

LUMPFISH – HROGNKELSI

Cyclopterus lumpus

GENERAL INFORMATION

Juvenile lumpfish are non-shoaling mainly pelagic and are distributed in open water throughout the Norwegian Sea, Denmark Strait and Irminger Sea. When they mature, lumpfish migrate to coastal areas around Iceland to spawn with males arriving January-February and females arriving February-March. During the migration, females exhibit a mix of pelagic and demersal behaviour. The weight of the roes close to spawning can account for 30-35% of female body weight. Lumpfish show pronounced sexual dimorphism, with the males maturing at a smaller size and have an intense red colouration during the spawning season. The females lay the eggs in nests in shallow water and the male will then guard the eggs until they hatch.

COMMERCIAL FISHERY

There are two separate fisheries for lumpfish, a small scale male fishery for the flesh and a much larger female fishery where the primary target is the roe. The male fishery mainly takes place from January to March and uses gillnets with a mesh of between 178 and 203 mm. The directed fishery for the males made up between 2 and 60% of the total landings per year between 2003 and 2016, with other landings of males coming from the female fishery and from other gears (cod gillnets, seine and bottom trawls). The male fishery is primarily along the north coast (Fig. 1).

The female fishery takes place from late march until august, and uses gillnets with a mesh between 267 and 292 mm. More than 99% of the landings of females are from the directed female fishery. The female fishery takes place close to shore and is located in Faxaflói Bay, Breiðafjörður and all along the northern coast (Fig 2).

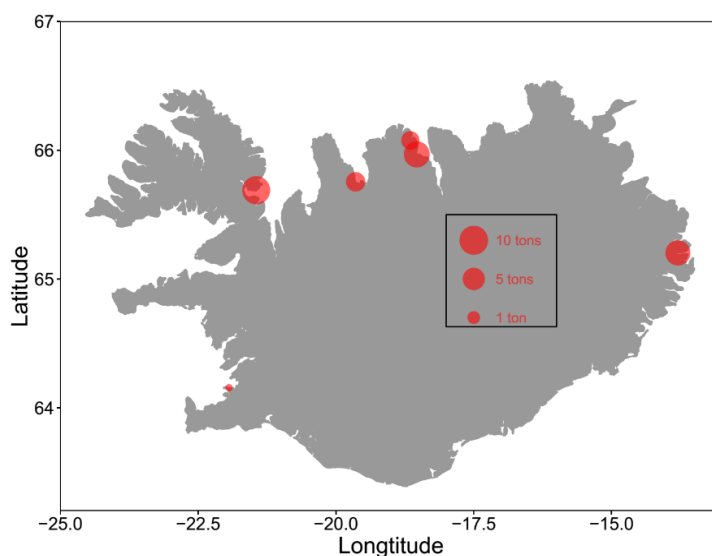


Fig.1. Lumpfish. Landings of males from the directed male fishery by harbour in 2016.

Mynd 1. Hrognkelsi. Landanir á rauðmaga úr rauðmaganetum árið 2016.

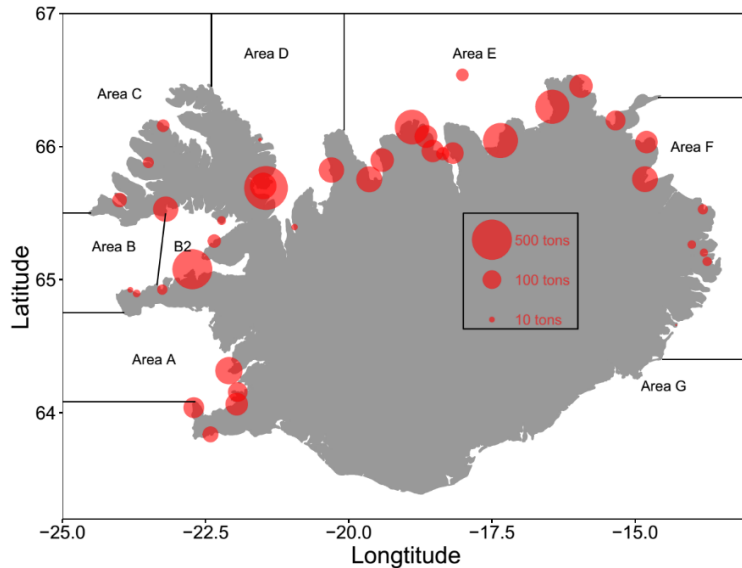


Fig.2 Lumpfish. Landings of females by harbour in 2016. Lumpfish management areas are shown.

Mynd 2. Hrognkelsi. Landanir á rauðmaga árið 2016. Stjórnunarsvæði grásleppuveiða eru afmörkuð.

Landings from the female fishery peaked between late 1970's and 1980's (Fig. 3). Between 1990 and 2017, landings have fluctuated between 2 and 6 thousand tonnes. Pre 2008, landings have been estimated from the number of barrels of roe produced with the numbers being provided by the National Small Boat Owners Association. From 2008, it became mandatory that all landings are recorded in a similar manner to all other fisheries in Iceland. Between 2002 and 2017, landings of males have fluctuated between 30 and 70 tonnes (Fig. 4).

As there is currently no TAC on either of these fisheries, there is no incentive to discard lumpfish.

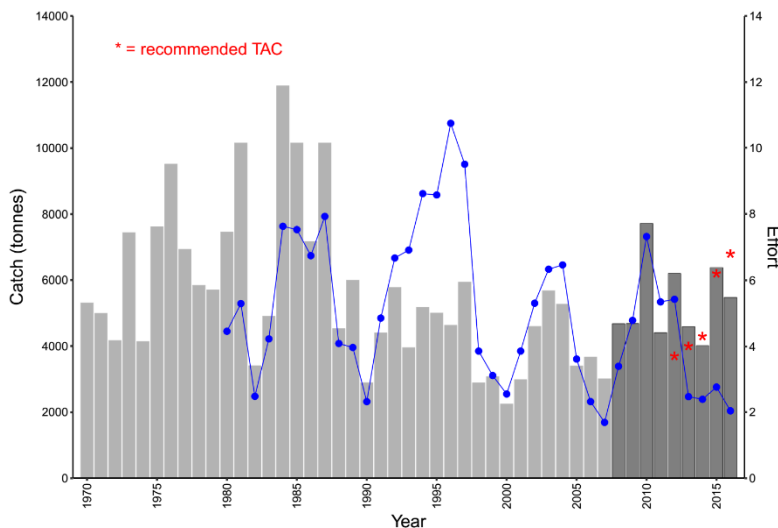


Fig.3. Lumpfish. Landings of females between 1970 and 2016 (grey bars) and effort in the female fishery (blue line). Light grey represents landings estimated from barrels of roe, dark grey represents landings as reported by the Directorate of Fisheries. The recommended TAC for each year is shown with red asterisks.

Mynd 3. Hrognkelsi. Landanir á grásleppu (gráar súlur) og sókn (blá lína) árin 1970-2016. Ljósgráar súlur sýna ár þar sem afli var metinn út frá fjölda tunna af hrognum, dökkgráar súlur sýna landanir skv. Fiskistofu. Ráðlögð heildarveiði er sýnd með rauðum stjörnum.

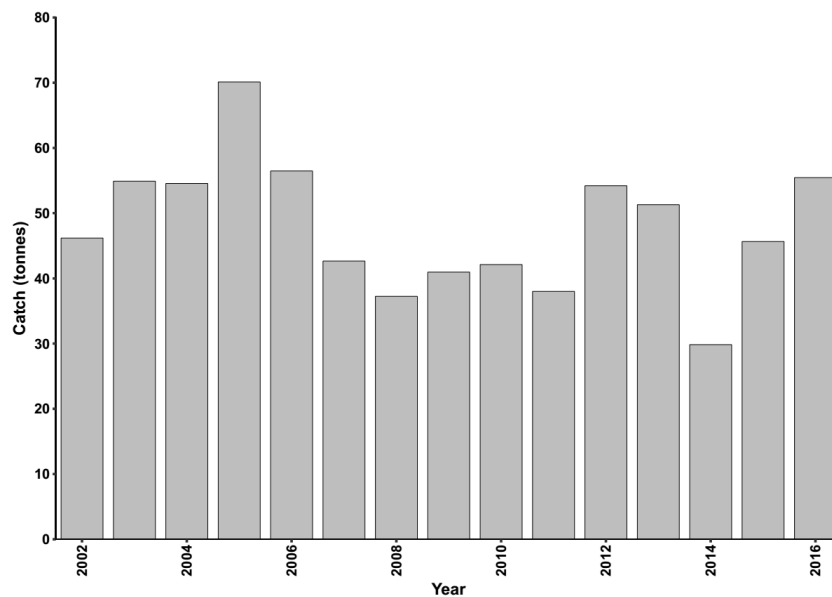


Fig.4. Lumpfish. Landings of males between 2002 and 2016.

Mynd 4. Hrognkelsi. Landanir á rauðmaga 2002-2016.

MANAGEMENT AND PREVIOUS ADVICE

The female lumpfish fishery is an effort controlled fishery with limits placed on the total length of nets, total number of fishing days and total number of boats. The total number of boats is limited as boats must have "Grásleppuréttindi", a permit which allows the boat to fish for lumpfish. In 2017 there were 458 boats with Grásleppuréttindi. No new permits are issued and a permit can only be obtained by transferring it from one boat to another. However, there is currently no system which can prevent all 458 boats taking part in the fishery of one particular year.

In order to participate in the fishery for the current year, a boat with permit to fish lumpfish must obtain a licence for that year. The coastline around Iceland is divided into 7 areas (Fig 2), each area is open for lumpfish fishing for approximately 2.5 months. Each boat must select an area for the current year and cannot fish in another. The licence allows fishing for lumpfish for the number of allocated days within the time period in which that area is open.

The primary method to limit catches is by altering the total number of fishing days for each boat. The number of days for each year is set by the Minister of Fisheries and Agriculture and is based upon an advised TAC from MFRI and discussions with the Small Boat Owners Association. MFRI have been advising on a TAC since 2012 (Table 1, Fig. 3), which is given in tons (see Advice section below).

EFFORT

The number of boats participating in the female fishery is influenced by the market price of the roe. The number of boats participating was highest before 1996; the number of boats generally varied between approximately 290 and 450 (Table 1). Post 1996, the number of boats has varied from 144 to 363. However, the number of nets per boat has increased between these two periods, while the number of days for which each boat can fish has decreased (Table 1). An index of effort is calculated from landings and CPUE (Effort = landings/CPUE) and is currently below the long term average (Fig. 3).

The number of boats participating in the male fishery has varied between 2 and 17 between 2001 and 2016.

LENGTH COMPOSITION

Pre 2012, obtaining length measurements from the female fishery was difficult due to the removal of roe before landing and disposing of the bodies at sea. Due to a change in regulations in 2012, the majority of landings are now ungutted lumpfish. The landings are aggregated at a small number of locations for processing making it more straightforward to sample from the fishery.

Mean length of fish caught in the female fishery is around 38-41 cm with limited variation between years (Fig.5).

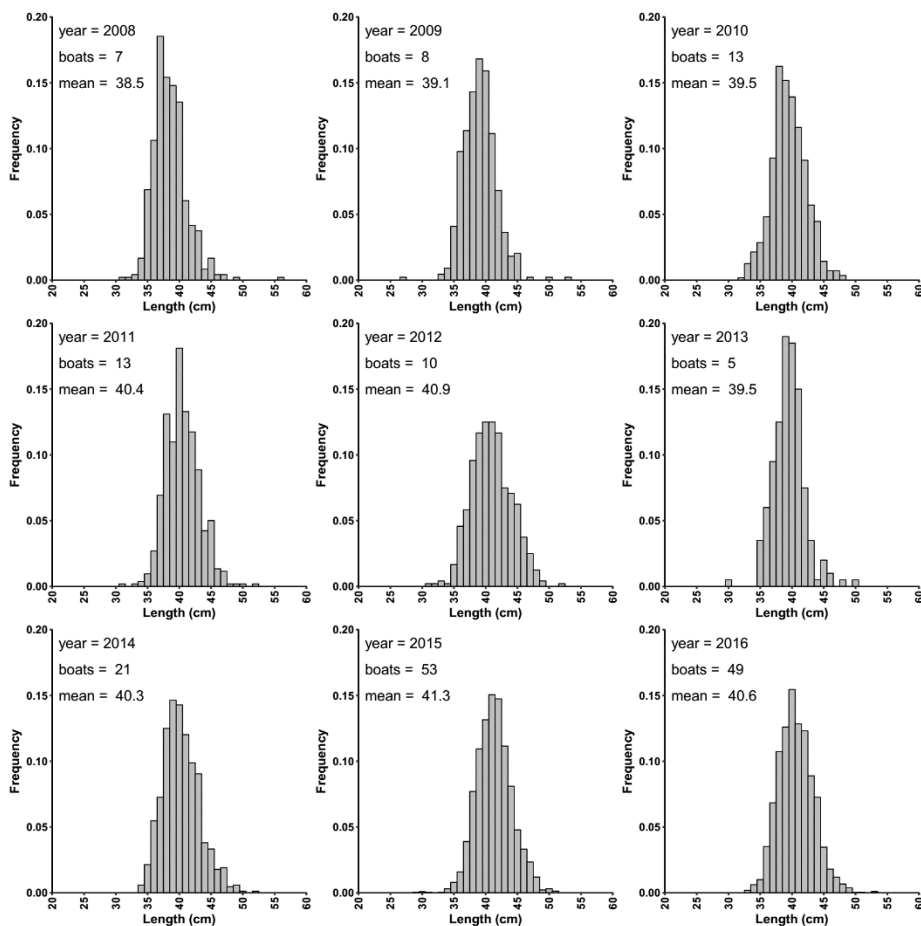


Fig.5. Lumpfish. Length distribution of females from the female fishery from 2008-2016. The number of boats sampled and mean length is given. Forty fish are measured from each boat.

Mynd 5. Hrognkelsi. Lengdardreifing grásleppu í afla árin 2008-2016, ásamt fjölda báta og meðallengd hvert ár. Fjörtíu fiskar eru mældir á hverjum báti.

CATCH PER UNIT EFFORT

The CPUE of the female fishery was highest in the 1980's but gradually decreased until 1996, it then increased until 2007, before dropping until 2011 (Fig. 7). It has now increased to a historical high. CPUE is currently unavailable from the male fishery.

BIOMASS INDICES

Data from the IS-SMB is currently used as the basis for tracking trends in biomass of the female lumpfish population. This survey covers the entire distribution of mature female lumpfish. Data from the annual gillnet survey is also taken into accounting as supporting information. Catchability of male lumpfish in the IS-SMB seems to be very poor and the trends are not considered to reflect the real changes in the population (Fig. 6). Data from the gillnet survey is still under evaluation.

In general, the biomass index for females from the IS-SMB was high between 1985-1990, low during the 1990's and at roughly at intermediate levels during the 2000's (Fig. 7). It decreased during the early 2010's but has recently increased to intermediate levels.

The length distribution has changed over time (Fig. 8), with females $\geq 45\text{cm}$ being more abundant during 1985-1990 than in the years post 1990. The abundance of large females reached a minimum in 1997 but has gradually increased since then, with the abundance in 2017 being the highest since 1990 (Fig. 7).

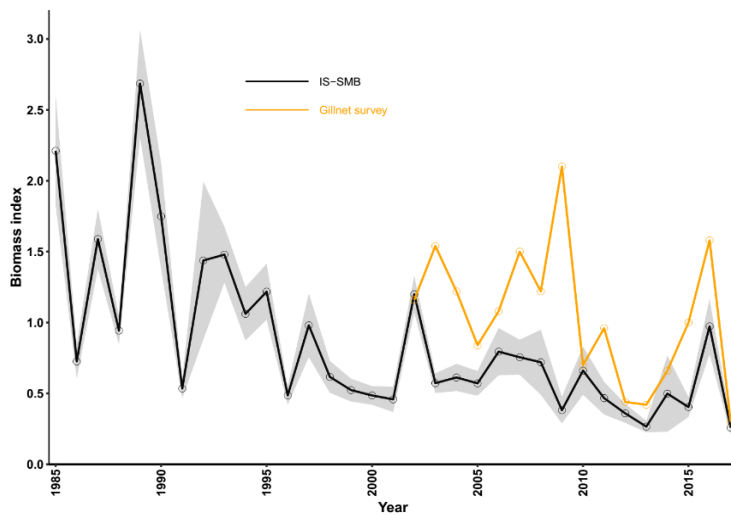


Fig.6. Lumpfish. Biomass index of males from the IS-SMB and abundance index from the gillnet survey.

Mynd 6. Hrognkelsi. Lífmassavísitala rauðmaga í stofnmælingu í mars (IS-SMB) og fjöldavísitala í netaralli.

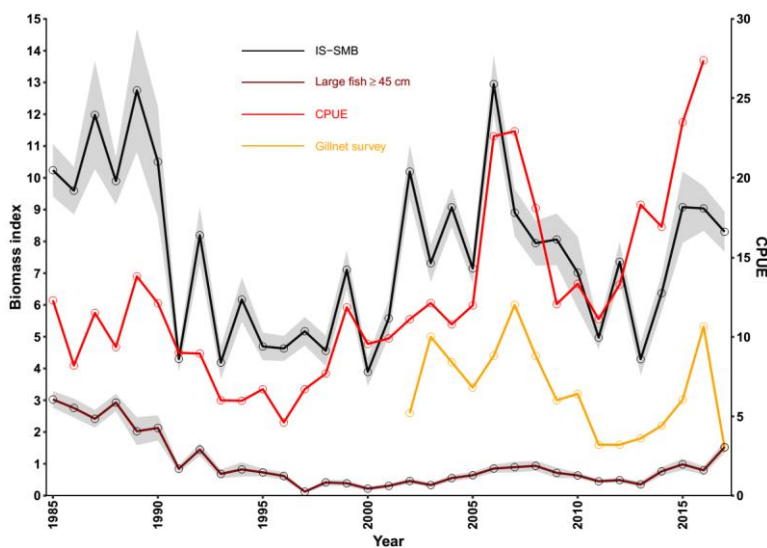


Fig.7. Lumpfish. Biomass index of females from the IS-SMB, biomass index of females $\geq 45\text{ cm}$ from the IS-SMB, CPUE from the female fishery, and abundance index from the gillnet survey.

Mynd 7. Hrognkelsi. Lífmassavísitölur grásleppu og grásleppu ≥ 45 cm í stofnmælingu í mars (IS-SMB), afli á sóknareiningu (CPUE) við grásleppuveiðar og fjöldavísitala í netaralli.

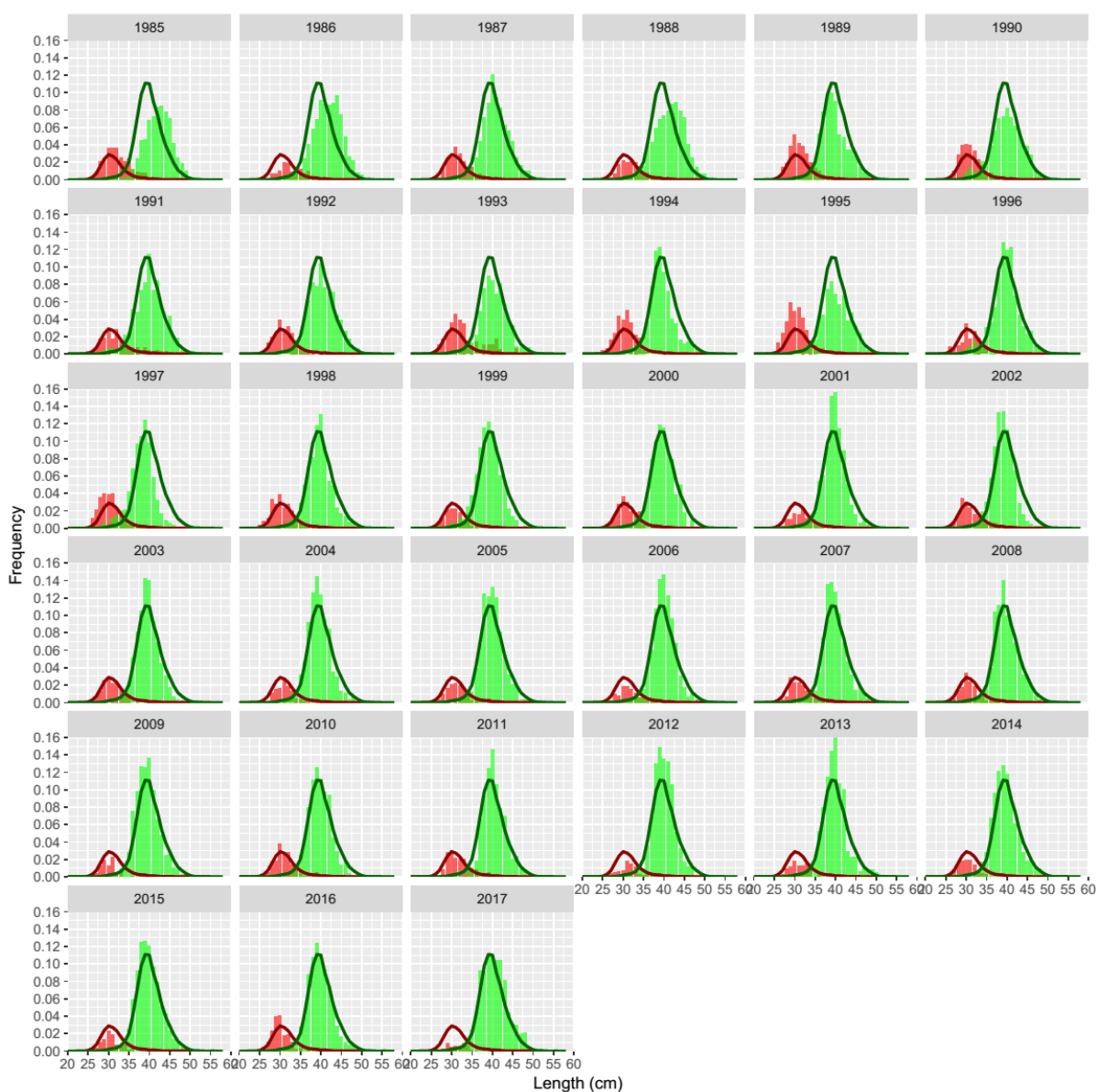


Fig.8. Lumpfish. Length distribution of male (red) and female (green) lumpfish caught in the IS-SMB. Lines represent the average length distribution for the whole study period.

Mynd 8. Hrognkelsi. Lengdardreifing rauðmaga (rautt) og grásleppa (grænt) sem veiddust í stofnmælingu í mars. Línur tákna meðal lengdardreifingu á rannsóknartímanum.

F_{PROXY}

Relative fishing mortality ($F_{\text{proxy}} = \text{Yield}/\text{Survey biomass}$), derived from the IS-SMB and landings of whole lumpfish, was generally highest before 1997, when it peaked (Fig.9). Between 1998 and 2009, F_{proxy} was generally lower than the average of the reference period (1985-2011) before increasing in 2010. From 2014 to 2016 F_{proxy} has been below the target F_{proxy} .

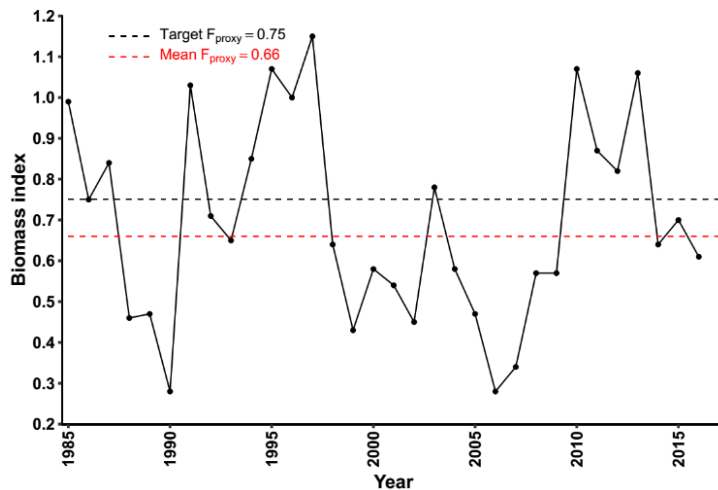


Fig.9. Lumpfish. F_{proxy} of females 1985-2016. The mean of the reference period (1985-2011), and target F_{proxy} is shown.

Mynd 9. Hrognkelsi. Vísitala veiðihlutfalls hrygna 1985-2016. Sýnt er meðaltal viðmiðunarára (1985-2011) og markgildi F_{proxy} .

ADVICE

When the advice for lumpfish was first formulated, the target F_{proxy} was set at the average from the reference period, 1985–2011. Initial evaluation of catches put this at 0.75, however, after reevaluation of the catches, this is now 0.66, but 0.75 remains as the target F_{proxy} . The lumpfish biomass index fluctuates considerably between years, therefore, the index from the current fishing year rather than that of the previous year is taken into account when considering the advice. In order to compensate for uncertainty in the measurements, the previous year's index is also taken into account. The current year's and previous year's survey are giving a weighting of 70 and 30 % respectively. The advice from the MFRI is thus given in two stages. For the 2018 season, preliminary TAC is calculated as the IS-SMB (2017) biomass index multiplied by 0.225. To this is added the biomass index from the IS-SMB (2018) multiplied 0.525. If the female biomass index falls below the historical minimum of IS-SMB, then that year will represent a value of zero in the calculation of TAC. Recommendations for a final TAC are delivered after the IS-SMB is completed.

Table 1. The number of boats which participated in the female fishery, the maximum number/total length of nets (the maximum number per crew member and the maximum per boat, in brackets, is shown for years 1980-2012), the number of fishing days for each boat, the advised TAC and total catch from 1980-2017. In 2017, the number of fishing days was increased from 36 to 46 days during the season.

| Year | Boats | Nets | Fishing days | Advice | Landings |
|------|-------|-----------|--------------|--------|----------|
| 1980 | 343 | 50 (150) | | | 7170 |
| 1981 | 347 | 50 (150) | | | 9764 |
| 1982 | 219 | 50 (150) | | | 3274 |
| 1983 | 292 | 50 (150) | | | 4719 |
| 1984 | 384 | 50 (150) | | | 11425 |
| 1985 | 401 | 50 (150) | | | 9764 |
| 1986 | 298 | 50 (150) | | | 6897 |
| 1987 | 350 | 50 (150) | | | 9764 |
| 1988 | 334 | 50 (150) | | | 4359 |
| 1989 | 353 | 50 (150) | | | 5765 |
| 1990 | 234 | 50 (150) | | | 2781 |
| 1991 | 356 | 50 (150) | | | 4230 |
| 1992 | 393 | 50 (150) | | | 5553 |
| 1993 | 326 | 50 (150) | | | 3804 |
| 1994 | 401 | 100 (300) | | | 4982 |
| 1995 | 417 | 100 (300) | | | 4810 |
| 1996 | 447 | 100 (300) | | | 4455 |
| 1997 | 372 | 100 (300) | | | 5712 |
| 1998 | 277 | 100 (300) | | | 2778 |
| 1999 | 258 | 100 (300) | | | 2959 |
| 2000 | 266 | 100 (300) | | | 2159 |
| 2001 | 197 | 100 (300) | | | 2870 |
| 2002 | 222 | 100 (300) | | | 4424 |
| 2003 | 272 | 100 (300) | | | 5459 |
| 2004 | 353 | 100 (300) | | | 5067 |
| 2005 | 256 | 100 (300) | 60 | | 3273 |
| 2006 | 163 | 100 (300) | 50 | | 3531 |
| 2007 | 144 | 100 (300) | 50 | | 2897 |
| 2008 | 205 | 100 (300) | 50 | | 4451 |
| 2009 | 265 | 100 (300) | 62 | | 4457 |
| 2010 | 338 | 100 (300) | 62 | | 7353 |
| 2011 | 363 | 100 (300) | 50 | | 4220 |
| 2012 | 334 | 100 (300) | 50 | 3700 | 6076 |
| 2013 | 282 | 200 | 32 | 4000 | 4546 |
| 2014 | 221 | 200 | 32 | 4300 | 4034 |
| 2015 | 316 | 7500m | 32 | 6200 | 6357 |
| 2016 | 239 | 7500m | 32 | 6800 | 5475 |
| 2017 | | 7500m | 32 (46) | 6350 | |