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Precision of the catch-at-age estimates from the Dutch market sampling programme.

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Table of Contents:

1. Samenvatting

1.1 Inleiding

In het F1 werkpakket van het F-project houden we ons bezig met verbetering van de toestandsbeoordeling van schol en tong. Een onderdeel van het F-project is gericht op het onderzoeken van de onzekerheid en bias in de toestandsbeoordeling. In een serie van kleinere deelstudies worden problemen betreffende onzekerheid en bias bestudeerd. In dit rapport presenteren we een analyse van de onzekerheid in de invoergegevens van de vangst per leeftijdsgroep en bespreken de invloed van deze onzekerheid op de toestandsbeoordeling.

Het rekenmodel dat voor de toestandsbeoordeling gebruikt wordt, heeft als invoer een getallen reeks (matrix) nodig met daarin voor elk jaar de vangsten in aantallen per leeftijdsgroep. Voor de berekening van biomassa en vangstvoorspellingen is bovendien een matrix nodig met voor elk jaar de gemiddelde gewichten per leeftijdsgroep. Deze gegevens zijn echter niet direct beschikbaar. De aantallen en gewichten moeten geschat worden. Hiertoe heeft elk land zijn marktbemonsteringsprogramma en zijn opwerkingsprocedure.

In de Nederlandse marktbemonstering worden de monsters per marktcategorie genomen. Van de gemonsterde vissen worden lengte, gewicht, en leeftijd genoteerd. Voor elk kwartaal is zowel het totale Nederlandse aanlandingsgewicht per marktcategorie als het gewicht van de marktmonsters per markcategorie bekend. De verhouding tussen deze twee gewichten is de "opwerkingsfactor" voor de betreffende marktcategorie in het betreffende kwartaal. De aantallen bemonsterde vissen van elk geslacht en van elke leeftijdsgroep worden dan vermenigvuldigd met de opwerkingsfactor om tot de geschatte aantallen aangelande vis per geslacht en leeftijdsgroep per marktcategorie te komen (voor het betreffende kwartaal) voor Nederland. Vervolgens worden deze aantallen over de markcategorieën opgeteld. Op gelijksoortige wijze worden de gemiddelde visgewichten per geslacht en leeftijdsgroep voor elk kwartaal berekend. Uiteindelijk worden de gegevens van de verschillende landen gecombineerd.

De getallen die in de toestandsbeoordeling gebruikt worden zijn dus schattingen die gebaseerd zijn op de marktbemonstering. Schattingen gaan altijd gepaard met onzekerheid. De mate van onzekerheid zou in principe geschat kunnen worden door de marktbemonsterings- en opwerkingsprocedures vele malen te herhalen en de schattingen te vergelijken: hoe verder de verschillende schattingen uit elkaar liggen, hoe onzekerder ze zijn. In de praktijk is het niet mogelijk de procedures vele malen te herhalen. Het zogenoemde "bootstrappen" is een techniek waarbij men in de computer herbemonstering simuleert door uit de bestaande markmonsters monsters te trekken. Met deze methode kan gemakkelijk 1000 keer "herbemonsterd" worden, en kunnen de onzekerheden in de schattingen bepaald worden.

Deze methode is in het internationale EMAS project toegepast (Pastoors *et al.* 2001) op Noordzee schol, kabeljauw en haring voor 1991-1998. In onze analyse passen we dezelfde methode toe op de gegevens van Noordzee schol van 1999-2001 en op die van tong van 1991-2001.

1.2 Methode

Voor elk kwartaal worden 1000 iteraties (gesimuleerde herbemonsteringen) uitgevoerd. Binnen elke iteratie wordt gekeken hoeveel oorspronkelijke marktmonsters er voor dat kwartaal zijn, bijvoorbeeld 26 monsters met in elk monster bijvoorbeeld 50 vissen. Vervolgens wordt dat zelfde aantal keren (in het voorbeeld 26 keer) een monster uit de bestaande monsters getrokken (met "teruglegging", zodat monsters meerdere malen getrokken kunnen worden).

Op deze manier ontstaat een nieuwe verzameling van, in het voorbeeld 26, monsters. Op deze nieuwe verzameling monsters met visgegevens wordt de hele opwerkinsgprocedure toegepast zoals in de inleiding beschreven, om tot schattingen van aantallen en gewichten per geslacht en per leeftijdsgroep te komen. Op dit moment is de betreffende iteratie afgesloten en wordt het hele proces van monsters trekken en opwerken nogmaals doorlopen in een volgende iteratie. Als er 1000 iteraties gedaan zijn wordt de spreiding van de schattingen over de 1000 herbemonsteringen berekend. De coëfficiënt van variatie ("coefficient of variation", CV) die berekend wordt is een maat voor de onzekerheid: hoe groter de coëfficiënt hoe groter de onzekerheid in de betreffende schatting. Een CV van 20% komt overeen met een redelijke precisie.

1.3 Resultaten

1.3.1 Schol

Voor de volledigheid nemen we hier ook de resulaten voor schol voor de jaren 1991-1998 op die in het EMAS-project (Pastoors *et al.* 2001) met dezelfde methode verkregen zijn. Figuren 2, 3, en 4 (uit Pastoors *et al.* 2001) geven de CVs van de aantallen per leeftijdsgroep voor de jaren 1991-1998 (de getallen waarop deze figuren gebaseerd zijn staan in Tabellen 1, 2, en 3 in de appendix). Figuren 5, 6, en 7 tonen de CVs van de aantallen per leeftijdsgroep voor de jaren 1999-2001 (de getallen waarop deze figuren gebaseerd zijn staan in Tabel 4 in de appendix). In de Figuren 2 en 5 zijn de resultaten opgesplitst naar jaar weergegeven, terwijl ze in de Figuren 3 en 6 ook naar kwartaal zijn opgesplitst, en in de Figuren 4 en 7 naar jaar, kwartaal en geslacht. De CVs van de aantallen per leeftijdsgroep laten grofweg dezelfde duidelijke patronen zien voor de jaren 1991-1998 als voor de jaren 1999-2001 (vergelijk Figuren 2, 3, en 4 met respectievelijk Figuren 5, 6, en 7). In alle figuren is te zien dat de geschatte CVs hoog zijn op de eerste leeftijd (rond 30-70%), laag op de leeftijden 3 tot 5 (rond 5-8%), en dan weer toenemen tot ongeveer 20-50% op leeftijden ouder dan 12. De CVs voor vrouwtjes nemen minder steil toe bij de hoge leeftijden dan de CVs voor mannetjes (Figuren 4 en 7). De patronen lijken sterk op elkaar ongeacht of de gegevens uitgesplitst zijn naar alleen jaar, of ook naar kwartaal en geslacht (vergelijk Figuren 2, 3 en 4 met elkaar, en vergelijk Figuren 5, 6 en 7 met elkaar).

Figuren 8, 9, en 10 tonen de CVs van de gewichten per leeftijdsgroep voor de jaren 1999-2001 (de getallen waarop deze figuren gebaseerd zijn staan in Tabel 6 in de appendix; Tabel 5 in de appendix [uit Pastoors *et al.* 2001] toont de CVs van gewichten per leeftijdsgroep voor de jaren 1991-1998). Ook wat betreft de CVs van de gewichten per leeftijdsgroep zijn de patronen grofweg dezelfde voor de jaren 1991-1998 als voor de jaren 1999-2001 (vergelijk Tabellen 5 en 6 in de appendix). De CVs zijn laag op jonge leeftijden en nemen toe op oudere leeftijden (Figuren 8, 9 en 10). Echter de CVs lijken in de latere jaren op iets jongere leeftijd al boven de 10% uit te komen (op ongeveer 10-jarige leeftijd) dan in de eerdere jaren (op ongeveer leeftijd 13, vergelijk Tabellen 5 en 6 in de appendix). De patronen in gewicht lijken sterk op elkaar ongeacht uitsplitsing naar jaar of naar kwartaal (vergelijk Figuren 8 en 9 met elkaar). Uitgesplitst naar geslacht is te zien dat de CVs op iets jongere leeftijd omhoog gaan bij mannetjes dan bij vrouwtjes (Figuur 10).

1.3.2 Tong

Figuren 11, 12, en 13 tonen de CVs van de aantallen per leeftijdsgroep voor de jaren 1991-2001 (de getallen waarop deze figuren gebaseerd zijn staan in Tabel 7 in de appendix). Figuren 14, 15, en 16 tonen de CVs van de gewichten per leeftijdsgroep voor de jaren 1991-2001 (de getallen waarop de figuren gebaseerd zijn staan in Tabel 8 in de appendix). De gevonden patronen voor tong lijken sterk op de patronen gevonden voor schol. Wat betreft de aantallen zijn de CVs op de jongste leeftijd hoog, op de midden leeftijden lager, en op de oudere leeftijden weer hoger (Figuren 11, 12, en 13). Wat betreft de gewichten zijn de CVs op de jonge en midden leeftijden laag en op de oudere leeftijden hoger (Figuren 14, 15, en 16).

1.3.3 Schol en tong samengevat

Voor scholvrouwtjes zijn de CVs van de aantallen per leeftijdsgroep voor de leeftijden 2-5 altijd lager dan 20%. Een CV van 20% komt overeen met een redelijke precisie. De CVs van aantallen scholmannetjes en van tong van beide geslachten op de leeftijden 2-5 komen vaak boven de 20%; deze schattingen zijn dus minder precies. Voor scholvrouwtjes zijn de CVs van de gewichten erg laag, maar voor de scholmannetjes en de tong van beide geslachten zijn de CVs soms hoger dan 10%, wat toch nog met een goede precisie overeenkomt. Al met al zijn de schattingen van de gewichten preciezer dan de schattingen van de aantallen.

1.4 Discussie

Zowel bij schol als tong zijn de CVs laag en dus de precisie hoog op de leeftijden waarop de aantallen groot zijn (Figuur 17). Dit is geen verassing want met grotere steekproeven kan een grotere precisie van schattingen bereikt worden. Dit geldt ook wanneer de beide geslachten vergeleken worden: in het algemeen zijn er meer vrouwtjes dan mannetjes (Figuur 17) en de vrouwtjes hebben in het algemeen lagere CVs dan mannetjes. Er zijn twee uitzonderingen op deze regel. Ten eerste zijn de CVs van de gewichten erg laag bij de jongste leeftijd, ondanks de lage aantallen op die leeftijd. Kennelijk zijn de gewichten van de jongste vissen niet erg variabel. Dit zou veroorzaakt kunnen worden door het feit dat de commerciële visserij slechts die vissen aanlandt die groter zijn dan de minimale aanlandingsmaat, waardoor vooral bij de jongste leeftijd slechts een deel van de gewichtsverdeling bemonsterd is. Bovendien is er bij jonge vissen nog niet veel tijd verstreken waarin verschillen in groeisnelheid zich hebben kunnen openbaren. Ten tweede gaan de CVs bij vrouwtjes minder steil omhoog op oudere leeftijden dan bij mannetjes, hoewel de aantallen op deze leeftijden behoorlijk gelijk zijn. Kennelijk zijn de aantallen en de gewichten van vrouwtjes op oudere leeftijden minder variabel dan die van mannetjes, maar het is niet duidelijk waarom. Wat betreft gewicht zou men zelfs het tegenovergestelde verwachten, vooral in het paaiseizoen (eerste kwartaal voor schol, tweede kwartaal voor tong), omdat sommige vrouwtjes net voor en andere net na het paaien gevangen zijn.

Voor de toestandsbeoordeling lijkt de precisie van de schattingen voor de leeftijden 2-5 het belangrijkst te zijn, omdat gegevens van deze leeftijdsgroepen het grootste deel uitmaken van de vangstgegevens waarop het rekenmodel gebaseerd is. Maar ook de aantallen van de oudere leeftijdsgroepen zijn belangrijk voor het berekenen van de grootte van het visbestand. Onzekerheid in de schattingen voor de oudere leeftijden kan de toestandsbeoordeling dus ook beïnvloeden.

De precisie van de schattingen zou verbeterd kunnen worden als er meer vis bemonsterd zou worden. Om de precisie bij de oudere leeftijden te vergroten zouden extra vissen in marktcategorie 1 bemonsterd kunnen worden. Omdat ongeveer 80% van de totale tong aanlanding door de Nederlandse vloot gevangen wordt, heeft de precisie van de Nederlandse schattingen veel invloed op gecombineerde precisie. Een verbetering in het Nederlandse bemonsteringsprogramma zou dus voor tong een relatief grote invloed hebben.

In het EMAS-project (Pastoors *et al.* 2001) zijn de gegevens van de verschillende landen voor de jaren 1991-1998 gecombineerd, en heeft men onderzocht wat de invloed is van de onzekerheid in de gecombineerde schattingen op de toestandsbeoordeling. De onzekerheid die voortkwam uit de vangstgegevens was vergelijkbaar met wat we in deze studie gevonden hebben, en had weinig invloed op de zekerheid van de schattingen van paaibiomassa en visserijsterfte.

1.5 Conclusies

- De precisie van de schattingen van aantallen per leeftijdsgroep is voor de belangrijkste leeftijden redelijk, voor schol iets meer dan voor tong.
- De precisie van de schattingen van gewichten per leeftijdsgroep is goed, voor schol iets beter dan voor tong.
- De gevonden niveaus van precisie in de schattingen blijken in een andere studie de zekerheid van de toestandsbeoordeling nauwelijks negatief te beïnvloeden.
- De kwaliteit van de Nederlandse marktbemonstering is dus voldoende.

2. Summary

The F1 working package of the F-project is concerned with the improvement of stock assessment of plaice and sole. The full range of problems of uncertainty and bias in the stock assessment will be analysed through a series of small investigations of single problems. The present report deals with the uncertainty in the input data on catch-at-age. These data are estimated through national market sampling and raising procedures.

The precision of the numbers-at-age and the mean weights-at-age derived from the Dutch market samples is analysed through bootstrapping (a resampling procedure).

The analysis of the quality of the age sampling for plaice and sole shows that the coefficients of variation (CV) are relatively low at those ages at which high numbers are found. This is likely to be due to sample size: with larger sample sizes we get more precise estimates. The same is true when comparing the sexes: the females are in general more numerous, and the females have in general lower CVs. Two exceptions to this pattern are found. Firstly, for the weights-at-age, the CVs are low at the youngest age, despite the low numbers at that age. Apparently the weights of very young fish are not variable. This could be caused by the fact that at the youngest age not much time has elapsed yet for variation in growth rate to be expressed. A more likely cause may be, however, that the commercial fishery harvests only the upper part of the size distribution of the young fish. Secondly, the CVs rise less steeply at older ages for females than for males, although the numbers at older ages are quite similar. Apparently numbers and weights of females at older ages are slightly less variable than those of males, but it is not clear why. The opposite would be expected for weights, especially during the spawning season where some females would be expected to be sampled just before spawning, and others just after.

From the point of view of stock assessments the variability in estimates for the ages 2-5 seems to be most important, because these ages contribute most to the catch on which the VPA is based. On the other hand, catch numbers at older ages are used to calculate stock numbers at younger ages in previous years; therefore, uncertainty in the estimates for the older ages may also affect the outcome of the VPA. Simulations could be designed to assess the extent of uncertainty caused by imprecision in the estimates for the older ages, but this exercise is out of the scope of this project. In order to be meaningful, such a simulation study should be based on well designed experiments to evaluate the reliability of age determinations. With VPA, the ages with the largest contributions in catch at age are the most important in terms of determining relative year class size. In a forward projection assessment approach, this could be less important. For female plaice the CVs of numbers-at-age at the ages 2-5 are always below 20%, but CVs for males are sometimes above 20%. For sole the CVs of numbers-at-age are often above 20% at the ages 2-5 for both sexes, but the more so in males. For weight-at-age the CVs are always much lower than for numbers-at-age, for plaice as well as sole.

The international project (EMAS) has investigated the impact of the precision that were found in that study (which were very similar to those found in this study) on the uncertainty of the stock assessment. In general it was found that the uncertainty induced by the imprecision of the catch at age data was small. Our conclusion is therefore that the market sampling programmes are adequate.

3. Introduction

The F-project is a 4-year research project with the objective to improve the mutual understanding between fishermen, scientists and fisheries managers, by stimulating communication and collaboration between fishermen and fisheries scientists. One of the three working packages of the F-project is concerned with the improvement of stock assessment of plaice and sole. The results of the annual stock assessments of plaice and sole by ICES have raised serious criticism on the transparency of the methodology, the quality of the input data and the quality of the stock assessment models used. The objectives of the F-project are to prepare for comprehensive fisheries evaluations of North Sea flatfish by analysing and seeking improvements of the following points:

- Representativity of the input data
- Uncertainty and bias in the stock assessment
- Uncertainty and bias in the short-term prognosis
- Biological reference points
- Produce a manual on quality assurance
- Explore alternative methods

These issues will be investigated in several smaller studies of which a total of 11 separate reports and 4 other products will be produced, which, taken together, represent an extensive analysis of the problem.

This report A1 presents an analysis of the precision of the input data for catch numbers-at-age and mean weights-at-age. The impact that the precision calculated in this report have on the uncertainty of the stock assessment is discussed.

The VPA model of the stock assessment is largely based on catch numbers-at-age (in the case of North Sea plaice and sole on landings-at-age). For the calculation of biomass and catch forecasts mean weights-at-age are required, In order to calculate catch numbers-at-age and mean weights-at-age for a stock, each country with catches from this stock uses a national market-sampling programme in which representative samples are taken from the landings, and a raising procedure is applied to raise to the total country's landings . In the Dutch market-sampling programme samples are taken by market category. Of the sampled fish the length, weight, and age are recorded. Within each quarter and year, the total catch weight as well as the total sample weight of each market category is recorded. The ratio of these two weights is the raising factor for that market category (in that quarter and year). The numbers of sampled fish of each sex and age group are then multiplied by the raising factors to arrive at estimated numbers of fish caught of each sex and age group per market category (within quarter and year). Subsequently, these numbers are summed over the market categories to arrive at total estimated numbers of fish caught of each sex and age group (within quarter and year). Similarly the mean fish weight is calculated by sex, age group, quarter, and year. Finally, the numbers-at-age are summed over the various countries, and the weights-at-age are averaged over the countries with appropriate weighting, to arrive at the data that will be input for the stock assessment.

Questions that arises are:

- How precise are the estimates of numbers-at-age and weight-at-age?
- Is the sampling programme adequate?
- How does uncertainty of these estimates impact on the certainty of the stock assessment?

The analysis presented in this report deals with the first question. The other two questions are discussed. It is important to note here, that the present study assumes (as the advice and management currently do) that the landings represent the true catches. This is likely not to be the case, due to the discarding of undersized fish. Discarding as a source of uncertainty is dealt with in report A3. The present study investigates only one source of uncertainty, namely the market sampling procedure.

In order to answer the first question, estimates of the uncertainty of the point estimates are required. The variance of estimates of numbers-at-age and mean weight-at-age can be derived analytically (e.g. Flatman 1990) or by means of resampling techniques (e.g. bootstrap or jack-knife). The aim of resampling methods is to resample from the observed data to provide information on the variability of the estimates as if the population had been resampled. These methods are necessary for catch-at-age data, as it is not possible to resample the population by repeating market sampling within a year.

The bootstrap resampling method was introduced by Efron (1979). A great deal of research has been carried out on the resampling methods in the last 20 years, and their use in fisheries applications is becoming more common. A standard reference on resampling methods is Efron and Tibshirani (1993), which gives detailed coverage of a range of topics. Manly (1997) gives an accessible account of the methods with references to biological applications. Patterson *et al.* (2001) provides an up-to-date review of methods of estimating uncertainty in fish stock assessment, including the bootstrap and jack-knife. Resampling methods have been applied in fisheries research on survey estimates (e.g. Smith 1997), calculation of biological reference points (e.g. O'Brien 1999) and stock assessment model parameters (e.g. Mohn 1993). The non-parametric bootstrap creates a new sample with the same number of observations as the original sample by sampling with replacement from the original data. The advantage of resampling techniques such as bootstrapping is that the variance of estimates can be derived if this is difficult to do analytically (due to not knowing the distribution of the data) or by actual multiple sampling (due to high costs). The disadvantage is that the resampling is done from the original sample, whereby the variance in the total population tends to be underestimated.

RIVO has participated in the international (EU-funded) EMAS project (Pastoors *et al.* 2001). In that project the bootstrap method has been developed and used to investigate the uncertainty of estimates derived from market sampling data for plaice, cod, and herring. The analyses for plaice market sampling covered the years 1991-1998. Here we extend these analyses for plaice to the years 1999-2001, and we apply the same method to market sampling data of sole for the years 1991-2001.

4. Material and methods

The methods are the same as those used in the EMAS project (Pastoors *et al.* 2001). Non-parametric bootstrap analyses were carried out for the Dutch raising procedures for plaice and sole (see **Figure 1**). The bootstrap consisted of 1000 iterations, within each quarter, using the same number of market samples as used for the contribution to the WGNSSK. Note that the resampling was done on the market samples, not on individual fish within the market samples. In other words, in each iteration, the bootstrap created a new set of market samples, with the same number of market samples as were in the original set, by sampling randomly with replacement from the original set of market samples. The individual fish contained within the samples stayed the same. The new set of market samples was then processed and raised in the same manner as the original market sampling data. Raising was stratified by quarter, sex and market category (see also **Figure 1**). This bootstrap approach has the considerable advantage of not requiring any modelling assumptions to produce estimates of uncertainty.

The algorithm for the bootstrap procedure used is as follows:

- Read the original data per fish: its sample number, market category, sex, age, length, weight.
- Read general information for year, quarter, species, area, stratum: commercial catch weight per market category, total commercial catch weight, and a list of sample identifiers (numbers).
- Start loop per quarter.
    - Start bootstrap, 1000 iterations.

        - (In the first iteration the original set of samples is used.)
        - Set the seed for the random number generator.
        - Draw random samples (by their identifiers) with replacement from the original set of samples until the new set of samples contains the same number of samples as the original set of samples. Calculate sampled weight by market category.
        - Form the ALD (numbers-at-age-and-length) per sex and per market category.
        - Raise the ALD to the total landings per sex and per market category.
        - Sum across the market categories.
        - Sum across length groups to get numbers-at-age per sex. Calculate mean length-at-age and mean weight-at-age per sex.
    - End bootstrap.
- End loop per quarter.

Note that the mean weight-at-age per sex for the raised population is calculated from the mean condition factor per age and sex averaged over the market categories that was calculated before raising.

5. Results

We focus on the coefficients of variation (CV, calculated as standard deviation/mean) of numbers-at-age and weight-at-age from the bootstrap analyses of the Dutch market sampling data for plaice and sole. For completeness, we include the results from the EMAS project for plaice 1991-1998.

5.1. Plaice

Figures 2, 3, and 4 are taken from Pastoors *et al.* (2001), and give the CVs of numbers-at-age for the years 1991-1998 (the data on which the figures are based can be found in Tables 1, 2, and 3 respectively in the appendix). Figures 5, 6, and 7 show the CVs of numbers-at-age for the years 1999-2001 (the data on which these Figures are based can be found in Table 4 in the appendix). In Figures 2 and 5 the results are disaggregated by year; in Figures 3 and 6 the results are disaggregated by year and quarter, and in Figures 4 and 7 the results are disaggregated by year, quarter and sex. The CVs of numbers-at-age show roughly the same patterns in the years 1991-1998 as in the years 1999-2001 (compare Figures 2, 3, and 4 with Figures 5, 6, and 7 respectively). In all Figures it can be seen that the CVs of numbers-at-age show a distinct pattern. The estimated CVs are high at the first age (around 30-70%), low at the ages 3 to 5 (around 5-8%), and then increase again to around 20-50% at ages older than 12. The CVs for females rise less steeply at the older ages than the CVs for males do (Figures 4 and 7). The quarterly data show very similar patterns compared to the annual data, as do the results for the analysis by sex (compare Figures 2, 3, and 4 with each other, and compare Figures 5, 6, and 7 with each other).

Figures 8, 9, and 10 show the CVs of weight-at-age for the years 1999-2001 (the data on which these figures are based can be found in Table 6 in the appendix; Table 5 in the appendix [from Pastoors *et al.* 2001] gives the CVs of weight-at-age for the years 1991-1998). Also in the case of the CVs of weights-at-age, the patterns are roughly the same in the years 1991-1998 as in the years 1999-2001 (compare Tables 5 and 6 in the appendix). The CVs are low at young ages and increase at older ages (Figures 8, 9, and 10). However, the CVs rise to about 10% and higher at a slightly younger age (about age 10) in the later years than in the earlier years (about age 13, compare Tables 5 and 6 in the appendix). The annual and the quarterly data show very similar patterns (compare Figures 8 and 9), and the data by sex reveal an increase of CVs at a slightly younger age in males than in females (Figure 10).

5.2. Sole

Figures 11, 12, and 13 show the CVs of numbers-at-age (the data on which these figures are based can be found in Table 7 in the appendix). Figures 14, 15, and 16 show the CVs of weight-at-age, for the years 1991-2001 (the data on which these figures are based can be found in table 8 in the appendix). The patterns seen for sole are very similar to the patterns seen for plaice. The numbers-at-age have high CVs at the youngest age (21.9-52.6% at age 1), lower CVs at the middle ages (2.4-10.8% at age 3), and higher CVs at the older ages (22.8-87.1 at age 12) (Figures 11, 12, and 13). The weights-at-age have low CVs at the young and middle ages and higher CVs at the older ages (Figures 14, 15 and 16).

5.3. Plaice and sole summarized

For female plaice the CVs of numbers-at-age at the ages 2-5 are always below 20%, but not for male plaice. For sole the CVs of numbers-at-age are often above 20% at the ages 2-5 for both sexes, but the more so in males. For plaice, the CVs of weights-at-age are very low in females, but sometimes higher than 10% for males. For sole the CVs of weights-at-age are more similar between the sexes and are sometimes higher than 10%.

6. Discussion

It is not surprising to find, for plaice as well as for sole, that the CVs are low at those ages at which high numbers are found (Figure 17): with larger sample sizes we get more precise estimates. The same is true when comparing the sexes: the females are in general more numerous (Figure 17), and the females have in general lower CVs. Two exceptions to this pattern are found. Firstly, for the weights-at-age the CVs are low at the youngest age, despite the low numbers at that age. Apparently the weights of very young fish are not variable. This could be caused by the fact that at the youngest age not much time has elapsed yet for variation in growth rate to be expressed. A more likely cause may be, however, that the commercial fishery harvests only the upper part of the size distribution of the young fish. Secondly, the CVs rise less steeply at older ages for females than for males, although the numbers at older ages are quite similar. Apparently numbers and weights of females at older ages are slightly less variable than those of males, but it is not clear why. The opposite would be expected for weights, especially during the spawning season where some females would be expected to be sampled just before spawning, and others just after.

From the point of view of stock assessments, uncertainty in estimates for the ages 2-5 seems to be most important, for plaice as well as sole, because these ages contribute most to the catch on which the VPA is based. On the other hand, catch numbers at older ages are used to calculate stock numbers at younger ages in previous years; therefore, uncertainty in the estimates for the older ages may also affect the outcome of the VPA. Simulations could be designed to assess the extent of uncertainty caused by imprecision in the estimates for the older ages, but this exercise is out of the scope of this project. In order to be meaningful, such a simulation study should be based on well designed experiments to evaluate the reliability of age determinations. With VPA, the ages with the largest contributions in catch at age are the most important in terms of determining relative year class size. In a forward projection assessment approach, this could be less important.

The precision of the estimates could be improved if the market sampling programme would sample more fish. In order to lower uncertainty at the older ages, the market sampling programme could sample extra fish in market category 1. Improved accuracy is more important for acquiring precise estimates of numbers-at-age than for weights-at-age, since the latter are already quite precise.

In the case of sole around 80% of the total landings are landed by the Dutch fleet, and therefore the uncertainty caused by the Dutch market sampling programme contributes to a large extent to the total uncertainty. Any improvement in the Dutch sampling programme may therefore have a relatively large impact.

In the international EMAS project (Pastoors *et al.* 2001) the consequences of the uncertainties in numbers-at-age and weights-at-age for the stock assessments were examined. By the same bootstrapping method as described here, CVs of numbers-at-age and weights-at-age were obtained for national and international estimates for the period 1991 to 1998. To determine the influence of the market sampling programmes on the stock parameters that are of most interest to fishery management (Spawning Stock Biomass, Fishing mortality and Recruitment), the uncertainty in the numbers-at-age was used in combination with a stock assessment model to determine the overall variability that is caused by the uncertainty in the catch at age data. In general it was found that the uncertainty induced by the catch at age data was small: it resulted in only relatively minor variation in the estimated fishing mortality, recruitment, and SSB series. The coefficients of variation of fishing mortality are larger than those SSB and recruitment. This would be expected as fishing mortality can be considered to be a function of the ratio of two bootstrap replicates from the cohort, whereas SSB and recruitment are derived from a weighted sum of the transformed replicates. This conclusion may be overstated: we use VPA that does assume that catches are known exactly. A different assessment approach could provide a different evaluation. Also, it is not a general conclusion, it is linked to the sampling intensity of the landings. An exception to the conclusion of the EMAS project was when both catch at age data and catch per unit effort (CPUE) data were used in the same model. In that case there was a substantial uncertainty in the estimates of fishing mortality at the different ages, mainly for the last year of the assessment (Pastoors *et al.* 2001).

7. Conclusions

- The precision of the estimates of numbers at age is reasonable for the most important age groups, for plaice slightly better than for sole.
- The precision of the estimates of weights at age is good, for plaice slightly better than for sole.
- The levels of precision of the estimates found in this study appeared in another study to have only small impact on the uncertainty of the stock assessments.
- The quality of the Dutch market sampling is therefore sufficient.

8. Figures

Figure 1. Dutch raising procedure for plaice and sole.

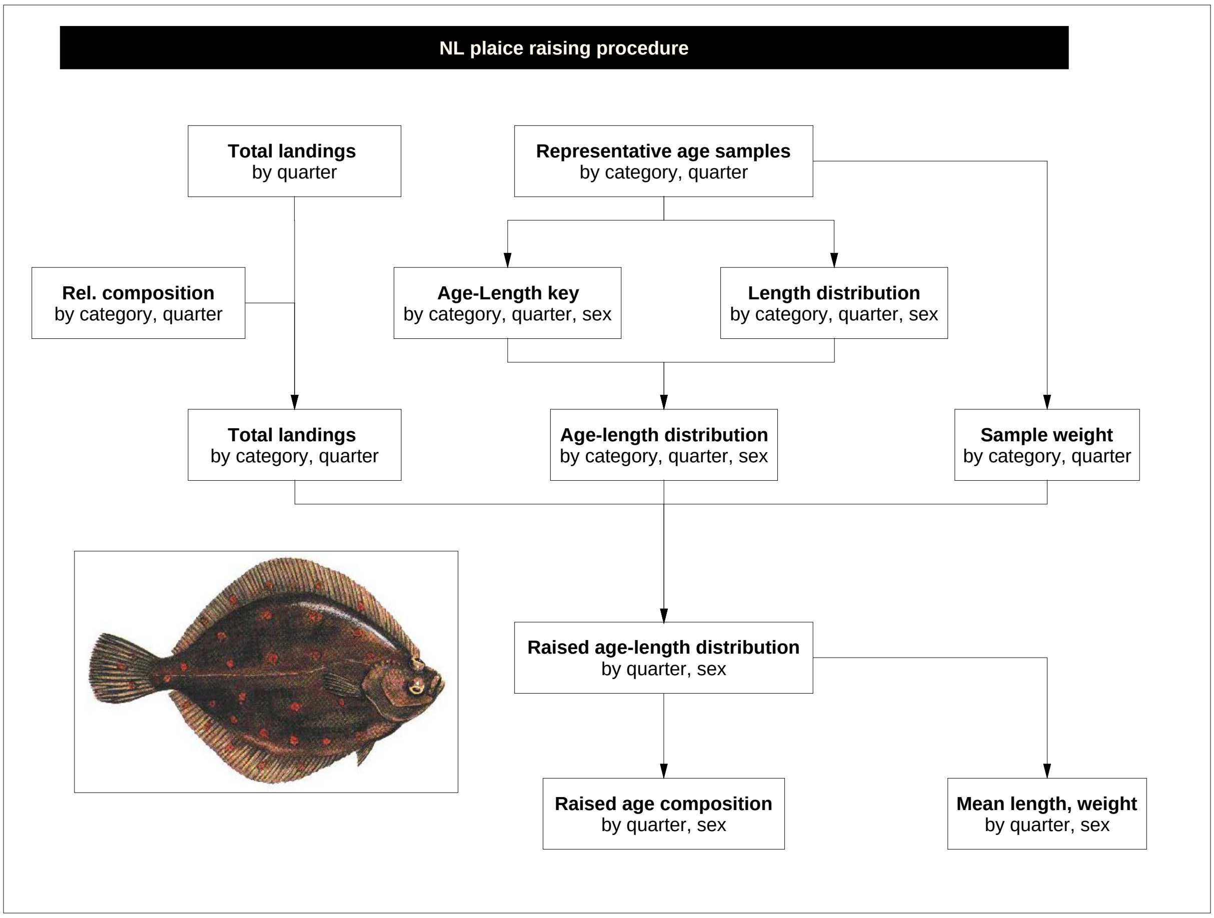


Figure 2. Plaice 1991-1998; CVs of numbers-at-age, sexes and seasons combined. [Figure 3.23 from Pastoors *et al*. (2001)].

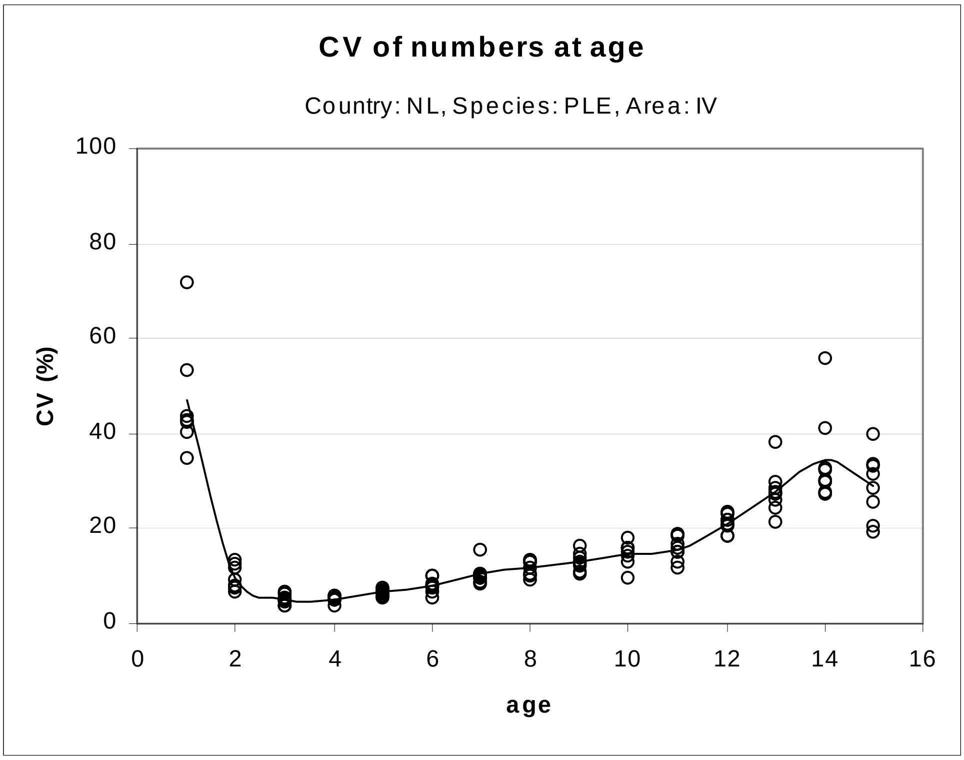


Figure 3. Plaice 1991-1998; CVs of numbers-at-age. Sexes combined; per quarter. [Figure 3.24 from Pastoors *et al*. (2001)].

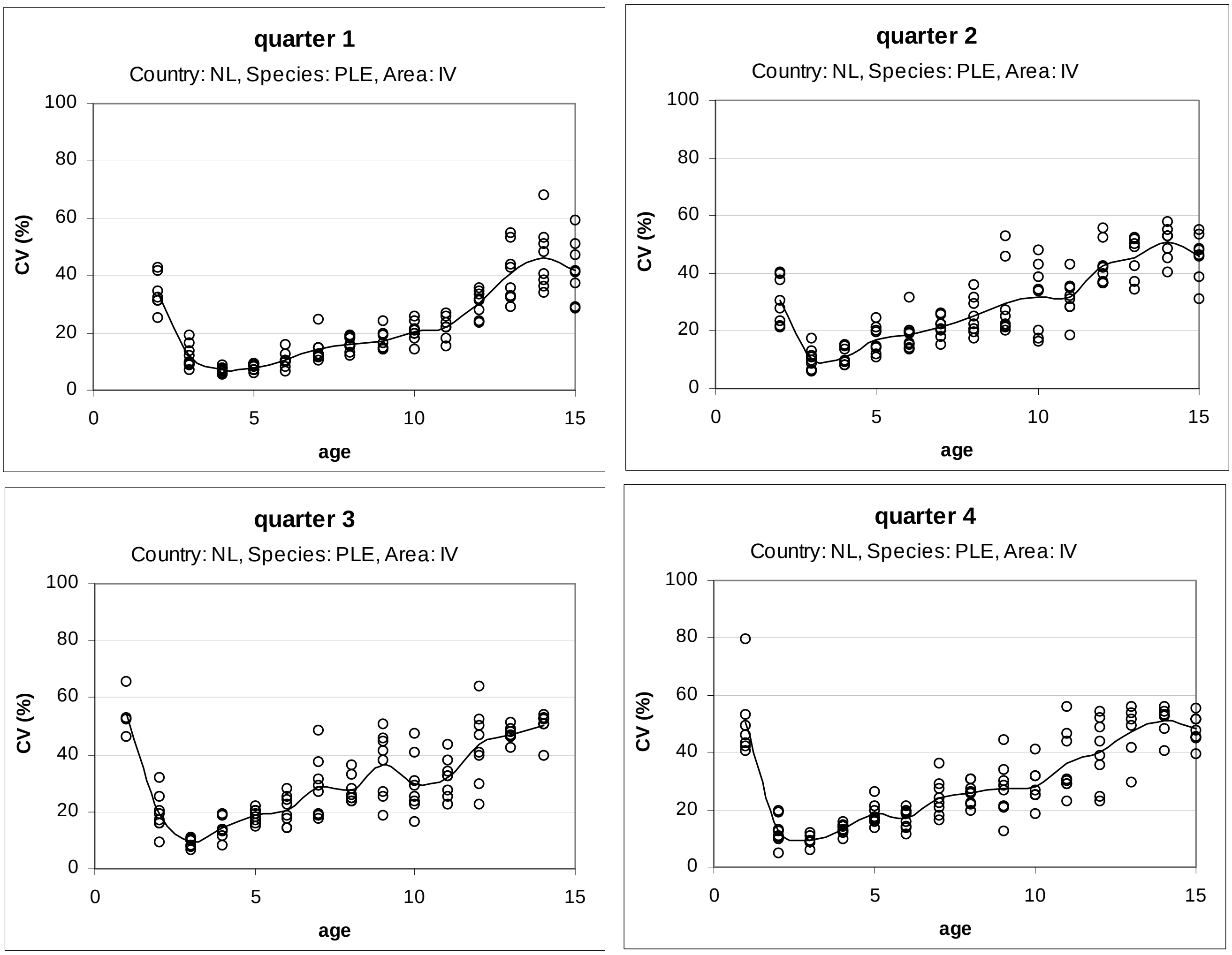


Figure 4. Plaice 1991-1998; CVs of numbers-at-age. Per sex, per quarter. [Figure 3.25 from Pastoors *et al.* (2001)].

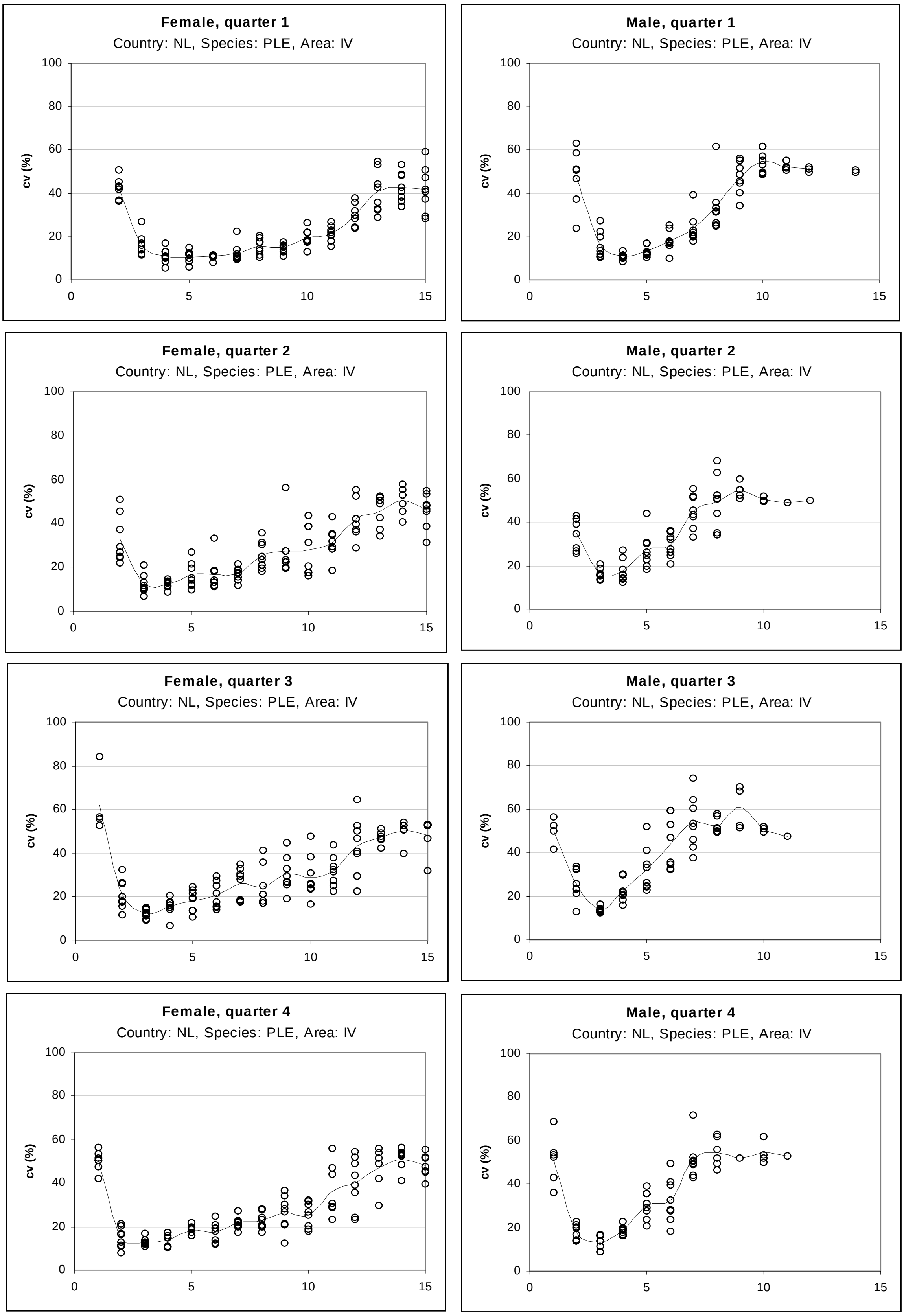


Figure 5. Plaice 1999-2001; CVs of numbers-at-age. Sexes and seasons combined

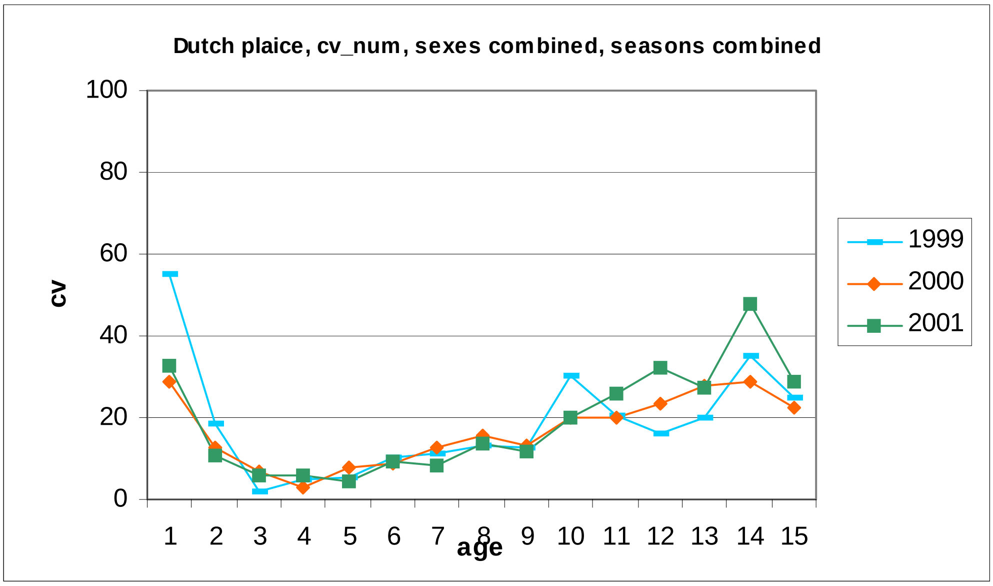


Figure 6. Plaice 1999-2001; CVs of numbers-at-age. Sexes combined, per quarter.

Figure 7. Plaice 1999-2001; CVs of numbers-at-age. Per sex, per quarter.

Figure 8. Plaice 1999-2001. CVs of weights-at-age. Sexes and seasons combined.

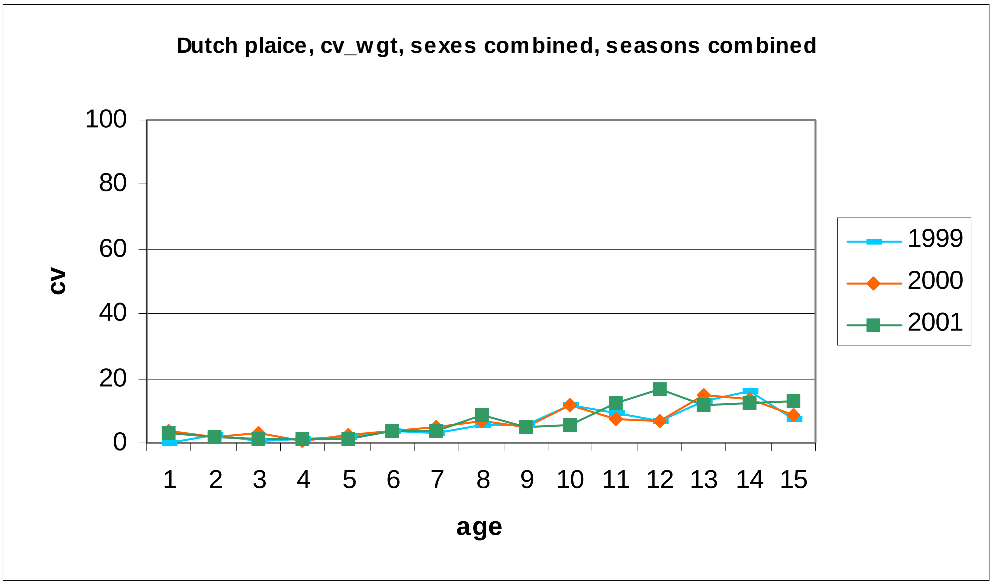
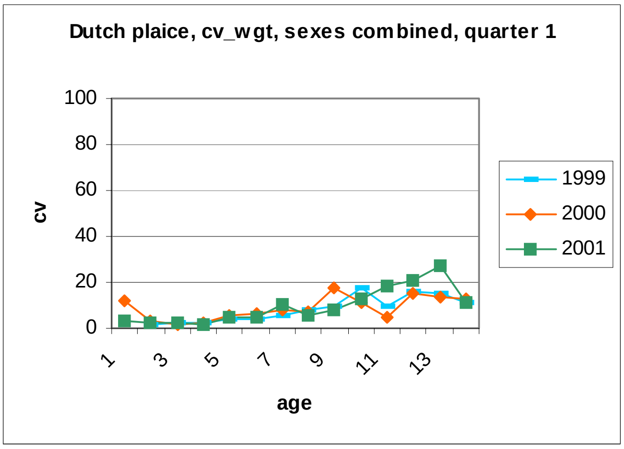
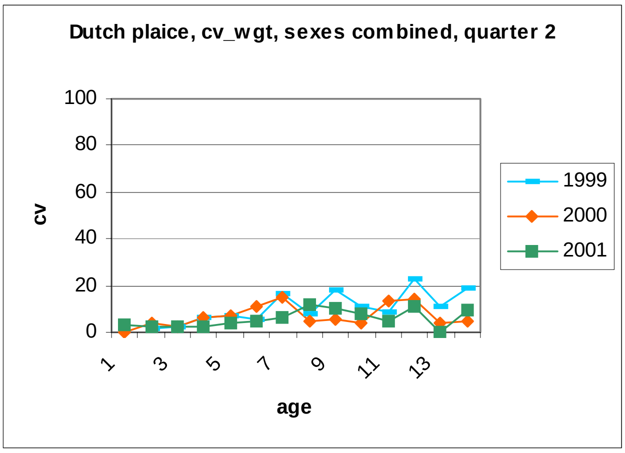
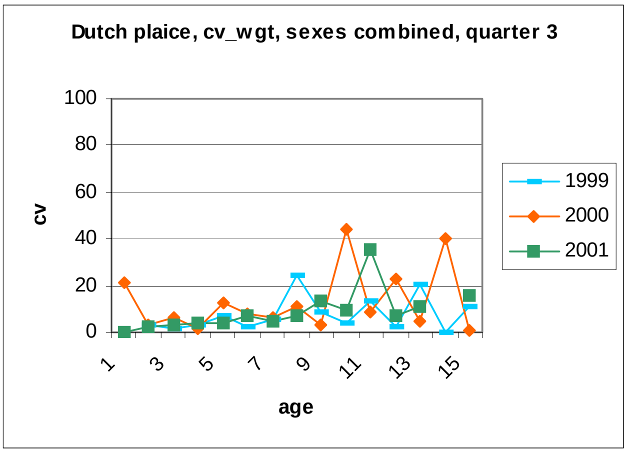


Figure 9. Plaice 1999-2001; CVs of weights-at-age. Sexes combined, per quarter.







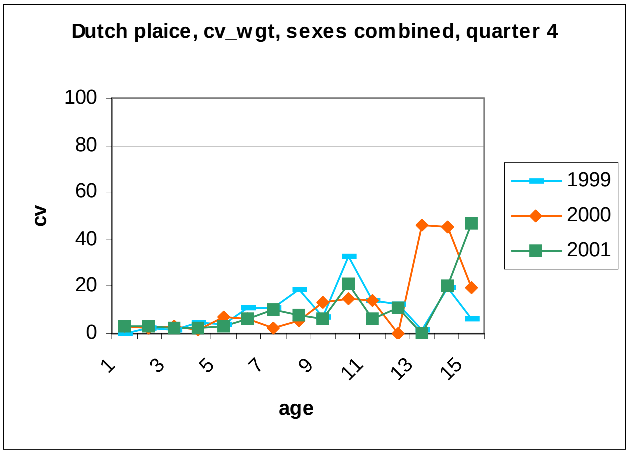


Figure 10. Plaice 1999-2001; CVs of weights-at-age. Per sex, per quarter.

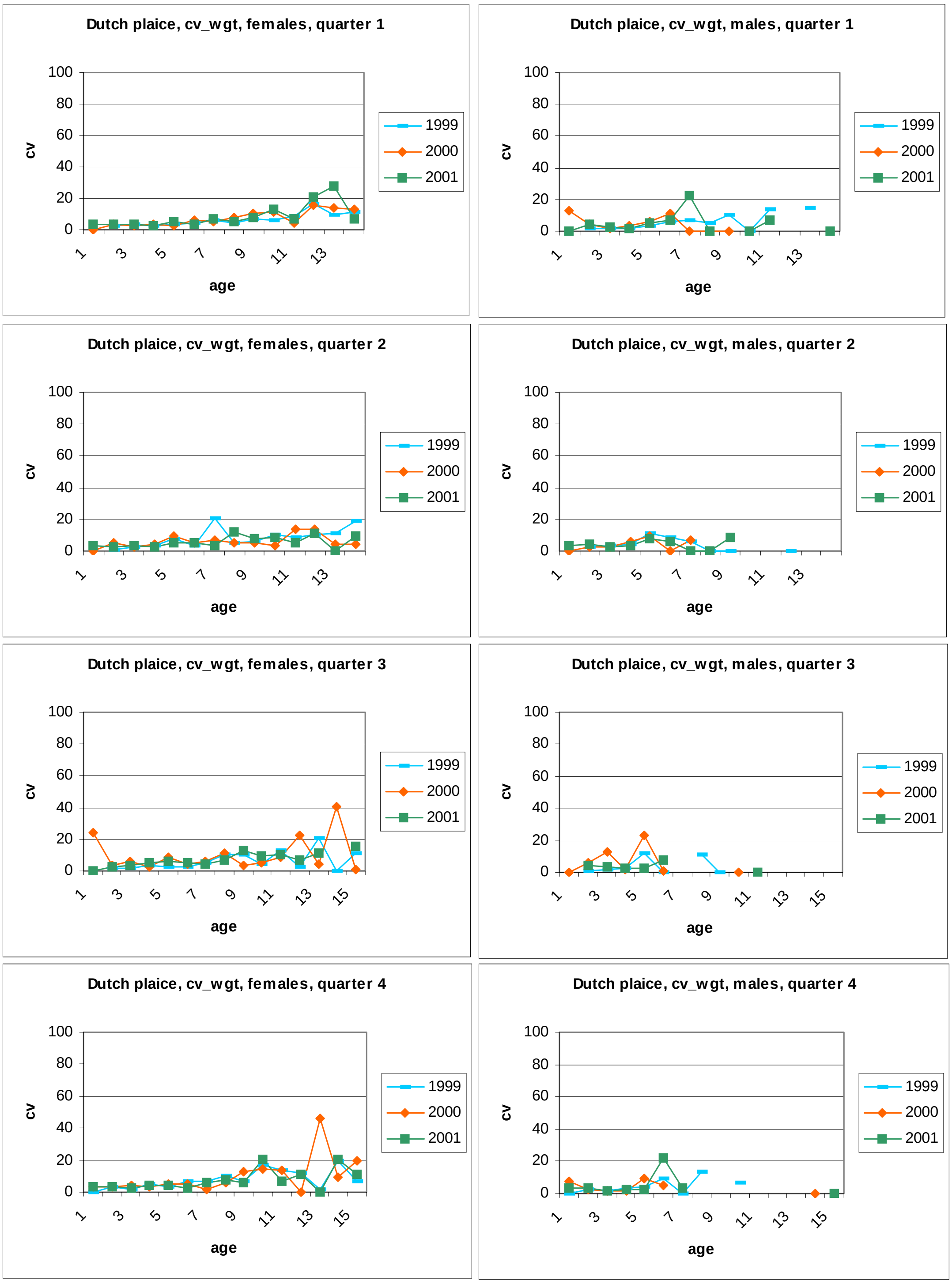


Figure 11. Sole 1991-2001; CVs of numbers-at-age. Sexes and seasons combined.

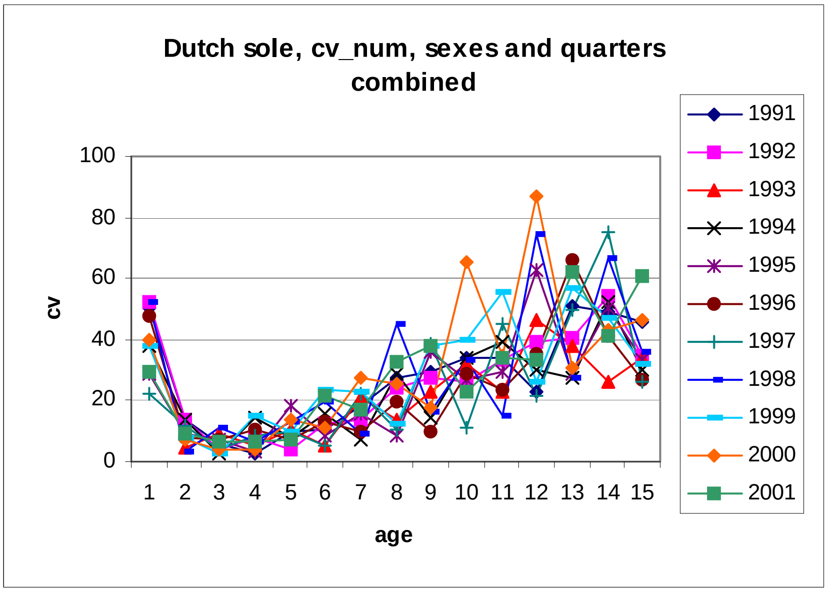
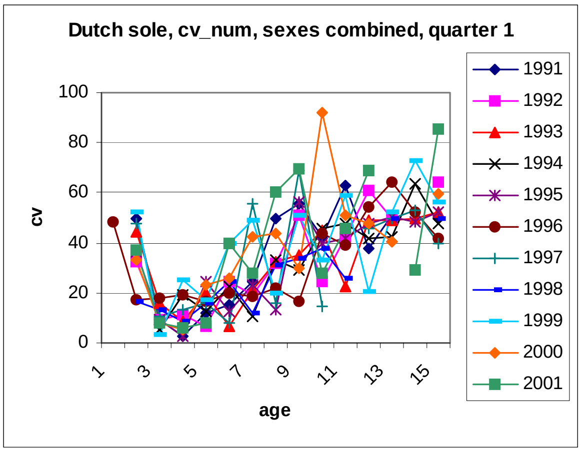
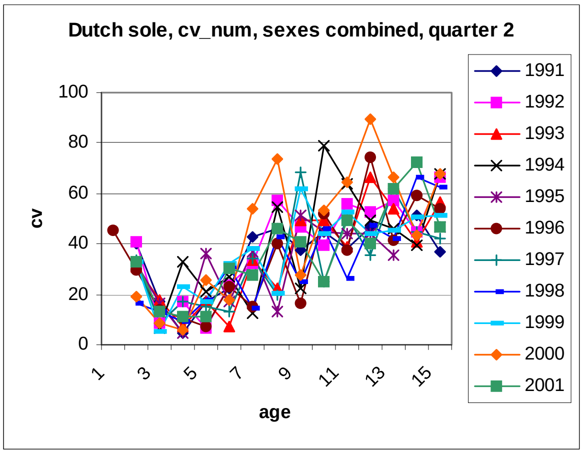
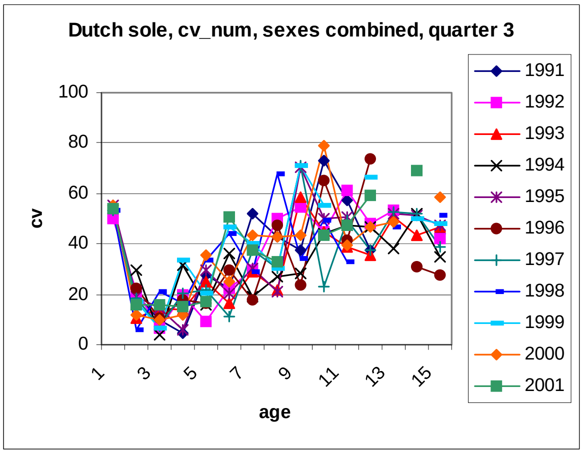


Figure 12. Sole 1991-2001; CVs of numbers-at-age. Sexes combined, per quarter.







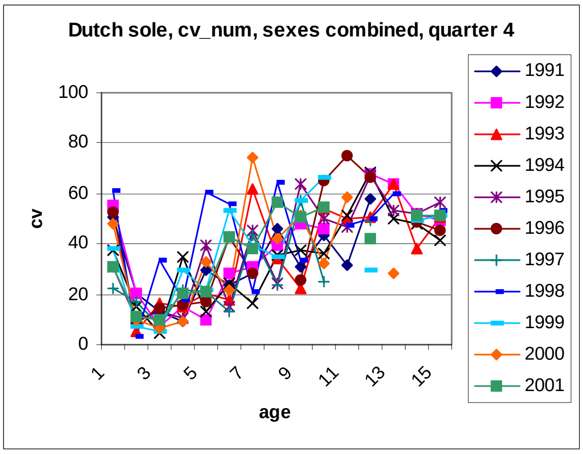


Figure 13. Sole 1991-2001; CVs of numbers-at-age. Per sex and per quarter.

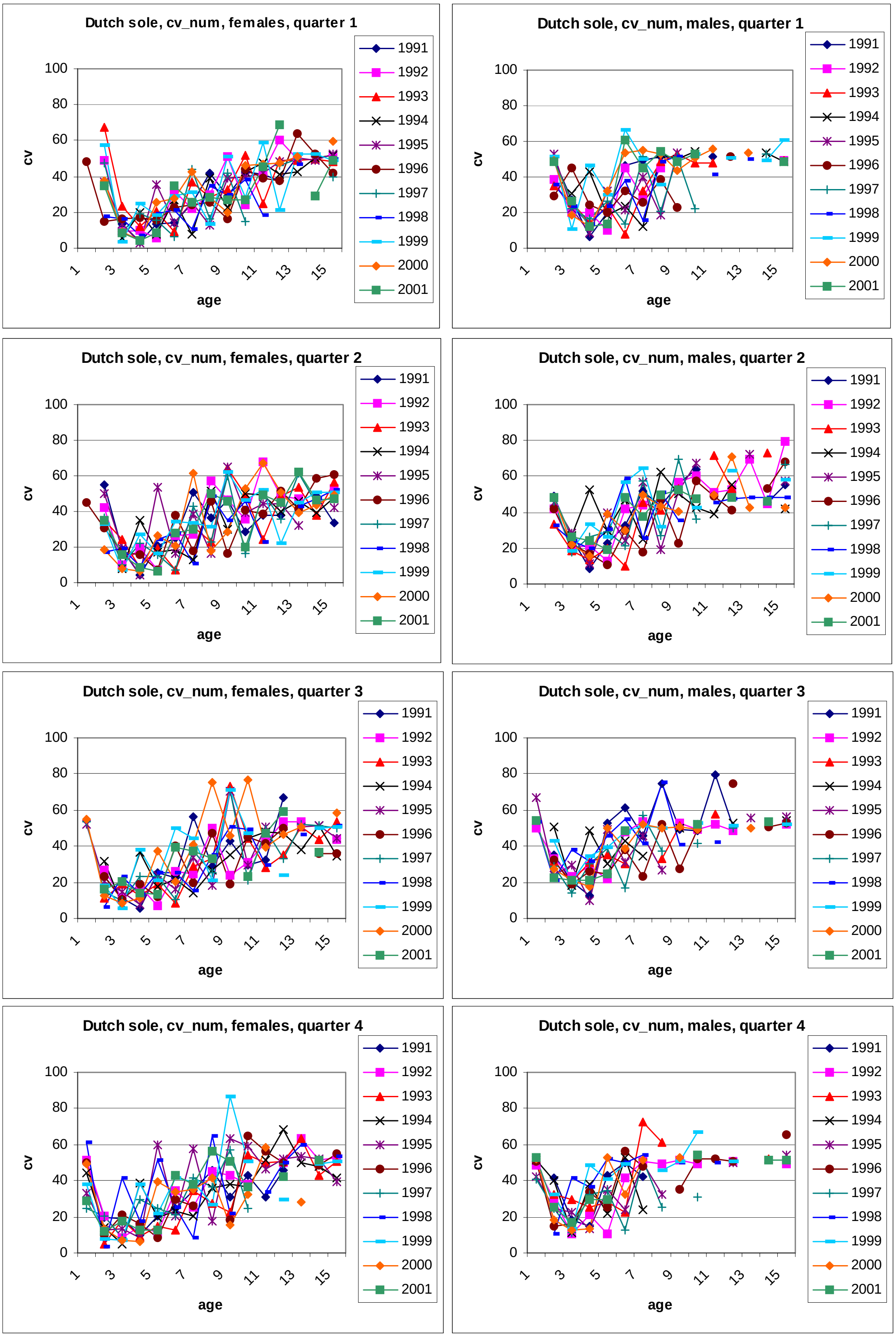


Figure 14. Sole 1991-2001; CVs of weights-at-age. Sexes and seasons combined.

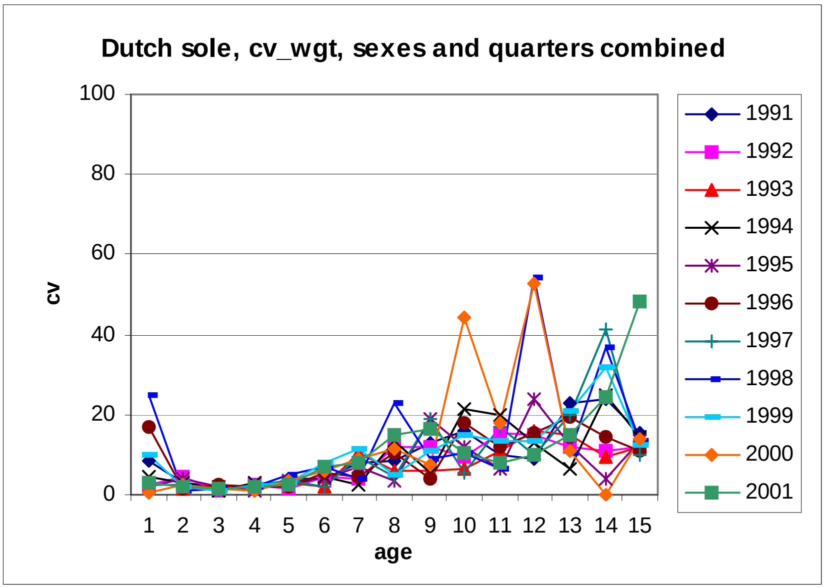


Figure 15. Sole 1991-2001; CVs of weights-at-age. Sexes combined, per quarter.

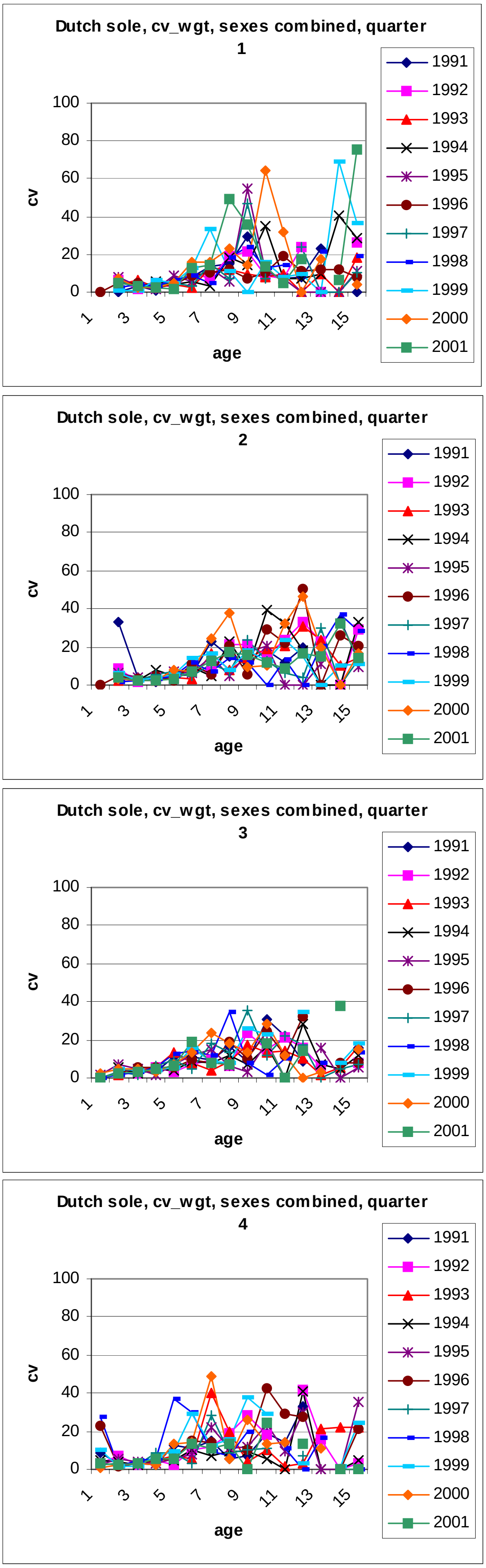


Figure 16. Sole 1991-2001; CVs of weights-at-age. Per sex and per quarter.

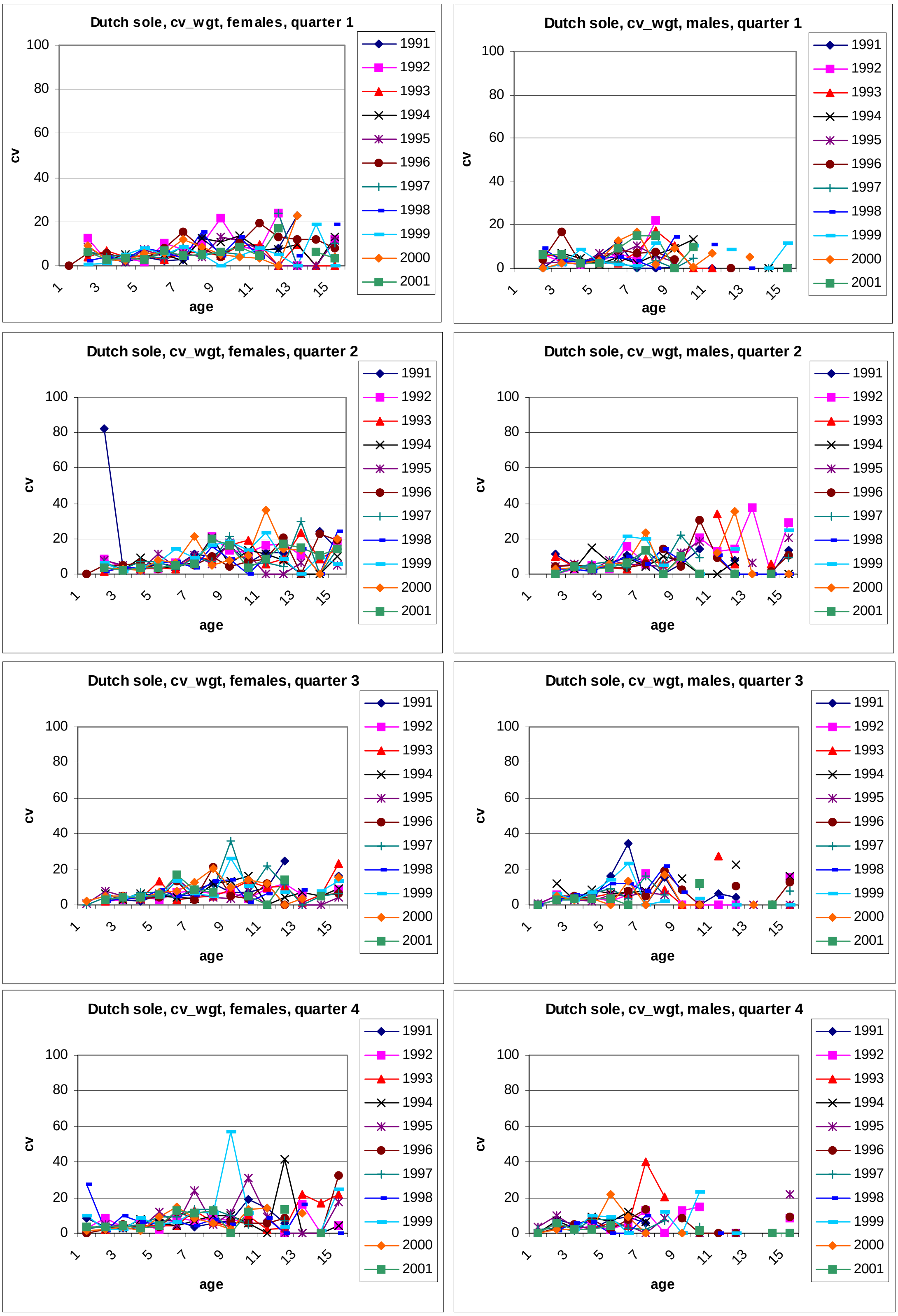
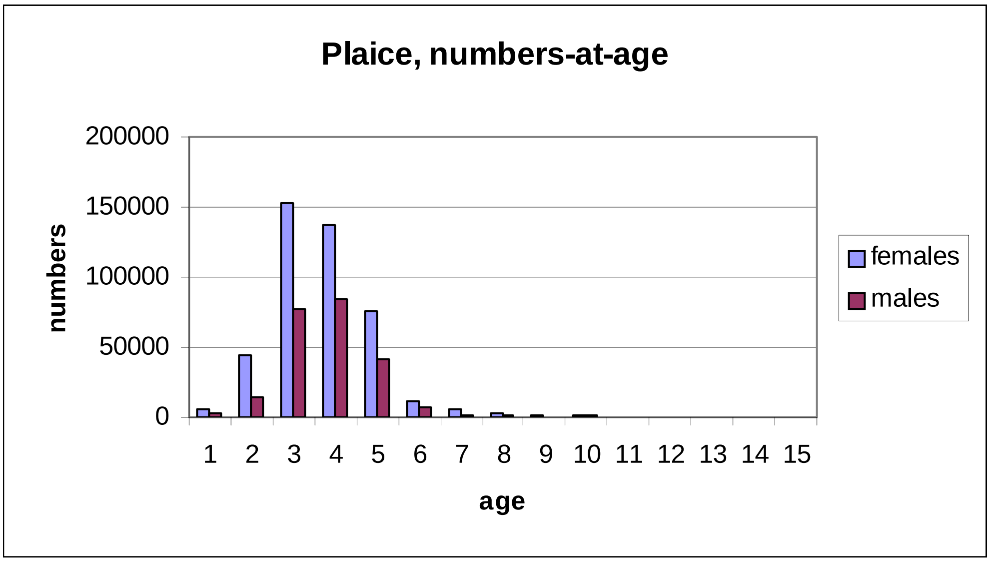
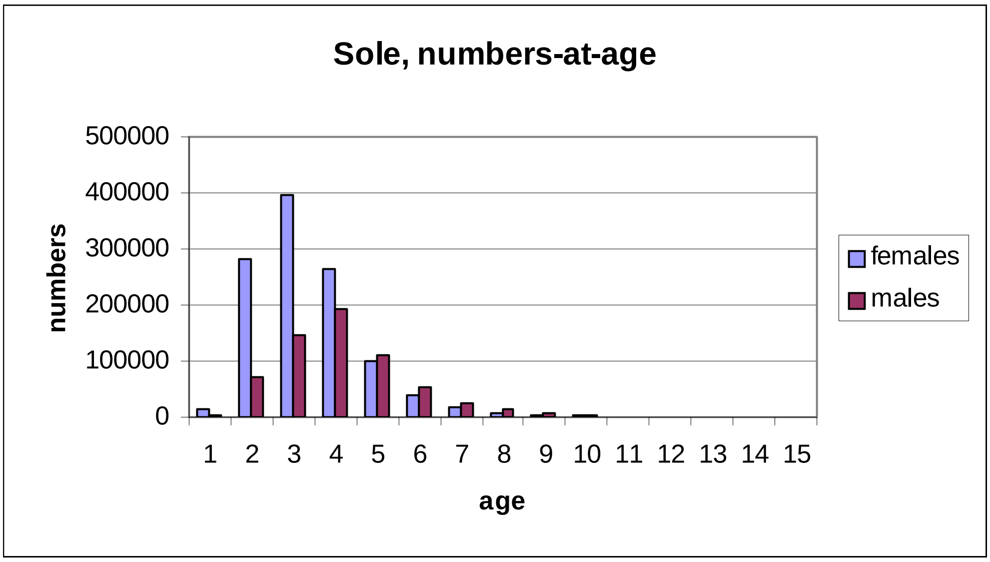


Figure 17. Mean numbers-at-age from the bootstrap analyses. A. Plaice 1999-2001. B. Sole 1991-2001.

A.



B.



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10. Appendix with Tables

Table 1. Plaice 1991-1998; CVs of numbers-at-age. Sexes and seasons combined. [lower part of Table 3.28 from Pastoors *et al*. (2001)]

CV of numbers at age

country	NL
species	PLE
area	IV

Average of cv_num	year								
age	1991	1992	1993	1994	1995	1996	1997	1998	Grand Total
1	42	72	40	44	35	43	53		47
2	13	13	12	8	9	7	8	8	10
3	6	5	7	5	5	4	4	4	5
4	6	6	5	6	5	5	5	4	5
5	6	7	7	7	6	7	8	6	7
6	5	7	8	8	10	8	7	10	8
7	11	9	9	10	11	10	10	16	10
8	13	13	9	10	10	12	13	13	12
9	14	13	12	11	13	11	15	16	13
10	13	15	16	14	10	18	16	16	15
11	15	15	13	16	19	12	19	17	16
12	23	22	24	21	22	21	18	18	21
13	29	30	28	21	38	26	27	24	28
14	28	27	30	56	33	41	32	30	35
15	21	19	33	28	31	33	25	40	29

Table 2. Plaice 1991-1998; CVs of numbers-at-age. Sexes combined, per quarter. [Table 3.30 from Pastoors *et al.* (2001)].

country	NL
species	PLE
area	IV

Average of cv_num		year								
quarter	age	1991	1992	1993	1994	1995	1996	1997	1998	Grand Total
1	2		31	42	32	25	43	35	31	34
	3	19	14	17	12	9	9	7	10	12
	4	8	9	8	7	8	7	6	5	7
	5	7	8	9	6	9	9	7	7	8
	6	7	10	12	10	16	11	8	10	11
	7	15	12	10	13	15	11	13	25	14
	8	19	19	12	13	15	16	16	18	16
	9	19	14	17	15	20	14	15	24	17
	10	20	21	24	18	14	22	20	26	21
	11	22	22	18	24	27	16	22	26	22
	12	32	31	35	24	36	28	34	24	30
	13	44	36	43	32	55	29	33	53	41
	14	38	36	34	68	53	51	41	48	46
	15	29	29	38	42	51	48	41	59	42
2	2	40	28	40	22	22	31	38	23	30
	3	13	11	18	12	9	6	10	6	11
	4	9	15	8	16	9	8	13	10	11
	5	11	20	15	21	12	14	24	20	17
	6	14	20	14	19	16	20	15	32	19
	7	15	18	26	22	20	23	26	21	21
	8	25	30	18	21	22	19	36	31	25
	9	22	53	22	25	20	22	46	27	30
	10	18	43	20	39	16	48	35	34	32
	11	35	43	28	35	28	19	31	32	31
	12	40	42	36	52	37	42	56	36	43
	13	42	52	34	52	50		49	37	45
	14		45	55	53	58	53	49	41	51
	15	31	39	54	46	55	49	48	46	46
3	1		53	53		46	66			54
	2	19	25	32	16	21	16	10	17	20
	3	10	11	10	8	11	11	7	8	9
	4	19	14	12	14	13	20	13	8	14
	5	15	16	20	22	18	21	17	20	19
	6	14	23	17	14	28	25	24	19	21
	7	29	19	19	18	27	49	32	38	29
	8	25	25	24	24	33	26	28	36	28
	9	38	45	27	19	42	26	46	51	37
	10	31	41	24	26	17	29	23	48	30
	11	44	28	34	25	33	23	33	38	32
	12	47	64	41	53	40	30	23	50	43
	13	48	51		46	42	49	46	47	47
	14	53	51	51	54	40	53			50
	15	47	53		53	53	53	32		48
4	1	42	80	46	44	41	50	53		51
	2	20	19	13	10	13	5	11	10	13
	3	9	9	12	9	11	9	6	9	9
	4	14	13	16	12	15	14	13	10	13
	5	16	17	22	18	20	16	26	14	19
	6	16	12	22	20	19	14	19	13	17
	7	29	18	27	24	36	21	17	22	24
	8	31	31	26	22	22	28	26	20	26
	9	21	30	28	13	21	27	45	34	27
	10	32	25	32	25	19	27	41	25	28
	11	31	30	44	23	29	47	56	29	36
	12	54	24	52	39	36	49	23	44	40
	13	52	54		30	56	49		42	47
	14	41	53		54	53	56	48	53	51
	15	51	40		52	45	55	46	48	48

Table 3. Plaice 1991-1998; CVs of numbers-at-age, per sex and per quarter. [Table 3.31 from Pastoors *et al*. (2001)].

country	NL
species	PLE
area	IV

Average of cv_num		year	sex														
		1991		**1992**		**1993**		**1994**		**1995**		**1996**		**1997**		**1998**	
quarter	age	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**
1	**2**			45	38	51	51	43	47	42	24	37	63	43	59	36	51
	3	27	27	17	20	16	22	19	15	14	11	12	12	11	10	14	13
	4	17	14	13	12	13	11	8	8	11	11	10	11	10	10	5	11
	5	12	10	15	12	12	12	12	12	10	17	10	13	8	13	6	17
	6	8	10	12	17	11	16	11	16	11	25	11	17	11	18	10	24
	7	14	23	9	21	10	18	10	21	10	27	11	20	12	22	22	39
	8	20	31	17	33	10	25	13	26	12	36	15	32	19	25	17	62
	9	15	34	13	40	14	45	11	52	16	55	15	49	16	46	18	56
	10	18	53	22	55	22	62	18	49	13	49	19	62	17	57	27	50
	11	23	52	22		18		25	51	27		16		21	55	21	52
	12	32		30	51	38	52	24		36		28		28	50	24	
	13	44		36		43		32		55		29		33		53	
	14	38		36		34		43	51	53		49	50	41		48	
	15	29		29		38		42		51		48		41		59	
2	**2**	51	39	29	35	45	43	25	26	22	27	24	42	37	41	27	28
	3	16	21	12	16	21	19	13	16	11	16	10	14	10	15	7	13
	4	15	16	14	24	12	14	14	27	13	14	13	12	11	18	9	16
	5	12	23	22	25	15	18	14	31	10	30	12	20	27	26	19	44
	6	14	26	18	32	13	21	13	28	11	35	12	33	18	25	33	36
	7	18	43	16	33	12	52	19	43	19	55	14	37	17	45	21	52
	8	23	51	30	51	18	35	20	52	25	34	21	44	32	68	36	63
	9	23	52	56	55	23	55	20	60	20		22		28	51	27	
	10	18		43		20		39		16		18	50	31	52	39	50
	11	35		43		28		35		28		19		29	49	32	
	12	40		42		36		52		37		42		56		29	50
	13	42		52		34		52		50				49		37	
	14			45		55		53		58		53		49		41	
	15	31		39		54		46		55		49		48		46	
3	**1**			53	53	56	56			57	42	84	50				
	2	20	26	27	32	32	33	18	23	26	23	16	21	12	13	18	34
	3	15	13	11	16	12	13	13	13	15	14	15	13	10	14	9	13
	4	21	21	16	22	15	21	14	22	16	18	17	30	18	30	7	16
	5	14	23	22	25	19	26	11	41	20	24	23	35	14	52	25	33
	6	15	36	22	32	16	35	15	59	27	33	25	47	30	53	18	59
	7	33	38	18	46	18	43	19	61	28	65	35	74	31	52	29	54
	8	25		17	57	18	49	17	49	21	58	21	51	41	51	36	50
	9	38		45		27		19	52	27	70	26		29	68	33	51
	10	31		38	52	24		26		17		26	51	24	50	48	
	11	44		28		34		25		33		23		32	47	38	
	12	47		64		41		53		40		30		23		50	
	13	48		51				46		42		49		46		47	
	14	53		51		51		54		40		53					
	15	47		53				53		53		53		32			
4	**1**	42		52	69	51	43	56	53	50	36	48	54	53	53		
	2	20	23	21	21	16	14	13	14	17	20	8	14	11	20	11	17
	3	12	11	14	17	12	16	17	9	13	16	12	14	11	9	13	14
	4	17	17	15	16	17	19	11	18	16	20	11	23	15	19	11	17
	5	19	24	22	21	16	36	19	28	17	36	16	29	19	39	20	31
	6	18	24	12	19	25	40	19	41	19	33	12	28	21	28	14	50
	7	22	44	20	50	20	43	22	50	23	72	21	53	17	49	27	51
	8	28	63	21	49	23	56	17	47	20	62	28		24	52	20	
	9	21		30		28		13		21		27		37	52	34	
	10	32		19	54	32		20	50	18	52	27		30	62	25	
	11	31		29	53	44		23		29		47		56		29	
	12	54		24		52		39		36		49		23		44	
	13	52		54				30		56		49				42	
	14	41		53				54		53		56		48		53	
	15	51		40				52		45		55		46		48	

Table 4. Plaice 1999-2001; CVs of numbers-at-age, per sex and per quarter. com = sexes combined.

cv_num		year	sex							
		1999			2000			2001		
quarter	age	com.	F	M	com.	F	M	com.	F	M
1	2				59.8	53.2	60.4	60.7	63.4	48.2
	3	7.3	10.3	11	18.9	22.4	24.1	15.7	20	23.5
	4	7.2	9.2	11.8	2.8	6.9	9.3	9.8	12.7	19.4
	5	5.4	5.3	12.2	9.3	12.2	13.2	4.2	7.8	12.7
	6	11.5	10	21.7	12.6	9.8	25	12.1	13.8	27.4
	7	15.1	17.2	28.8	16.1	14.8	39.6	10.2	10.3	32.3
	8	16.4	14.8	48.6	20.9	18.4	50.2	18.7	18.1	60
	9	17	15.7	33.3	17.4	18.4	47.6	14.7	14.4	50
	10	26.1	30.3	38.6	26.6	16.2	50.4	33	33	
	11	37.5	35.2	50.6	29.1	29.1		32.6	29.5	50
	12	21.2	20.4	67.1	31.6	31.6		36.7	22.4	51.4
	13	28.6	28.6		47.3	47.3		43.1	43.1	
	14	48.4	38.1	53.9	37.4	37.4		53.8	53.8	
	15	44.4	44.4		32.4	32.4		27.9	21	48.2
2	2				51.8	51.7	51.8	26.7	28	26.2
	3	7.3	8.7	10.6	20.9	24.8	20	13.3	14.5	21.5
	4	9.6	9.4	12.8	6.3	7.9	11.3	9.5	11.9	19.2
	5	19	9.2	33.7	20.1	11.5	41.8	10.2	11.2	16.8
	6	24.4	27.5	35.5	16.8	22.3	35.5	21.4	20	27.5
	7	18.3	19.1	44.7	32.4	25.6	50.6	19.6	19.6	51.7
	8	34.8	40.6	42.8	28.5	17.1	46.8	20.4	17.9	52.7
	9	30.6	21.6	53.2	28.3	28.3		27.2	27.9	53.8
	10	31.1	19.3	54.6	24.2	24.2		23.3	26	49.1
	11	26.3	26.3		31.1	31.1		25.9	25.9	
	12	27.9	27.9		33.1	33.1		29.8	29.8	
	13	38.8	31.8	53.2	48.5	48.5		32.5	32.5	
	14	33.6	33.6		48	48		52.7	52.7	
	15	36.7	36.7		30.1	30.1		25.8	25.8	
3	1				48.3	45	53.4	56.1	56.1	
	2	33.9	36.8	51.2	20.1	18.8	48.5	19	18.9	25.5
	3	3	5.7	7.6	7.1	8	13	11.7	11.6	18.1
	4	10.3	10.5	15.7	7.6	8	11.6	15.2	19.3	17.4
	5	12.4	8.4	33.8	29.5	18.3	68.6	13.2	17.6	14.9
	6	13.7	13.4	50.9	19.7	17	49.3	22.4	17.7	40.6
	7	20.7	20.7		22.2	22.2		16.8	16.8	
	8	40.2	30	49.3	26	26		26.1	26.1	
	9	27.8	26.8	51.5	36.2	36.2		32.9	32.9	
	10	34.9	34.9		72.2	42.5	54.3	21.4	21.4	
	11	48.1	48.1		48.1	48.1		60.3	30.2	52.9
	12	50.8	50.8		48.6	48.6		47	47	
	13	48	48		43.9	43.9		26.1	26.1	
	14	54	54		56.3	56.3				
	15	48.1	48.1		48.7	48.7		40.1	40.1	
4	1	55.1	55.1	55.1	34.5	36.3	32.5	35	40.7	33.1
	2	21.4	23.1	29.9	13.7	14.6	26.2	13.6	15.4	21
	3	3.2	5.3	5.9	10.4	11.6	19.1	8.6	9.1	15.5
	4	13.6	13.5	20.6	6.5	9.3	8.1	10.4	14.2	15.2
	5	13.7	12	27.9	15.1	16.8	30.7	12.1	13.3	13.7
	6	30.3	20.3	44.8	15.7	13	38.5	23.5	21.3	59.8
	7	23.3	18.1	54.6	24.2	24.2		17.9	17.9	49.9
	8	35.5	25.2	48.8	23.5	23.5		20.1	20.1	
	9	24.4	24.4		36.8	36.8		20.7	20.7	
	10	60.8	45.4	59.7	28.6	28.6		44.5	44.5	
	11	34.2	34.2		35.2	35.2		44.3	44.3	
	12	41.7	41.7		52.6	52.6		58.8	58.8	
	13	50.7	50.7		55.4	55.4		51.8	51.8	
	14	48.3	48.3		65.6	49.7	53.4	64.9	64.9	
	15	39	39		42.2	42.2		75.4	51.4	53.3
all	1	55.1	55.1	55.1	28.9	29.6	31	32.6	37.1	33.1
	2	18.4	19.7	26.5	12.8	12	24.4	10.8	11.4	14.9
	3	2.1	3.3	4.1	6.7	7.4	9.1	5.9	6.4	9.9
	4	4.8	5.3	7.3	2.7	4.1	4.9	5.7	7.5	10
	5	5.3	3.8	11.4	7.7	7.9	12.4	4.5	6	8.2
	6	10.3	8.4	18.9	8.6	8.3	18.8	9.1	9.4	19.4
	7	11	11.5	24.1	12.5	10.7	37.9	8.1	8.1	27.9
	8	13.2	14	28.5	15.4	13.9	42.7	13.8	12.9	56.3
	9	12.6	11.1	30.3	13.4	13.9	47.6	11.5	11.2	55.7
	10	30.4	19.5	41.4	20.1	12.3	53.3	20.2	21.5	49.1
	11	20.5	18.2	50.6	19.9	19.9		25.9	20.7	53.6
	12	16.2	15.6	67.1	23.3	23.3		32.4	18.2	51.4
	13	20.2	20.1	53.2	27.8	27.8		27.1	27.1	
	14	34.9	23.5	53.9	28.8	26	53.4	47.6	47.6	
	15	24.8	24.8		22.5	22.5		28.9	16.7	58.5

Table 5. Plaice 1991-1998; CVs of weights-at-age. Sexes and seasons combined. [lower part of Table 3.29 from Pastoors *et al*. (2001)].

CV of weight at age

country	NL
species	PLE
area	IV

Average of cv_wgt	year								
age	1991	1992	1993	1994	1995	1996	1997	1998	Grand Total
1	11.8	1.8	4.2	5.8	4.9	13.3	0.0		6.0
2	2.6	1.9	2.5	2.0	2.6	1.5	1.4	1.2	2.0
3	2.2	1.8	1.6	1.2	1.3	1.5	1.2	1.1	1.5
4	1.7	2.0	1.4	1.6	1.6	1.6	1.8	1.4	1.6
5	2.1	1.8	1.9	2.6	2.2	1.9	3.3	3.1	2.4
6	1.7	2.7	2.7	2.9	3.3	2.8	2.7	4.2	2.9
7	3.2	3.3	4.2	4.2	4.4	4.7	4.6	6.3	4.3
8	4.5	4.6	3.7	3.9	4.6	4.2	5.8	4.9	4.5
9	5.6	5.0	14.0	4.1	6.0	4.5	5.2	9.2	6.7
10	7.0	5.2	7.4	4.6	4.2	9.1	9.6	7.2	6.8
11	5.8	5.4	4.5	5.2	11.9	4.5	7.0	5.8	6.3
12	7.1	12.3	5.0	6.6	7.9	6.6	9.1	7.4	7.8
13	4.6	8.4	10.6	7.4	18.6	9.9	6.4	7.5	9.2
14	8.9	8.8	13.9	38.7	12.8	21.4	7.8	12.4	15.6
15	7.0	7.1	12.2	13.4	12.3	10.9	11.0	8.3	10.3

Table 6. Plaice 1999-2001; CVs of weights-at-age, per sex and per quarter. com = sexes combined.

cv_w gt		year	sex							
		1999			2000			2001		
quarter	age	com.	F	M	com.	F	M	com.	F	M
1	2				12.3	0	12.8	3.3	3.6	0
	3	1.8	2.2	2.1	3.3	3.8	4.5	2.8	3.6	4.1
	4	2.8	3.5	2	1.6	2.3	1.9	2.2	3.1	2.5
	5	2.1	2.4	1.5	2.4	3.7	3.6	1.5	2.2	1.7
	6	3.8	3.8	3.1	5.7	2.7	5.7	5	5	5.2
	7	4	4.6	5.9	6.1	6.1	11.1	4.8	3.9	7.2
	8	5.7	6.1	6.6	8.4	4.9	0	10.7	6.9	22.4
	9	7.8	4.5	5	6.9	7.5	0	5.8	5.6	0
	10	9.5	6.9	10.5	17.3	10.1	0	7.9	7.9	
	11	17.4	6.5	0	11.4	11.4		13.1	12.8	0
	12	9.5	8.9	13.7	4.7	4.7		18.4	7	7.1
	13	16.3	16.3		15.5	15.5		20.6	20.6	
	14	15.4	9.2	15	13.5	13.5		27.5	27.5	
	15	11.4	11.4		12.9	12.9		11.6	7.3	0
2	2				0.1	0.1	0	2.8	3.2	3.4
	3	1.3	1.2	2.6	3.7	5.1	2.6	2.2	2.5	4.2
	4	2.3	2.2	3.2	2.2	2.7	2.7	2.6	3.7	2.5
	5	6.1	3.8	4.4	6.5	4	6	2.3	2.5	3.2
	6	7.3	8	11.5	6.9	9.2	9.1	3.6	5.6	7.6
	7	5.7	3.1	9	10.7	5.2	0.1	4.8	5	5.7
	8	16.7	21.1	6.3	15.3	7.1	6.5	6.2	3.6	0
	9	8.1	5.3	0	5	5		11.6	11.9	0
	10	18.4	5.9	0	5.6	5.6		10	8.1	8.4
	11	10.7	10.7		3.7	3.7		8.2	8.2	
	12	9	9		13.7	13.7		4.9	4.9	
	13	23	10.3	0	13.8	13.8		11.2	11.2	
	14	11.1	11.1		4.3	4.3		0	0	
	15	18.7	18.7		4.7	4.7		9.4	9.4	
3	1				21.6	24	0	0	0	
	2	3.5	1.8	0.5	3.1	3.6	6	2.6	2.7	4.3
	3	1.2	1.5	1.8	6	6.2	13.2	3.1	3.1	3.7
	4	2.9	3.7	2.6	1.9	2.3	1.9	3.7	5.1	2.5
	5	7	2.6	11.8	12.8	8.9	23.5	4	6.4	2.5
	6	2.6	2.4	0	7.5	3.9	0.9	6.9	5.1	7.4
	7	5.2	5.2		6.3	6.3		4.7	4.7	
	8	24.2	10.5	11.2	11	11		6.7	6.7	
	9	8.7	10.1	0	3.5	3.5		13.1	13.1	
	10	3.9	3.9		44	5.6	0	9.8	9.8	
	11	13.1	13.1		9	9		35.5	10.3	0
	12	2.4	2.4		22.5	22.5		6.9	6.9	
	13	20.8	20.8		4.4	4.4		11.3	11.3	
	14	0	0		40.3	40.3				
	15	10.8	10.8		0.7	0.7		15.4	15.4	
4	1	0	0	0	2.8	3.2	7.6	3.2	3.8	3.7
	2	2.6	3.8	2.2	2.3	3.3	2.9	3.1	3.3	3.3
	3	1.5	1.9	1.7	2.8	4.3	2.1	2.1	2.9	1.4
	4	4.4	4.8	3.5	1.5	3.1	1.5	2.6	4.2	2.8
	5	4.1	3.8	4	7.1	4.9	8.9	3.1	4	2.7
	6	10.8	6.5	9.6	6.6	4.9	5.1	6.6	2.8	22
	7	11.1	6.6	0	2.1	2.1		10	6.3	3
	8	18.8	10.6	13.6	5.6	5.6		7.5	7.5	
	9	7	7		13.1	13.1		6.1	6.1	
	10	32.6	17.4	6.5	14.6	14.6		20.8	20.8	
	11	14.1	14.1		13.7	13.7		6.6	6.6	
	12	12.2	12.2		0	0		11	11	
	13	1.4	1.4		46.2	46.2		0	0	
	14	19.5	19.5		45.2	9.1	0	20.7	20.7	
	15	6.6	6.6		19.3	19.3		46.5	11.2	0
all	1	0	0	0	3.7	5.1	6.1	3.2	4	3.7
	2	2.2	3.1	2.6	2.1	2.4	2.4	1.9	2	2.4
	3	0.8	1	1.1	2.8	3.1	5.3	1.5	1.7	1.7
	4	1.5	1.8	1.3	0.9	1.4	1.1	1.5	2.2	1.5
	5	2.1	1.7	1.7	2.4	2.7	3	1.2	1.8	1.3
	6	3.4	3.1	3.2	4	3.4	4.4	3.5	3.7	4
	7	3.3	3.4	4.7	4.9	4	8	3.6	2.9	6.1
	8	5.5	6.7	5.6	7	3.9	4.9	8.4	5.5	20.5
	9	5.8	3.2	4.7	4.9	5.1	0	4.9	4.7	1.7
	10	11.7	4.8	8.2	11.8	6.9	8.8	5.6	5.8	8.4
	11	9.1	6	0	7.5	7.5		12.1	8.8	2.3
	12	7	6.2	13.7	6.6	6.6		16.4	5.1	7.1
	13	13.1	10.4	0	14.8	14.8		11.9	11.9	
	14	15.9	9	15	13.6	12.2	0	12.5	12.5	
	15	7.1	7.1		8.4	8.4		12.8	6	6.3

Table 7. Sole 1991-2001. CVs of numbers-at-age, per sex and per quarter. com = sexes combined.

cv_num		year	sex																
		1991			1992			1993			1994			1995			1996		
quarter	age	com	F	M	com	F	M	com	F	M	com	F	M	com	F	M	com	F	M
1	1																48.3	48.3	
	2	49.7		49.7	32.2	49.1	38.4	44.4	67.3	34.7				36.1	36.6	53.1	17	15	29
	3	9.2	13.8	27.5	9.6	8.9	19.7	16.1	23.7	25.4	5.4	5.4	30.5	9.3	13.2	22	18.1	16.3	45
	4	2.6	3.8	6.5	11.4	9.8	20.3	8.6	11.8	14.3	19	20.1	43	2.4	3	8.5	19.4	16.7	24.4
	5	12.2	13.6	19.9	6.7	5.7	9.8	20.1	20.4	23.4	12.4	7.6	18.6	24.2	35.7	32	16.3	15.5	20.1
	6	15.3	14.5	46.7	24.2	32.1	44.7	6.5	8.9	7.8	22.6	27.3	23.5	12.5	14.2	21.6	19.6	22.7	31.8
	7	24.4	24.9	49	19.2	21.8	28.8	21.4	36.6	32.1	10.3	7.9	12.5	23.3	25.8	40.1	18.3	23.9	25.4
	8	50	42	51.1	31.6	29.5	45.1	32.4	28.1	48.6	32.9	38.7	52.9	13.2	12.7	18.3	21.7	25.3	38.6
	9	55.9	29.1	50.6	51.2	51.2		35	32.7	52.8	29.2	22.9	50.1	56.3	38.7	53.3	16.4	16.4	22.8
	10	42.7	42.7		24.2	24.2		45	51.6	48.1	45.8	42.4	54.6	39.6	39.6		44	44	
	11	63.2	40.9	51.1	42.1	42.1		22.4	24.7	48.1	47.4	47.4		41.5	41.5		39.1	39.1	
	12	37.9	37.9		60.6	60.6		48.9	48.9		41.4	41.4		47.9	47.9		54.5	37.3	51.1
	13	50.8	50.8		49.8	49.8		49.1	49.1		42.7	42.7		50.5	50.5		64.1	64.1	
	14							50	50		63.8	50.7	53.3	48.6	48.6		52.2	52.2	
	15	49.4		49.4	64.2	51.4	49.2	52.2	48.1	49.3	48	51.5	48.7	52.2	52.2		41.8	41.8	
2	1																45.3	45.3	
	2	40.4	55.3	48.6	40.7	42.5	41.7	30.9	35	33.5				32	49.9	45.1	29.8	30.7	41.5
	3	17.2	18.6	25.8	8.7	10.1	20.5	17.5	24.1	18.1	6.9	8.2	27.2	16.4	19.6	28.2	13.5	17.4	22.3
	4	4.4	4.4	8.3	16.8	19.5	21.1	7.5	8.3	13.2	32.7	35.3	52.2	4.9	4.3	11.1	10.7	15.9	16.9
	5	17.2	21	22.8	6.6	6.8	12.8	17.2	19	19.8	21.2	17	29.5	36.2	53.7	39.5	7.1	6.9	10.7
	6	22.4	25	32.9	24	26.1	41.9	7.3	7	10.1	27.3	18.9	46.7	17.1	16.1	23.8	22.7	38	29.9
	7	43	50.5	51.6	32.5	27	43.8	33.5	31.4	45.5	12.5	13.2	24.5	37.1	38.3	56.5	15.1	17.8	18
	8	46.1	36.1	43.5	57.5	57.5		22.4	23.1	41.1	54.4	51.4	62.1	13.3	16.3	18.8	40.1	45.4	47.2
	9	37.7	46.2	56.1	47	46.6	56.8	49.2	64.1	53.5	22.6	30.3	50.2	51.2	65.2	52.1	16.7	16.7	22.6
	10	44.8	28.5	64.1	39.3	35.7	60.1	49.4	49.4		79	49.7	42.9	44.9	39.1	67.6	52.3	40.4	57.8
	11	37.9	37.9		55.7	68.1	51	39.1	24.3	71.5	63.5	49.2	39.1	44.4	44.4		37.8	38.6	48.9
	12	47	38.1	53.1	52.8	48.3	52.6	66.5	48.8	53	49.3	39.9	55.2	44	44		74.5	51.3	41.3
	13				57.1	46.9	69.5	53.8	53.8		45.8	45.8		35.4	32.3	72.4	41.3	41.3	
	14	51	48.5	45.2	44.8		44.8	41.1	37.8	73	39.6	39.6					58.9	58.8	53.4
	15	36.7	33.3	55	66.4	53	79.2	56.4	56.4		67.7	47.6	42.1	46.8	42	57.5	53.8	61	68.2
3	1				50.2		50.2							55.1	52	67.2			
	2	19.7	23	35.2	21.3	27	33.1	10.8	11.3	32	29.8	31.4	50.9	18.9	20.5	23.9	22.4	23.4	32.3
	3	10.1	11	20.2	6.8	11.1	23	14.8	18.8	20.2	4.1	7.7	18.2	14.8	14.6	29.7	10.5	10.7	19.1
	4	4.8	5.7	12.4	19.9	17.6	28.7	13.9	12.7	31.3	31.6	36.4	48.7	5.9	7.5	10	17.9	19.2	25.8
	5	27.5	25.7	52.5	9.5	7.3	21.7	25.1	18.9	35.2	15.5	17.7	30.2	29.3	23.7	49.5	16.5	11.9	24.7
	6	22.1	22.4	61.3	22.2	26.3	48.2	16.2	8.6	30.4	36.1	21.7	43.1	20.4	16.5	31.2	29.3	40.3	38.2
	7	52.3	56.3	46.1	29.7	24.5	53.2	28.7	28.7		19.1	14.1	34.2	30.2	33.9	45.9	17.5	19.8	23.4
	8	42.7	28.6	74.4	50.1	50.1		22	33	33.1	26.9	26.9		21.1	18.3	27.1	47.6	47.4	52.4
	9	37.3	43.2	49.1	54.3	24.1	53	58.3	73.5	51.6	28.4	34.9	50.2	70.7	70.7		24	18.9	27.4
	10	73.1	29.9	48.6	44.7	30.7	49.5	44.6	44.6		44.1	44.1		49.9	29.5	52.4	64.9	45.2	49.5
	11	57.2	32.2	79.8	61	42.5	51.9	38.8	28.5	57.5	47.6	47.6		50.6	50.6		41.4	41.4	
	12	37.5	67.1	50.7	47.9	53.5	48.4	35.3	35.3		46.6	47.1	52.5				73.9	50.3	74.7
	13				53.6	53.6		50.7	50.7		38.3	38.3		52.3	50.6	55.6			
	14							43.4	43.4		51.7	51.7		51.5	51.5		31.1	35.7	50.8
	15	44.2	44.2		41.9	43.9	52.2	46.6	53.2	54.2	34.8	34.4	54.4	47.2	44.5	56.2	27.7	36	53
4	1	50.6	50.6		55.2	51.3	48.9				37.7	44.5	51.4	30.9	33.1	42.6	52.6	49.8	50.7
	2	20.1	19.8	41.2	20.3	20.4	29.3	5.3	5.2	32.5	15	13.9	40.2	9.7	12.8	24.9	8.6	9.9	15
	3	13.1	18.9	18.2	7.2	8.7	10.7	16.5	18.3	29.7	4.9	4.9	11	13.2	13.7	22.3	14.6	21.3	16.3
	4	8.9	9.6	14.5	15.1	14.7	20.8	14.9	9.5	25.3	34.7	38.8	38.1	10.5	8.8	13.5	15.6	16.5	33.9
	5	29.3	20.4	43	9.7	11.2	10.5	20.6	14.6	28.2	13.3	19.5	22.1	39.5	60.2	35	17.3	8.7	25.4
	6	23.9	24.9	50.3	28.1	34.6	41.4	17.5	12.9	22.5	24.3	23	52.8	15.4	20.4	23.9	42.9	29.3	56.1
	7	28	34.4	42.3	30.7	25.7	50.7	62	34.5	72.3	16.7	20.6	24.2	45.6	57.6	49.9	28.4	26.3	48
	8	46	46		39.3	45.2	49.6	33.9	27.8	61.2	35.8	35.8		24.2	17.8	32.4			
	9	31.1	31.1		48.1	42.7	51.4	22.5	22.5		37.8	37.8		63.6	63.6		25.5	18.3	35.4
	10	43.3	43.3		46	38.1	49.4	53.9	53.9		36.4	36.4		50.3	59.2	53.4	65	64.5	52
	11	31.3	31.3					49.7	49.7		51.4	51.4		46.4	46.4		75.3	56.6	52.4
	12	57.7	45.9	50.7	67.5	50.3	50.8	50.6	50.6		68.4	68.4		67.2	52.2	50.3	66.4	50.3	50.5
	13				63.7	63.7		63.5	63.5		49.7	49.7		53.4	53.4				
	14	51.4	51.4		51.7	51.7		38	43	52.1	47.9	47.9		52.3	52.3		48.6	48.6	
	15	50.6		50.6	49.4	52.8	49.5	50.5	50.5		41.3	41.3		56.4	39.7	54.1	45.2	54.6	65.5
all	1	50.6	50.6		52.6	51.3	53.9				37.7	44.5	51.4	28.5	30.7	38	47.8	51.8	50.7
	2	13.4	14.7	24.3	13.6	15.5	19	4.9	5	20.9	13.4	12.8	33.8	8.9	10.8	15.8	8.1	8.5	12.9
	3	6	7.8	11.8	4	5.3	9.2	8.9	11.3	12.5	2.7	3.5	9.1	6.9	7.9	12.3	7	8.1	11.4
	4	2.3	2.5	5	7.8	7.5	11.9	5.5	5.4	10.6	14.5	16.7	23.7	3.1	2.8	5.8	10.6	9.7	14.5
	5	9.8	9.2	15.6	4.1	3.6	6.6	10.5	9.5	13.6	8	8	11.9	18.3	24.2	20.4	7.4	6.2	10.6
	6	10.3	10.5	25.5	12.4	15.5	22.7	5.3	4.5	7.4	15.9	13	21.6	8.4	8.5	13.1	13.1	16.6	18.7
	7	18	18.8	37	13.7	12.2	22.1	20.6	21	30.1	7.1	6.5	10	15.9	18.2	27.1	9.9	11.5	13.5
	8	27.3	23.3	56.6	23.9	28.6	41.2	13.8	14.4	23.9	28.6	19.6	53.7	8.7	8.1	12	19.5	20.3	30.7
	9	29.4	21.1	63.8	27.7	23.3	41.8	22.8	23.9	42.7	14.5	15.6	31.5	36.2	36.4	55	9.9	9.9	13.1
	10	33.7	19.6	57.6	26.4	18.8	40	31.9	34.6	48.1	33.8	23.4	53.4	27	25.9	50.6	28.9	30.5	52.3
	11	34.1	20.2	63.2	33.6	32.7	51.3	22.6	14.7	49.8	39	33.5	39.1	29.2	29.2		23.8	22.3	44.3
	12	22.8	28.9	37.8	39.2	54.8	48.6	46.3	28.2	53	30.2	39.7	43.2	63	49.5	50.3	35	29.7	48.7
	13	50.8	50.8		40.8	45.2	69.5	38	38		27.7	27.7		28.9	27.4	77.4	66.2	66.2	
	14	49.3	52.3	45.2	54.1	51.7	44.8	26.1	24.8	67.5	52.6	42.7	53.3	50.1	50.1		41.5	38	70.9
	15	45.9	27.3	70.2	34.7	27.5	45.7	33.8	38.6	57.6	29.8	22.9	53.9	33.6	25.8	44.3	26.9	30.5	54.8

Table 7 continued.

															cv_num	
1997			1998			1999			2000			2001				
com	F	M	com	F	M	com	F	M	com	F	M	com	F	M	quarter	age
															1	1
47.5	47.5		16.3	17.5	35.8	52.6	57.3	51.6	32.9	37.7	49.1	37.3	34.8	48.4		2
10.9	9.3	22.2	13.1	16.1	23.5	3.3	3.3	10.9	7.7	9.1	18.3	7.9	8.2	26.6		3
13.4	19.4	16.6	8.5	7	13.3	25.3	24.6	46.6	5	4.6	12	5.7	4.4	12.4		4
16.2	15.6	26.2	16	19	23.5	17.1	18.3	29.7	23.2	25.6	32.4	7.8	8.6	13.3		5
8.1	6.5	13.3	24.3	21.3	37.7	39.6	29.3	66.4	25.8	27.7	53.8	39.8	34.9	60.5		6
55.7	44	51.6	12.1	10.7	16	49	31.4	49.9	42.4	42.5	54.9	27.7	25.5	45.1		7
15.8	16.5	20.8	31.4	34.5	48.3	19.7	13.3	36	44	28.3	52.8	60.1	28.7	54.1		8
68.9	42	51.4	33.5	30.1	51.7	51.1	51.1		29.5	20	43.4	69.3	27	48.4		9
14.8	14.9	22.4	38	38		32.9	28.1	52.8	91.8	46.2	50.8	27.8	26.8	52.9		10
			25.8	18.2	41.6	58.7	58.7		50.8	47.1	55.4	45.6	45.6			11
45.9	45.9					20.3	21	51	47.7	47.7		69	69			12
50	50		49.7	46.5	50.2	52.3	52.3		40.6	51.1	53.6					13
52.9		52.9				73	52.5	49.2				29.4	29.4			14
40	40		49.5	49.5		56.3	48.9	60.4	59.4	59.4		85.4	49.1	48.3		15
															2	1
33.4	36.3	45.8	16.2	17.4	32.7	32.9	32.9		19.3	18.9	48	32.6	34.9	48.4		2
8.5	10.3	17.8	13.2	19.3	24.3	5	7.5	18.5	8.8	8.2	22.1	13.3	15.4	26.1		3
17.2	22.3	26.3	9.2	9.5	19.7	23.3	26.8	33.1	6.1	6.5	15.7	11.3	8.3	24		4
15	15.5	29	17.5	24	30.6	17.1	16.6	26.4	25.9	26.6	38.8	11.5	6.2	19.3		5
13	6.8	21.5	31.1	28	59.1	32	34.2	56.8	17.8	20.7	29.5	30.4	27.6	48.1		6
34.1	43.2	57.4	14.8	10.6	25.5	38.1	33.5	64.2	54.2	61.3	50	27.6	30.1	37.5		7
19.7	23.1	27.3	43	48.3	50.8	20.6	31.3	32.1	73.8	18.2	43.2	46.1	50.3	49.7		8
68.5	60	69.6	25.3	34.8	35.5	61.9	61.9		27.7	28.9	40.6	40.9	45.5	52.7		9
24.7	16.4	36.3	45.8	45.8		44.3	46.4	42.6	53.1	53.1		25.2	19.7	47.4		10
50.9	50.9		26	22.7	45.7	52.4	52.4		64.8	66.9	49.4	49.4	49.4			11
35.5	35.5		47.5		47.5	43.9	22.2	62.9	89.6	50.7	71	40.1	45	48.5		12
61.6	61.6		42.4	43.2	48	45.2	45.2		66.4	39.5	42.8	62.1	62.1			13
44.5	44.5		66.5	46.9	48	50.5	50.5		43.3	43.3		72.5	46.6	45.9		14
42.1	48.9	66.9	62.8	52.3	48	51.4	50.8	58.4	68	49.4	42.8	46.8	46.8			15
53.5	53.5		53.6		53.6				55	55		54		54	3	1
18.1	14.5	29	6.1	6.5	20.8	17.2	18.1	43.1	12.1	12.6	27.3	16	16.5	22.4		2
7.1	10.1	14.4	20.8	22.9	38	6.3	5.4	20.1	10	8.8	21.4	16.1	20.1	21.2		3
20.4	23.2	30.6	16.5	13.4	31.9	33.5	38.2	34.6	11.6	11.2	17.4	15.3	14.3	21		4
21.8	23.3	38.5	33.6	25.6	46.1	20.1	20.8	39.3	35.2	37.5	50.1	17.4	13.1	25		5
10.9	10.4	16.6	44.3	25.7	54.8	46.4	49.9	48.2	25	20.6	38.4	50.5	39.6	48.8		6
37.6	37.1	56.9	29.1	15.2	41.9	40	44.1	51.5	43.7	40.9	52	37.2	37.2			7
30.4	25.4	37	67.8	35.4	75.1	30.1	21.4	49.9	43	75.6	49.9	32.9	32.9			8
71	71		34.1	50.5	41.1	71.2	71.2		43.2	45.5	50.7					9
23.1	21	41.2	49.4	49.4		55	47.1	52.6	79.1	76.5	49	43.1	23.4	52.2		10
49.1	49.1		33	29.9	42				39.2	39.2		47.1	47.1			11
37.5	32.8	50.3				66.3	24.2	51.2	46.6	46.6		59.4	59.4			12
52.4	52.4		46.6	46.6					48.4	51	50					13
51.7	51.7					50.3	50.3					69.4	36.6	53.2		14
38.5	50.1	53	51.3	51.3		48.1	50.6	52	58.3	58.3						15
22.2	24.7	41	61.4	61.4		38.2	38.2		47.7	49.4	52.3	30.8	28.8	52.7	4	1
17.4	20.6	24.4	3.5	3.8	10.4	7.3	7.6	32.3	10.1	13.2	18.6	11.5	11.7	25.3		2
7.1	8.2	11.3	33.8	41.3	41.8	5.1	6.8	13.3	6.7	7.1	12.9	9.9	17.7	16.7		3
21.6	29.7	32.3	17.8	17.8	36.8	29.6	38.1	48.3	9	6.1	13.3	20.1	12.9	29.5		4
21	24.3	34.6	60.5	51.7	52.3	21.9	22.1	41	33.2	39.3	52.8	21.2	12.9	29.7		5
13.4	20.8	12.4	55.9	25.6	50.3	53	41.4	49.5	21.7	34	32.4	42.8	42.8			6
43.3	41.6	51.1	20.8	8.7	54.4	39.6	39.6		74.6	35.3	51.1	38	38			7
23.9	36.6	25.6	64.6	64.6		34.8	26.8	45.6	41.9	41.9		56.3	56.3			8
57	57		33.3	21.7	50.2	57.2	86.4	50.7	51.1	15.6	52.6	50.4	50.4			9
24.9	24.7	31.1				66.4	50.5	67	32.3	32.3		54.6	36.8	54.3		10
			47.3	33.8	50.3				58.5	58.5						11
49.4	49.4		50.1	50.1		29.8	29.4	50.8				42.2	42.2			12
			59.9	59.9					28.2	28.2						13
						49.5	49.5					51.4	51.4	51.4		14
			53.5	53.5		51	51					51.6		51.6		15
21.9	24.3	41	52.2	61.4	53.6	38.2	38.2		39.6	40.6	52.3	29.1	28.8	55	all	1
11.9	13	18.1	3.1	3.5	8.8	7.9	8.3	26	7.4	8.3	15.4	9	9.1	15.8		2
4.2	4.7	7.9	10.8	13	16	2.4	2.9	7.4	4.1	4.3	9	6.8	8.9	10.9		3
8.4	11.3	12.3	6.5	6	12.7	14.9	16.8	20	3.7	3.5	7	6.4	5	10.5		4
9.7	9.7	16.6	12.9	13.5	20.1	9.6	9.6	16.9	13.7	15.3	21.7	7.5	5.5	11.5		5
5.3	4.8	7.8	19.6	13.3	30.1	23.5	23.8	33.8	11.1	13.1	18.3	21.3	17.5	43		6
22.1	22.2	36.6	8.9	5.7	14	22.8	21.1	41.5	27.4	29	34.8	17.1	17.1	29.2		7
10.6	11.9	13.7	45.3	23	74.1	12.2	13.5	20	25.5	21.8	40	32.6	35.7	56.3		8
38.3	31.9	59.2	16.1	18.2	24.8	38.2	44.4	50.7	17.8	15.4	29.6	37.7	31.6	58.7		9
10.9	10.1	16.1	33.5	33.5		39.7	23.8	50.2	65.6	57.3	63.6	23	13.3	35.7		10
44.8	44.8		15.3	12.2	24.1	55.8	55.8		34.7	35.1	62.6	33.9	33.9			11
21.7	21	50.3	74.8	50.1	47.5	26.1	12.2	50.9	87.1	50.9	71	33.2	34.1	48.5		12
49.9	49.9		27.2	28.4	53.6	57	57		30.7	26.6	56.3	62.1	62.1			13
75.2	52.2	52.9	66.5	46.9	48	47.1	33.3	49.2	43.3	43.3		41.1	20.3	66.4		14
26.2	29.1	67.3	35.8	30	48	32.1	34.2	47.9	46.3	39.4	42.8	60.7	36.8	66.2		15

Table 8. Sole 1991-2001; CVs of weights-at-age, per sex and per quarter. com = sexes combined.

cv_wgt		year	sex																
		1991			1992			1993			1994			1995			1996		
quarter	age	com	F	M	com	F	M	com	F	M	com	F	M	com	F	M	com	F	M
1	1																0	0	
	2	0		0	6.5	12.3	6.3	4.2	3.9	6.5				7.8	8.8	2.4	4.5	5.5	4.2
	3	3	3.2	6.4	1.6	2.4	2.9	6	7.1	5.3	2	2.4	6.7	2.9	3.4	3	4.9	5.5	17
	4	1.1	1.5	2.9	4.4	3.6	2	2	3.7	2.8	5.4	5	4.4	1.4	1.7	1.7	2.3	3.6	2.1
	5	6.3	4.1	5.6	2.5	1.8	3.1	4	4.6	2.6	4.2	4.6	2	8.9	7.3	6.7	3.8	3.4	3.8
	6	7.6	2.5	12.4	10.6	10.5	6.7	2.4	2.9	2.2	5.9	5.3	5.2	5.7	3.9	6.1	8.6	8.2	8.4
	7	13.1	3	0	6.9	7.4	3.8	12.5	5.9	7.8	3.5	2.4	2.4	12.6	5.6	10.3	10.2	15.3	6.7
	8	15.3	12.7	0	18.9	9.8	22.2	12.2	6.4	17.1	18.5	12.5	6.1	5.8	4.1	5.7	12.3	7.9	7.6
	9	29	5.7	0.4	21.4	21.4		9.7	4.7	10.4	14.1	10.7	9.3	54.4	13.2	2.8	7.2	3.9	4.2
	10	9.3	9.3		8.7	8.7		8	8.9	0	34.8	13.9	13.1	11.1	11.1		10.4	10.4	
	11	7.5	7.1	0	7.3	7.3		9.8	9.6	0	7.2	7.2		7.3	7.3		19.4	19.4	
	12	7.9	7.9		23.6	23.6		0	0		7.5	7.5		0	0		10.8	13.1	0
	13	23	23		0	0		9.4	9.4		9.7	9.7		0	0		11.7	11.7	
	14							0	0		40.2	0	0	0	0		11.7	11.7	
	15	0		0	26.5	11.7	0	18.1	0	0	28.2	13.2	0	11.5	11.5		7.7	7.7	
2	1																0	0	
	2	33.2	82.4	11	8.7	8.5	0	2.6	1.7	9.9				6	7.9	4.1	4.5	5.3	4.5
	3	3.7	3.9	4.6	1.9	3.4	3	3.9	3.5	4.2	2.2	2.2	3	4.2	4.7	5.4	3.5	4.8	4.7
	4	1.9	2	2	3.8	3.8	5.1	2.7	3.1	3.5	8	9.1	15.1	2	1.8	2.4	4.8	6.2	4.1
	5	5.1	6.4	4.9	2.8	2.6	3	3.6	3.6	3.9	5.1	3.5	6.2	7.1	11.7	7.7	2.4	2.5	3.5
	6	5.5	4.4	10.7	8.8	6.3	15.3	3	2.7	3.1	9.5	4.2	9.2	6.1	4.5	5.4	10.7	5.4	3.5
	7	22.8	11.6	6.8	7.4	5.6	5.7	16.8	9.8	8.2	5.1	6.5	4.5	14.6	10.6	5	5.8	4.7	5.7
	8	15.3	9.7	0	21	21		7.7	7.5	6	23	20.8	10.2	4.8	5.8	4.5	20.8	10.1	14.2
	9	11.5	16.3	5.6	21.3	13.7	7.8	14.5	16.5	10.1	7.9	5.4	7.8	17	17.7	12.1	5.5	4.4	4.1
	10	18.2	6.7	14.4	15.9	12.4	20.5	18.9	18.9		39	13.3	0	20.3	11.4	18.2	28.8	6.8	30.5
	11	11.9	11.9		23.9	16.2	12.6	20.4	5.6	33.9	32.4	11	0	0	0		22.3	8.3	9.3
	12	19.4	12	8	32.7	17	14	30.9	8.3	5.5	17.8	7.9	7.3	0	0		50.3	20.8	0
	13				22.6	10.9	37.5	23.6	23.6		0	0		11	6.3	6.5	0	0	
	14	33.7	23.8	0	0		0	10.2	8.6	5.7	0	0					26.2	22.9	1.5
	15	12.3	14.4	13.8	29.2	18.6	29.1	14.1	14.1		32.9	9.7	0	9.2	5.3	20.5	20.5	18.8	10.3
3	1				0		0							1.3	0.7	0.5			
	2	4.1	4.3	2.5	2.7	2.4	5.3	1.7	1.8	3.7	5.3	6	11.8	6.9	7.9	5	2.1	2.7	4.7
	3	3	3.1	3.7	2.6	2.7	4.3	3.8	3.8	4.5	2	2.6	2.6	4.5	4.9	2.6	5.2	4.7	5.1
	4	2.8	1.8	3	5.3	4.8	4	5.5	3.4	4.3	4.4	6.1	8.8	1.8	2.7	1.8	5.5	3.7	3.6
	5	11	5.9	16	3.5	3	2.3	13.5	13.3	6.5	4	4.6	6.4	7.3	6.3	5.9	5.4	4	3.2
	6	11.1	4.1	34.6	6.8	6.8	5.3	7.7	2.5	6.5	8.8	4.1	6.9	12.1	14.6	4.9	9.6	13.1	7.7
	7	9.4	8.7	0	9.5	7.5	17.7	4.2	4.2		8	3.5	7.7	14.6	6.3	7.3	8	3	4.8
	8	16.3	11.8	15.7	6.1	6.1		9	5.1	8.5	12	12		6.2	3.9	5.6	19.1	21.2	18.7
	9	8.7	6.7	0	23.3	7.3	0	17.6	8.4	0	7.2	13.1	14.7	3.3	3.3		9.9	4.6	8.4
	10	31	6.7	0	14.9	3.8	0	13.6	13.6		16.4	16.4		18.9	7.7	0	24.6	3.5	0
	11	22	10.1	6.3	21.2	9.1	0	13.8	9.7	27.7	0	0		0	0		12.1	12.1	
	12	8.9	24.5	4.4	15.7	12.1	0	10.4	10.4		28.3	4.1	22.4				32	0	10.5
	13				5.4	5.4		1.2	1.2		7.3	7.3		16.1	0	0			
	14							5.3	5.3		4.9	4.9		0	0		8.1	5.5	0
	15	15.9	15.9		7.7	8.3	15.6	16.2	23.5	0	11.9	9	16.3	5.8	4	0.3	8	6.4	12.9
4	1	8.7	8.7		2.8	2.6	0				4.5	2.7	0	2.3	2.3	3.5	22.5	0	0
	2	3.2	3.4	7.7	6.9	8.2	5.3	2	2.1	4.2	3.7	3.5	6.7	5.6	5.1	9.6	1.5	1.9	3
	3	3	2.8	4.6	2.6	3.8	2.3	3.4	4.2	3.8	2.1	2.9	3.1	3.9	4.4	3.7	3.2	4.8	4.8
	4	2.1	2	2	5.1	4.9	4.5	4.9	3.9	2.7	6.5	7.7	9.5	3	2.8	2.5	4.4	3.4	7.4
	5	12.7	7.3	7.7	2.2	2.2	1.9	6.7	4.1	5.3	4.8	5.6	6.4	5.9	12	4.3	5.3	3.3	2.2
	6	11	6.9	9.1	9.9	8.7	5.6	5.9	4.1	4	10	4	11.7	7.8	4.6	4.1	14.6	11.7	7.6
	7	15.3	3.5	5.7	11.5	7.2	12.5	40.5	12.9	39.9	6.9	7.2	6	22.4	23.8	0	14	8.4	13.1
	8	5.6	5.6		18.8	8.4	0	19.8	6.4	20.7	9.7	9.7		11.4	5.1	8.2			
	9	6.8	6.8		28.2	6.8	12.4	3.7	3.7		9.7	9.7		11.5	11.5		9.9	6.5	8.4
	10	18.8	18.8		18.2	7.9	15	10.2	10.2		5.9	5.9		23.5	31.2	0	42.2	5.5	0
	11	14.3	14.3					1.8	1.8		0	0		9.2	9.2		29.2	5.7	0
	12	32.9	5.6	0	41.7	0	0	3	3		41.2	41.2		30.3	0	0	27.5	8.7	0
	13				15.9	15.9		21.5	21.5		0	0		0	0				
	14	0	0		0	0		22.3	16.9	0	0	0		0	0		0	0	
	15	0		0	2.8	3.9	8.6	22.1	22.1		4.4	4.4		35.4	17.7	22.1	20.9	32.4	8.9
all	1	8.7	8.7		2.6	2.6	2.2				4.5	2.7	0	2.1	2.1	2.6	17	19.4	0
	2	3.1	3.1	4.7	4.4	5.4	3.3	1.4	1.5	2.4	3.1	2.9	5.9	4.1	4.3	4.9	1.5	1.7	2.2
	3	1.8	1.8	2.4	1.2	1.6	1.7	2.1	2.3	2.5	1	1.3	1.9	2.1	2.5	1.9	2.3	2.5	3.7
	4	1	0.9	1.3	2.5	2.3	2	1.9	1.8	1.6	2.9	3.5	4	1	1.1	1	2.1	3.1	1.7
	5	4.1	3.1	3.1	1.4	1.3	1.3	3.1	3.2	2	2.3	2.4	2.5	3.5	4.5	3	2.1	1.7	1.8
	6	4.1	2.1	6.8	4.4	4.1	4.5	2	1.5	1.7	4.5	2.4	3.6	4.1	4.3	2.3	5.3	5.8	3.5
	7	8	3.2	9.1	4.2	3.5	4.2	10.2	4.5	6.2	2.6	2.6	2.1	7.1	5.6	4.6	4.7	5.5	3.5
	8	8.5	6.5	10.1	11.7	6.8	20.3	6.1	3.5	6.3	13.2	7.6	8	3.4	2.7	2.9	10.4	7.9	7.4
	9	13.1	6.9	16.9	11.7	7.2	7.5	5.8	5	8	5.6	5.1	6.2	18.7	13.1	18.1	3.9	2.4	3
	10	16	4.2	12.1	9.6	5.9	11.1	6.4	6.6	0	21.6	7.6	10.6	11.9	11.3	12.4	18.1	7.5	17.4
	11	9.8	5.1	12.4	15.5	10.3	8.6	10.8	5.5	24.4	19.9	5.6	0	6.3	6.3		12.1	9.5	7.1
	12	8.9	11.9	4.3	15.1	27.1	13.3	16	5.8	5.5	12.8	19.3	14.5	24	14.1	0	15.3	10.8	8.4
	13	23	23		11.8	9.6	37.5	14.9	14.9		6.4	6.4		12.5	9.6	5.4	19.4	19.4	
	14	24.1	19	0	10.9	0	0	9.4	7.7	8.9	25.1	14.7	0	4	4		14.3	11.6	1.5
	15	15.6	10.9	14	11.8	4.7	10.5	11.8	11.3	15.8	14.2	5.9	20.5	13.6	6.5	15.8	10.7	12.2	8.8

Table 8 continued.

															cv_wgt	
1997			1998			1999			2000			2001				
com.	F	M	com.	F	M	com.	F	M	com.	F	M	com.	F	M	quarter	age
															1	1
6.6	6.6		2.6	2.4	9.4	0.7	0.4	0	7.4	9.2	0	5.1	6.4	6.3		2
2.7	4	2.9	4	4.1	3.2	1.1	1.3	1.7	2.2	2.7	2.5	3.2	2.8	6.2		3
3	5.1	4	2.8	2.8	3	6.4	5.3	8.9	2.2	2.4	2.2	2.6	3.3	2.1		4
5.1	4.3	2.7	6.4	7.9	4.6	4.9	8.2	3	5	5.8	3.5	1.8	2.7	2.1		5
3.4	3.5	2.7	9.1	6.5	5.3	12.6	5.3	1.5	15.5	5.9	13	12.9	7.1	9.5		6
15	9	0	5	3.4	3.3	33.4	8.7	1.3	15.5	12.1	17	14	4.6	15.3		7
7.4	4.6	3.5	18	15.6	0	11.1	5.1	11.3	22.7	8.7	1.9	49	5.2	15.1		8
46.8	6	0	23.7	4.5	14.5	0	0		14.1	5.3	9.4	35.5	6.2	0.1		9
7.1	5.2	4.4	13	13		16	4.5	10.3	63.9	4.2	0.7	13.4	8.4	9.7		10
			14.1	3.9	10.9	7.9	7.9		31.5	3.5	6.7	4.4	4.4			11
23.9	23.9					9.4	5.1	8.6	0	0		17.3	17.3			12
0	0		21.1	4.7	0	0	0		17.7	22.5	5.2					13
0		0				68.9	19	0				6.5	6.5			14
10.2	10.2		19	19		36.4	0	11.5	3.9	3.9		75.4	3.2	0		15
															2	1
6.3	6.6	0	1.6	1.7	3.1	6.3	6.3		3.1	3.4	2.5	3.6	3.8	0		2
2.2	2.8	3.5	2.4	3.4	2.9	2	1.6	3.6	2.6	2.6	3.3	2.4	2.3	4		3
5.4	7.3	5.9	3	3.3	1.7	3.7	4.6	4.6	2.5	2.2	2.6	2.5	3.4	2.6		4
6.9	7.3	6.9	4.4	6.1	5.7	5.5	6.7	5.3	7.5	7.7	5.8	3	3.3	3.7		5
4.7	2.5	3.5	12.1	7.2	10.2	14.5	14	21.4	7.1	6.6	6.2	7	5.3	6.3		6
11	9.1	13.3	6.7	3.7	5.4	16.8	9.4	20.1	24.7	21.6	23.2	12.4	5.9	13.6		7
7.2	6.8	4.7	13.9	15.4	14.2	8.1	16.4	5	37.8	4.9	0	17.4	19.6	0		8
23.3	21.2	21.7	11.9	8.2	7.7	18.1	18.1		9.2	7.5	9.4	16	16.2	10.2		9
12.5	4.8	9.1	0	0		12.5	13.5	0	10.6	10.6		12	3.9	0		10
6.5	6.5		13.4	9.8	10.4	23.4	23.4		32.5	36.3	12.4	8.7	8.7			11
4.3	4.3		0		0	15.3	8.3	14.1	46.5	14.1	35.7	16.5	17.2	0		12
30	30		20.5	14	0	0	0		19.6	13.7	0	15.1	15.1			13
0	0		36.8	0	0	10	10		0	0		32.3	10.7	0		14
13.4	14.2	9.1	28.5	23.9	0	11.3	5.8	25	16.3	19.9	0	14.3	14.3			15
0	0		0		0				2.1	2.1		0		0	3	1
3.1	4.1	3	1.9	2.2	2.8	4.5	4.9	6.5	4.4	4.7	4.6	2	2.7	2.5		2
1.7	2.5	2.9	3.5	3.4	5.6	4	4	2.6	4.5	4.7	2.7	3.2	4.2	3.6		3
6.1	7.3	6.3	5.2	3.6	5.8	4.1	5.9	7.2	3.2	3.2	3.5	4.8	4.2	3.8		4
9.3	7	9.1	12.6	8.8	12.3	5.6	5	13.9	6.9	7.3	0	6.3	5.9	3.6		5
4.7	4.1	3.3	14.2	5.2	11.9	15.8	13.3	23.1	13.4	7.5	13.6	19.1	17	0		6
17.8	8.9	16.5	11.7	5.6	7.4	8.7	6.3	0	23.3	13	0	8.2	8.2			7
13	8.1	5.9	34.3	13.2	21.7	8.1	5.1	1.9	18.5	20.3	16.7	6.7	6.7			8
35.8	35.8		7.6	14.4	7.2	26.1	26.1		13.6	10.1	0					9
12.2	6.2	10.6	1.4	1.4		22.5	10.8	3.3	28.2	14.2	0	18.3	4.9	12.3		10
21.9	21.9		10.4	6.2	4.5				12	12		0	0			11
17.3	11	0				34.9	7.1	0	0	0		14.2	14.2			12
0	0		8.1	8.1					2.9	3.3	0					13
5	5					7.8	7.8					38	4.9	0.1		14
6.9	6.3	7.6	13.5	13.5		18.2	13.6	0	15.3	15.3						15
2.4	2.7	2.4	27.5	27.5		10.1	10.1		0.8	1.6	0	3.4	3.7	0	4	1
3.2	3.5	2.6	1.4	1.5	1.7	1.6	2.2	5.5	2.6	2.4	2.3	2.5	3.3	5.3		2
2.5	3.5	1.5	5	9.9	5.9	1.9	2.4	2.1	2.8	3.2	2.4	2.9	4.2	2.2		3
8.5	4.7	7.4	5.8	6	6	7.2	8.3	9.9	2.3	1.7	1.8	5.3	2.5	2.2		4
8.5	9.5	8	37.4	5	0	9.7	4.9	9.1	13.5	8.9	21.9	5.4	4	4.5		5
3	8.9	3.1	30.2	6	0	29.1	6.1	0	14	15	9.3	13	13			6
28	13.5	2.2	9.8	4	9.6	12.3	12.3		48.5	8.4	0	11	11			7
8.4	13.3	6.7	7.4	7.4		16.1	11.2	12.1	5.5	5.5		13	13			8
10.2	10.2		20	4.6	0	37.5	56.8	0	25.9	2.4	0	0	0			9
11.4	4.7	3.2				29.5	11.3	23.1	13.6	13.6		24.8	12.2	1.1		10
			11	8.8	0				14.3	14.3						11
6.8	6.8		0	0		3.3	3.7	0				13.7	13.7			12
			16.5	16.5					11.2	11.2						13
						1.7	1.7					0	0	0		14
			0	0		24.6	24.6					0		0		15
2.3	2.6	2.4	24.7	27.5	0	10.1	10.1		0.7	1	0	3.2	3.7	1.5	all	1
2.7	3.1	2.3	1	1.2	1.4	1.9	2.2	4.1	2.4	2.5	2.4	1.8	2.3	2.6		2
1	1.6	1.4	1.7	2.3	2.8	1.2	1.3	1.2	1.4	1.6	1.3	1.6	2	1.9		3
2.6	3.7	2.8	2.1	2	1.9	2.5	2.9	3.2	1.2	1.3	1.2	1.8	1.9	1.3		4
3.6	3.2	2.5	4.8	4.5	4.1	3.2	3.9	3.1	3.4	3.6	4.8	2.6	2.4	2.4		5
1.9	2.2	1.6	7.2	3.8	4.4	8.1	7.6	10.9	5.8	3.9	4.5	7.2	5.5	5.9		6
9.4	5.1	9.5	3.9	2.1	2.6	11.2	5.1	12.2	9.1	9	9.2	8	4	9.5		7
4.4	3.6	2.4	23.1	8	18.3	5	6.7	4.6	11.3	6.9	10.2	15	13.8	31.4		8
18.9	12.2	25.6	9	5	6.5	10.9	17.4	0	7.4	4.5	5.7	16.2	12.6	9.1		9
5.3	3.4	3.5	10.6	10.6		14.8	7.8	13.4	44.2	21.3	8.3	10.4	3.6	7.4		10
16.8	16.8		6.5	4.3	4.3	13.2	13.2		17.7	18.4	24.1	8	8			11
10.1	8.8	0	54.3	0	0	13.3	3.5	11.5	52.9	14.5	35.7	10	10.4	0		12
20.1	20.1		10.3	8.1	16.5	20.7	20.7		10.7	10.6	13	15.1	15.1			13
41.1	15.4	0	36.8	0	0	31.8	10.6	0	0	0		24.6	5.5	28.4		14
9.9	9.8	11.8	13.3	10.9	0	12.6	11.3	13.3	13.8	10.3	0	48.5	8.7	47.6		15