# Report of the North Western Working Group (NWWG)

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DRAFT

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International Council for
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# 8      Icelandic saithe

## 8.1    Stock description and management units

Description of the stock and management units is provided in the stock annex.

## 8.2    Fisheries-dependent data

### 8.2.1   Landings, advice and TAC

Landings of saithe in Icelandic waters in 2017 are estimated to have been 49 200 t (Table 8.1 and Figure 8.1). Of the landings, 44 200 t were caught by trawl, 1346 t by gillnets, and the rest caught by other fishing gear. The domestic as well as ICES advice for the fishing year 2016/2017 was based on the 20% harvest control rule and was 55 kt. The TAC issued was also 55 kt but the landings are now estimated to be 45 000 tons. Part of the low catch is caused by a strike by the fishing fleet from December 2016 – February 2017 (figure 8.2) . The trajectory of the landings in the current fishing year and calendar year is shown in Figure 8.2 indicating that the TAC of 60 kt might be reached.

Most of the catch is caught in bottom trawl (83% in 2010-2017), with gillnet and jiggers taking the majority of the rest, 5% each fleet. The share taken by the gillnet fleet was larger in the past, 26% in 1982-1996 compared to 9% in 1997-2016  (Figure 8.1). Saithe does not appear much in the longline fishery that has been increasing in last 20 years.  The share of longlines has though gradually been increasing from 0.8% before 2000 to 2.2% in last 4 years.

### 8.2.2   Landings by age

Catch in numbers by age based on landings are listed in Table 8.2. Discarding is not considered to be a problem in the Icelandic saithe fisheries, with an estimated discard proportion of 0.1% (annual reports by Palsson et al. 2003 and later). Since the amount of discards is likely to be small, not taking discards into account in the total catches and catch in numbers is not considered to have major effect on the stock assessment.

In 2017  sea samples constitute about 80% of the length measured fish that is  used in the calculation of the catch in number and 84% of the length samples.  88% of the length samples are taken from trawl that is accounting for 90% of the catches. On the other hand only  43% of the aged otoliths come from sea samples.

The sampling program was slightly revised in 2013 and 2014, but the approach used for calculating catch in numbers has not changed. In 2013, the sampling frequency was reduced for bottom trawl, while the sampling frequency was increased for gillnets, jiggers, and demersal seine in 2014.  Also in 2014, the number of otoliths from each sample was halved from 50 to 25 for all fishing gears. These revisions in the sampling program were based on the analysis of Thordarson (2012) and lead to approximately 50% reduction in the number of age samples.

The sampling in 2017 was considerably less than in 2016 and earlier years, approximately 30% less in bottom trawl but 70% less in the other gears.  The reason for this reduction in sampling but the strike in January – February has some effects, most on the number of gillnet samples.

The age and length sampling in 2017 is indicated in the following table:

| Fleet | Landings (t) | No. of otolith samples | No. of otoliths read | No. of length samples | No. of length measurements |
|---|---|---|---|---|---|
| Long lines | 802 | 0 | 0 | 0 | 199 |
| Gillnets | 1346 | 2 | 46 | 3 | 375 |
| Jiggers | 1182 | 2 | 48 | 4 | 291 |
| Danish seine | 905 | 2 | 50 | 3 | 561 |
| Bottom trawl | 44234 | 50 | 1226 | 125 | 23830 |
| Other gear | 596 | 0 | 0 | 0 | 0 |
| Total | 49057 | 83 | 1370 | 135 | 25057 |

Foreign landings that are 270 tonnes are included in the numbers above. They are mostly caught by longlines (71 tonnes) and handlines (105 tonnes) .

Two age-length keys are used to calculate catch at age, one key for the gillnet catch and another key for other gears combined. The same length-weight relationship ($W = 0.02498 * L^{2.75674}$) is applied to length distributions from both fleets.

In recent years increased proportion of saithe catches has been caught north-west of Iceland (figure 8.3). This situation could lead to potential problem, if the sampling effort does not follow distribution in the catches. To look at this problem catch in numbers were recompiled using 12 cells, 3 gear (bottom trawl, gillnets and handlines), 2 areas (north and south) and 2 time periods (Jan-May and June-Dec). The resulting catch in numbers are nearly identical (figure 8.6) and using it in assessment leads to less than 1% difference of reference biomass. Catch in number 2017 is somewhat different from last year's prediction (figure 8.5). More is caught of age 5 but less of most other age groups.

### 8.2.3   Mean weight and maturity at age

Weights of ages 3-6 have been low in recent years, but older ages are close to average weight (Table 8.3 and Figures 8.7 and 8.8). The large 2012 yearclass has the lowest mean weight of all yearclasses, both in catches and in the survey. This is in line with density dependent growth that has been observed in this stock and can for example be seen for yearclasses 1984 and 2000 that are both large.  Yearclasses 2013 and 2014 that seem to be large have higher mean weight at age than the 2012 yearclass.  The long-term trend since 1980 has been a gradual decline in the weight of all ages.

Weighs at age in the landings are used to compile the reference biomass (B4+) that is the basis for the catch advice.  Catch weights are also used to compile the spawning stock.  Catch weights for the assessment year are predicted by applying a linear model using survey weights in the assessment year and the weight of the same year class in catches in the previous year as predictors (Magnusson 2012).

Maturity at ages 4-9 has decreased in recent years and is currently around average (Table 8.4 and Figure 8.9). A model using maturity at age from the Icelandic groundfish spring survey is used to derive smoothed trends in maturity by age and year (see stock annex).

### 8.2.4   Logbook data

Commercial CPUE indices are not used for tuning in this assessment. Although these indices have been explored for inclusion in the past, they were not considered for inclusion in the benchmark (ICES 2010), as the trends in CPUE are considered unreliable as an indicator of changes in abundance.

## 8.3   Scientific surveys

In the benchmark in 2010, spring survey data were considered superior to the autumn survey for calibrating the assessment, both due to more stations (lower CV) and longer time series. Saithe is among the most difficult demersal fishes to get reliable information on from bottom trawl surveys. In the spring survey, which has 500-600 stations, a large proportion of the saithe is caught in relatively few hauls and there seems to be considerable inter-annual variability in the number of these hauls.

The survey biomass indices fluctuated greatly in 1985-1995, but were consistently low in 1995-2001.  Since 1995 the indices have been variable but compared to the period 1985 -1995 the variability seems "real" rather than noise.  This difference is also seen by the estimated confidence intervals of the indices that are smaller after 1995.  In 2018 the indices are the highest in the series and have tripled since 2014.   (Table 8.5 and Figure 8.10).  Most of the increase is caused by the 2012 yearclass that was strong in the surveys 2015 - 2017 (figure 8.12).

The high index in March 1986 (figure 8.10)  is mostly the result of one large haul that is scaled down to the second largest haul when compiling  indices for tuning.  The scaling is from 16 tons to 1 ton.

When last benchmark was conducted (2010) the survey series for the autumn survey was relatively short and not considered suitable for tuning but "burn in period" of a survey is longer when the indices are noisy.  This might change in the next benchmark and the 2004 autumn survey might require "special treatment" like the 1986 survey in March.

Internal consistency in the March survey measured by the correlation of the indices for the same year class in 2 adjacent surveys is relatively poor, with $R^2$ close to 0.35 where it is highest.

Young saithe tend to live very close to shore, so it is not surprising that survey indices for ages 1 and 2 are poor measures of recruitment, and the number of young saithe caught in the survey is very low.

The biomass index from the March survey indicates that the stock is at the highest level in the series (the 1986 value is considered an outlier) and has been increasing rapidly since 2014.  The autumn survey shows the stock at its highest  level (2004 is an outlier) but the vales before 2000 might be underestimate due to stations added in 2000 (figure 8.4) where some saithe is found  The upward trend of last 3 years is not as strong in the autumn survey indices that are noisier than the indices from the March survey. Indices from the gillnet survey conducted south and west of Iceland since 1996 have been high from 2015-2018.  (figure 8.11).  The gillnet survey is mostly targeting large saithe (mean weight in 2016 was 6.7 kg).  To summarize all the surveys indicate that the stock is relatively large in 2018.

## 8.4    Assessment method

In accordance with the recommendation from the benchmark (ICES 2010), a separable forward-projecting statistical catch-age model, developed in AD Model Builder, is used to fit commercial catch at age (ages 3-14 from 1980 onwards) and survey indices at age (ages 2-10 from 1985 onwards). The selectivity pattern is constant within each period (Figure 8.13). Natural mortality is set at 0.2 for all ages.

The commercial catch-at-age residuals ( Figure 8.18) are relatively small  in 2017 for younger ages.  The survey residuals (figure 8.17) show positive values in 2018 for ages 4-6, the age groups accounting for most of the biomass. The survey catch-at-age residuals (Figure 8.17) have year blocks with all residuals being only negative or only positive in some years. The survey residuals are modelled as multivariate normal distribution with the correlation estimated (one coefficient).

The assessment model is also used for short term forecast.

The input for the short-term forecast is shown in Tables 8.3, 8.4 and 8.7. Future weights, maturity, and selectivity are assumed to be the same as in the assessment year, as described in the stock annex. Recruitment predictions are based on the segmented stock-recruitment function estimated in the assessment model which is essentially geometric mean when the stock is above estimated break point that is near $B_{loss}$.

The landings for the ongoing calendar year are predicted based on the 20% HCR, with the calendar year landings consisting of remainder  the ongoing fishing year's TAC and 1/3 of the next fishing year's TAC.  Looking at last two fishing years where the TAC was not caught the value obtained is likely to be an overestimate but trends in landings (figure 8.2) indicate that the TAC might be reached.

## 8.5    Reference points and HCR

In April 2013, the Icelandic government adopted a management plan for managing the Icelandic saithe fishery (Ministry of Industries and Innovation 2013). ICES evaluated this management plan and concluded that it was in accordance with the precautionary approach and the ICES MSY framework. In the harvest control rule (HCR) evaluation (ICES 2013) $B_{lim}$ was defined as 61 kt, based on $B_{loss}$ as estimated in 2010, and $B_{trigger}$ was defined as 65 kt, based on an estimated hockey-stick recruitment function.

The TAC set in year $t$ is for the upcoming fishing year, from 1 September in year $t$, to 31 August in year $t$+1. The 20% HCR consists of two equations, as follows.

When $SSB \geq B_{trigger}$, the TAC set in year $y$ equals the average of 0.20 times the current biomass and last year's TAC:

$$TAC_{y+1/y} = 0.5 \times 0.20\, B_{y,4+} + 0.5\, TAC_{y/y-1} \tag{Eq. 1}$$

When SSB is below $B_{trigger}$, the harvest rate is reduced below 0.20:

$$TAC_{y+1/y} = SSB_y/B_{trigger} [ (1 - 0.5\, SSB_y/B_{trigger})\, 0.20\, B_{t,4+}) + 0.5\, TAC7_{y/y-1} \quad ]$$
(Eq. 2)

Equation 1 is a plain average of two numbers. Equation 2 is continuous over $SSB_y/B_{trigger}$, so the rule does not lead to very different TAC when $SSB_y$ is slightly below or above $B_{trigger}$ .

At the NWWG  meeting 2016 definition of $B_{lim}$ and $B_{pa}$ were revisited.  Also  $F_{pa}$ and $F_{lim}$ were defined  but these points were not considered necessary when the HCR was evaluated in 2013.  The new values of $B_{lim}$ and $B_{pa}$ were 44 and 61 thous. tonnes.

## 8.6    State of the stock

The results of the principal stock quantities (Table 8.6 and Figure 8.14) show that the reference biomass (B4+)  has historically ranged from 130 to 410 kt (in 1999 and 1988), but this range has been narrower since 2003, between 220 and 327 kt. The current estimated stock size of  B4+ of 490 kt is the highest in the time series (1980 to the present). Spawning biomass is estimated as 232 kt, the highest in the timeseries.

The harvest rate peaked around 30% in the mid 1990's, but has been below the HCR target of 20% since in last 3 years.  The explanations are that the allocated TAC has not been fished and current assessment is a significant upward revision of stock size. Fishing mortality has been low since 2004 compared to before that.  Part of the difference is caused by change in selection pattern that leads to F before and after 2004 not being comparable.  SSB has been  at a relatively high level during the last ten years.

Recruitment has been relatively stable since year class 2006,  above average. Year-classes 2012-2014 are  estimated to be strong.   The details of the fishing mortality and stock in numbers are presented in Tables 8.7 and 8.8.

The predicted landings in 2018 are 70 kt, what is left of the TAC 2017/18 in the beginning of the year 2018 plus 1/3rd of the TAC 2018/19 (79 kt).  Assumptions about catches in 2018 have no effect on the TAC 2018/19 that is based on the biomass in the beginning of the year 2018.

## 8.7    Uncertainties in assessment and forecast

The assessment of Icelandic saithe is relatively uncertain due to fluctuations in the survey data, poor recruitment estimates and  irregular changes in the fleet selectivity. The internal consistency in the spring bottom trawl survey is low for saithe. This is not surprising, considering the nature of the species that is partly pelagic, schooling, and relatively widely migrating. There are also indications of time-varying selectivity, so changes in the commercial catch at age may not reflect changes in the age distribution of the population. The retrospective pattern (Figure 8.19) reveals some of the assessment uncertainty. The harvest control rule evaluations incorporated uncertainties om  assessment estimates, among other sources of uncertainty (ICES 2013).

Using  retrospective pattern based on the assessment years 2005-2018 Mohns rho for the reference biomass is -0.114, -0.118 for the SSB and -0.26 for recruitment.  Those values are based on comparing estimated values in the beginning of the assessment year to values estimated in 2018.  (the 2018 value is of course estimated).  What matters here is of course retrospective pattern of the reference biomass.  Mohns rho for the fishing mortality is 0.143.

The results from the default separable assessment model (ADSEP) are compared to alternative model configuration, both in terms of how fishing mortality are modelled and treatment of survey indices.

| NR | TYPE OF MODEL AND SETTINGS | B4+ 2018 | TAC |
|----|----------------------------|----------|-----|
| 1  | Separable 3 period         | 490      | 79.1 |
| 2  | Separable 1 period         | 527      | 82.8 |
| 3  | Separable 3 periods less weight on survey | 275 | 57.6 |
| 4  | Separable 3 periods survey outliers not included | 525 | 82.7 |

| 5 | Separable 3 periods random walk | 418 | 72 |
|---|---|---|---|
| 6 | VPA | 538 | 84 |
| 7 | Cod model flexible selection pattern, random walk | 417 | 71.9 |
| 8 | Stdsam | 466 | 76.8 |
| 9 | Sam different settings | 456 | 75.8 |

(* CV of survey is estimated automatically but weighted down to 5% here). All models except model 7-9 are based on more or less same code. Model 4 uses different data, i.e. survey indices are compiled by Winchorizing. Std SAM are the default settings while number of observation parameters has been increased in the other SAM run.

The results of the different models can be somewhat different (figure 8.21 and table above) with B4+ in 2018 (the number that matters for the advice) ranging from 275 thous. tonnes to 538 thous. tonnes. The highest number is from an Adapt type model and the lowest numbers from model with very low weight on the survey (the survey practically ignored). Adapt type models have not been considered suitable for this stock as they do not utilize the information included in the catch data, which is a problem when survey data are as noisy as they are here. The extreme models are model not using the survey (#4) and model only using the survey (#6). The general trend is that the survey indicates larger stock than catch data.

Taking the catch at age models tuned with the survey the range of B4+$_{2018}$ is from 417-525. The lowest values are from models incorporating random walk in fishing mortality while the highest value is from a model assuming 1 selection period, settings that are questionable (figure 8.13) This difference between models is well within what could be expected according to precision of the stock estimate CV(B4+)=0.2. The assessment indicates higher stock than last year's assessment (figures 8.15, 8.19). The retrospective pattern shows that the results do often change much by including one more year of data.

The main uncertainty in the current advisory process is the fact that the TAC has not been fished in some recent years. The assessment models indicate substantial reduction of fishing mortality and harvest rate in last 3 years, partly because the TAC has not been fished . Random walk constrain on fishing mortality works against this reduction, therefore models with random walk constraint indicate smaller stock. The selection pattern observed since 2004 (figure 8.13) indicates that the fisheries are targeting younger fish than before, something that could be interpreted as lack of large fish. This trend is even greater than observed in the figure as mean weight at age of ages 4 – 5 have been low in recent years (figure 8.8) Other measures of stock size, not used directly in the assessment model like the autumn survey and gillnet survey (figures 8.10 and 8.11) do indicate that the stock is large.

The problem seen in recent years is not new and the fact that fishing mortality of saithe was never really high indicates that it might be difficult to catch. One reason is that most of the gear is demersal while saithe is partly pelagic. Change of fleet and fishing practice in recent 10-20 years might also have effects. (see section 8.9) and the conclusions of that section is really that there is nothing wrong with the saithe assessment, change in fishing patterns and gear composition of the fleet is increasing the problem of catching the saithe quota.

## 8.8 Ecosystem considerations

Changes in the distribution of large pelagic stocks (blue whiting, mackerel, Norwegian spring-spawning herring, Icelandic summer-spawning herring) may affect the

tendency of saithe to migrate off shelf and between management units. Saithe is a migrating species and makes both vertical and long-distance feeding and spawning migrations (Armannsson et al. 2007, Armannsson and Jonsson 2012, i Homrum et al. 2013). The evidence from tagging experiments (ICES 2008) show some migrations along the Faroe-Iceland Ridge, as well as onto the East Greenland shelf.

## 8.9   Changes in fishing technology and fishing patterns

Before 2000 the 15-40% of the saithe was caught in gillnets but only around 5% in recent years. This change is caused by substantial reduction of gillnet boats, especially since 2007. From 1998 to 2015 increased part of the catch of cod (main target species of the Icelandic demersal fleet) was caught by longliners. The fleet has changed so the number of longliners is increasing but the number of gillnets boats, boats operating Danish seine and trawlers is decreasing. Longliners do hardly catch saithe but the other 3 gear types are all catching saithe.

Reduced harvest rate of cod that seems to be a more easily caught fish leads to saithe fishing being difficult without catching too much cod. Large part of the cod is exported fresh and the captains of many trawlers are asked to avoid cod except in the last 2 days of each fishing trip (5-6 days). Recent distribution of saithe in the Northwest area could make this a difficult stragety and having to avoid cod is an extra constraint on saithe fisheries.

Many captains complain that finding saithe is difficult and the changes in selection seen in last decade (figure 8.13) indicates that the fleet is targeting much smaller saithe than before (mean weight at age of ages 3-5 is also very low in recent years). The observed change in selection pattern indicates that the larger saithe is less available to the trawl fisheries than before. The selection pattern observed since 2004 leads to 10% less yield per recruit compared to average selection of the time period.

Looking at the catches of trawlers divided into those that freeze the catch and those that land it fresh, 50% of the catch of saithe by trawlers is taken by the freezing vessels, 50% of redfish but only 20% of the cod catch (figure 8.21). Freezing vessels are not required to catch the cod just before landing so some bycatch of cod is therefore not considered a problem there. The difference shown here could be an indication of the problem that the captains of the "fresh fish trawlers" are facing but "fresh fish trawlers" are majority of the trawlers.

Redfish is a species that has some effect on saithe fisheries. In recent years, catching redfish has been relatively easy as it can be found in very dense schools west of Iceland. Also, the distribution has changed so it is now abundant in the regions northwest of Iceland where cod and saithe is caught. Redfish is not a wanted bycatch in cod fisheries as it scratches the skin of the cod making it less valuable (less of a problem for freezing trawlers where the fish is unskinned). Therefore, the directed cod-fisheries are conducted with relatively large mesh size to get rid of most of redfish. A consequence is that bycatch of saithe is small as saithe in the area is relatively small.

If the conclusions above are correct, lowering the target harvest rate to get better balance in mixed fisheries. might be an option. A harvest rate of 16% next year would lead to 70 thous. tonnes TAC in next year and probably little change in the following years. There are still no indications that the premises behind the HCR evaluations in 2013 need to be investigated again, the problem described is a mixed fisheries problem. Harvest rate of 16% is well below the maximum that would be considered in conformity with the ICES MSY approach that, is 20% or higher.

## 8.10 References

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**Table 8.1. Saithe in division Va. Nominal catch (t) by countries, as officially reported to ICES.**

| | Belgium | Faroes | France | Germany | Iceland | Norway | UK (E/W/NI) | UK (Scot) | UK | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 980 | 4 930 | | | 52 436 | 1 | | | | 58 347 |
| 1981 | 532 | 3 545 | | | 54 921 | 3 | | | | 59 001 |
| 1982 | 201 | 3 582 | 23 | | 65 124 | 1 | | | | 68 931 |
| 1983 | 224 | 2 138 | | | 55 904 | | | | | 58 266 |
| 1984 | 269 | 2 044 | | | 60 406 | | | | | 62 719 |
| 1985 | 158 | 1 778 | | | 55 135 | 1 | 29 | | | 57 101 |
| 1986 | 218 | 2 291 | | | 63 867 | | | | | 66 376 |
| 1987 | 217 | 2 139 | | | 78 175 | | | | | 80 531 |
| 1988 | 268 | 2 596 | | | 74 383 | | | | | 77 247 |
| 1989 | 369 | 2 246 | | | 79 796 | | | | | 82 411 |
| 1990 | 190 | 2 905 | | | 95 032 | | | | | 98 127 |
| 1991 | 236 | 2 690 | | | 99 811 | | | | | 102 737 |
| 1992 | 195 | 1 570 | | | 77 832 | | | | | 79 597 |
| 1993 | 104 | 1 562 | | | 69 982 | | | | | 71 648 |
| 1994 | 30 | 975 | | 1 | 63 333 | | | | | 64 339 |
| 1995 | | 1 161 | | 1 | 47 466 | 1 | | | | 48 629 |
| 1996 | | 803 | | 1 | 39 297 | | | | | 40 101 |
| 1997 | | 716 | | | 36 548 | | | | | 37 264 |
| 1998 | | 997 | | 3 | 30 531 | | | | | 31 531 |
| 1999 | | 700 | | 2 | 30 583 | 6 | 1 | 1 | | 31 293 |
| 2000 | | 228 | | 1 | 32 914 | 1 | 2 | | | 33 146 |
| 2001 | | 128 | | 14 | 31 854 | 44 | 23 | | | 32 063 |
| 2002 | | 366 | | 6 | 41 687 | 3 | 7 | 2 | | 42 071 |
| 2003 | | 143 | | 56 | 51 857 | 164 | | | 35 | 52 255 |
| 2004 | | 214 | | 157 | 62 614 | 1 | 105 | | | 63 091 |
| 2005 | | 322 | | 224 | 67 283 | 2 | | | 312 | 68 143 |
| 2006 | | 415 | | 33 | 75 197 | 2 | | | 16 | 75 663 |
| 2007 | | 392 | | | 64 008 | 3 | | | 30 | 64 433 |
| 2008 | | 196 | | | 69 992 | 2 | | | | 70 190 |
| 2009 | | 269 | | | 61 391 | 3 | | | | 61 663 |
| 2010 | | 499 | | | 53 772 | 1 | | | | 54 272 |
| 2011 | | 735 | | | 50 386 | 2 | | | | 51 123 |
| 2012 | | 940 | | | 50 843 | | | | | 51 783 |
| 2013 | | 925 | | | 57 077 | | | | | 58 002 |
| 2014 | | 746 | | | 45 733 | 4 | | | | 46 483 |
| 2015 | | 499 | | | 47 973 | 3 | | | | 48 473 |
| 2016 | | 287 | | | 48 920 | 5 | | | | 49 212 |
| 2017 | | 261 | | | 48 786 | 4 | | | 4 | 49 057 |

**Table 8.2. Saithe in division Va. Commercial catch at age (thousands).**

| YEAR | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12+ |
|------|------|-------|------|-------|-------|------|------|------|------|------|
| 1980 | 275 | 2540 | 5214 | 2596 | 2169 | 1341 | 387 | 262 | 155 | 209 |
| 1981 | 203 | 1325 | 3503 | 5404 | 1457 | 1415 | 578 | 242 | 61 | 417 |
| 1982 | 508 | 1092 | 2804 | 4845 | 4293 | 1215 | 975 | 306 | 59 | 129 |
| 1983 | 107 | 1750 | 1065 | 2455 | 4454 | 2311 | 501 | 251 | 38 | 18 |
| 1984 | 53 | 657 | 800 | 1825 | 2184 | 3610 | 844 | 376 | 291 | 546 |
| 1985 | 376 | 4014 | 3366 | 1958 | 1536 | 1172 | 747 | 479 | 74 | 166 |
| 1986 | 3108 | 1400 | 4170 | 2665 | 1550 | 1116 | 628 | 1549 | 216 | 95 |
| 1987 | 956 | 5135 | 4428 | 5409 | 2915 | 1348 | 661 | 496 | 498 | 133 |
| 1988 | 1318 | 5067 | 6619 | 3678 | 2859 | 1775 | 845 | 226 | 270 | 132 |
| 1989 | 315 | 4313 | 8471 | 7309 | 1794 | 1928 | 848 | 270 | 191 | 221 |
| 1990 | 143 | 1692 | 5471 | 10112 | 6174 | 1816 | 1087 | 380 | 151 | 168 |
| 1991 | 198 | 874 | 3613 | 6844 | 10772 | 3223 | 858 | 838 | 228 | 51 |
| 1992 | 242 | 2928 | 3844 | 4355 | 3884 | 4046 | 1290 | 350 | 196 | 125 |
| 1993 | 657 | 1083 | 2841 | 2252 | 2247 | 2314 | 3671 | 830 | 223 | 281 |
| 1994 | 702 | 2955 | 1770 | 2603 | 1377 | 1243 | 1263 | 2009 | 454 | 428 |
| 1995 | 1573 | 1853 | 2661 | 1807 | 2370 | 905 | 574 | 482 | 521 | 154 |
| 1996 | 1102 | 2608 | 1868 | 1649 | 835 | 1233 | 385 | 267 | 210 | 447 |
| 1997 | 603 | 2960 | 2766 | 1651 | 1178 | 599 | 454 | 125 | 95 | 234 |
| 1998 | 183 | 1289 | 1767 | 1545 | 1114 | 658 | 351 | 265 | 120 | 251 |
| 1999 | 989 | 732 | 1564 | 2176 | 1934 | 669 | 324 | 140 | 72 | 75 |
| 2000 | 850 | 2383 | 896 | 1511 | 1612 | 1806 | 335 | 173 | 57 | 57 |
| 2001 | 1223 | 2619 | 2184 | 591 | 977 | 943 | 819 | 186 | 94 | 69 |
| 2002 | 1187 | 4190 | 3147 | 2970 | 519 | 820 | 570 | 309 | 101 | 53 |
| 2003 | 2284 | 4363 | 6031 | 2472 | 1942 | 285 | 438 | 289 | 196 | 72 |
| 2004 | 952 | 7841 | 7195 | 5363 | 1563 | 1057 | 211 | 224 | 157 | 124 |
| 2005 | 2607 | 3089 | 7333 | 6876 | 3592 | 978 | 642 | 119 | 149 | 147 |
| 2006 | 1380 | 10051 | 2616 | 5840 | 4514 | 1989 | 667 | 485 | 118 | 229 |
| 2007 | 1244 | 6552 | 8751 | 2124 | 2935 | 1817 | 964 | 395 | 190 | 99 |
| 2008 | 1432 | 3602 | 5874 | 6706 | 1155 | 1894 | 1248 | 803 | 262 | 307 |
| 2009 | 2820 | 5166 | 2084 | 2734 | 2883 | 777 | 1101 | 847 | 555 | 373 |
| 2010 | 2146 | 6284 | 3058 | 997 | 1644 | 1571 | 514 | 656 | 522 | 409 |
| 2011 | 2004 | 4850 | 4006 | 1502 | 677 | 1065 | 1145 | 323 | 433 | 469 |
| 2012 | 1183 | 4816 | 3514 | 2417 | 903 | 432 | 883 | 1015 | 354 | 549 |
| 2013 | 1163 | 5538 | 6366 | 2963 | 1610 | 664 | 375 | 537 | 460 | 320 |
| 2014 | 668 | 3499 | 4867 | 2805 | 1276 | 725 | 347 | 241 | 312 | 401 |
| 2015 | 781 | 2712 | 6461 | 2917 | 1509 | 694 | 589 | 249 | 133 | 347 |
| 2016 | 1588 | 6230 | 2653 | 2838 | 1648 | 1059 | 526 | 337 | 148 | 131 |
| 2017 | 750 | 3333 | 7542 | 1806 | 1449 | 813 | 648 | 229 | 127 | 237 |

**Table 8.3. Saithe in division Va. Mean weight at age (g) in the catches and in the spawning stock, with predictions in gray.**

| YEAR | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12+ |
|------|------|------|------|------|------|------|------|------|------|------|
| 1980 | 1428 | 1983 | 2667 | 3689 | 5409 | 6321 | 7213 | 8565 | 9147 | 9979 |
| 1981 | 1585 | 2037 | 2696 | 3525 | 4541 | 6247 | 6991 | 8202 | 9537 | 9523 |
| 1982 | 1547 | 2194 | 3015 | 3183 | 5114 | 6202 | 7256 | 7922 | 8924 | 10021 |
| 1983 | 1530 | 2221 | 3171 | 4270 | 4107 | 5984 | 7565 | 8673 | 8801 | 9445 |
| 1984 | 1653 | 2432 | 3330 | 4681 | 5466 | 4973 | 7407 | 8179 | 8770 | 10520 |
| 1985 | 1609 | 2172 | 3169 | 3922 | 4697 | 6411 | 6492 | 8346 | 9401 | 10767 |
| 1986 | 1450 | 2190 | 2959 | 4402 | 5488 | 6406 | 7570 | 6487 | 9616 | 11080 |
| 1987 | 1516 | 1715 | 2670 | 3839 | 5081 | 6185 | 7330 | 8025 | 7974 | 10886 |
| 1988 | 1261 | 2017 | 2513 | 3476 | 4719 | 5932 | 7523 | 8439 | 8748 | 9823 |
| 1989 | 1403 | 2021 | 2194 | 3047 | 4505 | 5889 | 7172 | 8852 | 10170 | 11194 |
| 1990 | 1647 | 1983 | 2566 | 3021 | 4077 | 5744 | 7038 | 7564 | 8854 | 11284 |
| 1991 | 1224 | 1939 | 2432 | 3160 | 3634 | 4967 | 6629 | 7704 | 9061 | 9547 |
| 1992 | 1269 | 1909 | 2578 | 3288 | 4150 | 4865 | 6168 | 7926 | 8349 | 10181 |
| 1993 | 1381 | 2143 | 2742 | 3636 | 4398 | 5421 | 5319 | 7006 | 8070 | 9842 |
| 1994 | 1444 | 1836 | 2649 | 3512 | 4906 | 5539 | 6818 | 6374 | 8341 | 10388 |
| 1995 | 1370 | 1977 | 2769 | 3722 | 4621 | 5854 | 6416 | 7356 | 6815 | 8799 |
| 1996 | 1229 | 1755 | 2670 | 3802 | 4902 | 5681 | 7182 | 7734 | 9256 | 9601 |
| 1997 | 1325 | 1936 | 2409 | 3906 | 5032 | 6171 | 7202 | 7883 | 8856 | 9865 |
| 1998 | 1347 | 1972 | 2943 | 3419 | 4850 | 5962 | 6933 | 7781 | 8695 | 10043 |
| 1999 | 1279 | 2106 | 2752 | 3497 | 3831 | 5819 | 7072 | 8078 | 8865 | 10872 |
| 2000 | 1367 | 1929 | 2751 | 3274 | 4171 | 4447 | 6790 | 8216 | 9369 | 10443 |
| 2001 | 1280 | 1882 | 2599 | 3697 | 4420 | 5538 | 5639 | 7985 | 9059 | 10419 |
| 2002 | 1308 | 1946 | 2569 | 3266 | 4872 | 5365 | 6830 | 7067 | 9240 | 10190 |
| 2003 | 1310 | 1908 | 2545 | 3336 | 4069 | 5792 | 7156 | 8131 | 8051 | 10825 |
| 2004 | 1467 | 1847 | 2181 | 2918 | 4017 | 5135 | 7125 | 7732 | 8420 | 9547 |
| 2005 | 1287 | 1888 | 2307 | 2619 | 3516 | 5080 | 6060 | 8052 | 8292 | 8569 |
| 2006 | 1164 | 1722 | 2369 | 2808 | 3235 | 4361 | 6007 | 7166 | 8459 | 9583 |
| 2007 | 1140 | 1578 | 2122 | 2719 | 3495 | 4114 | 5402 | 6995 | 7792 | 9848 |
| 2008 | 1306 | 1805 | 2295 | 2749 | 3515 | 4530 | 5132 | 6394 | 7694 | 9589 |
| 2009 | 1412 | 1862 | 2561 | 3023 | 3676 | 4596 | 5651 | 6074 | 7356 | 9237 |
| 2010 | 1287 | 1787 | 2579 | 3469 | 4135 | 4850 | 5558 | 6289 | 6750 | 8785 |
| 2011 | 1175 | 1801 | 2526 | 3680 | 4613 | 5367 | 5685 | 6466 | 6851 | 7739 |
| 2012 | 1160 | 1668 | 2369 | 3347 | 4430 | 5486 | 6161 | 6448 | 7220 | 8236 |
| 2013 | 1056 | 1675 | 2219 | 3244 | 4529 | 5628 | 6397 | 7055 | 7378 | 8342 |
| 2014 | 1211 | 1575 | 2229 | 2983 | 4378 | 5598 | 6773 | 8023 | 7875 | 9020 |
| 2015 | 1072 | 1639 | 2141 | 3122 | 4262 | 5555 | 6633 | 7697 | 8269 | 8773 |
| 2016 | 1105 | 1468 | 2260 | 3071 | 4127 | 5272 | 6379 | 7247 | 8566 | 8969 |
| 2017 | 1282 | 1674 | 2199 | 3255 | 4314 | 5718 | 6361 | 7630 | 8590 | 9238 |
| 2018 | 1153 | 1766 | 2314 | 2964 | 4159 | 5381 | 6933 | 7525 | 8475 | 8989 |
| 2019 | 1153 | 1766 | 2314 | 2964 | 4159 | 5381 | 6933 | 7525 | 8475 | 8992 |

**Table 8.4. Saithe in division Va. Maturity at age, with predictions in gray.**

| YEAR | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|------|---|-------|-------|-------|-------|-------|-------|----|----|----|
| 1980 | 0 | 0.083 | 0.188 | 0.372 | 0.603 | 0.796 | 0.909 | 1 | 1 | 1 |
| 1981 | 0 | 0.083 | 0.188 | 0.372 | 0.603 | 0.796 | 0.909 | 1 | 1 | 1 |
| 1982 | 0 | 0.083 | 0.188 | 0.372 | 0.603 | 0.796 | 0.909 | 1 | 1 | 1 |
| 1983 | 0 | 0.083 | 0.188 | 0.372 | 0.603 | 0.796 | 0.909 | 1 | 1 | 1 |
| 1984 | 0 | 0.083 | 0.188 | 0.372 | 0.603 | 0.796 | 0.909 | 1 | 1 | 1 |
| 1985 | 0 | 0.083 | 0.188 | 0.372 | 0.603 | 0.796 | 0.909 | 1 | 1 | 1 |

| 1986 | 0 | 0.074 | 0.171 | 0.345 | 0.575 | 0.776 | 0.899 | 1 | 1 | 1 |
|------|---|-------|-------|-------|-------|-------|-------|---|---|---|
| 1987 | 0 | 0.067 | 0.156 | 0.321 | 0.548 | 0.757 | 0.888 | 1 | 1 | 1 |
| 1988 | 0 | 0.061 | 0.143 | 0.3 | 0.523 | 0.738 | 0.878 | 1 | 1 | 1 |
| 1989 | 0 | 0.057 | 0.133 | 0.283 | 0.503 | 0.722 | 0.869 | 1 | 1 | 1 |
| 1990 | 0 | 0.054 | 0.127 | 0.271 | 0.488 | 0.71 | 0.863 | 1 | 1 | 1 |
| 1991 | 0 | 0.052 | 0.123 | 0.265 | 0.481 | 0.704 | 0.859 | 1 | 1 | 1 |
| 1992 | 0 | 0.052 | 0.123 | 0.265 | 0.481 | 0.704 | 0.859 | 1 | 1 | 1 |
| 1993 | 0 | 0.054 | 0.127 | 0.272 | 0.489 | 0.711 | 0.863 | 1 | 1 | 1 |
| 1994 | 0 | 0.057 | 0.135 | 0.286 | 0.507 | 0.725 | 0.871 | 1 | 1 | 1 |
| 1995 | 0 | 0.064 | 0.148 | 0.309 | 0.534 | 0.746 | 0.883 | 1 | 1 | 1 |
| 1996 | 0 | 0.073 | 0.168 | 0.341 | 0.57 | 0.773 | 0.897 | 1 | 1 | 1 |
| 1997 | 0 | 0.087 | 0.196 | 0.385 | 0.616 | 0.804 | 0.913 | 1 | 1 | 1 |
| 1998 | 0 | 0.105 | 0.231 | 0.435 | 0.664 | 0.835 | 0.928 | 1 | 1 | 1 |
| 1999 | 0 | 0.126 | 0.27 | 0.486 | 0.708 | 0.862 | 0.941 | 1 | 1 | 1 |
| 2000 | 0 | 0.147 | 0.307 | 0.532 | 0.744 | 0.882 | 0.95 | 1 | 1 | 1 |
| 2001 | 0 | 0.165 | 0.336 | 0.565 | 0.769 | 0.895 | 0.956 | 1 | 1 | 1 |
| 2002 | 0 | 0.174 | 0.351 | 0.581 | 0.78 | 0.901 | 0.959 | 1 | 1 | 1 |
| 2003 | 0 | 0.173 | 0.35 | 0.58 | 0.779 | 0.901 | 0.959 | 1 | 1 | 1 |
| 2004 | 0 | 0.165 | 0.337 | 0.566 | 0.77 | 0.895 | 0.956 | 1 | 1 | 1 |
| 2005 | 0 | 0.154 | 0.318 | 0.544 | 0.754 | 0.887 | 0.953 | 1 | 1 | 1 |
| 2006 | 0 | 0.142 | 0.297 | 0.52 | 0.735 | 0.877 | 0.948 | 1 | 1 | 1 |
| 2007 | 0 | 0.131 | 0.28 | 0.499 | 0.718 | 0.867 | 0.944 | 1 | 1 | 1 |
| 2008 | 0 | 0.125 | 0.268 | 0.484 | 0.706 | 0.86 | 0.941 | 1 | 1 | 1 |
| 2009 | 0 | 0.121 | 0.261 | 0.475 | 0.699 | 0.856 | 0.938 | 1 | 1 | 1 |
| 2010 | 0 | 0.119 | 0.257 | 0.47 | 0.694 | 0.853 | 0.937 | 1 | 1 | 1 |
| 2011 | 0 | 0.117 | 0.253 | 0.465 | 0.691 | 0.851 | 0.936 | 1 | 1 | 1 |
| 2012 | 0 | 0.115 | 0.25 | 0.46 | 0.686 | 0.849 | 0.935 | 1 | 1 | 1 |
| 2013 | 0 | 0.112 | 0.244 | 0.452 | 0.679 | 0.844 | 0.933 | 1 | 1 | 1 |
| 2014 | 0 | 0.107 | 0.234 | 0.44 | 0.668 | 0.838 | 0.93 | 1 | 1 | 1 |
| 2015 | 0 | 0.1 | 0.222 | 0.423 | 0.653 | 0.828 | 0.925 | 1 | 1 | 1 |
| 2016 | 0 | 0.093 | 0.209 | 0.403 | 0.634 | 0.816 | 0.919 | 1 | 1 | 1 |
| 2017 | 0 | **0.086** | 0.194 | 0.382 | 0.613 | 0.802 | 0.912 | 1 | 1 | 1 |
| 2018 | 0 | 0.079 | 0.18 | 0.36 | 0.591 | 0.787 | 0.905 | 1 | 1 | 1 |
| 2019 | 0 | 0.079 | 0.18 | 0.36 | 0.591 | 0.787 | 0.905 | 1 | 1 | 1 |

**Table 8.5. Saithe in division Va. Survey indices at age.**

| YEAR | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------|------|-------|-------|-------|-------|------|------|------|------|
| 1985 | 0.59 | 0.56 | 3.1 | 5.31 | 1.8 | 1.09 | 0.51 | 1.4 | 0.15 |
| 1986 | 2.3 | 2.46 | 2.15 | 2.2 | 1.49 | 0.65 | 0.3 | 0.19 | 0.33 |
| 1987 | 0.38 | 11.84 | 13.22 | 6.61 | 4.08 | 3.18 | 0.82 | 0.37 | 0.27 |
| 1988 | 0.31 | 0.47 | 2.74 | 2.85 | 1.75 | 0.98 | 0.41 | 0.07 | 0.08 |
| 1989 | 1.42 | 3.95 | 5.09 | 6.65 | 2.53 | 1.81 | 0.92 | 0.4 | 0 |
| 1990 | 0.34 | 1.71 | 4.96 | 6.42 | 12.51 | 3.37 | 1.23 | 0.65 | 0.12 |
| 1991 | 0.22 | 1.38 | 1.7 | 2.18 | 1.12 | 2.49 | 0.31 | 0.02 | 0.03 |
| 1992 | 0.14 | 0.91 | 5.88 | 5.65 | 2.84 | 2.72 | 1.94 | 0.28 | 0.06 |
| 1993 | 1.27 | 11.03 | 1.89 | 6.59 | 2.34 | 2.19 | 1.02 | 3.94 | 0.66 |
| 1994 | 0.81 | 0.74 | 1.93 | 1.78 | 2 | 0.53 | 0.81 | 0.94 | 3.48 |
| 1995 | 0.49 | 1.98 | 1.12 | 0.52 | 0.29 | 0.34 | 0.1 | 0.15 | 0.15 |
| 1996 | 0.13 | 0.49 | 3.78 | 1.16 | 1.03 | 0.59 | 0.98 | 0.06 | 0.09 |
| 1997 | 0.32 | 0.91 | 4.73 | 3.98 | 0.95 | 0.4 | 0.16 | 0.1 | 0.05 |
| 1998 | 0.13 | 1.66 | 2.36 | 2.55 | 1.27 | 0.72 | 0.3 | 0.09 | 0.07 |
| 1999 | 0.73 | 3.74 | 0.94 | 1.27 | 1.7 | 0.59 | 0.16 | 0.02 | 0.02 |
| 2000 | 0.38 | 2.01 | 2.55 | 0.61 | 0.86 | 0.54 | 0.45 | 0.08 | 0.03 |
| 2001 | 0.92 | 2.06 | 2.73 | 1.68 | 0.22 | 0.23 | 0.39 | 0.14 | 0.07 |
| 2002 | 1.02 | 2.23 | 3.01 | 3.11 | 2.19 | 0.42 | 0.47 | 0.32 | 0.22 |
| 2003 | 0.05 | 9.79 | 5.14 | 2.98 | 1.37 | 0.78 | 0.21 | 0.05 | 0.1 |
| 2004 | 0.9 | 1.39 | 9.6 | 6.27 | 4.52 | 1.52 | 0.84 | 0.17 | 0.17 |
| 2005 | 0.25 | 4.29 | 2.41 | 7.5 | 4.72 | 2.36 | 0.88 | 0.45 | 0.13 |
| 2006 | 0 | 2.19 | 6.76 | 1.98 | 8.85 | 3.5 | 1.21 | 0.29 | 0.25 |
| 2007 | 0.06 | 0.31 | 1.75 | 3.27 | 0.82 | 1.64 | 0.71 | 0.29 | 0.16 |
| 2008 | 0.08 | 2.26 | 1.81 | 2.88 | 4.05 | 0.62 | 0.79 | 0.34 | 0.15 |
| 2009 | 0.21 | 2.45 | 1.85 | 0.69 | 0.91 | 0.84 | 0.12 | 0.26 | 0.15 |
| 2010 | 0.07 | 1.24 | 5.07 | 2.55 | 0.64 | 0.61 | 0.47 | 0.07 | 0.12 |
| 2011 | 0.15 | 3.84 | 4.24 | 3.1 | 1.17 | 0.41 | 0.39 | 0.44 | 0.17 |
| 2012 | 0.02 | 1.77 | 12.01 | 6.75 | 2.76 | 0.63 | 0.17 | 0.38 | 0.5 |
| 2013 | 0.11 | 4.28 | 7.57 | 6.85 | 4.67 | 2.58 | 1.12 | 0.3 | 0.43 |
| 2014 | 0.03 | 0.39 | 3.89 | 3.74 | 2.02 | 0.87 | 0.42 | 0.15 | 0.11 |
| 2015 | 0.04 | 1.08 | 1.93 | 3.22 | 1.73 | 0.82 | 0.72 | 0.66 | 0.43 |
| 2016 | 0.05 | 3.17 | 16.21 | 2.75 | 2.27 | 1.08 | 0.53 | 0.44 | 0.28 |
| 2017 | 0.02 | 1.48 | 6.67 | 14.64 | 3.03 | 1.68 | 0.87 | 0.45 | 0.3 |
| 2018 | 0.03 | 0.5 | 17.92 | 10.5 | 15.28 | 1.51 | 0.84 | 0.43 | 0.32 |

**Table 8.6. Saithe in division Va. Main population estimates.**

| YEAR | B4+ | SSB | N3 | YIELD | F4-9 | HR |
|------|-----|-----|-----|-------|------|-----|
| 1980 | 312 | 113 | 28 | 58 | 0.29 | 18.5 |
| 1981 | 305 | 120 | 20 | 58 | 0.26 | 18.9 |
| 1982 | 295 | 137 | 22 | 68 | 0.3 | 23 |
| 1983 | 270 | 137 | 32 | 57 | 0.24 | 20.9 |
| 1984 | 287 | 140 | 42 | 60 | 0.23 | 21 |
| 1985 | 300 | 138 | 35 | 54 | 0.24 | 17.9 |
| 1986 | 319 | 136 | 67 | 65 | 0.28 | 20.4 |
| 1987 | 336 | 128 | 91 | 80 | 0.35 | 23.9 |
| 1988 | 416 | 124 | 51 | 77 | 0.32 | 18.6 |
| 1989 | 399 | 128 | 32 | 82 | 0.31 | 20.6 |
| 1990 | 378 | 135 | 21 | 98 | 0.35 | 25.8 |
| 1991 | 337 | 145 | 29 | 102 | 0.37 | 30.3 |
| 1992 | 289 | 137 | 15 | 80 | 0.37 | 27.6 |
| 1993 | 231 | 113 | 20 | 72 | 0.4 | 31 |
| 1994 | 188 | 94 | 18 | 64 | 0.45 | 33.9 |
| 1995 | 153 | 70 | 30 | 48 | 0.46 | 31.5 |
| 1996 | 150 | 60 | 26 | 39 | 0.4 | 26.3 |
| 1997 | 157 | 61 | 17 | 37 | 0.36 | 23.4 |
| 1998 | 155 | 68 | 9 | 31 | 0.29 | 19.8 |
| 1999 | 133 | 73 | 31 | 31 | 0.31 | 23.2 |
| 2000 | 144 | 75 | 31 | 33 | 0.32 | 22.7 |
| 2001 | 164 | 83 | 55 | 32 | 0.27 | 19.2 |
| 2002 | 223 | 101 | 64 | 42 | 0.29 | 18.9 |
| 2003 | 284 | 126 | 72 | 52 | 0.29 | 18.4 |
| 2004 | 325 | 145 | 26 | 65 | 0.26 | 19.9 |
| 2005 | 291 | 154 | 73 | 69 | 0.28 | 23.8 |
| 2006 | 317 | 160 | 42 | 75 | 0.3 | 23.8 |
| 2007 | 289 | 155 | 19 | 64 | 0.28 | 22.3 |
| 2008 | 258 | 153 | 27 | 69 | 0.32 | 26.9 |
| 2009 | 234 | 142 | 40 | 60 | 0.3 | 25.8 |
| 2010 | 235 | 132 | 39 | 54 | 0.27 | 22.9 |
| 2011 | 244 | 127 | 50 | 51 | 0.24 | 20.8 |
| 2012 | 257 | 126 | 48 | 51 | 0.23 | 19.9 |
| 2013 | 275 | 133 | 51 | 58 | 0.25 | 20.9 |
| 2014 | 287 | 139 | 34 | 46 | 0.18 | 15.9 |
| 2015 | 296 | 153 | 101 | 48 | 0.17 | 16.4 |
| 2016 | 378 | 172 | 57 | 49 | 0.15 | 13 |
| 2017 | 440 | 202 | 61 | 49 | 0.12 | 11.2 |
| 2018 | 490 | 233 | 15 | | | |
| Average 1980-2017 | 278 | 127 | 40 | 59 | 0.29 | 22.1 |

Table 8.7. Saithe in division Va. Stock in numbers. Shaded area is input to prediction.

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1980 | 32.3 | 24.7 | 28.3 | 46.8 | 30.9 | 10.3 | 8.2 | 3.7 | 1.3 | 0.7 | 0.7 | 0.5 | 0.3 | 0.1 |
| 1981 | 47.9 | 26.4 | 20.2 | 22.8 | 35.2 | 21.2 | 6.3 | 4.6 | 2 | 0.7 | 0.4 | 0.4 | 0.3 | 0.2 |
| 1982 | 62.7 | 39.2 | 21.6 | 16.3 | 17.3 | 24.6 | 13.3 | 3.7 | 2.6 | 1.1 | 0.4 | 0.2 | 0.2 | 0.2 |
| 1983 | 52.7 | 51.3 | 32.1 | 17.4 | 12.2 | 11.8 | 14.8 | 7.5 | 1.9 | 1.4 | 0.6 | 0.2 | 0.1 | 0.1 |
| 1984 | 100.5 | 43.1 | 42 | 25.9 | 13.3 | 8.6 | 7.6 | 9 | 4.3 | 1.1 | 0.8 | 0.4 | 0.1 | 0.1 |
| 1985 | 136.3 | 82.3 | 35.3 | 34 | 19.8 | 9.5 | 5.6 | 4.7 | 5.2 | 2.6 | 0.7 | 0.5 | 0.2 | 0.1 |
| 1986 | 75.8 | 111.6 | 67.4 | 28.5 | 25.9 | 14 | 6.1 | 3.4 | 2.7 | 3.1 | 1.5 | 0.4 | 0.3 | 0.1 |
| 1987 | 47.4 | 62 | 91.3 | 54.3 | 21.5 | 17.9 | 8.7 | 3.5 | 1.8 | 1.5 | 1.6 | 0.8 | 0.2 | 0.2 |
| 1988 | 31 | 38.8 | 50.8 | 73.3 | 40.1 | 14.3 | 10.3 | 4.6 | 1.7 | 0.9 | 0.7 | 0.9 | 0.5 | 0.1 |
| 1989 | 43.9 | 25.4 | 31.8 | 40.8 | 54.7 | 27.1 | 8.5 | 5.7 | 2.3 | 0.9 | 0.5 | 0.4 | 0.5 | 0.2 |

| 1990 | 22.1 | 36 | 20.8 | 25.6 | 30.6 | 37.2 | 16.3 | 4.7 | 2.9 | 1.3 | 0.5 | 0.3 | 0.2 | 0.3 |
| 1991 | 29.6 | 18.1 | 29.5 | 16.7 | 18.9 | 20.3 | 31.4 | 8.7 | 2.3 | 1.5 | 0.6 | 0.2 | 0.1 | 0.1 |
| 1992 | 26.4 | 24.3 | 14.8 | 23.6 | 12.3 | 12.4 | 11.4 | 16.2 | 4.1 | 1.1 | 0.7 | 0.3 | 0.1 | 0.1 |
| 1993 | 44.7 | 21.6 | 19.9 | 11.9 | 17.4 | 8 | 7 | 5.9 | 7.7 | 2 | 0.5 | 0.4 | 0.2 | 0.1 |
| 1994 | 38.3 | 36.6 | 17.7 | 15.9 | 8.7 | 11.2 | 4.4 | 3.5 | 2.7 | 3.6 | 0.9 | 0.3 | 0.2 | 0.1 |
| 1995 | 25.3 | 31.4 | 30 | 14.1 | 11.4 | 5.4 | 5.8 | 2.1 | 1.5 | 1.2 | 1.5 | 0.4 | 0.1 | 0.1 |
| 1996 | 13 | 20.7 | 25.7 | 23.9 | 10.1 | 7.1 | 2.8 | 2.7 | 0.9 | 0.6 | 0.5 | 0.7 | 0.2 | 0.1 |
| 1997 | 45.7 | 10.6 | 17 | 20.6 | 17.4 | 6.5 | 3.9 | 1.4 | 1.2 | 0.4 | 0.3 | 0.2 | 0.4 | 0.1 |
| 1998 | 46.9 | 37.5 | 8.7 | 13.4 | 14.6 | 11.3 | 3.9 | 2.1 | 0.7 | 0.6 | 0.2 | 0.1 | 0.1 | 0.2 |
| 1999 | 81.4 | 38.4 | 30.7 | 6.9 | 9.8 | 9.9 | 7.2 | 2.3 | 1.1 | 0.4 | 0.3 | 0.1 | 0.1 | 0.1 |
| 2000 | 95.5 | 66.7 | 31.5 | 24.4 | 5 | 6.6 | 6.2 | 4.2 | 1.2 | 0.6 | 0.2 | 0.2 | 0.1 | 0 |
| 2001 | 107.7 | 78.2 | 54.6 | 25 | 17.6 | 3.3 | 4.1 | 3.5 | 2.2 | 0.6 | 0.3 | 0.1 | 0.1 | 0 |
| 2002 | 38.5 | 88.2 | 64 | 43.5 | 18.3 | 12.1 | 2.2 | 2.5 | 2 | 1.2 | 0.3 | 0.2 | 0.1 | 0 |
| 2003 | 109.2 | 31.5 | 72.2 | 50.9 | 31.7 | 12.5 | 7.7 | 1.3 | 1.3 | 1 | 0.6 | 0.2 | 0.1 | 0 |
| 2004 | 63.3 | 89.4 | 25.8 | 57.5 | 37.2 | 21.6 | 8 | 4.5 | 0.7 | 0.7 | 0.5 | 0.3 | 0.1 | 0 |
| 2005 | 28.4 | 51.9 | 73.2 | 20.4 | 38.9 | 23.2 | 13.3 | 5 | 2.9 | 0.4 | 0.4 | 0.3 | 0.2 | 0.1 |
| 2006 | 40.3 | 23.2 | 42.5 | 57.5 | 13.5 | 23.7 | 14 | 8.2 | 3.1 | 1.7 | 0.2 | 0.2 | 0.2 | 0.1 |
| 2007 | 59.9 | 33 | 19 | 33.2 | 37.6 | 8.1 | 13.9 | 8.4 | 5 | 1.8 | 1 | 0.1 | 0.1 | 0.1 |
| 2008 | 58.6 | 49.1 | 27 | 14.9 | 22.2 | 23 | 4.9 | 8.6 | 5.3 | 3 | 1.1 | 0.5 | 0.1 | 0.1 |
| 2009 | 74.2 | 48 | 40.2 | 21.1 | 9.7 | 13 | 13.3 | 2.9 | 5.2 | 3 | 1.7 | 0.6 | 0.3 | 0 |
| 2010 | 72 | 60.8 | 39.3 | 31.5 | 13.9 | 5.8 | 7.7 | 8.1 | 1.8 | 3.1 | 1.7 | 0.9 | 0.3 | 0.2 |
| 2011 | 75.9 | 59 | 49.8 | 30.9 | 21.2 | 8.6 | 3.5 | 4.8 | 5.1 | 1.1 | 1.8 | 1 | 0.5 | 0.2 |
| 2012 | 50.3 | 62.1 | 48.3 | 39.3 | 21.2 | 13.4 | 5.4 | 2.3 | 3.1 | 3.2 | 0.7 | 1.1 | 0.6 | 0.3 |
| 2013 | 151.3 | 41.2 | 50.9 | 38.2 | 27.1 | 13.5 | 8.5 | 3.5 | 1.5 | 2 | 2 | 0.4 | 0.6 | 0.3 |
| 2014 | 85.3 | 123.9 | 33.7 | 40.2 | 26 | 17.1 | 8.4 | 5.4 | 2.2 | 0.9 | 1.2 | 1.1 | 0.2 | 0.4 |
| 2015 | 90.3 | 69.9 | 101.4 | 26.9 | 28.7 | 17.6 | 11.4 | 5.7 | 3.7 | 1.5 | 0.6 | 0.8 | 0.7 | 0.1 |
| 2016 | 22.8 | 73.9 | 57.2 | 81 | 19.4 | 19.6 | 11.9 | 7.9 | 4 | 2.5 | 1 | 0.4 | 0.5 | 0.5 |
| 2017 | 48.4 | 18.7 | 60.5 | 45.8 | 59.2 | 13.5 | 13.6 | 8.4 | 5.5 | 2.8 | 1.7 | 0.7 | 0.3 | 0.3 |
| 2018 | 52.3 | 39.6 | 15.3 | 48.7 | 34.3 | 42.6 | 9.7 | 9.8 | 6.1 | 4 | 1.9 | 1.2 | 0.5 | 0.2 |
| 2019 | 52.7 | 42.8 | 32.5 | 12.2 | 35.3 | 23.6 | 29.1 | 6.7 | 6.9 | 4.2 | 2.7 | 1.3 | 0.8 | 0.3 |
| 2020 | 52.7 | 43.2 | 35 | 25.8 | 8.6 | 23.4 | 15.5 | 19.5 | 4.5 | 4.5 | 2.7 | 1.6 | 0.8 | 0.5 |

**Table 8.8. Saithe in division Va. Fishing mortality rate. Shaded areas show predictions i.e where catches are unknown.**

| Year | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 0.016 | 0.085 | 0.178 | 0.295 | 0.362 | 0.437 | 0.407 | 0.437 | 0.358 | 0.358 | 0.358 | 0.358 |
| 1981 | 0.015 | 0.076 | 0.159 | 0.263 | 0.324 | 0.39 | 0.363 | 0.39 | 0.32 | 0.32 | 0.32 | 0.32 |
| 1982 | 0.017 | 0.088 | 0.183 | 0.304 | 0.374 | 0.45 | 0.419 | 0.45 | 0.369 | 0.369 | 0.369 | 0.369 |
| 1983 | 0.014 | 0.07 | 0.147 | 0.243 | 0.299 | 0.36 | 0.336 | 0.36 | 0.295 | 0.295 | 0.295 | 0.295 |
| 1984 | 0.013 | 0.067 | 0.14 | 0.231 | 0.285 | 0.343 | 0.319 | 0.343 | 0.281 | 0.281 | 0.281 | 0.281 |
| 1985 | 0.014 | 0.071 | 0.148 | 0.245 | 0.302 | 0.364 | 0.339 | 0.364 | 0.298 | 0.298 | 0.298 | 0.298 |
| 1986 | 0.016 | 0.082 | 0.17 | 0.282 | 0.347 | 0.419 | 0.39 | 0.419 | 0.343 | 0.343 | 0.343 | 0.343 |
| 1987 | 0.02 | 0.102 | 0.212 | 0.351 | 0.432 | 0.521 | 0.485 | 0.521 | 0.426 | 0.426 | 0.426 | 0.426 |
| 1988 | 0.018 | 0.093 | 0.195 | 0.323 | 0.397 | 0.479 | 0.446 | 0.479 | 0.392 | 0.392 | 0.392 | 0.392 |
| 1989 | 0.017 | 0.089 | 0.185 | 0.307 | 0.378 | 0.455 | 0.423 | 0.455 | 0.372 | 0.372 | 0.372 | 0.372 |
| 1990 | 0.019 | 0.101 | 0.211 | 0.35 | 0.43 | 0.519 | 0.483 | 0.519 | 0.425 | 0.425 | 0.425 | 0.425 |
| 1991 | 0.021 | 0.108 | 0.226 | 0.375 | 0.461 | 0.555 | 0.517 | 0.555 | 0.455 | 0.455 | 0.455 | 0.455 |
| 1992 | 0.02 | 0.106 | 0.221 | 0.367 | 0.452 | 0.544 | 0.507 | 0.544 | 0.446 | 0.446 | 0.446 | 0.446 |
| 1993 | 0.022 | 0.115 | 0.24 | 0.398 | 0.49 | 0.59 | 0.549 | 0.59 | 0.483 | 0.483 | 0.483 | 0.483 |
| 1994 | 0.025 | 0.131 | 0.272 | 0.451 | 0.555 | 0.669 | 0.622 | 0.669 | 0.547 | 0.547 | 0.547 | 0.547 |
| 1995 | 0.026 | 0.133 | 0.278 | 0.46 | 0.566 | 0.682 | 0.635 | 0.682 | 0.559 | 0.559 | 0.559 | 0.559 |
| 1996 | 0.022 | 0.116 | 0.243 | 0.402 | 0.495 | 0.596 | 0.555 | 0.596 | 0.488 | 0.488 | 0.488 | 0.488 |
| 1997 | 0.035 | 0.144 | 0.23 | 0.31 | 0.412 | 0.517 | 0.555 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| 1998 | 0.029 | 0.117 | 0.186 | 0.252 | 0.334 | 0.419 | 0.45 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 |
| 1999 | 0.03 | 0.122 | 0.194 | 0.262 | 0.348 | 0.437 | 0.469 | 0.448 | 0.449 | 0.449 | 0.449 | 0.449 |
| 2000 | 0.031 | 0.128 | 0.205 | 0.277 | 0.367 | 0.461 | 0.494 | 0.472 | 0.473 | 0.473 | 0.473 | 0.473 |
| 2001 | 0.026 | 0.108 | 0.172 | 0.232 | 0.308 | 0.387 | 0.415 | 0.397 | 0.397 | 0.397 | 0.397 | 0.397 |
| 2002 | 0.029 | 0.117 | 0.187 | 0.253 | 0.336 | 0.422 | 0.453 | 0.432 | 0.433 | 0.433 | 0.433 | 0.433 |
| 2003 | 0.028 | 0.115 | 0.184 | 0.248 | 0.329 | 0.413 | 0.444 | 0.424 | 0.424 | 0.424 | 0.424 | 0.424 |

| 2004 | 0.038 | 0.19 | 0.27 | 0.281 | 0.261 | 0.251 | 0.28 | 0.316 | 0.358 | 0.358 | 0.358 | 0.358 |
|------|-------|------|------|-------|-------|-------|------|-------|-------|-------|-------|-------|
| 2005 | 0.041 | 0.207 | 0.296 | 0.307 | 0.286 | 0.275 | 0.306 | 0.345 | 0.392 | 0.392 | 0.392 | 0.392 |
| 2006 | 0.045 | 0.223 | 0.319 | 0.331 | 0.308 | 0.296 | 0.33 | 0.372 | 0.422 | 0.422 | 0.422 | 0.422 |
| 2007 | 0.041 | 0.204 | 0.291 | 0.303 | 0.281 | 0.271 | 0.302 | 0.34 | 0.386 | 0.386 | 0.386 | 0.386 |
| 2008 | 0.047 | 0.235 | 0.335 | 0.348 | 0.323 | 0.311 | 0.347 | 0.391 | 0.444 | 0.444 | 0.444 | 0.444 |
| 2009 | 0.044 | 0.22 | 0.314 | 0.326 | 0.303 | 0.291 | 0.325 | 0.367 | 0.416 | 0.416 | 0.416 | 0.416 |
| 2010 | 0.039 | 0.197 | 0.281 | 0.292 | 0.271 | 0.261 | 0.291 | 0.328 | 0.372 | 0.372 | 0.372 | 0.372 |
| 2011 | 0.036 | 0.18 | 0.256 | 0.266 | 0.247 | 0.238 | 0.265 | 0.299 | 0.34 | 0.34 | 0.34 | 0.34 |
| 2012 | 0.034 | 0.172 | 0.245 | 0.255 | 0.237 | 0.228 | 0.254 | 0.287 | 0.325 | 0.325 | 0.325 | 0.325 |
| 2013 | 0.037 | 0.184 | 0.262 | 0.273 | 0.253 | 0.244 | 0.272 | 0.306 | 0.348 | 0.348 | 0.348 | 0.348 |
| 2014 | 0.027 | 0.135 | 0.192 | 0.2 | 0.185 | 0.178 | 0.199 | 0.224 | 0.254 | 0.254 | 0.254 | 0.254 |
| 2015 | 0.025 | 0.126 | 0.18 | 0.187 | 0.174 | 0.167 | 0.187 | 0.21 | 0.239 | 0.239 | 0.239 | 0.239 |
| 2016 | 0.023 | 0.113 | 0.162 | 0.168 | 0.156 | 0.15 | 0.167 | 0.189 | 0.214 | 0.214 | 0.214 | 0.214 |
| 2017 | 0.018 | 0.089 | 0.128 | 0.133 | 0.123 | 0.119 | 0.132 | 0.149 | 0.169 | 0.169 | 0.169 | 0.169 |
| 2018 | 0.024 | 0.122 | 0.174 | 0.181 | 0.168 | 0.162 | 0.181 | 0.203 | 0.231 | 0.231 | 0.231 | 0.231 |
| 2019 | 0.03 | 0.148 | 0.211 | 0.219 | 0.204 | 0.196 | 0.219 | 0.247 | 0.28 | 0.28 | 0.28 | 0.28 |

**Table 8.9. Saithe in division Va. Output from short-term projections.**

| 2018 | | | |
|------|-----|------|----------|
| B4+ | SSB | Fbar | Landings |
| 490 | 233 | 0.165 | 70 |

| 2019 | | | | 2020 | | |
|------|-----|------|----------|------|-----|-----------|
| B4+ | SSB | Fbar | Landings | B4+ | SSB | Rationale |
| 452 | 259 | 0.2 | 81 | 417 | 263 | 20% HCR |

**20% HCR = average between 0.2 B4+ (current year) and last year's TAC.**
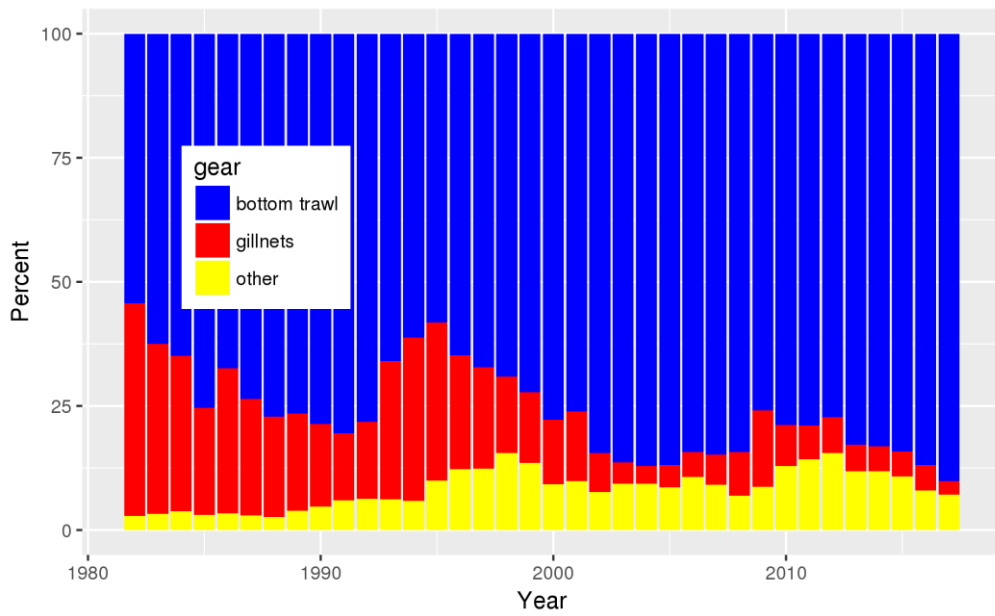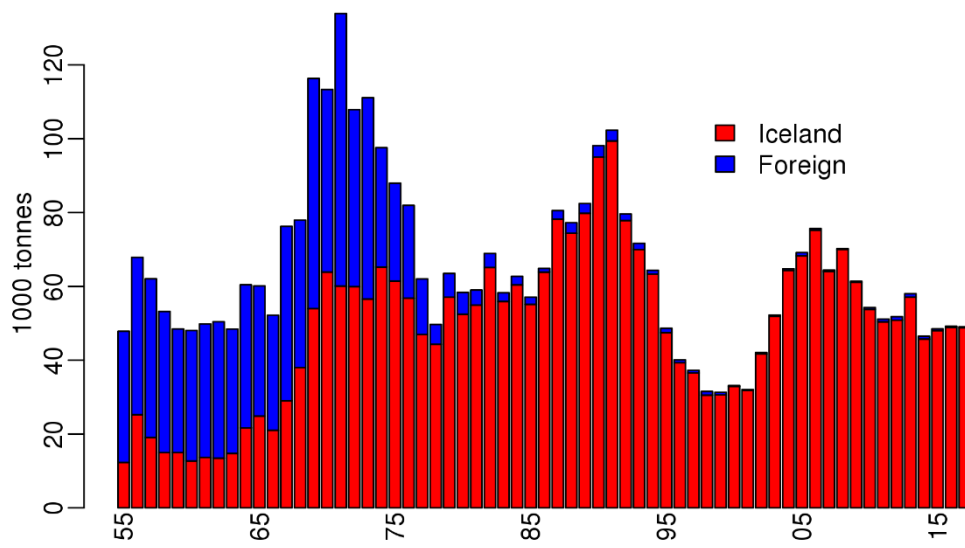
**Figure 8.1 Saithe in Division Va.  Total landings and percent by gear.**
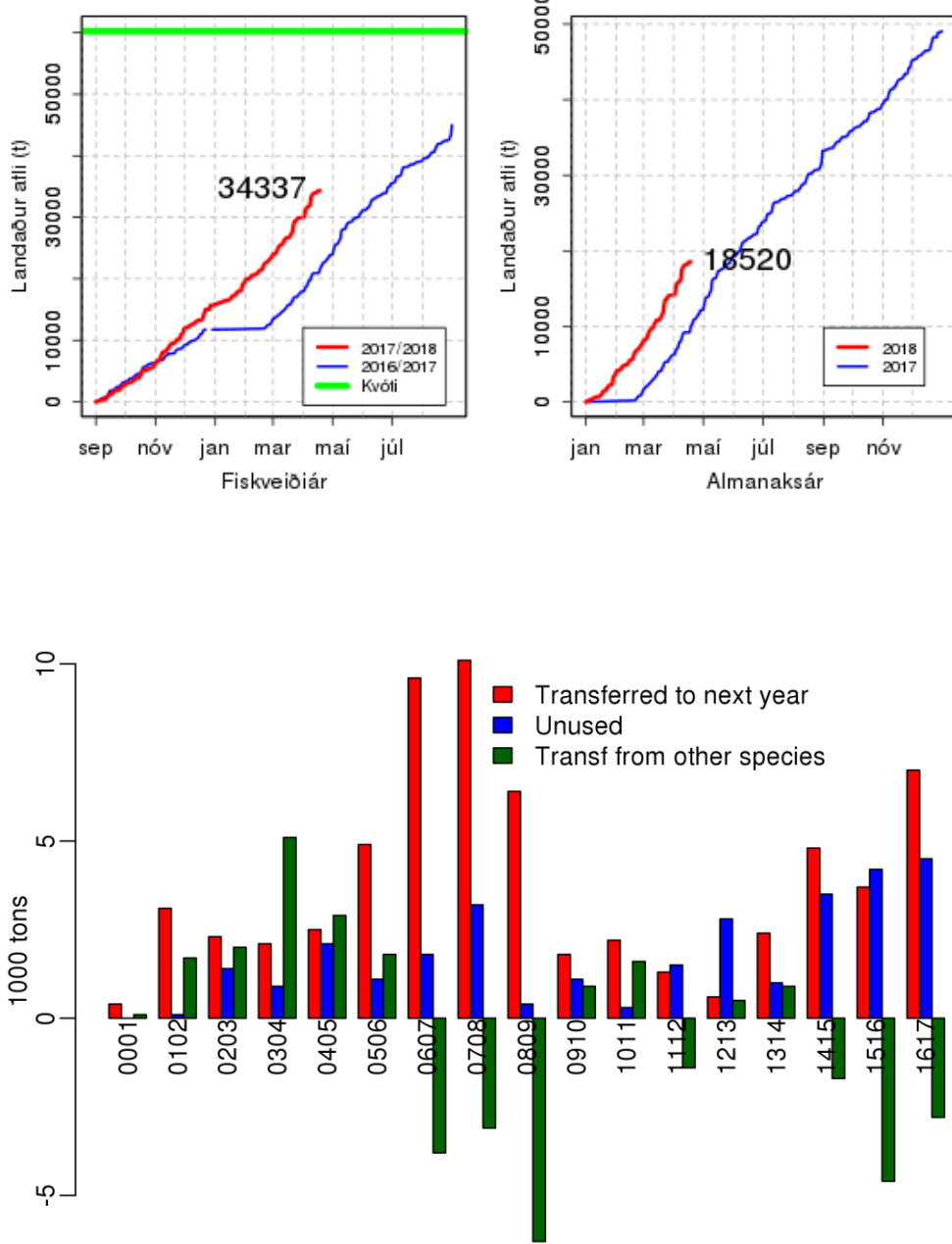
**Figure 8.2 Saithe in division Va. Upper figure. Cumulative landings in the current fishing year (left) and calendar year (right). The vertical (green line) in the left figure shows the quota for the current fishing year. Lower figure. Transfer of quota to next fishing year, unused quota and transfer from other species (negative transfer from other species means transfer to other species).**
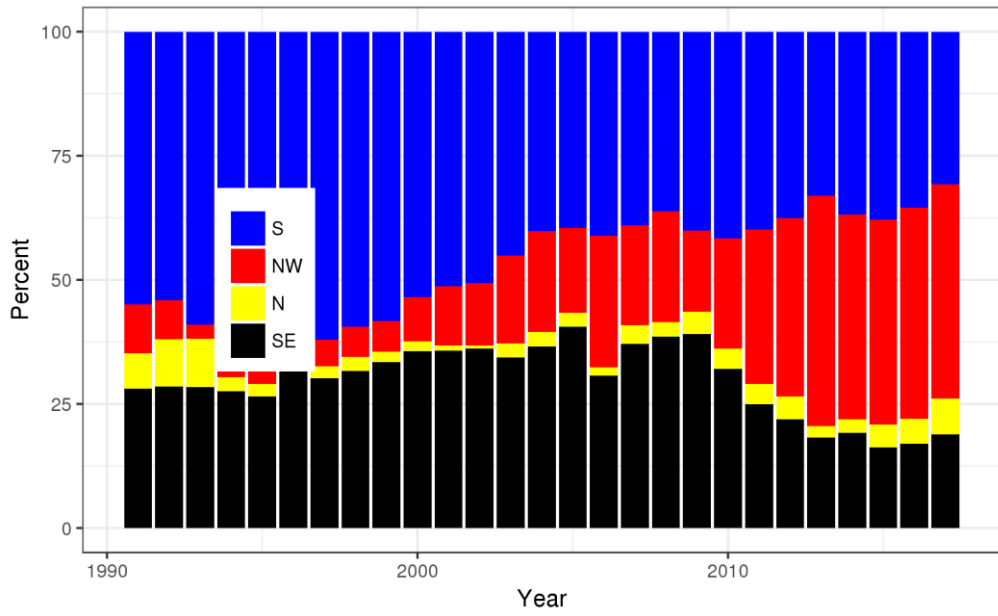
**Figure 8.3 Saithe in division Va. Percent of landings by regions defined in figure 8.4.**
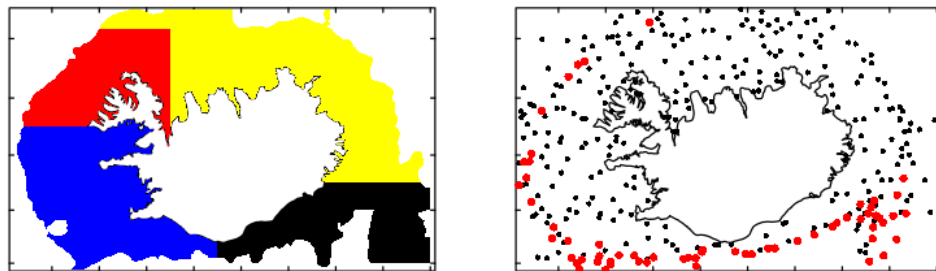


**Figure 8.4 Saithe in division Va. Left, definitions of regions used in figures 8.3 and 8.6. Right, stations added in the autumn survey in 2000 (red dots).**
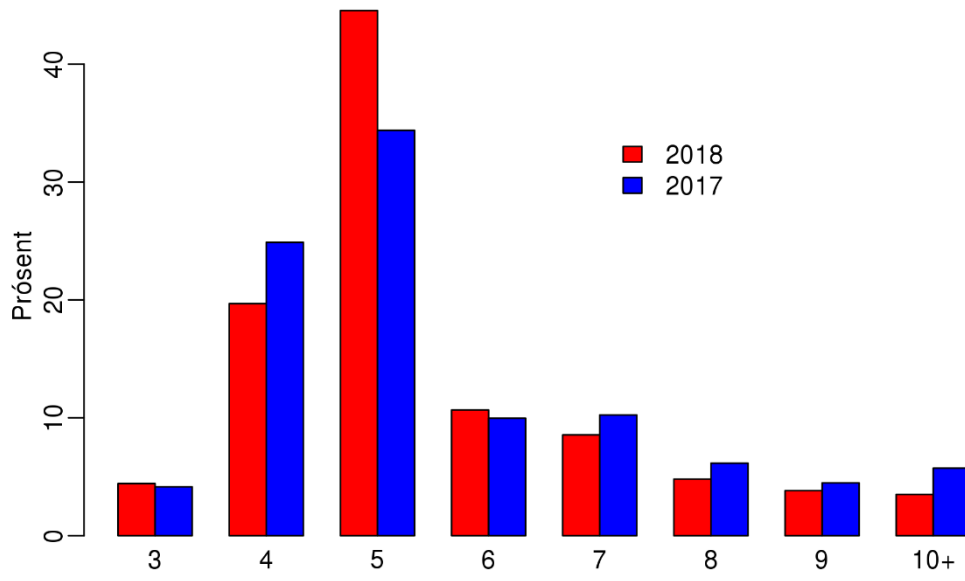
**Figure 8.5. Catch in numbers 2017 compared to last years prediction.**
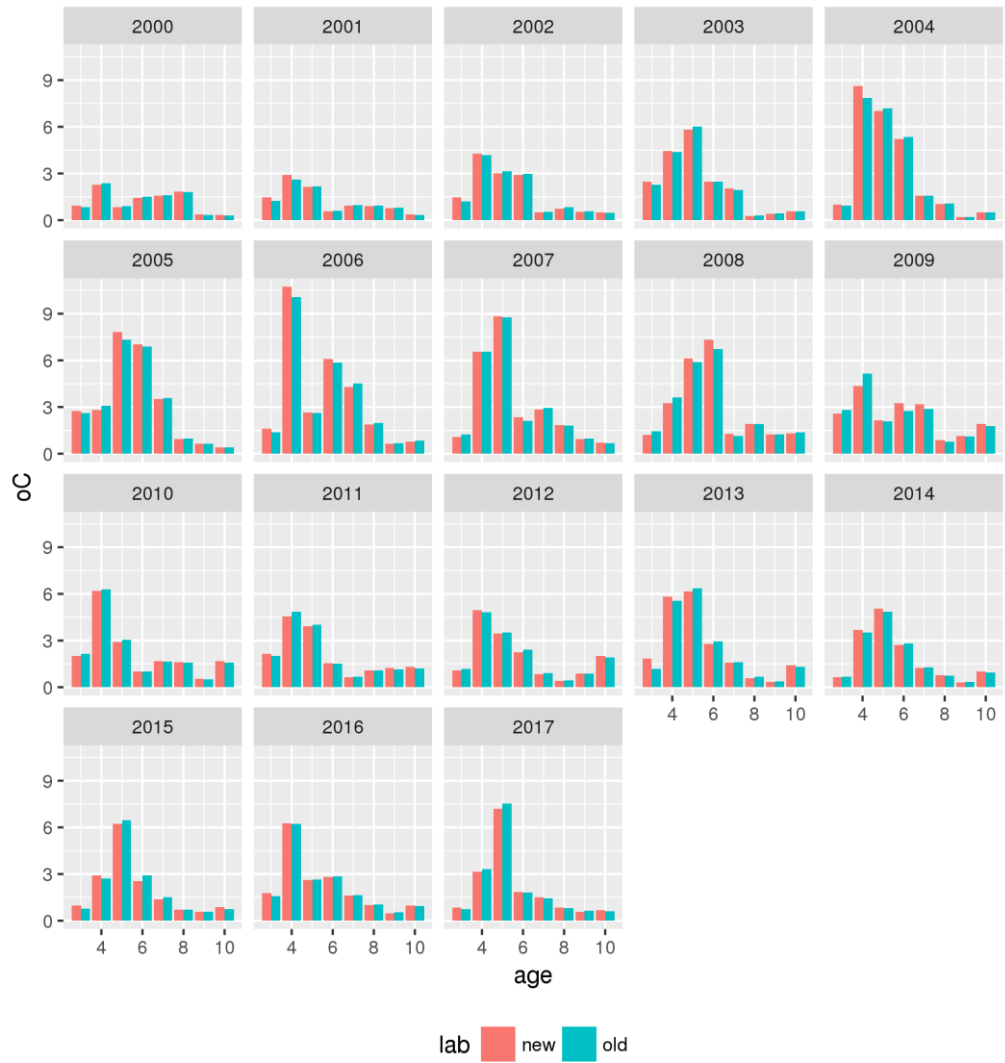
**Figure 8.6. Catch in numbers 2000-2017 compiled by 1 region and 1 time interval (old) compared to catch in numbers compiled by 2 regions and 2 time interval (new) . The regions are shown in figure 8.4, north red and yellow and south blue and black.**
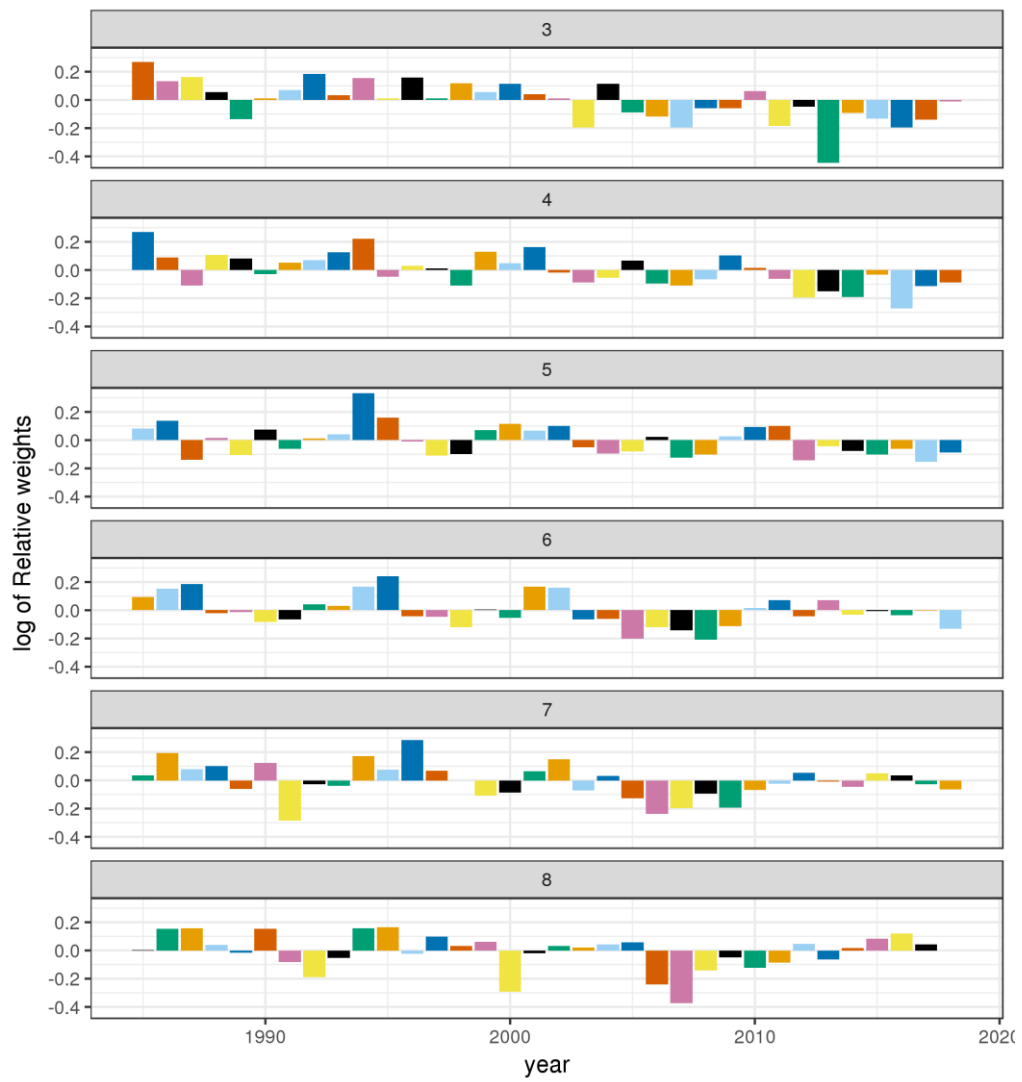
**Figure 8.7 Saithe in division Va. Weight at age in the survey, as relative deviations from the mean.**
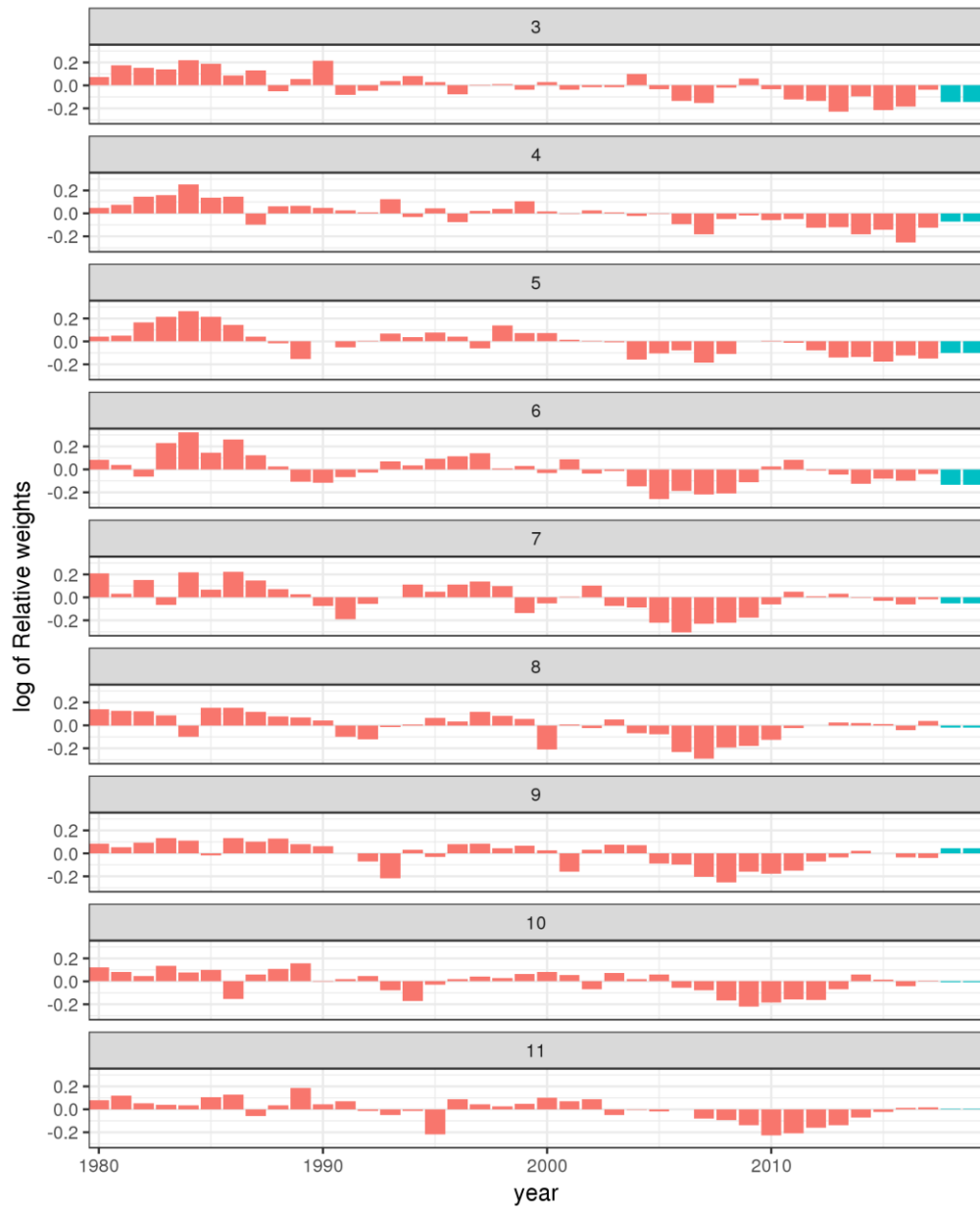
**Figure 8.8 Saithe in division Va. Weight at age in the catches, as relative deviations from the mean. Blue bars show prediction.**
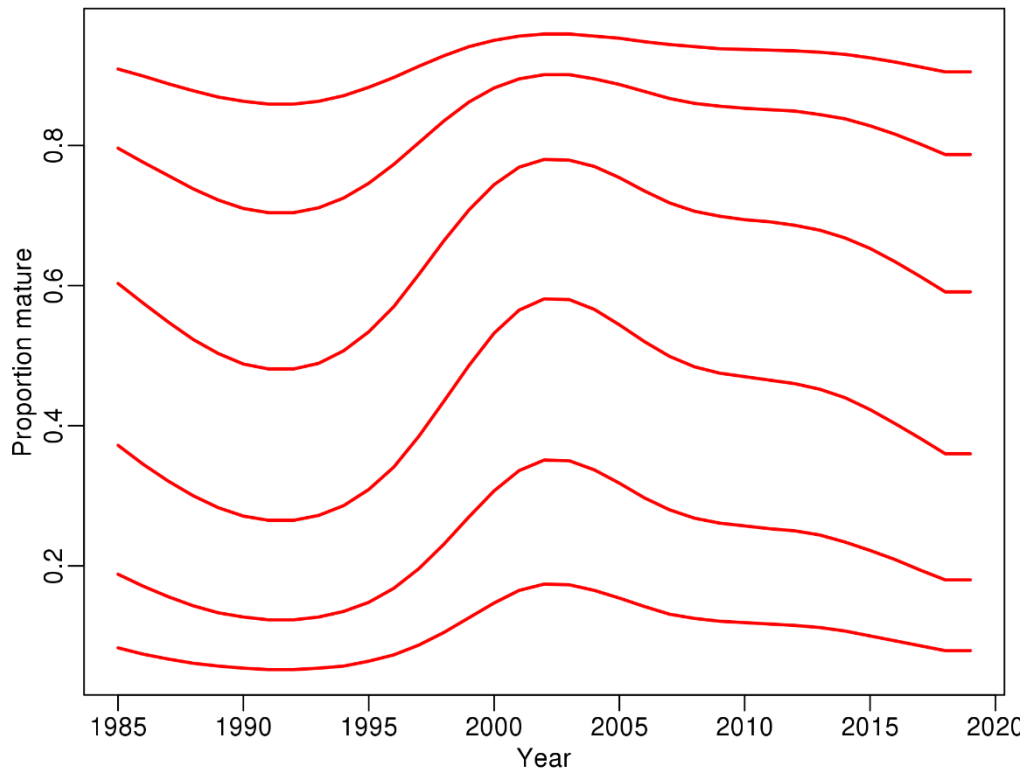
**Figure 8.9 Saithe in division Va. Maturity at age used for calculating the SSB.**
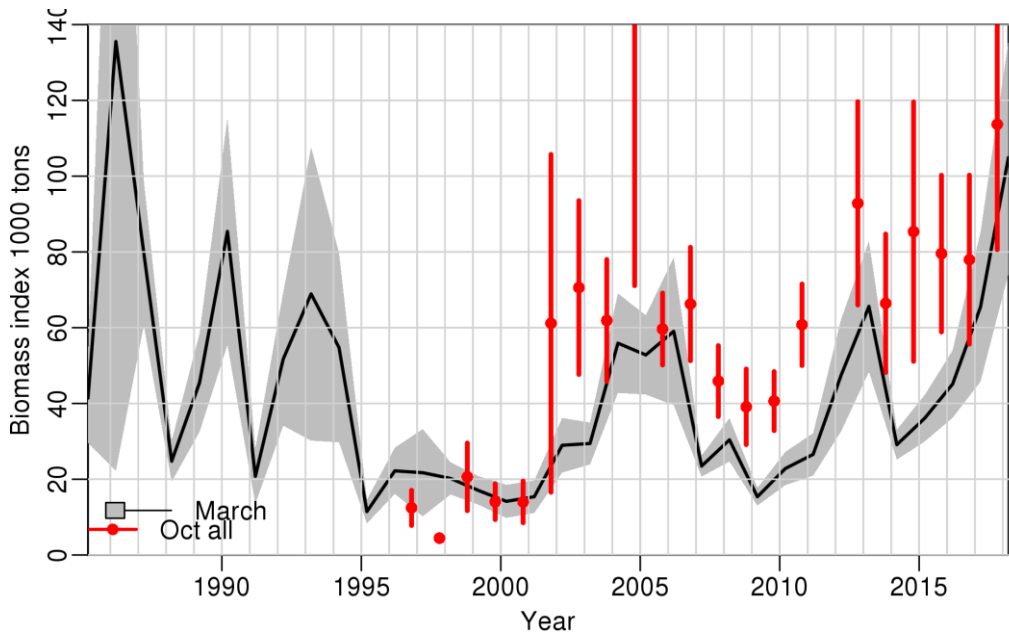


**Figure 8.10 Saithe in division Va. Biomass index from the groundfish surveys in March and October.**
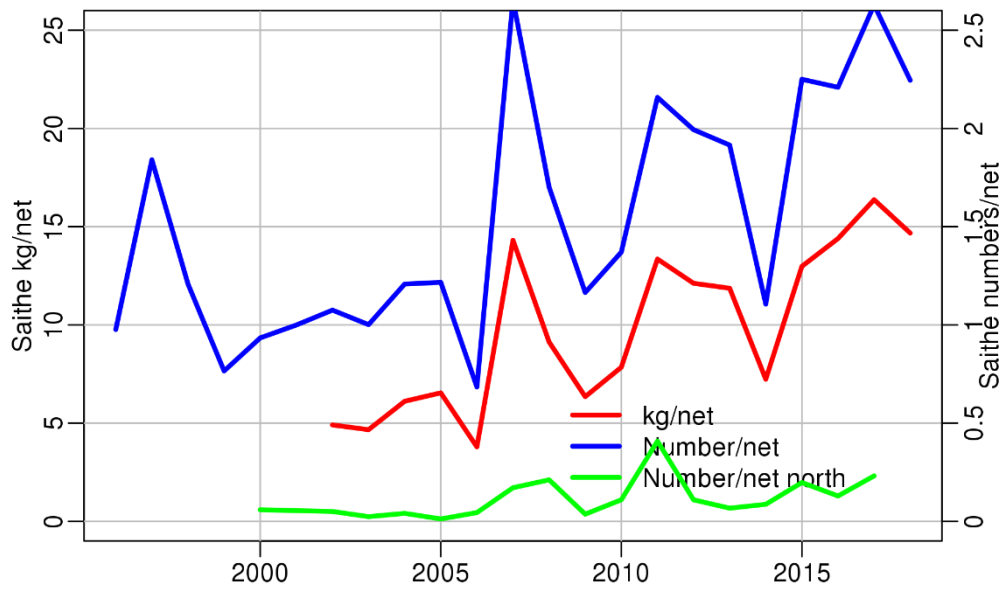
**Figure 8.11 Saithe in division Va Indices from the gillnet survey in April 1996-2018. Saithe was not length measured in the survey before 2002 so catch in kg cannot be compiled. (add 2018)**
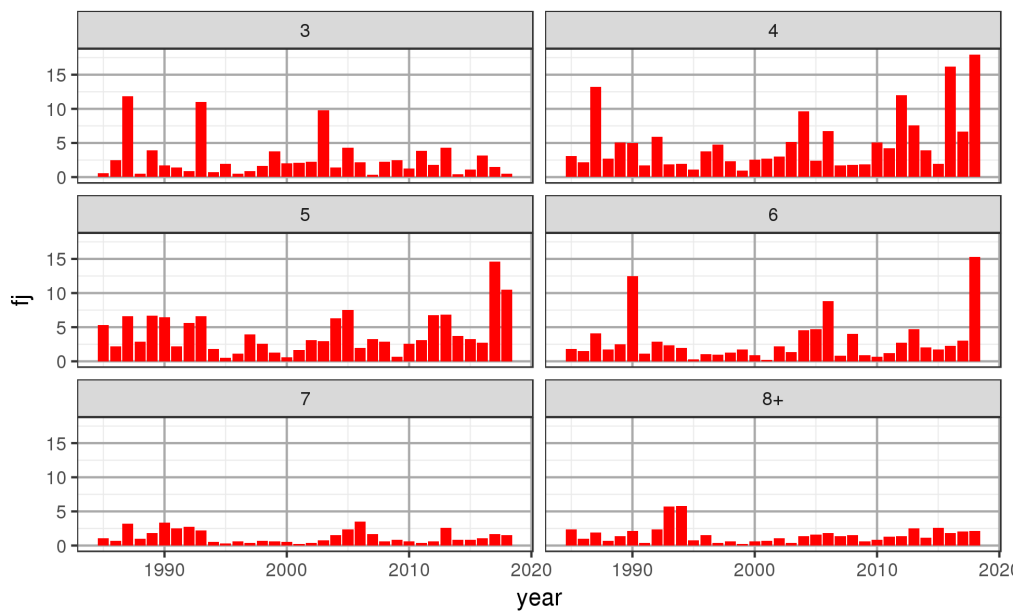


**Figure 8.12 Saithe in division Va Survey indices by age from the spring survey.**
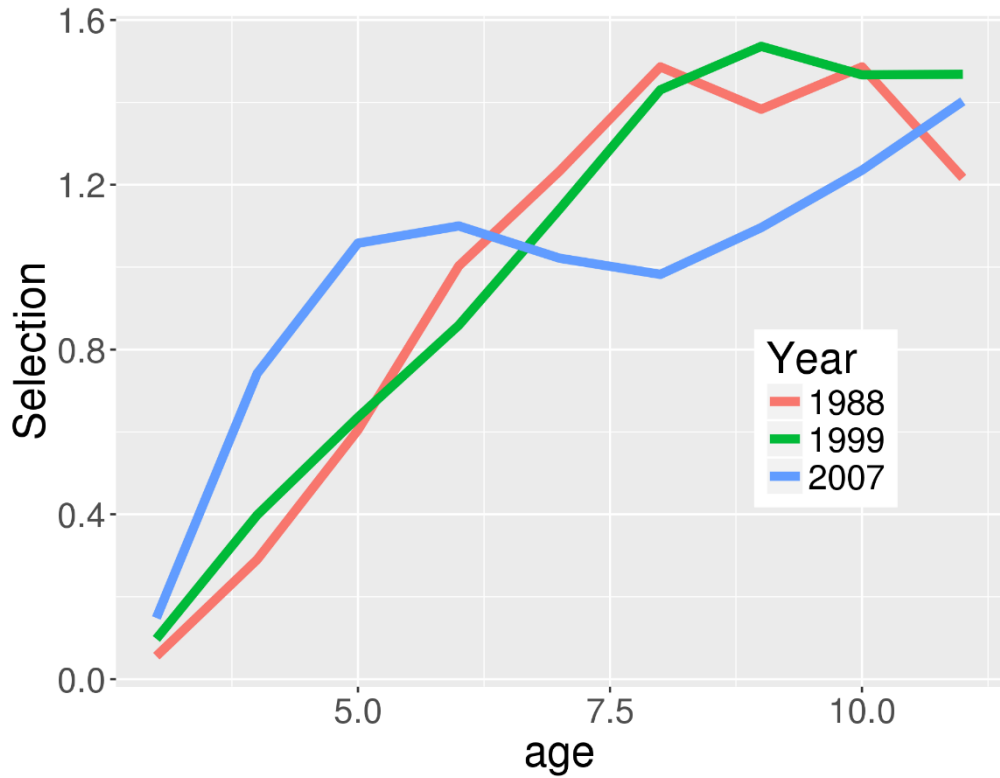
**Figure 8.13. Estimated selectivity patterns for the 3 periods, 1980-1996, 1997-2003 and 2014-2016.**
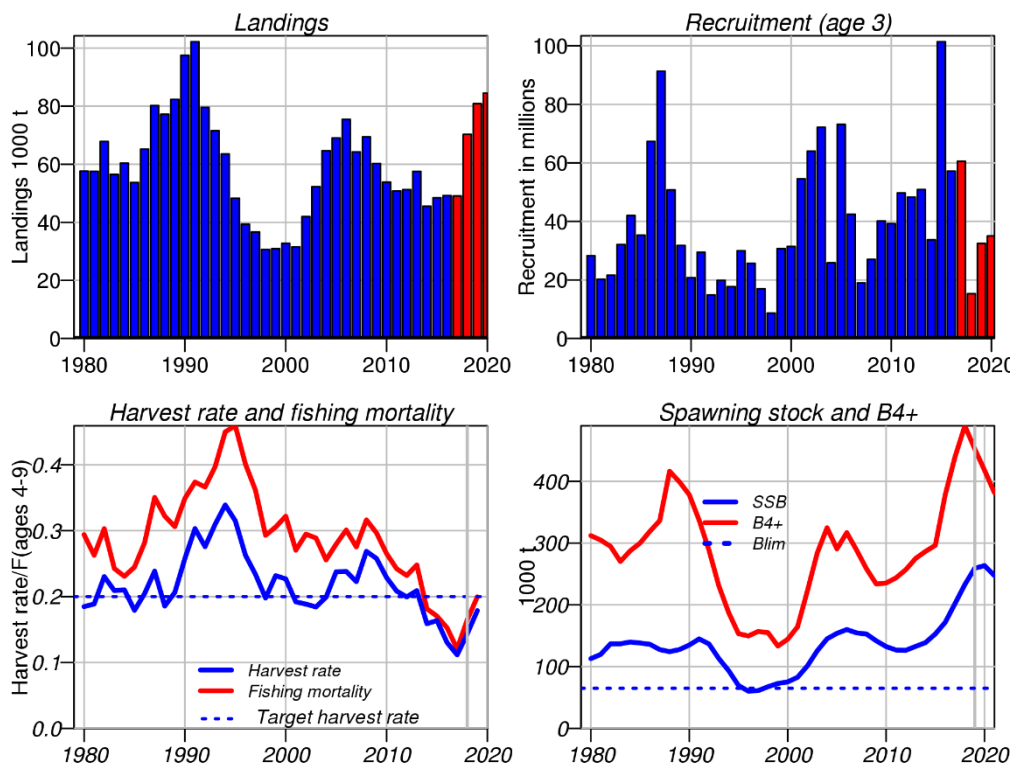


**Figure 8.14. Saithe in division Va. Results from the fitted model and short-term forecast. The red line indicates the time of the current assessment.**
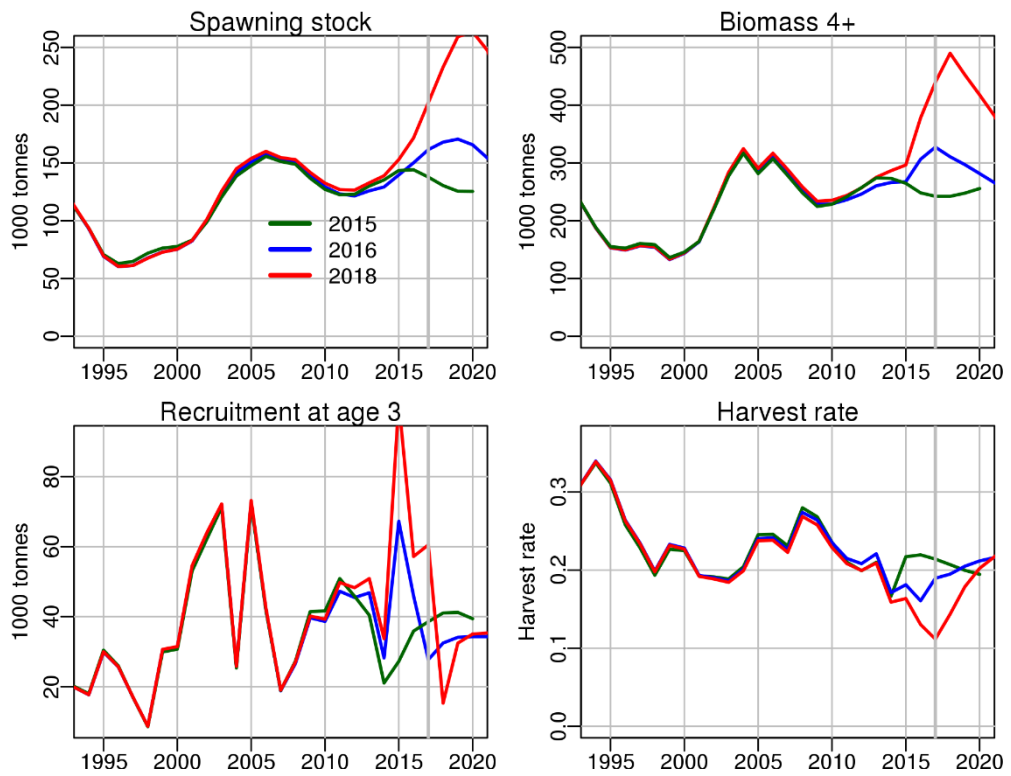
**Figure 8.15. Saithe in division Va. Comparison of this year's assessment and short term forecast with results from two earlier years.**
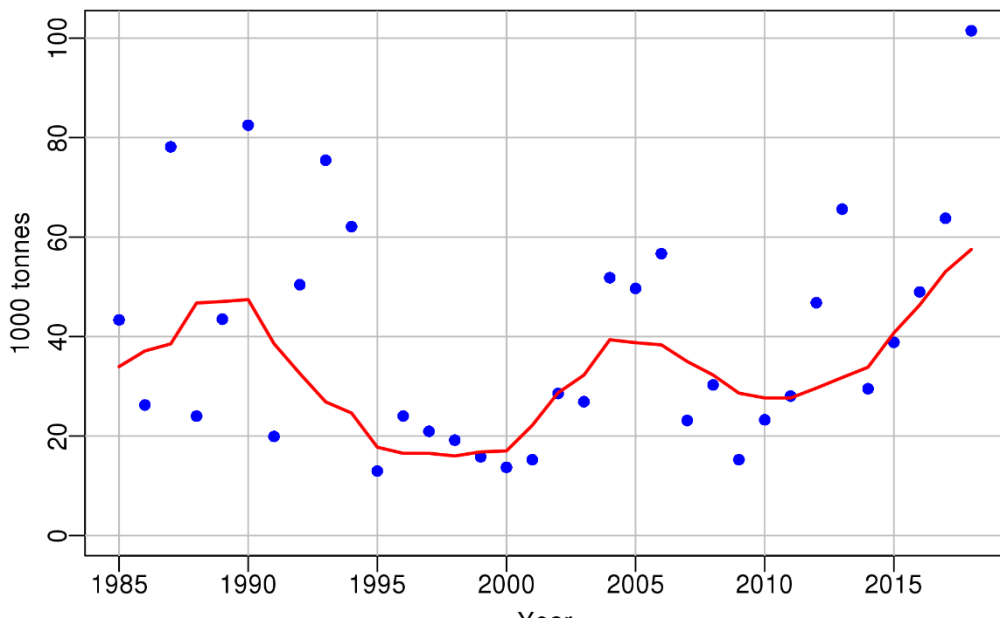


**Figure 8.16. Saithe in division Va. Observed and predicted survey biomass from the "SPALY model".**
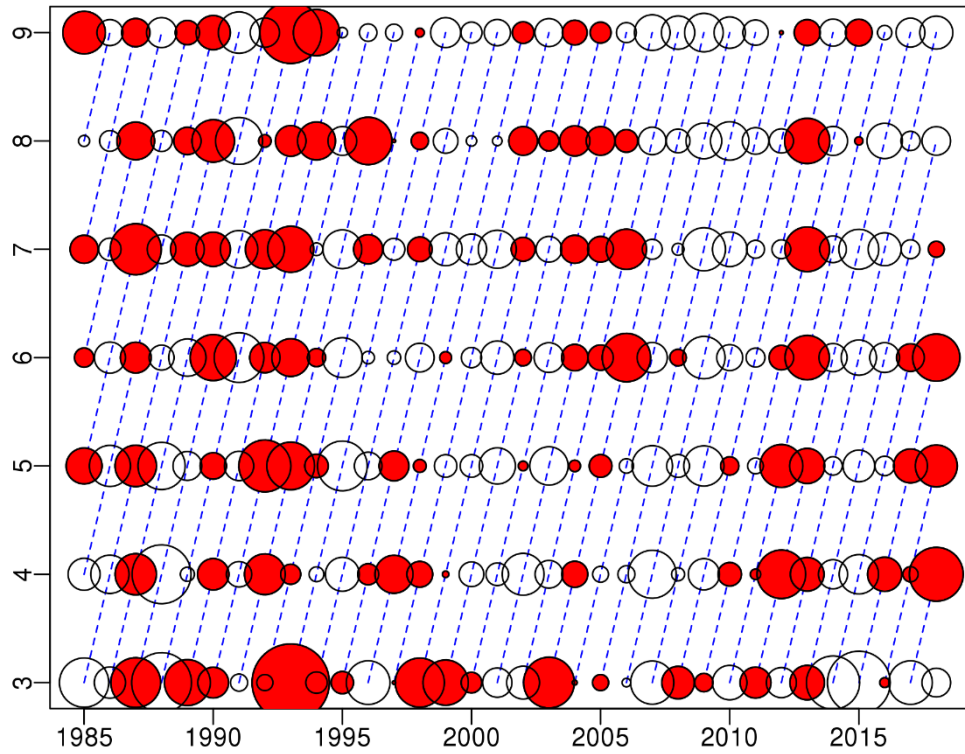
Figure 8.17. Saithe in division Va. Survey residuals from the "SPALY model".
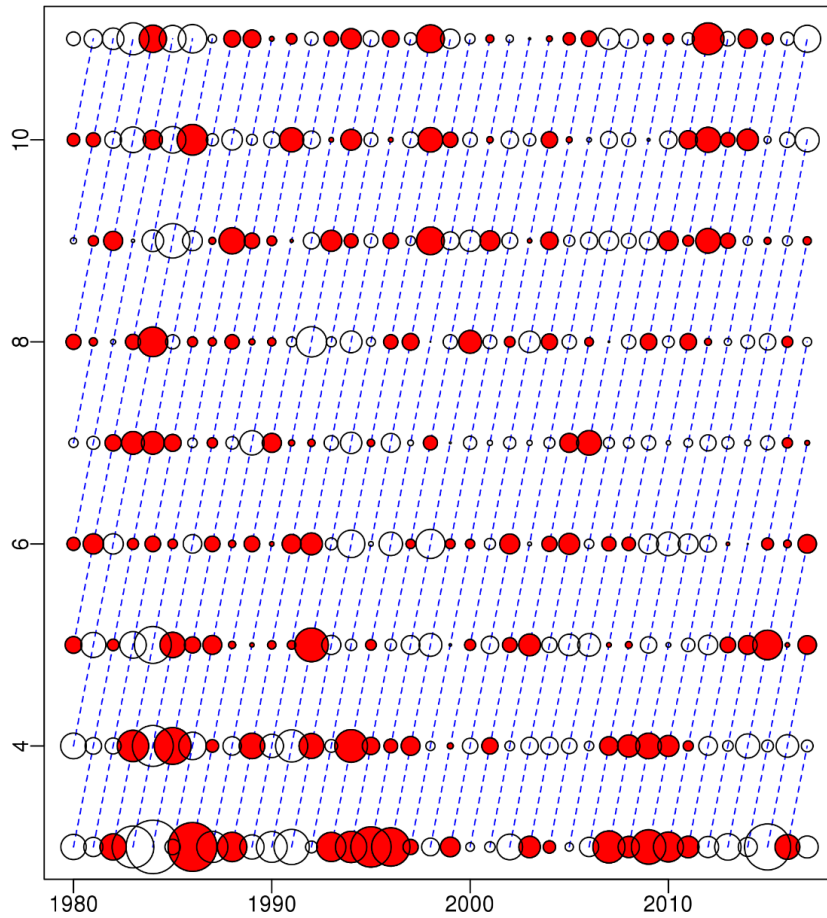


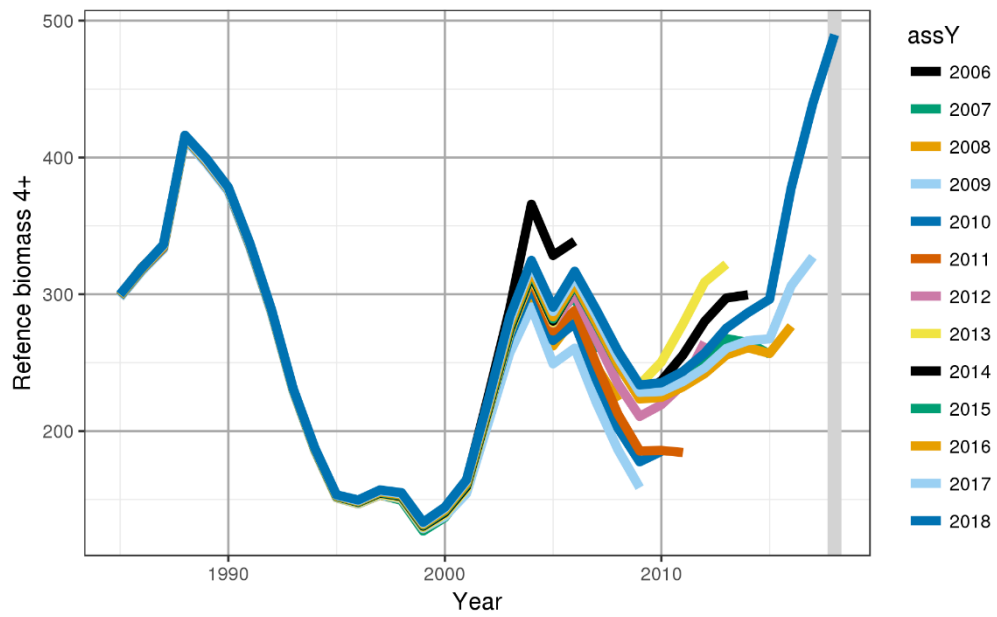Figure 8.18. Saithe in division Va. Catch residuals from the "SPALY model".

**Figure 8.19. Saithe in division Va. Retrospective pattern for the assessment model. The figure shows estimate of B4+. The grey vertical lines shows the year 2018.**
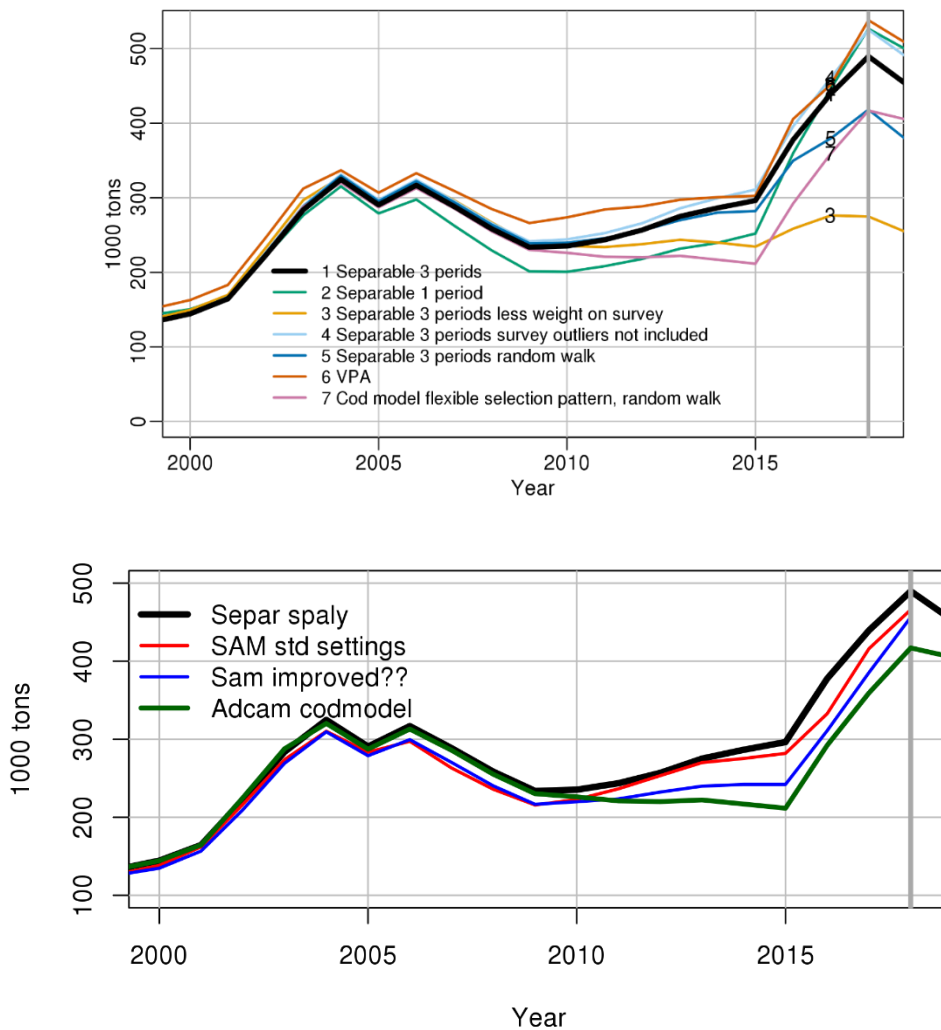




**Figure 8.20. Saithe in division Va. Comparison between the default separable model (ADSEP) and alternative assessment model settings.**
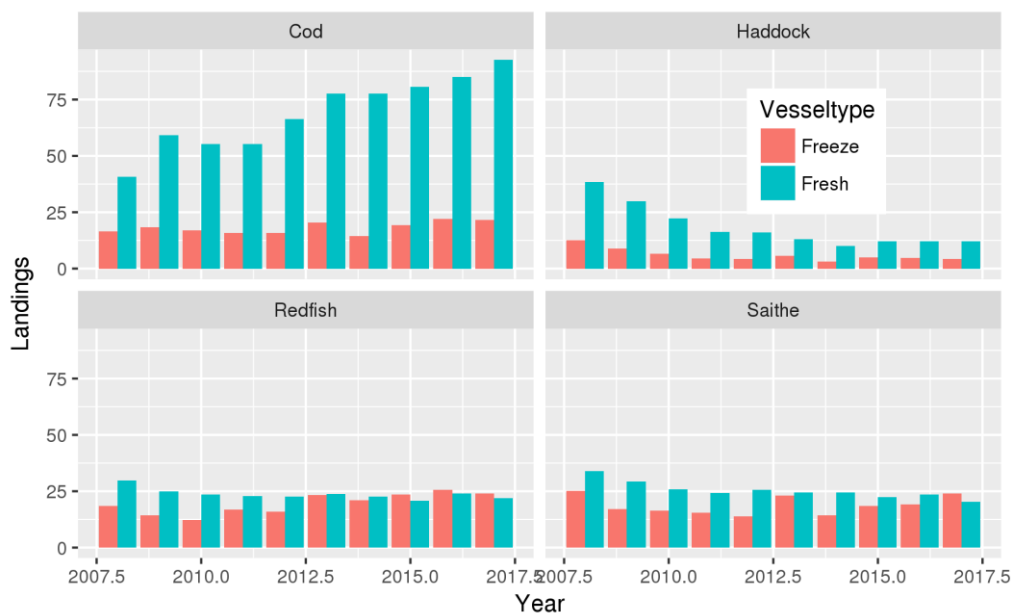
**Figure 8.21. Saithe in division Va. Catch by trawlers divided between those that freeze the catch and those that do not. Number of trawlers landing has been reducing gradually from 73 in 2008 to 63 in 2017 (including vessels landing > 500 t each year) but the number of freezing trawlers has been 17-18 all the time. The freezing trawlers have therefore been 20-28% of the total number of trawlers.**