578 | 239085 | 82892 | 32938 | 10845 | 9244 |
| 1970.00 | 2304087 | 1338027 | 480252 | 682955 | 499558 | 429512 | 281595 | 139599 | 47575 | 21258 | 13377 |
| 1971.00 | 7460417 | 1258574 | 579796 | 324285 | 303152 | 228973 | 243661 | 130382 | 77266 | 19947 | 19640 |
| 1972.00 | 1138007 | 6028985 | 667899 | 309749 | 169889 | 146502 | 119687 | 115682 | 61966 | 30575 | 20551 |
| 1973.00 | 2336523 | 931722 | 4350855 | 481941 | 121063 | 70132 | 52761 | 54102 | 51165 | 27434 | 19153 |
| 1974.00 | 1625829 | 1912063 | 612115 | 2859196 | 277069 | 63139 | 30305 | 23481 | 26162 | 20577 | 15920 |
| 1975.00 | 247148 | 1314489 | 880008 | 416859 | 1619372 | 165491 | 34561 | 15639 | 13330 | 10013 | 15485 |
| 1976.00 | 721821 | 199459 | 790742 | 505119 | 229479 | 864256 | 76167 | 17278 | 8846 | 6633 | 11862 |
| 1977.00 | 4140082 | 590760 | 113384 | 461878 | 275572 | 126138 | 466414 | 43093 | 9149 | 3712 | 10202 |
| 1978.00 | 1346542 | 3388555 | 345406 | 64483 | 183136 | 119041 | 57492 | 223170 | 22748 | 4650 | 6640 |
| 1979.00 | 449149 | 1070510 | 2428553 | 245946 | 41184 | 41880 | 36645 | 19392 | 85497 | 8737 | 5577 |
| 1980.00 | 1572601 | 367423 | 710840 | 1762597 | 152252 | 28826 | 13695 | 13722 | 5372 | 33069 | 5530 |
| 1981.00 | 1669566 | 1285424 | 289533 | 509414 | 1017308 | 99518 | 19663 | 7007 | 5380 | 1742 | 19616 |
| 1982.00 | 2302859 | 1366925 | 959470 | 191249 | 324647 | 429492 | 51910 | 13919 | 3261 | 2687 | 15067 |
| 1983.00 | 4078558 | 1882180 | 1027016 | 649787 | 136178 | 177676 | 163382 | 29368 | 9523 | 1459 | 12505 |
| 1984.00 | 5027358 | 3334284 | 1368188 | 705449 | 313500 | 89458 | 91080 | 53687 | 14768 | 6242 | 9665 |
| 1985.00 | 1831446 | 4116052 | 2650036 | 900974 | 376340 | 126232 | 52833 | 55107 | 18747 | 3661 | 3339 |
| 1986.00 | 1059683 | 1491312 | 3174345 | 1865475 | 466213 | 175956 | 65335 | 30614 | 28819 | 8199 | 4231 |
| 1987.00 | 1397314 | 867538 | 1107979 | 2350120 | 1263666 | 330393 | 115620 | 43795 | 21173 | 20943 | 8641 |
| 1988.00 | 1402121 | 1141947 | 635497 | 793177 | 1449894 | 816318 | 229125 | 77124 | 29291 | 14309 | 20825 |
| 1989.00 | 1744792 | 1147823 | 801237 | 418406 | 474081 | 797432 | 456423 | 149316 | 44100 | 20211 | 22792 |
| 1990.00 | 1185286 | 1428507 | 847967 | 553224 | 286863 | 316617 | 500869 | 304651 | 105755 | 28664 | 29022 |
| 1991.00 | 580113 | 970430 | 1008686 | 577026 | 299029 | 154199 | 168576 | 229434 | 144872 | 58346 | 31605 |
| 1992.00 | 828526 | 474956 | 707104 | 664313 | 307709 | 165459 | 89108 | 92807 | 115502 | 77782 | 45147 |
| 1993.00 | 1670794 | 678331 | 237829 | 459567 | 287419 | 138770 | 68058 | 42110 | 44318 | 41855 | 51322 |
| 1994.00 | 765808 | 1367780 | 486504 | 155331 | 202619 | 118567 | 53210 | 25559 | 15329 | 16757 | 47789 |
| 1995.00 | 787026 | 626854 | 1026138 | 270629 | 79046 | 61008 | 32720 | 11675 | 7694 | 4808 | 29650 |
| 1996.00 | 807744 | 642709 | 411113 | 642482 | 121182 | 31874 | 17619 | 7218 | 3798 | 2546 | 22374 |
| 1997.00 | 1255453 | 661324 | 492372 | 302582 | 296885 | 50499 | 11077 | 6271 | 2963 | 1519 | 17787 |
| 1998.00 | 1210331 | 1027556 | 490437 | 324458 | 177573 | 125953 | 24405 | 4487 | 1903 | 1623 | 14463 |
| 1999.00 | 1366456 | 990811 | 603316 | 345380 | 141599 | 58988 | 17499 | 1949 | 317 | 64 | 11681 |
| 2000.00 | 808714 | 1104185 | 614362 | 298964 | 149363 | 63520 | 27576 | 3317 | 214 | 57 | 9586 |
| 2001.00 | 1165706 | 656672 | 674333 | 320540 | 102331 | 44893 | 18617 | 2602 | 115 | 11 | 7859 |
| 2002.00 | 1411767 | 953222 | 456819 | 352737 | 116031 | 40317 | 15237 | 1657 | 68 | 6 | 6436 |
| 2003.00 | 1037771 | 1130477 | 548514 | 254904 | 99755 | 25889 | 7981 | 784 | 27 | 1 | 5269 |
| 2004.00 | 544249 | 818117 | 510883 | 246524 | 72187 | 22967 | 5707 | 431 | 23 | 1 | 4314 |
| 2005.00 | 465563 | 408112 | 375161 | 240207 | 47314 | 12545 | 2925 | 174 | 3 | 0 | 3532 |
| 2006.00 | 1000000 | 374497 | 245522 | 191005 | 64139 | 12975 | 3399 | 232 | 6 | 0 | 2892 |
| 2007.00 | 1000000 | 815051 | 212921 | 96937 | 43640 | 10176 | 1715 | 449 | 31 | 1 | 2360 |

Fishing Mortality

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 0.089 | 0.370 | 0.039 | 0.219 | 0.172 | 0.135 | 0.043 | 0.163 | 0.045 | 0.106 | 0.002 |
| 1966.00 | 0.064 | 0.480 | 0.257 | 0.109 | 0.524 | 0.236 | 0.264 | 0.277 | 1.028 | 0.252 | 0.002 |
| 1967.00 | 0.140 | 0.386 | 0.136 | 0.239 | 0.236 | 0.538 | 0.525 | 0.127 | 0.021 | 0.490 | 0.139 |
| 1968.00 | 0.152 | 0.917 | 0.237 | 0.101 | 0.443 | 0.243 | 0.681 | 0.625 | 0.819 | 0.440 | 2.943 |
| 1969.00 | 0.071 | 0.433 | 0.529 | 0.214 | 0.293 | 0.307 | 0.338 | 0.355 | 0.238 | 0.318 | 0.090 |
| 1970.00 | 0.405 | 0.636 | 0.193 | 0.612 | 0.580 | 0.367 | 0.570 | 0.392 | 0.669 | 0.450 | 0.248 |
| 1971.00 | 0.013 | 0.434 | 0.427 | 0.446 | 0.527 | 0.449 | 0.545 | 0.544 | 0.727 | 0.533 | 0.383 |
| 1972.00 | 0.000 | 0.126 | 0.126 | 0.739 | 0.685 | 0.821 | 0.594 | 0.616 | 0.615 | 0.678 | 0.960 |
| 1973.00 | 0.000 | 0.220 | 0.220 | 0.354 | 0.451 | 0.639 | 0.610 | 0.527 | 0.711 | 0.622 | 1.402 |
| 1974.00 | 0.013 | 0.576 | 0.184 | 0.369 | 0.315 | 0.403 | 0.462 | 0.366 | 0.760 | 0.475 | 0.958 |
| 1975.00 | 0.014 | 0.308 | 0.355 | 0.397 | 0.428 | 0.576 | 0.493 | 0.370 | 0.498 | 0.545 | 0.579 |
| 1976.00 | 0.000 | 0.365 | 0.338 | 0.406 | 0.398 | 0.417 | 0.370 | 0.436 | 0.668 | 0.416 | 0.383 |
| 1977.00 | 0.000 | 0.337 | 0.364 | 0.725 | 0.639 | 0.586 | 0.537 | 0.439 | 0.477 | 0.539 | 0.540 |
| 1978.00 | 0.029 | 0.133 | 0.140 | 0.248 | 1.275 | 0.978 | 0.887 | 0.759 | 0.757 | 0.838 | 0.324 |
| 1979.00 | 0.001 | 0.209 | 0.121 | 0.280 | 0.157 | 0.918 | 0.782 | 1.084 | 0.750 | 0.830 | 0.639 |
| 1980.00 | 0.002 | 0.038 | 0.133 | 0.350 | 0.225 | 0.183 | 0.470 | 0.736 | 0.926 | 0.435 | 0.775 |
| 1981.00 | 0.000 | 0.092 | 0.215 | 0.251 | 0.662 | 0.451 | 0.145 | 0.565 | 0.494 | 0.413 | 0.129 |
| 1982.00 | 0.002 | 0.086 | 0.190 | 0.140 | 0.403 | 0.767 | 0.370 | 0.180 | 0.604 | 0.708 | 0.077 |
| 1983.00 | 0.001 | 0.119 | 0.176 | 0.529 | 0.220 | 0.468 | 0.913 | 0.487 | 0.222 | 0.655 | 0.124 |
| 1984.00 | 0.000 | 0.030 | 0.218 | 0.428 | 0.710 | 0.327 | 0.302 | 0.852 | 1.195 | 0.483 | 3.753 |
| 1985.00 | 0.005 | 0.060 | 0.151 | 0.459 | 0.560 | 0.459 | 0.346 | 0.448 | 0.627 | 0.445 | 0.168 |
| 1986.00 | 0.000 | 0.097 | 0.101 | 0.189 | 0.144 | 0.220 | 0.200 | 0.169 | 0.119 | 0.201 | 0.095 |
| 1987.00 | 0.002 | 0.111 | 0.134 | 0.283 | 0.237 | 0.166 | 0.205 | 0.202 | 0.192 | 0.179 | 0.086 |
| 1988.00 | 0.000 | 0.154 | 0.218 | 0.315 | 0.398 | 0.381 | 0.228 | 0.359 | 0.171 | 0.344 | 0.163 |
| 1989.00 | 0.000 | 0.103 | 0.170 | 0.177 | 0.204 | 0.265 | 0.204 | 0.145 | 0.231 | 0.232 | 0.160 |
| 1990.00 | 0.000 | 0.148 | 0.185 | 0.415 | 0.421 | 0.430 | 0.581 | 0.543 | 0.395 | 0.517 | 0.300 |
| 1991.00 | 0.000 | 0.117 | 0.218 | 0.429 | 0.392 | 0.348 | 0.397 | 0.486 | 0.422 | 0.421 | 0.630 |
| 1992.00 | 0.000 | 0.492 | 0.231 | 0.638 | 0.596 | 0.688 | 0.550 | 0.539 | 0.815 | 0.663 | 0.691 |
| 1993.00 | 0.000 | 0.132 | 0.226 | 0.619 | 0.685 | 0.759 | 0.779 | 0.811 | 0.773 | 0.773 | 0.273 |
| 1994.00 | 0.000 | 0.087 | 0.386 | 0.476 | 1.000 | 1.087 | 1.317 | 1.001 | 0.959 | 1.125 | 0.440 |
| 1995.00 | 0.003 | 0.222 | 0.268 | 0.603 | 0.708 | 1.042 | 1.311 | 0.923 | 0.906 | 1.098 | 0.142 |
| 1996.00 | 0.000 | 0.066 | 0.107 | 0.572 | 0.675 | 0.857 | 0.833 | 0.691 | 0.717 | 0.821 | 0.082 |
| 1997.00 | 0.000 | 0.099 | 0.217 | 0.333 | 0.657 | 0.527 | 0.704 | 0.993 | 0.402 | 0.591 | 0.056 |
| 1998.00 | 0.000 | 0.332 | 0.151 | 0.629 | 0.902 | 1.774 | 2.328 | 2.451 | 3.188 | 1.897 | 0.031 |
| 1999.00 | 0.013 | 0.278 | 0.502 | 0.638 | 0.602 | 0.560 | 1.463 | 2.011 | 1.510 | 0.801 | 0.000 |
| 2000.00 | 0.008 | 0.293 | 0.451 | 0.872 | 1.002 | 1.027 | 2.161 | 3.160 | 2.779 | 1.436 | 0.000 |
| 2001.00 | 0.001 | 0.163 | 0.448 | 0.816 | 0.731 | 0.881 | 2.219 | 3.443 | 2.700 | 1.361 | 0.000 |
| 2002.00 | 0.022 | 0.353 | 0.383 | 1.063 | 1.300 | 1.420 | 2.767 | 3.909 | 4.162 | 1.853 | 0.000 |
| 2003.00 | 0.038 | 0.594 | 0.600 | 1.062 | 1.269 | 1.312 | 2.720 | 3.324 | 3.218 | 1.683 | 0.000 |
| 2004.00 | 0.088 | 0.580 | 0.555 | 1.451 | 1.550 | 1.861 | 3.291 | 4.804 | 5.509 | 2.187 | 0.000 |
| 2005.00 | 0.018 | 0.308 | 0.475 | 1.120 | 1.094 | 1.106 | 2.334 | 3.170 | 2.183 | 1.358 | 0.000 |
| 2006.00 | 0.005 | 0.365 | 0.729 | 1.276 | 1.641 | 1.823 | 1.823 | 1.823 | 1.823 | 1.823 | 0.003 |

Appendix IV: ADAPT VPA run using age reader differences (Reader 1 vs external reader) to modify the CAA and the German Bank acoustic index of abundance for 1999 to 2006.

Catch R1 Ext

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 270378 | 1084719 | 34835 | 234383 | 49925 | 10592 | 1693 | 561 | 54 | 37 | 1 |
| 1966.00 | 154323 | 914093 | 448940 | 73382 | 321857 | 45916 | 13970 | 7722 | 1690 | 215 | 1 |
| 1967.00 | 722208 | 613970 | 153626 | 266454 | 110051 | 159203 | 57948 | 4497 | 409 | 296 | 148 |
| 1968.00 | 164703 | 2389061 | 224956 | 83109 | 290285 | 73087 | 90617 | 31977 | 15441 | 5668 | 1175 |
| 1969.00 | 108875 | 290329 | 531812 | 132319 | 162439 | 112631 | 62506 | 22595 | 6345 | 2693 | 722 |
| 1970.00 | 699720 | 576896 | 76532 | 286278 | 201215 | 120280 | 111937 | 41257 | 21271 | 7039 | 2674 |
| 1971.00 | 87570 | 404224 | 183896 | 106630 | 113566 | 75593 | 93620 | 50022 | 36618 | 7536 | 5695 |
| 1972.00 | 0 | 649254 | 71984 | 148516 | 77207 | 75384 | 49065 | 48700 | 26055 | 13792 | 11679 |
| 1973.00 | 1018 | 167454 | 781061 | 130851 | 40128 | 30334 | 22046 | 20249 | 23871 | 11630 | 13386 |
| 1974.00 | 18411 | 766064 | 93606 | 803651 | 68276 | 19093 | 10232 | 6565 | 12786 | 7102 | 9031 |
| 1975.00 | 3199 | 317641 | 239827 | 124599 | 514605 | 66302 | 12298 | 4409 | 4778 | 3847 | 6225 |
| 1976.00 | 240 | 55596 | 206535 | 153782 | 68804 | 268839 | 21460 | 5571 | 3951 | 2059 | 3446 |
| 1977.00 | 1170 | 153921 | 31572 | 218478 | 119234 | 51173 | 177247 | 13977 | 3170 | 1415 | 3894 |
| 1978.00 | 35381 | 383611 | 40887 | 12906 | 122108 | 68410 | 31088 | 108975 | 11082 | 2425 | 1676 |
| 1979.00 | 342 | 183982 | 250393 | 54620 | 5430 | 23142 | 18255 | 11836 | 41389 | 4527 | 2411 |
| 1980.00 | 2339 | 12503 | 80518 | 474091 | 27930 | 4373 | 4692 | 6560 | 2985 | 10641 | 2739 |
| 1981.00 | 0 | 103051 | 50883 | 102743 | 451482 | 32978 | 2418 | 2767 | 1917 | 538 | 2149 |
| 1982.00 | 3589 | 102133 | 150764 | 22640 | 98206 | 211043 | 14627 | 2080 | 1354 | 1250 | 1014 |
| 1983.00 | 5488 | 191682 | 150328 | 244007 | 24483 | 60678 | 89982 | 10352 | 1728 | 642 | 1324 |
| 1984.00 | 0 | 88433 | 243542 | 224354 | 146096 | 22716 | 21654 | 28299 | 9515 | 2183 | 9000 |
| 1985.00 | 9022 | 216740 | 337591 | 302782 | 147670 | 42404 | 14075 | 18178 | 7997 | 1201 | 470 |
| 1986.00 | 63 | 125300 | 275903 | 292792 | 56937 | 31599 | 10770 | 4320 | 2942 | 1356 | 349 |
| 1987.00 | 2300 | 82940 | 126436 | 527443 | 242597 | 45933 | 19481 | 7292 | 3361 | 3120 | 650 |
| 1988.00 | 151 | 148399 | 113208 | 195096 | 434192 | 236089 | 42533 | 21208 | 4186 | 3797 | 2845 |
| 1989.00 | 8 | 101788 | 114095 | 61842 | 79451 | 169023 | 76684 | 18303 | 8270 | 3814 | 3057 |
| 1990.00 | 0 | 178532 | 130176 | 171560 | 89922 | 101066 | 201901 | 116788 | 31466 | 10572 | 6848 |
| 1991.00 | 0 | 96960 | 179463 | 183647 | 88431 | 41352 | 50380 | 80732 | 45516 | 18291 | 13524 |
| 1992.00 | 9 | 168561 | 132642 | 286923 | 126510 | 75473 | 34458 | 35369 | 59136 | 34558 | 20653 |
| 1993.00 | 166 | 76405 | 43766 | 194198 | 130713 | 67708 | 33820 | 21481 | 21893 | 20684 | 11175 |
| 1994.00 | 151 | 103885 | 142260 | 53700 | 118015 | 72512 | 36059 | 14889 | 8706 | 10447 | 15533 |
| 1995.00 | 1831 | 113457 | 219777 | 112245 | 36784 | 36402 | 22127 | 6474 | 4217 | 2957 | 3566 |
| 1996.00 | 0 | 37496 | 37715 | 256063 | 54534 | 16862 | 9151 | 3300 | 1782 | 1310 | 1605 |
| 1997.00 | 356 | 56561 | 87395 | 78098 | 131062 | 18917 | 5131 | 3636 | 894 | 620 | 874 |
| 1998.00 | 137 | 264901 | 62322 | 138751 | 97065 | 97464 | 20679 | 3856 | 1730 | 1288 | 398 |
| 1999.00 | 4392 | 118853 | 211074 | 143071 | 123602 | 57531 | 20959 | 3327 | 3379 | 166 | 64 |
| 2000.00 | 11790 | 358294 | 69561 | 95481 | 106504 | 59137 | 44005 | 10420 | 8044 | 604 | 395 |
| 2001.00 | 3361 | 103517 | 261959 | 76219 | 48232 | 30168 | 28496 | 7031 | 6353 | 535 | 325 |
| 2002.00 | 33768 | 298976 | 89253 | 153348 | 80382 | 37065 | 35866 | 8442 | 8278 | 545 | 266 |
| 2003.00 | 37027 | 508508 | 237194 | 125324 | 67973 | 29951 | 37187 | 9075 | 9131 | 341 | 88 |
| 2004.00 | 32069 | 363223 | 221359 | 137253 | 61719 | 29752 | 34815 | 8064 | 8319 | 204 | 93 |
| 2005.00 | 7718 | 105533 | 115603 | 115563 | 64131 | 23738 | 18491 | 3300 | 3480 | 68 | 16 |
| 2006.00 | | | | | | | | | | | |

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET......... 0.000261
MEAN SQUARE RESIDUALS ....... 0.299838

| Parameter | Est. | Std. Err. | Rel. Err. | Bias | Rel. Bias |
|---|---|---|---|---|---|
| N[2006 7] | 4.41E4 | 1.19E4 | 0.271 | 1.39E3 | 0.032 |
| q ID#[1] | 7.74Eý1 | 1.75Eý1 | 0.227 | 1.74Eý2 | 0.022 |
| q ID#[2] | 1.96E0 | 4.39Eý1 | 0.224 | 4.36Eý2 | 0.022 |
| q ID#[3] | 2.77E0 | 6.16Eý1 | 0.222 | 6.21Eý2 | 0.022 |
| q ID#[4] | 2.50E0 | 5.46Eý1 | 0.219 | 5.55Eý2 | 0.022 |
| q ID#[5] | 5.25E0 | 1.14E0 | 0.218 | 1.17Eý1 | 0.022 |
| q ID#[6] | 3.33E0 | 7.16Eý1 | 0.215 | 7.46Eý2 | 0.022 |

VPA using analytical bias adjusted parameters (linear scale)
Population Numbers

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 3503535 | 3848688 | 995990 | 1312007 | 348049 | 92556 | 44658 | 4104 | 1354 | 406 | 500 |
| 1966.00 | 2737874 | 2624572 | 2177169 | 784001 | 863223 | 239988 | 66231 | 35035 | 2855 | 1060 | 707 |
| 1967.00 | 6078739 | 2102325 | 1329624 | 1378701 | 575717 | 418512 | 155171 | 41661 | 21740 | 836 | 1253 |
| 1968.00 | 1286169 | 4325978 | 1170158 | 950143 | 889042 | 372334 | 200109 | 75150 | 30056 | 17430 | 1311 |
| 1969.00 | 1754254 | 904620 | 1415817 | 755635 | 702962 | 467578 | 239085 | 82892 | 32938 | 10845 | 9244 |
| 1970.00 | 2304088 | 1338028 | 480253 | 682955 | 499558 | 429512 | 281595 | 139599 | 47575 | 21258 | 13377 |
| 1971.00 | 7460434 | 1258575 | 579796 | 324285 | 303152 | 228973 | 243661 | 130382 | 77266 | 19947 | 19640 |
| 1972.00 | 1138008 | 6028999 | 667900 | 309749 | 169890 | 146502 | 119687 | 115682 | 61966 | 30575 | 20551 |
| 1973.00 | 2336523 | 931722 | 4350866 | 481941 | 121064 | 70133 | 52761 | 54102 | 51165 | 27435 | 19153 |
| 1974.00 | 1625831 | 1912064 | 612116 | 2859205 | 277070 | 63139 | 30305 | 23481 | 26162 | 20577 | 15921 |
| 1975.00 | 247162 | 1314490 | 880009 | 416859 | 1619380 | 165492 | 34562 | 15639 | 13330 | 10013 | 15485 |
| 1976.00 | 721833 | 199470 | 790743 | 505120 | 229480 | 864262 | 76168 | 17278 | 8846 | 6633 | 11863 |
| 1977.00 | 4140121 | 590770 | 113394 | 461879 | 275573 | 126138 | 466419 | 43094 | 9150 | 3713 | 10203 |
| 1978.00 | 1346680 | 3388588 | 345415 | 64491 | 183137 | 119042 | 57492 | 223174 | 22748 | 4650 | 6640 |
| 1979.00 | 449252 | 1070623 | 2428580 | 245953 | 41190 | 41881 | 36645 | 19393 | 85500 | 8737 | 5577 |
| 1980.00 | 1572778 | 367507 | 710933 | 1762618 | 152258 | 28831 | 13695 | 13722 | 5372 | 33072 | 5530 |
| 1981.00 | 1669897 | 1285569 | 289602 | 509489 | 1017326 | 99522 | 19667 | 7007 | 5380 | 1742 | 19618 |
| 1982.00 | 2303924 | 1367196 | 959589 | 191306 | 324709 | 429506 | 51914 | 13923 | 3261 | 2688 | 15069 |
| 1983.00 | 4081061 | 1883051 | 1027237 | 649884 | 136224 | 177727 | 163394 | 29371 | 9526 | 1459 | 12507 |
| 1984.00 | 5030043 | 3336333 | 1368902 | 705631 | 313579 | 89495 | 91121 | 53697 | 14771 | 6244 | 9667 |
| 1985.00 | 1833301 | 4118251 | 2651713 | 901558 | 376488 | 126296 | 52863 | 55141 | 18754 | 3663 | 3342 |
| 1986.00 | 1060672 | 1492831 | 3176145 | 1866848 | 466689 | 176076 | 65387 | 30639 | 28846 | 8205 | 4235 |
| 1987.00 | 1400341 | 868348 | 1109222 | 2351593 | 1264789 | 330783 | 115719 | 43838 | 21194 | 20965 | 8649 |
| 1988.00 | 1406315 | 1144424 | 636159 | 794195 | 1451098 | 817237 | 229444 | 77205 | 29327 | 14326 | 20850 |
| 1989.00 | 1749083 | 1151257 | 803265 | 418948 | 474913 | 798416 | 457173 | 149577 | 44165 | 20240 | 22826 |
| 1990.00 | 1187825 | 1432021 | 850778 | 554883 | 287307 | 317297 | 501674 | 305265 | 105969 | 28718 | 29073 |
| 1991.00 | 604751 | 972509 | 1011561 | 579326 | 300383 | 154561 | 169132 | 230089 | 145373 | 58521 | 31691 |
| 1992.00 | 889251 | 495128 | 708805 | 666665 | 309586 | 166565 | 89404 | 93261 | 116036 | 78190 | 45360 |
| 1993.00 | 1780535 | 728049 | 254282 | 460959 | 289332 | 140298 | 68956 | 42351 | 44687 | 42288 | 51827 |
| 1994.00 | 1016073 | 1457629 | 527198 | 168791 | 203751 | 120122 | 54450 | 26287 | 15524 | 17057 | 48553 |
| 1995.00 | 1140072 | 831754 | 1099691 | 303871 | 90028 | 61920 | 33968 | 12661 | 8281 | 4965 | 30514 |
| 1996.00 | 1027279 | 931758 | 578770 | 702636 | 148259 | 40804 | 18353 | 8213 | 4596 | 3021 | 23208 |
| 1997.00 | 1346422 | 841065 | 729013 | 439830 | 345898 | 72539 | 18326 | 6865 | 3771 | 2167 | 18855 |
| 1998.00 | 880054 | 1102036 | 637578 | 518105 | 289808 | 165848 | 42397 | 10397 | 2382 | 2284 | 15866 |
| 1999.00 | 1675115 | 720404 | 664191 | 465814 | 299571 | 150254 | 49187 | 16263 | 5059 | 425 | 13355 |
| 2000.00 | 910895 | 1367501 | 482810 | 354471 | 253012 | 134714 | 71512 | 21533 | 10323 | 1152 | 11076 |
| 2001.00 | 1579011 | 735130 | 797772 | 332635 | 204466 | 111912 | 57445 | 19501 | 8332 | 1388 | 9117 |
| 2002.00 | 2017076 | 1289749 | 508625 | 418266 | 203818 | 124049 | 64533 | 21618 | 9668 | 1235 | 7828 |
| 2003.00 | 1796861 | 1620948 | 787197 | 336089 | 205093 | 94934 | 68300 | 20923 | 10143 | 705 | 6693 |
| 2004.00 | 1861229 | 1437711 | 870964 | 431657 | 162934 | 106970 | 50859 | 22817 | 9019 | 407 | 5674 |
| 2005.00 | 1000000 | 1494886 | 850751 | 514207 | 230302 | 78137 | 60866 | 10862 | 11455 | 224 | 4712 |
| 2006.00 | 1000000 | 811760 | 1128706 | 592389 | 317095 | 130973 | 42673 | 33241 | 5932 | 6256 | 3966 |

Fishing Mortality

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965.00 | 0.089 | 0.370 | 0.039 | 0.219 | 0.172 | 0.135 | 0.043 | 0.163 | 0.045 | 0.106 | 0.002 |
| 1966.00 | 0.064 | 0.480 | 0.257 | 0.109 | 0.524 | 0.236 | 0.264 | 0.277 | 1.028 | 0.252 | 0.002 |
| 1967.00 | 0.140 | 0.386 | 0.136 | 0.239 | 0.236 | 0.538 | 0.525 | 0.127 | 0.021 | 0.490 | 0.139 |
| 1968.00 | 0.152 | 0.917 | 0.237 | 0.101 | 0.443 | 0.243 | 0.681 | 0.625 | 0.819 | 0.440 | 2.943 |
| 1969.00 | 0.071 | 0.433 | 0.529 | 0.214 | 0.293 | 0.307 | 0.338 | 0.355 | 0.238 | 0.318 | 0.090 |
| 1970.00 | 0.405 | 0.636 | 0.193 | 0.612 | 0.580 | 0.367 | 0.570 | 0.392 | 0.669 | 0.450 | 0.248 |
| 1971.00 | 0.013 | 0.434 | 0.427 | 0.446 | 0.527 | 0.449 | 0.545 | 0.544 | 0.727 | 0.533 | 0.383 |
| 1972.00 | 0.000 | 0.126 | 0.126 | 0.739 | 0.685 | 0.821 | 0.594 | 0.616 | 0.615 | 0.678 | 0.960 |
| 1973.00 | 0.000 | 0.220 | 0.220 | 0.354 | 0.451 | 0.639 | 0.610 | 0.527 | 0.711 | 0.622 | 1.402 |
| 1974.00 | 0.013 | 0.576 | 0.184 | 0.369 | 0.315 | 0.403 | 0.462 | 0.366 | 0.760 | 0.475 | 0.958 |
| 1975.00 | 0.014 | 0.308 | 0.355 | 0.397 | 0.428 | 0.576 | 0.493 | 0.370 | 0.498 | 0.545 | 0.579 |
| 1976.00 | 0.000 | 0.365 | 0.338 | 0.406 | 0.398 | 0.417 | 0.370 | 0.436 | 0.668 | 0.416 | 0.383 |
| 1977.00 | 0.000 | 0.337 | 0.364 | 0.725 | 0.639 | 0.586 | 0.537 | 0.439 | 0.477 | 0.539 | 0.540 |
| 1978.00 | 0.029 | 0.133 | 0.140 | 0.248 | 1.275 | 0.978 | 0.887 | 0.759 | 0.757 | 0.838 | 0.324 |
| 1979.00 | 0.001 | 0.209 | 0.121 | 0.280 | 0.157 | 0.918 | 0.782 | 1.084 | 0.750 | 0.830 | 0.639 |
| 1980.00 | 0.002 | 0.038 | 0.133 | 0.350 | 0.225 | 0.183 | 0.470 | 0.736 | 0.926 | 0.435 | 0.776 |
| 1981.00 | 0.000 | 0.092 | 0.215 | 0.250 | 0.662 | 0.451 | 0.145 | 0.565 | 0.494 | 0.413 | 0.129 |
| 1982.00 | 0.002 | 0.086 | 0.190 | 0.140 | 0.403 | 0.766 | 0.370 | 0.180 | 0.604 | 0.708 | 0.077 |
| 1983.00 | 0.001 | 0.119 | 0.176 | 0.529 | 0.220 | 0.468 | 0.913 | 0.487 | 0.222 | 0.655 | 0.124 |
| 1984.00 | 0.000 | 0.030 | 0.218 | 0.428 | 0.709 | 0.326 | 0.302 | 0.852 | 1.194 | 0.482 | 3.748 |
| 1985.00 | 0.005 | 0.060 | 0.151 | 0.458 | 0.560 | 0.458 | 0.345 | 0.448 | 0.627 | 0.445 | 0.168 |
| 1986.00 | 0.000 | 0.097 | 0.101 | 0.189 | 0.144 | 0.220 | 0.200 | 0.169 | 0.119 | 0.201 | 0.095 |
| 1987.00 | 0.002 | 0.111 | 0.134 | 0.283 | 0.237 | 0.166 | 0.205 | 0.202 | 0.192 | 0.179 | 0.086 |
| 1988.00 | 0.000 | 0.154 | 0.218 | 0.314 | 0.397 | 0.381 | 0.228 | 0.359 | 0.171 | 0.344 | 0.163 |
| 1989.00 | 0.000 | 0.102 | 0.170 | 0.177 | 0.203 | 0.265 | 0.204 | 0.145 | 0.230 | 0.232 | 0.159 |
| 1990.00 | 0.000 | 0.148 | 0.184 | 0.414 | 0.420 | 0.429 | 0.579 | 0.542 | 0.394 | 0.515 | 0.299 |
| 1991.00 | 0.000 | 0.116 | 0.217 | 0.427 | 0.390 | 0.347 | 0.395 | 0.485 | 0.420 | 0.419 | 0.627 |
| 1992.00 | 0.000 | 0.466 | 0.230 | 0.635 | 0.591 | 0.682 | 0.547 | 0.536 | 0.809 | 0.659 | 0.687 |
| 1993.00 | 0.000 | 0.123 | 0.210 | 0.616 | 0.679 | 0.746 | 0.764 | 0.804 | 0.763 | 0.761 | 0.270 |
| 1994.00 | 0.000 | 0.082 | 0.351 | 0.429 | 0.991 | 1.063 | 1.259 | 0.955 | 0.940 | 1.090 | 0.431 |
| 1995.00 | 0.002 | 0.163 | 0.248 | 0.518 | 0.591 | 1.016 | 1.220 | 0.813 | 0.808 | 1.039 | 0.138 |
| 1996.00 | 0.000 | 0.045 | 0.075 | 0.509 | 0.515 | 0.600 | 0.783 | 0.578 | 0.552 | 0.641 | 0.079 |
| 1997.00 | 0.000 | 0.077 | 0.142 | 0.217 | 0.535 | 0.337 | 0.367 | 0.858 | 0.301 | 0.376 | 0.052 |
| 1998.00 | 0.000 | 0.306 | 0.114 | 0.348 | 0.457 | 1.015 | 0.758 | 0.520 | 1.524 | 0.948 | 0.028 |
| 1999.00 | 0.003 | 0.200 | 0.428 | 0.410 | 0.599 | 0.542 | 0.626 | 0.255 | 1.280 | 0.557 | 0.005 |
| 2000.00 | 0.014 | 0.339 | 0.173 | 0.350 | 0.616 | 0.652 | 1.099 | 0.749 | 1.806 | 0.845 | 0.040 |
| 2001.00 | 0.002 | 0.168 | 0.446 | 0.290 | 0.300 | 0.351 | 0.777 | 0.502 | 1.709 | 0.547 | 0.040 |
| 2002.00 | 0.019 | 0.294 | 0.214 | 0.513 | 0.564 | 0.397 | 0.926 | 0.557 | 2.418 | 0.657 | 0.038 |
| 2003.00 | 0.023 | 0.421 | 0.401 | 0.524 | 0.451 | 0.424 | 0.896 | 0.642 | 3.017 | 0.749 | 0.015 |
| 2004.00 | 0.019 | 0.325 | 0.327 | 0.428 | 0.535 | 0.364 | 1.344 | 0.489 | 3.496 | 0.791 | 0.018 |
| 2005.00 | 0.009 | 0.081 | 0.162 | 0.283 | 0.364 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.004 |