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# Assessment of the International Fishery for Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2014

**by**

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**Abstract**

The development of the international shrimp (*Pandalus borealis*) fishery in NAFO Division 3M is described. Various indices show that even the stock was in high levels in 2006 and 2007 the lack of good recruitments in the last years and the progressive disappearance of the strong year classes 2001 and 2002 have caused a drastic decline of the stock. Although the fishing effort in recent years was low and from 2011 a moratorium over shrimp fishery was established, the increase of cod biomass (the most important predator of northern shrimp in 3M) has probably been the cause of the successive bad recruitments and resulting decline of the stock. The revised Nominal catches declined from 63 970 tonnes in 2003 to 5 448 tonnes in 2009 and 1 988 in 2010. No catches have been recorded since 2011 due to the moratorium. The female biomass from EU survey was variable though without trends at a relative high level from 1998 to 2007 but since then the estimated biomass initiated a drastic decline to lowest levels in the EU survey series from 2011 to present. Also after the strong 2002 year-class (i.e. age 2 in 2004), all the subsequent year classes have been weak and the recruitment prospects remain uncertain.

Considering the 15% of the maximum survey female biomass index as a limit reference point for biomass ($B_{lim}$), the stock remain since 2011 in the collapse zone defined by the NAFO PA framework. The low exploitation rates in the recent past years and the moratorium in 2011-2014 have not provoked changes in the state of the stock. Also the recruitment prospects remain uncertain and therefore the fishing mortality would be set as close to zero as possible in 2015.

## 1. INTRODUCTION

The fishery for northern shrimp at Flemish Cap began in the spring of 1993 and has since continued with estimated annual catches (as estimated by STACFIS, Table 1) of approximately 26 000 t to 48 000 t in the years 1993 through 1996. After 1996 the catches were lower and rising slowly from 26 000 t in 1997 to 53 000 t in 2000 and 200. There was 50 000 t taken in 2002. The catch increased in 2003, reaching the highest value in the catches series (64 000 t). After 2003 the catches decreased all years to 1 988 t in 2010. Due to moratorium initiated in 2011 have not been recorded catches from that year and in 2014 are only expected very low catches from discards of other fisheries.

Since 1993 the number of vessels ranged from 40-110, and in 2006 there were approximately 20 vessels fishing shrimp in Div. 3M compared to 50 in 2004. There is not a lot of information on the number of vessels taking part in the shrimp fishery since 2007 but probably they do not exceeded 13 units in 2010. Since 2011 due to the moratorium there is no vessels directed to shrimp fishery in Div. 3M.

With the closure of the international shrimp (*Pandalus borealis*) fishery in NAFO Division 3M, various indices from the EU surveys are listed with the purpose of tracking the status of the Flemish Cap shrimp stock. Among these the indices of female stock from the EU surveys is used. The results from the ageing are presented and some recruitment indices from the EU survey are provided.

## 2. MATERIAL AND METHODS

*Samples*

From 2011 due to the moratorium shrimp samples were only taken from EU-Flemish Cap research summer surveys. They were separated into 3 categories namely, males, primiparous females (including transitional) and multiparous females according to the sternal spine criterion (McCrary. 1971), oblique carapace lengths were measured using sliding callipers and grouped into 0.5 mm length-classes.

Modal analysis (MacDonald and Pitcher, 1979) was conducted each year on length frequency distribution by sex group resulting from the survey. This analysis provided the proportion; mean lengths and standard deviations of the mean length (sigma) for each age component and sex group. The total number of individuals in every age/sex group according to the estimated biomass was calculated transforming the mean length to weight using the weight length relationship. So, the mean lengths were converted to mean weights to estimate the annual abundance and biomass indices by year and sex group (Skúladóttir and Diaz, 2001).

## 3. CATCH and CPUE

The total catch per year is listed by nations in Table 1. The annual catches come mostly from Statlant 21A reports and in some cases from the shrimp specialists of individual countries. Because the moratorium no catches have been recorded from 2011 and to 10 September in 2014 the table was only revised and updated (Fig. 1).

The closure of shrimp fishery from 2011 and therefore the lack of commercial catches of shrimp do not permit to follow the evolution of the stock using the standardized CPUE series estimated from the international fleet directed to the fishing shrimp in Div. 3M.

## 4. EXPLOITATION RATE

Considering the Exploitation rate estimated as nominal catches divided by the EU survey biomass index of the same year (Figure 2 and Table 2), this was high in the years 1994-1997 when biomass was generally lower. In the years 1998-2004 the catch rate has been rather stable at a lower level. From 2005 to 2008 despite the exploitation rate remained stable at relative low values (between 1.9-1.5), the UE survey indexes estimated decreased year after year. This trend continued in the recent years despite the moratorium established on 3M shrimp stock since 2011. In October 2011 Scientific Council noted that there are indications of factors other than fishery that may be involved in the current decline of the stock.

## 5. FEMALE INDICES

The biomass indices From EU surveys have been corrected in the years 1988 to 2002 for adjusting for the more efficient research vessel taken into use in 2003 (Casas *et al*. 2004). The spawning stock (female biomass) as determined from the EU survey biomass index (Figure 3 and Table 3) increased rapidly during the years prior to the fishery, from 1989 and 1990 to 1992. This may have been due to a gradual increase in stock size after the cod biomass declined in the area. But this was also a reflection of the very strong 1986 year class, most of which were

female during 1992. With the beginning of the shrimp fishery in 1993 the biomass declined up to 1997. After that the stock recovered reasonably well although with high annual variability (historical maximums in 2002 and 2005 were followed by years with lower biomass but at a relative high level). In 2009 the female biomass decreased to values close to the historical minimums in the survey series. In 2010 despite of the biomass increase about 77% compared to 2009 this was still among the lowest in the historical series. The female biomass estimated from the moratorium (2011-2014) were the lowest values in the EU survey series, well below $B_{lim}$ proxy and shows the depletion state of the shrimp stock. In 2014 although the shrimp biomass increased slightly (4%) from 2013, the estimated biomass (717 t.) remained between the lowest recorded in the historical series. These low values in the size of the shrimp stock are likely associated to the increase of the cod stock experimented in recent years (Table 3 and Figures 4 and 5). In 2014 the cod biomass reached the historical maximum in the series and although this increase in the cod biomass was not followed by the corresponding decrease in the shrimp biomass, the significant and inverse correlation between cod and female shrimp biomass can still be observed.

## 6. SHRIMP PREDATION BY COD

In 2014 was carried out studies on feeding of cod but the information recorded has not yet been processed and so there is no new information since 2012 about the predation on shrimp by cod in Flemish Cap and the impact of the cod stock recovery in recent years on shrimp stock.

## 7. AGE ASSESSMENTS

Age analysis and sex composition was carried out on biological samples obtained from commercial fishery of a few nations in the past years (1993-2005). Since 2006 the samples obtained from the fishery were insufficient to assess the age of the catches and from 2011 due to the moratorium no sampling is available. So, the perception of the age composition and evolution of different year class along the years in the shrimp stock come from the age composition estimated in EU surveys (tables 4 and 5).

From those tables, some strong year-classes may be followed according the abundance by age groups from EU surveys (1988-2014). If the assignation of the age is right, the 1986 year-class stand out in the beginning of historical series with 4, 5 and 6 years olds in the years 1990, 1991 and 1992. The individuals with 4 year olds were also especially abundant in the years 1999-2002 indicating the strong of year-classes 1995, 1996, 1997 and 1998. The 1999 year-class stand out especially judging by the high number of 3 and 6 year olds in 2002 and 2005 years respectively. In these two years both the biomass and the abundance reached out the highest values in the series, especially in 2005 where the strong 2002 year class with 3 years old was also present. From 2004 to present the virtual absence of age group 1 in the catches and very low values for the ages 2 and 3 show the weakness of the 2003 -2013 year classes.

## 8. RECRUITMENT

Considering the abundance at age 2 as indicator of recruitment, the EU survey provided two recruitment indices. The abundance of two years olds obtained in the main trawl since 1996 and the abundance for this age group in the juvenile shrimp bag attached to the gear since 2001. Both are presented together in table 6 and Figure 6. The early years of the series showed very small numbers of age 2 but from 2002 the abundance increased. Also, from 2003 when automatic winches were introduced in the EU bottom trawl survey, the gear was considered to catch much more young shrimp than before.

Although the evolution of these two recruitment indices showed some differences along the years, the 2002 year-class, 2 year old in 2004 was the biggest seen in both gears and was also very conspicuous as seen in deviations and length frequencies as 3 year olds in 2005 and as 4 year olds in 2006 (Skúladóttir, 2006). The following year-classes (2003-2012) were weak and well below average.

## 9. PRECAUTIONARY APPROACH

In the absence of other suitable methods to indicate a limit reference point for biomass the EU survey biomass female index was used (SCS Doc. 04/12). The point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for $B_{lim}$.

The EU survey of Division 3M provides an index of female shrimp biomass from 1988 to 2014 with a maximum value of 17 091t in 2002 and a similar value of 15 500 in 1992. An 85% decline in this value would give a $B_{lim}$ = 2 600 t. The female biomass index was below this value before the beginning of the fishery (1989 and 1990) and most recently in 2009 and since 2011. If this method is accepted to define $B_{lim}$ the index in 2014 it is remain in the collapse zone (Figure 7).

## 10. SUMMARY

Catches of shrimp on the Flemish Cap have been maintained at a high level averaging 43 000 t. between 1995 and 2005. However since 2006 they decreased gradually being in 2010 around 1990 t. No catches have been reported since 2011 as consequence of the moratorium of this fishery.

After some years with exploitation rates stables at relative low values (1.9-1.5 from 2005 to 2008) the UE survey indexes estimated decreased year after year up to 2013. Although in 2014 the survey indexes increased compared to last year, they remain at very low level despite the moratorium established on 3M shrimp stock from 2011.

The female biomass index from the EU survey decreased between 1993 and 1994, increased since 1997 to 1998 and stayed stable to 2007. The strong decline of the female biomass index from 2008 to the present year confirms the decreasing trend of this stock, mainly caused by the weak recruitment in the last nine years.

Considering the 15% of the maximum survey female biomass index as a limit reference point for biomass ($B_{lim}$), the stock continues in 2013 in the collapse zone defined by the NAFO PA framework.

## 11. ACKNOWLEDGEMENT

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Table 1. Annual nominal catches (t) by country of northern shrimp (*Pandalus borealis*) caught in NAFO Div. 3M.

| Nation | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Canada** | 3724 | 1041 | 970 | 906 | 807 | 484 | 490 [2] | 618 [2] | 295 [1] | 16 | | | | 10 [1] | | | | | | | |
| **Cuba** | | | | | | | 119 | 46 [1] | 1037 [1] | 1537 [1] | 1462 [1] | 969 [1] | 964 [1] | 1126 [1] | 446 [1] | 11 | | | | | |
| **EU/Estonia** | | 1081 | 2092 | 1900 | 3240 | 5694 | 10835 [1] | 13256 [2] | 9851 [1] | 14215 [2] | 12851 [1] | 13444 [1] | 12009 [1] | 8466 [2] | 10607 [2] | 10255 [2] | 2152 [2] | 266 [2] | | | |
| **EU/Denmark** | 800 | 400 | 200 | | | 437 | 235 | | 93 [1] | 359 [1] | | | | | | | | | | | |
| **EU/Latvia** | | 300 | 350 | 1940 | 997 [1] | 1191 [1] | 3080 [1] | 3105 [1] | 2961 [1] | 1892 [1] | 3533 [1] | 3059 [1] | 2212 [1] | 1330 [1] | 1939 [1] | 1285 [1] | 1194 [1] | 611 [1] | | | |
| **EU/Lithuania** | | 1225 | 675 | 2900 | 1785 [1] | 3107 [1] | 3370 [1] | 3529 [1] | 2701 [1] | 3321 [1] | 3744 [1] | 4802 [1] | 3652 [1] | 1245 [1] | 1992 [1] | 485 [1] | | 102 [1] | | | |
| **EU/Poland** | | | | | 824 | 148 [1] | 894 [1] | 1692 [1] | 209 [1] | | | 1158 [1] | 458 [1] | 224 [1] | | | | | | | |
| **EU/Portugal** | 300 | | 150 | | 170 [1] | 203 [1] | 227 [1] | 289 [1] | 420 [1] | 16 [1] | | 50 [1] | | | | | 3 | | | | |
| **EU/Spain** | 240 | 300 | 158 | 50 | 423 [1] | 912 [1] | 1020 [1] | 1347 [1] | 855 [1] | 674 [1] | 857 [1] | 1049 [2] | 725 [2] | 997 [2] | 768 [1] | 406 [2] | 537 [1] | 507 [2] | | | |
| **EU/United Kingdom** | | | | | | | | | | | 547 [1] | | | | | | | | | | |
| **Faroe Is.** | 7333 | 6791 | 5993 | 8688 | 7410 | 9368 | 9199 | 7719 [2] | 10228 [2] | 8516 [2] | 12676 [2] | 4952 [1] | 2457 [1] | 1102 [1] | 2303 [1] | 1201 | 1349 [1] | 495 [1] | | | |
| **France (SPM)** | | | | | 150 | | | 138 [1] | 337 [1] | 161 [1] | | | 487 | | 741 [1] | | 193 [1] | | | | |
| **Greenland** | 3788 [1] | 2275 [1] | 2400 [1] | 1107 [1] | 104 [1] | 866 [1] | 576 [1] | 1734 [1] | | 644 [1] | 1990 [2] | | 12 [1] | 778 [2] | | | | | | | |
| **Iceland** | 2243 | 2355 [1] | 7623 | 20680 [1] | 7197 [1] | 6572 [1] | 9277 [2] | 8912 [2] | 5265 [2] | 5754 [1] | 4715 [1] | 3567 [1] | 4014 [1] | 2099 [1] | | | | | | | |
| **Japan** | | | | | | | | 114 [1] | 130 | 100 [1] | 117 [1] | | | | | | | | | | |
| **Norway** | 7183 | 8461 | 9533 | 5683 | 1831 [1] | 1339 [1] | 2975 [1] | 2669 [2] | 12972 [1] | 11833 [1] | 21238 [1] | 11738 [1] | 223 [1] | 890 [2] | 1914 [1] | 321 [2] | | | | | |
| **Russia** | | 350 | 3327 | 4445 | 1090 | | 1142 | 7070 [1] | 5687 [1] | 1176 [1] | 3 [1] | 654 [1] | 266 [1] | 46 [1] | 73 [1] | 21 [1] | 20 [1] | 7 [1] | | | |
| **Ukraine** | | | | | | | | | 348 [1] | | 237 [1] | 315 [1] | | 282 [1] | | | | | | | |
| **USA** | | | | | | | | 629 [1] | | | | | | | | | | | | | |
| **Total** | 25611 | 24579 | 33471 | 48299 | 26028 | 30321 | 43439 | 52867 | 53389 | 50214 | 63970 | 45757 | 27479 | 18595 | 20741 | 13985 | 5448 | 1988 | 0 | 0 | 0 |

1 NAFO Statlant 21 A
2 From the fisheries biologist of respective countries
* Provisional to 10 September

**Table 2.- Exploitation Rate of Shrimp (Div. 3M) as Nominal Catches (tons) divided by UE Survey Female Index (tons).**

| | Nominal Catches | UE Survey Index | Exploitation Rate |
|---|---|---|---|
| 1993 | 25611 | 6923 | 3.7 |
| 1994 | 24579 | 2945 | 8.3 |
| 1995 | 33471 | 4857 | 6.9 |
| 1996 | 48299 | 5132 | 9.4 |
| 1997 | 26028 | 4885 | 5.3 |
| 1998 | 30321 | 11444 | 2.6 |
| 1999 | 43439 | 13669 | 3.2 |
| 2000 | 52867 | 10172 | 5.2 |
| 2001 | 53389 | 13336 | 4.0 |
| 2002 | 50214 | 17091 | 2.9 |
| 2003 | 63970 | 11589 | 5.5 |
| 2004 | 45757 | 12081 | 3.8 |
| 2005 | 27479 | 14381 | 1.9 |
| 2006 | 18595 | 11359 | 1.6 |
| 2007 | 20741 | 12843 | 1.6 |
| 2008 | 13985 | 8630 | 1.6 |
| 2009 | 5448 | 1764 | 3.1 |
| 2010 | 1988 | 3819 | 0.5 |
| 2011 | 0 | 1132 | 0.0 |
| 2012 | 0 | 791 | 0.0 |
| 2013 | 0 | 691 | 0.0 |
| 2014[1] | 0 | 717 | 0.0 |

[1]Provisional to 10 September

**Table 3.- Shrimp Female and Cod biomass Indices from the EU survey series.**

| Year | Northern shrimp | | Cod |
|---|---|---|---|
| | Biomass (t) | St error | Biomass (t) |
| 1988 | 4525 | 842 | 40839 |
| 1989 | 1359 | 256 | 114050 |
| 1990 | 1363 | 172 | 59362 |
| 1991 | 6365 | 750 | 40248 |
| 1992 | 15472 | 2623 | 26719 |
| 1993 | 6923 | 995 | 60963 |
| 1994 | 2945 | 445 | 26463 |
| 1995 | 4857 | 521 | 9695 |
| 1996 | 5132 | 383 | 9013 |
| 1997 | 4885 | 345 | 9966 |
| 1998 | 11444 | 816 | 4986 |
| 1999 | 13669 | 1038 | 2854 |
| 2000 | 10172 | 775 | 3062 |
| 2001 | 13336 | 909 | 2695 |
| 2002 | 17091 | 1493 | 2496 |
| 2003 | 11589 | 921 | 1593 |
| 2004 | 12081 | 761 | 4071 |
| 2005 | 14381 | 933 | 5242 |
| 2006 | 11359 | 1238 | 12505 |
| 2007 | 12843 | 1564 | 23886 |
| 2008 | 8630 | 1399 | 42195 |
| 2009 | 1764 | 238 | 75228 |
| 2010 | 3819 | 381 | 69295 |
| 2011 | 1132 | 133 | 106314 |
| 2012 | 791 | 166 | 113218 |
| 2013 | 691 | 58 | 72289 |
| 2014 | 717 | 90 | 163420 |

**Table 4. Abundance ($10^6$) at age by years in EU Flemish Cap surveys.**

| Year<br>Age-class | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994[1] | 1995 | 1996 | 1997 | 1998[2] | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | 94 | 1 | 9 | 3 | 181 | 14 | | | | | | | 8 | | | 1 | |
| 2 | | | | | | | | | 342 | 63 | 5497 | 474 | 107 | 332 | 1100 | 1257 | 2742 | 179 | 58 | 30 | 22 | 118 | 110 | 60 | 23 | 6 | |
| 3 | 13 | 1 | | 47 | 159 | 788 | 43 | 243 | 857 | 289 | 4235 | 2392 | 1704 | 1877 | 4787 | 1774 | 960 | 6903 | 301 | 387 | 646 | 161 | 387 | 90 | 89 | 18 | 38 |
| 4 | 123 | 82 | 404 | 260 | 146 | 376 | 88 | 276 | 153 | 241 | 707 | 1496 | 1074 | 2015 | 1128 | 548 | 643 | 524 | 1949 | 1221 | 857 | 169 | 236 | 109 | 56 | 60 | 49 |
| 5 | 233 | 81 | 92 | 465 | 440 | 205 | 73 | 120 | 273 | 322 | 789 | 601 | 572 | 1184 | 1047 | 907 | 783 | 1050 | 1205 | 1276 | 575 | 91 | 80 | 31 | 12 | 40 | 46 |
| 6 | 163 | 83 | 33 | 389 | 1129 | 446 | 181 | 215 | 65 | 115 | 414 | 204 | 349 | 323 | 311 | 243 | 133 | 758 | 522 | 588 | 40 | 25 | 15 | 0 | 1 | 3 | 7 |
| 7 | 15 | 11 | 2 | 103 | 398 | 49 | 8 | 122 | 44 | 16 | 15 | 8 | 61 | 16 | 55 | 9 | 21 | 141 | 65 | 129 | | 7 | | | | | |
| 8 | | | | 33 | | | | | | | | | | | | | | | | | | | | | | | |
| total ('000000) | 548 | 258 | 530 | 1296 | 2271 | 1864 | 391 | 976 | 1734 | 1046 | 11751 | 5177 | 3876 | 5750 | 8608 | 4753 | 5281 | 9554 | 4098 | 3631 | 2141 | 570 | 836 | 290 | 179 | 128 | 140 |

[1]Codend mesh-size 40 mm.
[2]Codend mesh-size 25 mm.

**Table 5. Biomass estimated (tons) at age by years in EU Flemish Cap surveys.**

| Year<br>Age-class | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994[1] | 1995 | 1996 | 1997 | 1998[2] | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | 60 | 0.5 | 6 | 2 | 114 | 6 | | | | | | | 9 | | | 1 | |
| 2 | | | | | | | | | 609 | 139 | 9039 | 832 | 183 | 572 | 2178 | 2541 | 4660 | 187 | 57 | 38 | 33 | 303 | 372 | 177 | 63 | 21 | |
| 3 | 44 | 2 | | 166 | 610 | 2144 | 145 | 685 | 4552 | 1270 | 16203 | 7811 | 5924 | 5018 | 16710 | 7134 | 3730 | 15782 | 586 | 837 | 2094 | 600 | 2029 | 461 | 450 | 85 | 139 |
| 4 | 575 | 387 | 2053 | 1214 | 705 | 2083 | 554 | 1658 | 1071 | 1705 | 4099 | 9016 | 5233 | 9992 | 6436 | 2762 | 3969 | 2109 | 5882 | 4764 | 4491 | 892 | 1690 | 726 | 431 | 379 | 322 |
| 5 | 2377 | 626 | 888 | 3843 | 3683 | 1823 | 681 | 892 | 2703 | 2853 | 5719 | 4784 | 3838 | 8321 | 7758 | 6197 | 6206 | 5702 | 5547 | 6330 | 4084 | 635 | 644 | 250 | 104 | 323 | 376 |
| 6 | 2334 | 1053 | 436 | 4094 | 13637 | 4948 | 2374 | 2313 | 827 | 1249 | 4038 | 2138 | 3112 | 3087 | 2696 | 2339 | 1430 | 5531 | 3606 | 3971 | 390 | 224 | 149 | 5 | 7 | 35 | 65 |
| 7 | 285 | 183 | 28 | 1478 | 5801 | 675 | 124 | 1728 | 700 | 234 | 207 | 112 | 706 | 215 | 616 | 108 | 254 | 1365 | 621 | 1105 | | 81 | | | | | 0 |
| 8 | | | | 557 | | | | | | | | | | | | | | | | | | | | | | | |
| total (ton.) | 5615 | 2252 | 3405 | 11352 | 24436 | 11673 | 3879 | 7276 | 10461 | 7449 | 39365 | 24695 | 19002 | 27206 | 36508 | 21087 | 20248 | 30675 | 16299 | 17045 | 11092 | 2735 | 4893 | 1619 | 1055 | 844 | 902 |

[1]Codend mesh-size 40 mm.
[2]Codend mesh-size 25 mm.

**Table 6.- Estimated recruitment index as number of Age 2 in the EU Survey series.**

| | Age 2 | |
|---|---|---|
| Year | Main gear ($10^5$) | Juvenile bag |
| 1996 | 3424 | |
| 1997 | 629 | |
| 1998 | 54968* | |
| 1999 | 4735 | |
| 2000 | 1069 | |
| 2001 | 3321 | 1361 |
| 2002 | 11004 | 2125 |
| 2003 | 12572 | 0 |
| 2004 | 27415 | 41818 |
| 2005 | 1792 | 3741 |
| 2006 | 582 | 7498 |
| 2007 | 301 | 3824 |
| 2008 | 221 | 4969 |
| 2009 | 1177 | 3011 |
| 2010 | 1103 | 954 |
| 2011 | 601 | 2440 |
| 2012 | 229 | 160 |
| 2013 | 63 | 102 |
| 2014 | - | 56 |

*1998 mesh size 25 mm was used instead of 35 mm. in EU survey, main gear.

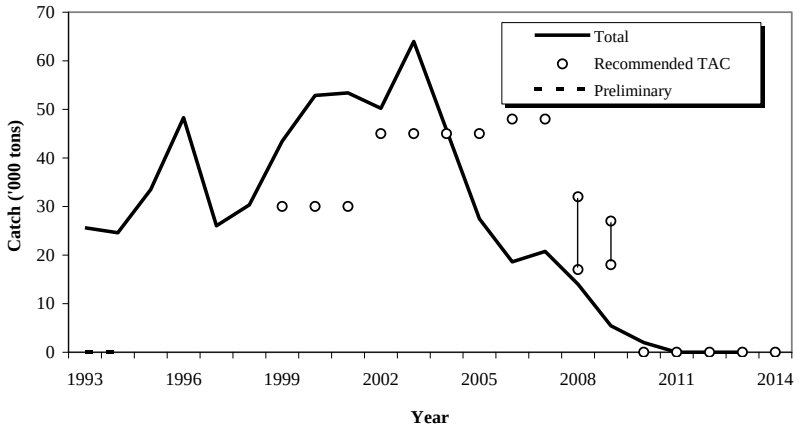


**Fig.1. Shrimp in Div. 3M: catch.**

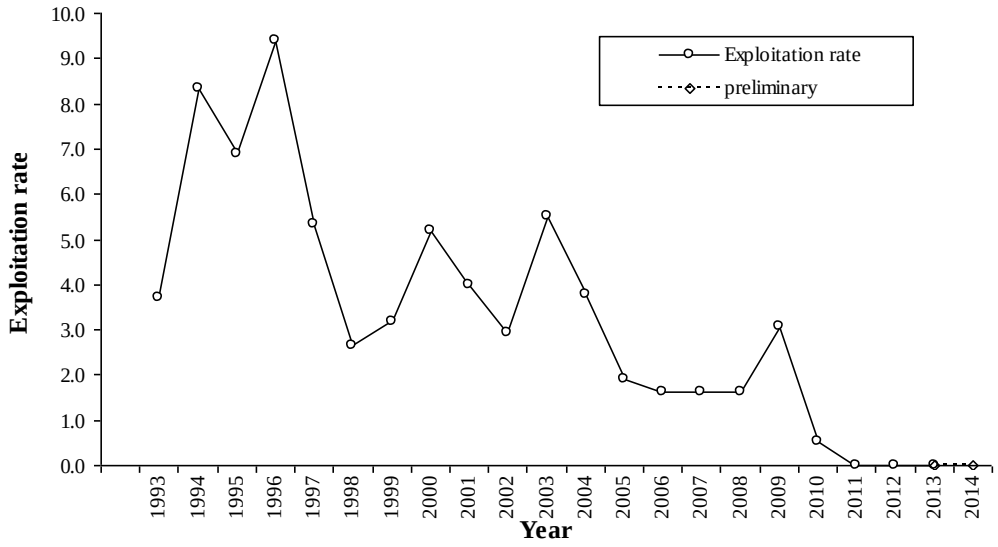


**Fig. 2. Exploitation rates as nominal catch divided by the EU survey biomass index of the same year.**

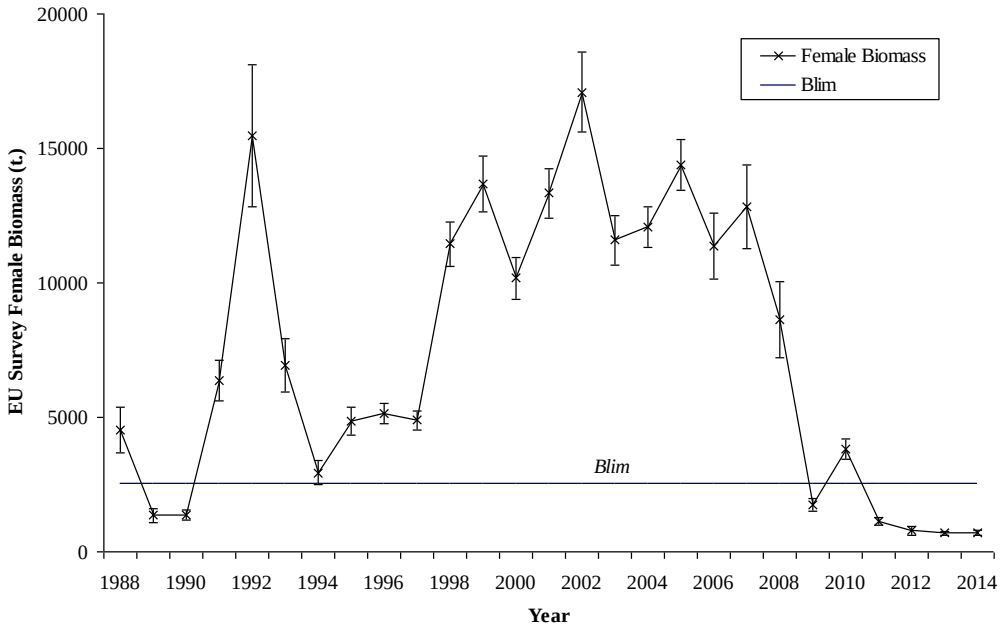


**Fig. 3. Shrimp in Div. 3M: Female biomass index from EU surveys, 1988-2014.**

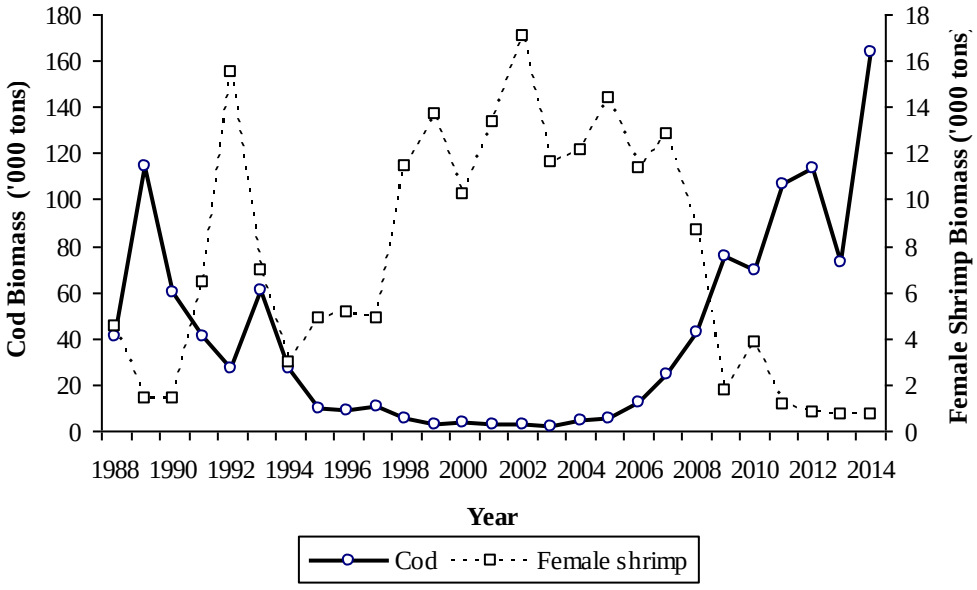


**Figure 4. EU survey cod biomass (black line) and female shrimp biomass (dotted line) in the years 1988-2014 on Flemish Cap.**

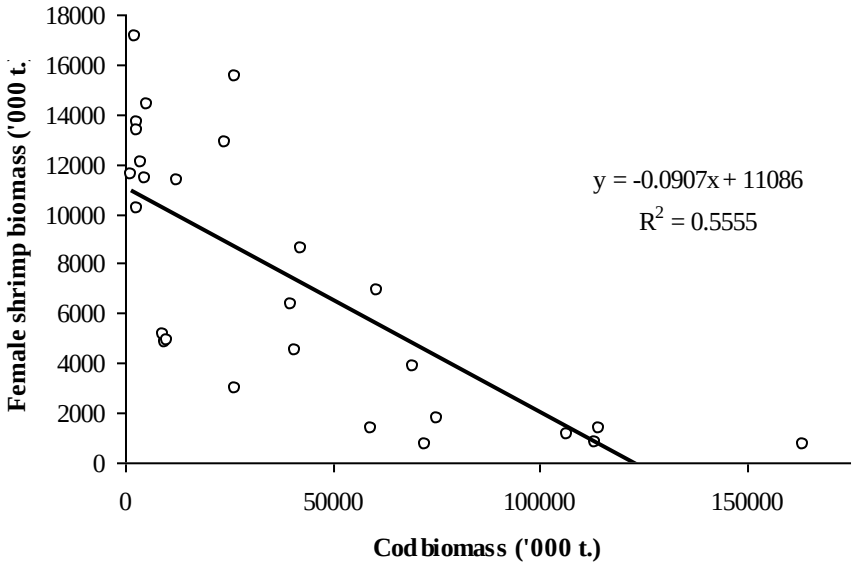


**Figure 5 Relationship from cod biomass and female shrimp biomass from EU Survey indexes estimated in the years 1988-2014 on Flemish Cap.**

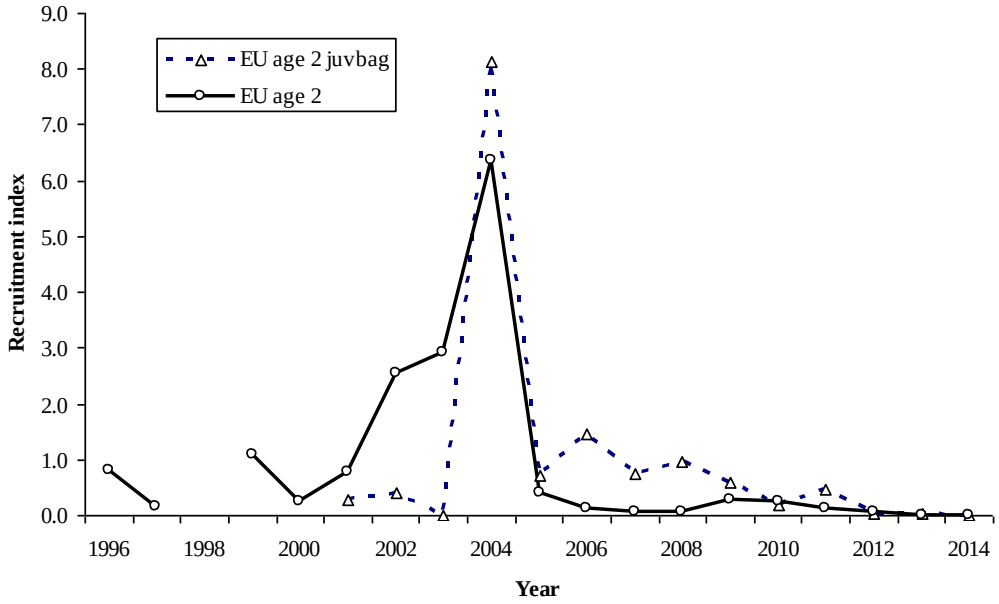


**Fig. 6. Recruitment indices, abundances of age 2 in EU Survey from main gear and juvenile bag. Each series was standardized to its mean.**

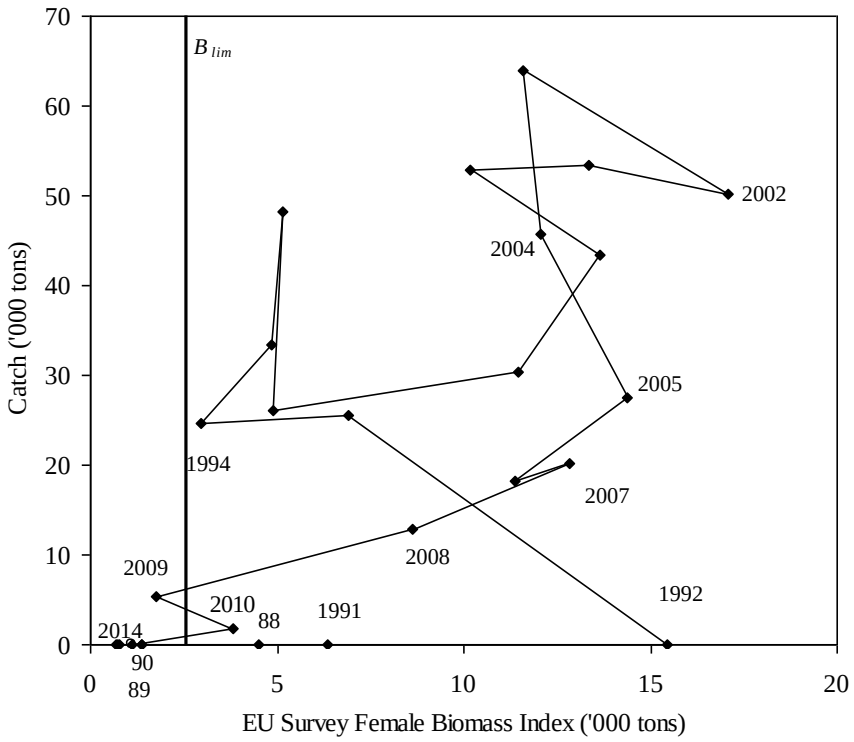


**Fig. 7. Catch plotted against female biomass index from EU survey. Line denoting $B_{lim}$ is drawn where biomass is 85% lower than the maximum point in 2002. Due to moratorium on shrimp fishery the expected catch in 2014 is 0 t.**