

Atlantic salmon at West Greenland

Summary of the advice for 2017

The advice provided by ICES in 2015 indicated that there were no catch options for the West Greenland fishery for the years 2015–2017. The NASCO Framework of Indicators for the West Greenland Commission was run in 2016 and 2017, and did not indicate a need for revised analysis of catch options in either year. The assessment was updated to 2016 and the stock status is consistent with the previous years' assessments and catch advice.

NASCO 4.1 Describe the key events of the 2016 fishery, including details of catch, gear, effort, composition and origin of the catch, rates of exploitation, and location of the catch as in-river, estuarine, and coastal

Fishing for salmon at Greenland is currently allowed using hook, fixed gillnets, and driftnets along the entire coast of Greenland (Figure 1). The commercial fishery for export closed in 1998; however, the fishery for internal use only continues. Since 2002, licensed fishers have only been allowed to sell salmon to hotels, institutions, and local markets. People fishing for private consumption only are not required to have a licence, but they are prohibited from selling salmon. From 2012, licensed fishers were also allowed to land to factories, although the export ban persisted and the landed salmon could only be sold within Greenland. Since 2012, the Government of Greenland has unilaterally set the quota for the fishery, since the quota could not be agreed to by all parties of the West Greenland Commission of NASCO (Table 2). In 2012 and 2013 a quota of 35 t was applied to the factory landings only. The factory quota was reduced to 30 t in 2014. In 2015 the Government of Greenland set a quota for all components of the fishery (private, commercial, and factory landings) of 45 t, indicating that any overharvest in a particular year would result in an equal reduction in the catch limit in the following year. As a result of an overharvest in 2015, the 2016 quota was set by Greenland to 32 t. The export ban persisted and landed salmon could only be sold within Greenland, but no sales to factories were allowed in 2016. The fishing season opened on 15 August and closed on 30 October.

Catches of Atlantic salmon at West Greenland (Figure 2 and Table 2) increased through the 1960s, reaching a peak reported harvest of approximately 2700 t in 1971 and then decreased until the closure of the commercial fishery for export in 1998. However, the fishery for internal use has been increasing in recent years.

A total catch of 27.1 t of salmon was reported for the 2016 fishery (Figure 1 and Table 3). In total, 72% of the landings in 2016 came from licensed fishers. Of the catches reported for private use, 41% (7.6 t) came from unlicensed fishers and 59% (10.8 t) were from licensed fishers. Although not allowed to sell their catch, 0.4% (0.1 t, approximately 30 fish) of the commercial landings were reported as coming from unlicensed fishers.

Table 1 Reported 2016 catches by fisheries.

| Licence type | Reported consumption type | Reported 2016 catch (t) |
|--------------|---------------------------|-------------------------|
| Licensed | Commercial | 8.6 |
| | Private | 10.8 |
| Unlicensed | Commercial | 0.1 |
| | Private | 7.6 |
| All | Commercial | 8.7 |
| | Private | 18.4 |
| All | Total | 27.1 |

Landings were reported across all NAFO divisions and a harvest of 1.5 t was reported from ICES Division 14 (East Greenland) (Tables 3 and 4). The 2016 commercial landings (8.7 t) decreased below the 2015 value (33.8 t) while the private landings in 2016 (18.4 t) remained approximately equal to the 2015 value (19.2 t; Table 4).

Review of the results of the recent phone surveys and advise on the appropriateness for incorporating resulting estimates of unreported catch into the assessment process

There is currently no quantitative approach for estimating the unreported catch for the private fishery, but the 2016 value is likely to have been at the same level as in recent years (10 t), as reported by the Greenlandic authorities. The 10 t

estimate was historically meant to account for private non-licensed fishers in smaller communities fishing for personal consumption, and not meant to represent underreporting by commercial fishers.

The variations in the numbers of people reporting catches, variation in reported landings in each of the NAFO divisions, and documentation of underreporting of landings suggest that there are inconsistencies in the catch data. An adjustment for some unreported catch, primarily for commercial landings, has been done since 2002 by comparing the weight of salmon seen by the sampling teams and the corresponding community-specific reported landings for the entire fishing season (commercial and private landings combined). However, sampling only occurs during a portion of the fishing season and therefore these adjustments are considered to be minimum adjustments for unreported catch (Table 6).

Telephone surveys were conducted after the 2014, 2015, and 2016 fishing seasons to gain further information on catch and effort. The number of fishers contacted, the questions asked, and the method to estimate unreported catch differed from year to year. In 2015, attempts were made to contact all licensed fishers, including those who reported and those who did not report catches in 2014 (ICES, 2015). In 2016, a subset of licensed fishers who did not report catches were contacted (ICES, 2016a). In 2017 a random sample of 49 licensed fishers were interviewed, 30 who had not reported catches and 19 who had. In all years, one of the questions was aimed at obtaining an estimate of the landings by licensed fishers that were not reported to the Greenland authorities.

Analysis of the 2015 results suggested that there was no systematic bias between catches reported and values indicated during the telephone survey. A total of 12.2 t of non-reported harvest was recorded during the 2015 survey, but a division-specific weighting was not applied and a total estimate of non-reported harvest was not derived. In 2016 and 2017, division-specific weightings were developed and applied (Table 5). The total unreported catches by licensed fishers as estimated from these surveys were 12.2 t in 2014, 5 t in 2015, and 4.2 t in 2016.

The post-season telephone survey provides a method to derive unreported catches by licensed fishers who do not report during the year. It does not, however, provide an estimate of unreported catches from unlicensed fishers. There is currently no information with which to conduct a survey on the unlicensed pool of participants, and the unreported catch from this component remains unknown. In 2015 and 2016, the harvests declared by the interviewed licensed fishers who had not reported were raised to account for the total number of licensed fishers who had not reported during the year. This provided an estimate of the unreported catch by licensed fishers. These data, in combination with the adjusted landings values from sampling, are used by ICES for the assessment. Some of the extra catch observed by samplers may be accounted for during the phone survey. In the years when the adjustments were made, the sample adjustments were very small. Adjusted landings for assessment do not replace the official reported statistics. For the assessment the unreported catch of 10 t provided by the Government of Greenland is also included. The time-series of reported landings, adjusted landings (sampling), adjusted landings (survey), and landings for assessment is presented in Table 6.

Biological characteristics of the catches

The international sampling programme continued in the fishery in 2016 (Figure 1). In 2016, a total of 1302 samples were obtained from four communities representing four Northwest Atlantic Fisheries Organization (NAFO) divisions: Sisimiut in 1B (n = 318), Maniitsoq in 1C (n = 542), Paamiut in 1E (n = 125), and Qaqortoq in 1F (n = 317). DNA isolation and the subsequent microsatellite analyses were used to assign the continent of origin (King *et al.*, 2001) for the 2016 samples, and the North American region-specific origin of salmon in the 2015 fishery was reported by Bradbury *et al.* (2016).

In total, 66.4% of the salmon sampled were determined to be of North American origin and 33.6% of European origin. A large proportion of North American origin individuals contributed to the fishery in recent years; however, the 2016 value is the lowest proportion of North American origin fish since 2003 (Figure 3).

The 1SW age group represented over 95% of the sampled catch in 2016, similar to previous years (Table 7). Approximately 5100 (about 17.2 t) North American origin fish and approximately 3300 (about 8.7 t) European origin fish were estimated to have been harvested in 2016. The number of fish harvested in 2016 was the lowest since 2011, and well below the 2015 estimate. The harvest in 2016 was only 2.5% of the maximum estimated (336 000 fish) harvest from 1982 (Figure 4).

New assignment results were available for the North American contributions to the 2015 Greenland fishery. As in previous years (ICES, 2015; Bradbury *et al.*, 2016), three regions of eastern North America contributed to the majority of the samples in 2015: Québec, Gulf of St Lawrence, and Labrador. Smaller contributions were made by other regions (Newfoundland, Scotia–Fundy, and USA).

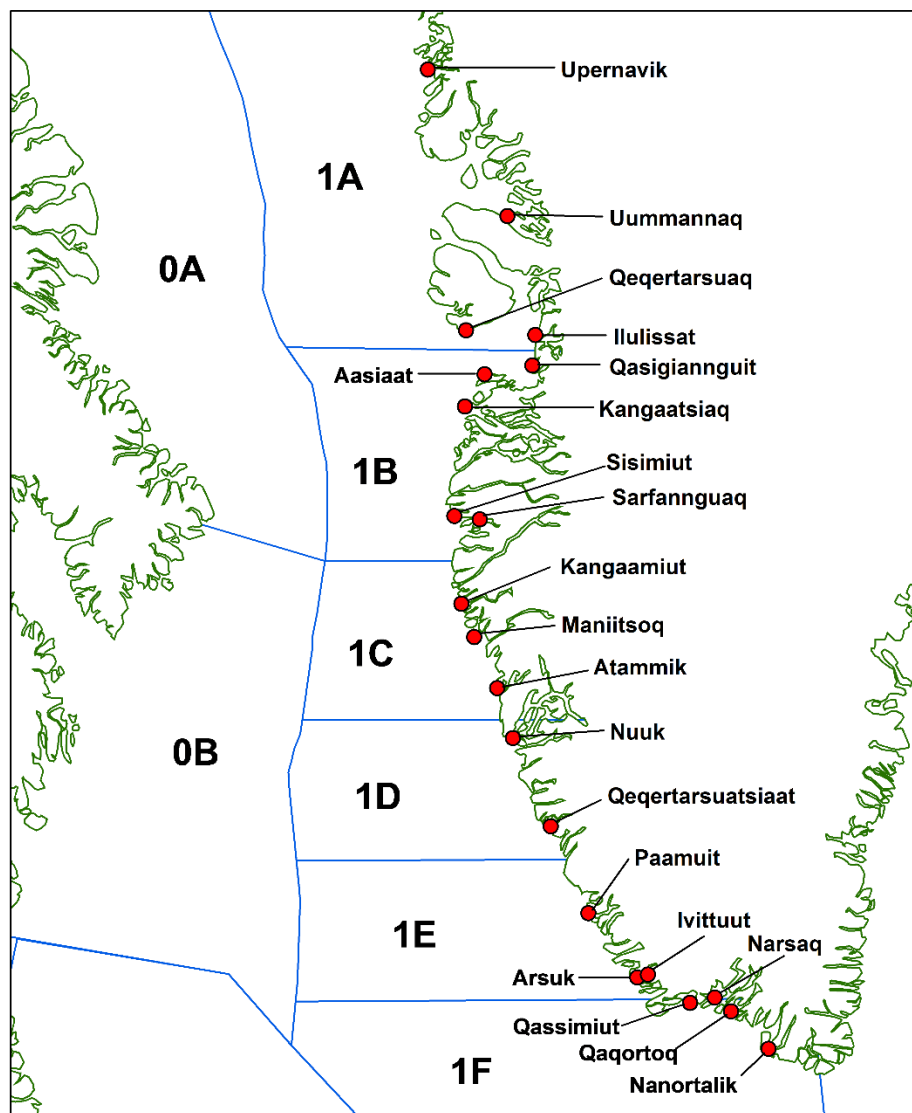


Figure 1 Map of southwest Greenland, showing communities to which Atlantic salmon have historically been landed and the corresponding NAFO divisions. In 2016 fishery samples were obtained from Sisimiut (NAFO division 1B), Maniitsoq (1C), Paamuit (1E), and Qaqortoq (1F).

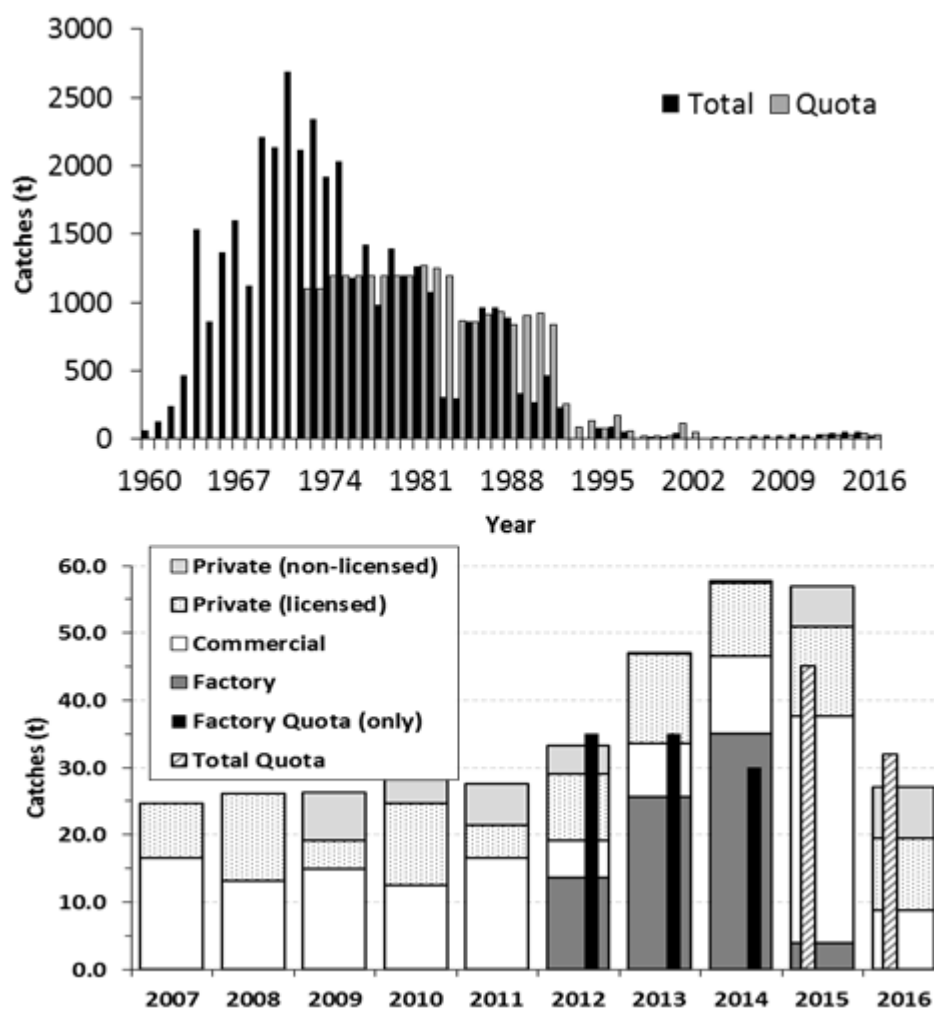


Figure 2

Nominal catches and commercial quotas (tonnes, round fresh weight) of salmon at West Greenland for 1960–2016 (top panel) and 2007–2016 (bottom panel). Total reported landings from 2007 to 2016 are displayed by landings type. No quotas were set from 2002 to 2011, a factory only quota was set from 2012 to 2014, and a single quota of 45 t for all components of the fishery was applied in 2015. The 2016 quota for all components of the fishery was reduced to 32 t because of overharvest of the 2015 TAC. There were no factory landings permitted in 2016.

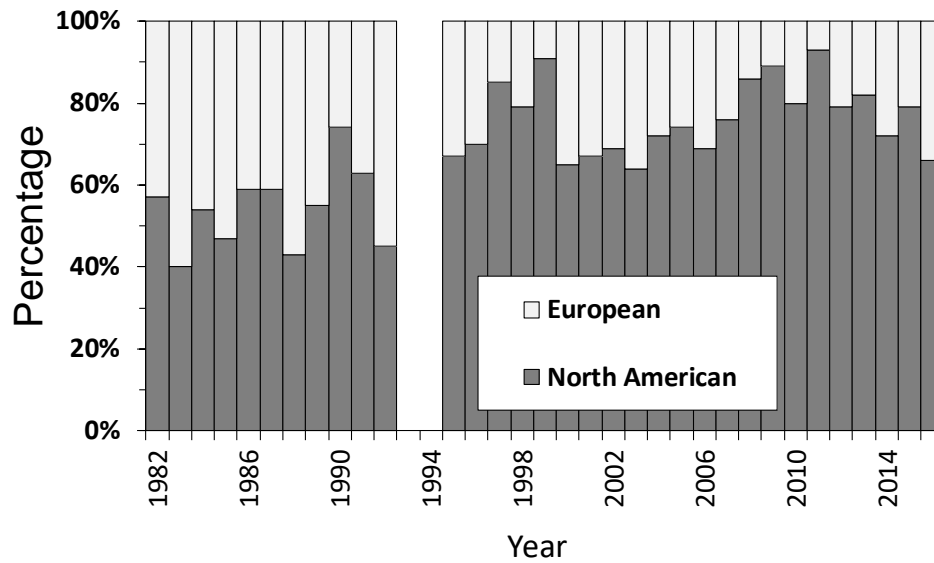


Figure 3 Percentage of the sampled catch by continent of origin of Atlantic salmon in the West Greenland fishery samples, 1982 to 2016.

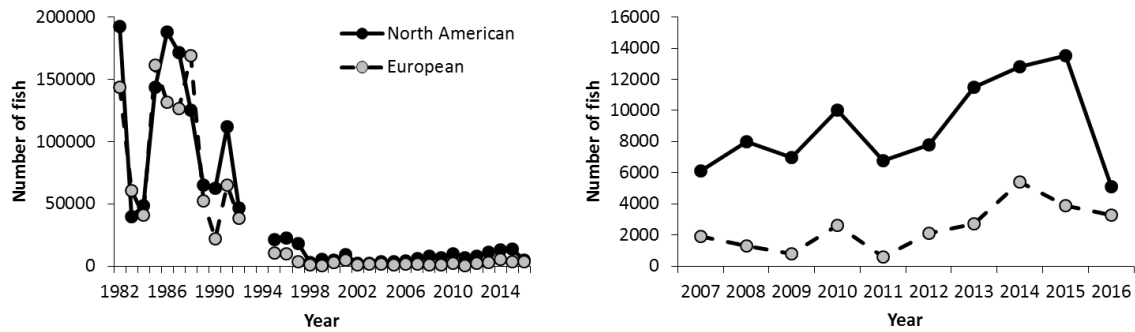


Figure 4 Estimated number of North American and European Atlantic salmon caught at West Greenland from 1982 to 2016 (left panel) and 2007 to 2016 (right panel). Estimates are based on continent of origin by NAFO division, weighted by catch (weight) in each division. Numbers are rounded to the nearest hundred fish. Unreported catch is not included in this calculation.

Table 2 Nominal catches of salmon at West Greenland since 1960 (tonnes, round fresh weight) by participating nations. For Greenlandic vessels specifically, all catches up to 1968 were taken with set gillnets only; catches after 1968 were taken with set gillnets and driftnets. All non-Greenlandic vessel catches from 1969 to 1975 were taken with driftnets. The quota figures applied to Greenlandic vessels only and entries in parentheses identify when quotas did not apply to all sectors of the fishery.

| YEAR | NORWAY | FAROEES | SWEDEN | DENMARK | GREENLAND | TOTAL | QUOTA | COMMENTS |
|------|--------|---------|--------|---------|-----------|-------|-------|---|
| 1960 | - | - | - | - | 60 | 60 | | |
| 1961 | - | - | - | - | 127 | 127 | | |
| 1962 | - | - | - | - | 244 | 244 | | |
| 1963 | - | - | - | - | 466 | 466 | | |
| 1964 | - | - | - | - | 1539 | 1539 | | |
| 1965 | - | 36 | - | - | 825 | 858 | | Norwegian harvest figures not available, but known to be less than Faroese catch. |
| 1966 | 32 | 87 | - | - | 1251 | 1370 | | |
| 1967 | 78 | 155 | - | 85 | 1283 | 1601 | | |
| 1968 | 138 | 134 | 4 | 272 | 579 | 1127 | | |
| 1969 | 250 | 215 | 30 | 355 | 1360 | 2210 | | |
| 1970 | 270 | 259 | 8 | 358 | 1244 | 2139 | | Greenlandic total includes 7 t caught by longlines in the Labrador Sea. |
| 1971 | 340 | 255 | - | 645 | 1449 | 2689 | - | |
| 1972 | 158 | 144 | - | 401 | 1410 | 2113 | 1100 | |
| 1973 | 200 | 171 | - | 385 | 1585 | 2341 | 1100 | |
| 1974 | 140 | 110 | - | 505 | 1162 | 1917 | 1191 | |
| 1975 | 217 | 260 | - | 382 | 1171 | 2030 | 1191 | |
| 1976 | - | - | - | - | 1175 | 1175 | 1191 | |
| 1977 | - | - | - | - | 1420 | 1420 | 1191 | |
| 1978 | - | - | - | - | 984 | 984 | 1191 | |
| 1979 | - | - | - | - | 1395 | 1395 | 1191 | |
| 1980 | - | - | - | - | 1194 | 1194 | 1191 | |
| 1981 | - | - | - | - | 1264 | 1264 | 1265 | Quota set to a specific opening date for the fishery. |
| 1982 | - | - | - | - | 1077 | 1077 | 1253 | Quota set to a specific opening date for the fishery. |
| 1983 | - | - | - | - | 310 | 310 | 1191 | |
| 1984 | - | - | - | - | 297 | 297 | 870 | |
| 1985 | - | - | - | - | 864 | 864 | 852 | |
| 1986 | - | - | - | - | 960 | 960 | 909 | |
| 1987 | - | - | - | - | 966 | 966 | 935 | |
| 1988 | - | - | - | - | 893 | 893 | 840 | Quota for 1988–1990 was 2520 t with an opening date of August 1. Annual catches were not to exceed an annual average (840 t) by more than 10%. The quota was adjusted to 900 t in 1989 and 924 t in 1990 for later opening dates. |
| 1989 | - | - | - | - | 337 | 337 | 900 | |
| 1990 | - | - | - | - | 274 | 274 | 924 | |
| 1991 | - | - | - | - | 472 | 472 | 840 | |
| 1992 | - | - | - | - | 237 | 237 | 258 | Quota set by Greenland authorities. |
| 1993 | - | - | - | - | | | 89 | The fishery was suspended. NASCO adopted a new quota allocation model. |
| 1994 | - | - | - | - | | | 137 | The fishery was suspended and the quotas were bought out. |
| 1995 | - | - | - | - | 83 | 83 | 77 | Quota advised by NASCO. |
| 1996 | - | - | - | - | 92 | 92 | 174 | Quota set by Greenland authorities. |
| 1997 | - | - | - | - | 58 | 58 | 57 | Private (non-commercial) catches to be reported after 1997. |
| 1998 | - | - | - | - | 11 | 11 | 20 | Fishery restricted to catches used for internal consumption in Greenland. |
| 1999 | - | - | - | - | 19 | 19 | 20 | |

| YEAR | NORWAY | FAROEES | SWEDEN | DENMARK | GREENLAND | TOTAL | QUOTA | COMMENTS |
|------|--------|---------|--------|---------|-----------|-------|-------|--|
| 2000 | - | - | - | - | 21 | 21 | 20 | |
| 2001 | - | - | - | - | 43 | 43 | 114 | Final quota calculated according to the <i>ad hoc</i> management system. |
| 2002 | - | - | - | - | 9 | 9 | 55 | Quota bought out, quota represented the maximum allowable catch (no factory landing allowed), and higher catch figures based on sampling programme information are used for the assessments. |
| 2003 | - | - | - | - | 9 | 9 | | Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments. |
| 2004 | - | - | - | - | 15 | 15 | | Same as previous year. |
| 2005 | - | - | - | - | 15 | 15 | | Same as previous year. |
| 2006 | - | - | - | - | 22 | 22 | | Quota set to nil (no factory landing allowed) and fishery restricted to catches used for internal consumption in Greenland. |
| 2007 | - | - | - | - | 25 | 25 | | Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments. |
| 2008 | - | - | - | - | 26 | 26 | | Same as previous year. |
| 2009 | - | - | - | - | 26 | 26 | | Same as previous year. |
| 2010 | - | - | - | - | 40 | 40 | | No factory landing allowed and fishery restricted to catches used for internal consumption in Greenland. |
| 2011 | - | - | - | - | 28 | 28 | | Same as previous year. |
| 2012 | - | - | - | - | 33 | 33 | (35) | Unilateral decision made by Greenland to allow factory landing with a 35 t quota for factory landings only, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments. |
| 2013 | - | - | - | - | 47 | 47 | (35) | Same as previous year. |
| 2014 | - | - | - | - | 58 | 58 | (30) | Unilateral decision made by Greenland to allow factory landing with a 30 t quota for factory landings only, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments. |
| 2015 | - | - | - | - | 57 | 57 | 45 | Unilateral decision made by Greenland to set a 45 t quota for all sectors of the fishery, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments. |

| YEAR | NORWAY | FAROEES | SWEDEN | DENMARK | GREENLAND | TOTAL | QUOTA | COMMENTS |
|------|--------|---------|--------|---------|-----------|-------|-------|--|
| 2016 | - | - | - | - | 27 | 27 | 32 | Unilateral decision made by Greenland to reduce the previously set 45 t quota for all sectors of the fishery to 32 t based on coverage of 2015 fishery, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments. |

Table 3 Distribution of nominal catches (metric tonnes) by Greenland vessels since 1960, by NAFO divisions 1A–1F. Since 2005, gutted weights have been reported and converted to total weight by a factor of 1.11.

| Year | 1A | 1B | 1C | 1D | 1E | 1F | Unknown | West Greenland | East Greenland | Total |
|-------|------|-----|------|------|------|------|---------|----------------|----------------|-------|
| 1960 | | | | | | | 60 | 60 | | 60 |
| 1961 | | | | | | | 127 | 127 | | 127 |
| 1962 | | | | | | | 244 | 244 | | 244 |
| 1963 | 1 | 172 | 180 | 68 | 45 | | | 466 | | 466 |
| 1964 | 21 | 326 | 564 | 182 | 339 | 107 | | 1539 | | 1539 |
| 1965 | 19 | 234 | 274 | 86 | 202 | 10 | 36 | 861 | | 861 |
| 1966 | 17 | 223 | 321 | 207 | 353 | 130 | 87 | 1338 | | 1338 |
| 1967 | 2 | 205 | 382 | 228 | 336 | 125 | 236 | 1514 | | 1514 |
| 1968 | 1 | 90 | 241 | 125 | 70 | 34 | 272 | 833 | | 833 |
| 1969 | 41 | 396 | 245 | 234 | 370 | | 867 | 2153 | | 2153 |
| 1970 | 58 | 239 | 122 | 123 | 496 | 207 | 862 | 2107 | | 2107 |
| 1971 | 144 | 355 | 724 | 302 | 410 | 159 | 560 | 2654 | | 2654 |
| 1972 | 117 | 136 | 190 | 374 | 385 | 118 | 703 | 2023 | | 2023 |
| 1973 | 220 | 271 | 262 | 440 | 619 | 329 | 200 | 2341 | | 2341 |
| 1974 | 44 | 175 | 272 | 298 | 395 | 88 | 645 | 1917 | | 1917 |
| 1975 | 147 | 468 | 212 | 224 | 352 | 185 | 442 | 2030 | | 2030 |
| 1976 | 166 | 302 | 262 | 225 | 182 | 38 | | 1175 | | 1175 |
| 1977 | 201 | 393 | 336 | 207 | 237 | 46 | - | 1420 | 6 | 1426 |
| 1978 | 81 | 349 | 245 | 186 | 113 | 10 | - | 984 | 8 | 992 |
| 1979 | 120 | 343 | 524 | 213 | 164 | 31 | - | 1395 | + | 1395 |
| 1980 | 52 | 275 | 404 | 231 | 158 | 74 | - | 1194 | + | 1194 |
| 1981 | 105 | 403 | 348 | 203 | 153 | 32 | 20 | 1264 | + | 1264 |
| 1982 | 111 | 330 | 239 | 136 | 167 | 76 | 18 | 1077 | + | 1077 |
| 1983 | 14 | 77 | 93 | 41 | 55 | 30 | - | 310 | + | 310 |
| 1984 | 33 | 116 | 64 | 4 | 43 | 32 | 5 | 297 | + | 297 |
| 1985 | 85 | 124 | 198 | 207 | 147 | 103 | - | 864 | 7 | 871 |
| 1986 | 46 | 73 | 128 | 203 | 233 | 277 | - | 960 | 19 | 979 |
| 1987 | 48 | 114 | 229 | 205 | 261 | 109 | - | 966 | + | 966 |
| 1988 | 24 | 100 | 213 | 191 | 198 | 167 | - | 893 | 4 | 897 |
| 1989 | 9 | 28 | 81 | 73 | 75 | 71 | - | 337 | - | 337 |
| 1990 | 4 | 20 | 132 | 54 | 16 | 48 | - | 274 | - | 274 |
| 1991 | 12 | 36 | 120 | 38 | 108 | 158 | - | 472 | 4 | 476 |
| 1992 | - | 4 | 23 | 5 | 75 | 130 | - | 237 | 5 | 242 |
| 1993* | - | - | - | - | - | - | - | - | - | - |
| 1994* | - | - | - | - | - | - | - | - | - | - |
| 1995 | + | 10 | 28 | 17 | 22 | 5 | - | 83 | 2 | 85 |
| 1996 | + | + | 50 | 8 | 23 | 10 | - | 92 | + | 92 |
| 1997 | 1 | 5 | 15 | 4 | 16 | 17 | - | 58 | 1 | 59 |
| 1998 | 1 | 2 | 2 | 4 | 1 | 2 | - | 11 | - | 11 |
| 1999 | + | 2 | 3 | 9 | 2 | 2 | - | 19 | + | 19 |
| 2000 | + | + | 1 | 7 | + | 13 | - | 21 | - | 21 |
| 2001 | + | 1 | 4 | 5 | 3 | 28 | - | 43 | - | 43 |
| 2002 | + | + | 2 | 4 | 1 | 2 | - | 9 | - | 9 |
| 2003 | 1 | + | 2 | 1 | 1 | 5 | - | 9 | - | 9 |
| 2004 | 3 | 1 | 4 | 2 | 3 | 2 | - | 15 | - | 15 |
| 2005 | 1 | 3 | 2 | 1 | 3 | 5 | - | 15 | - | 15 |
| 2006 | 6 | 2 | 3 | 4 | 2 | 4 | - | 22 | - | 22 |
| 2007 | 2 | 5 | 6 | 4 | 5 | 2 | - | 25 | - | 25 |
| 2008 | 4.9 | 2.2 | 10.0 | 1.6 | 2.5 | 5.0 | - | 26.2 | - | 26.2 |
| 2009 | 0.2 | 6.2 | 7.1 | 3.0 | 4.3 | 4.8 | - | 25.6 | 0.8 | 26.3 |
| 2010 | 17.3 | 4.6 | 2.4 | 2.7 | 6.8 | 4.3 | - | 38.1 | 1.7 | 39.6 |
| 2011 | 1.8 | 3.7 | 5.3 | 8.0 | 4.0 | 4.6 | - | 27.4 | 0.1 | 27.5 |
| 2012 | 5.4 | 0.8 | 15.0 | 4.6 | 4.0 | 3.0 | - | 32.6 | 0.5 | 33.1 |
| 2013 | 3.1 | 2.4 | 17.9 | 13.4 | 6.4 | 3.8 | - | 47.0 | - | 47.0 |
| 2014 | 3.6 | 2.8 | 13.8 | 19.1 | 15.0 | 3.4 | - | 57.8 | 0.1 | 57.9 |
| 2015 | 0.8 | 8.8 | 10.0 | 18.0 | 4.2 | 14.1 | - | 55.9 | 1.0 | 56.8 |
| 2016 | 0.8 | 1.2 | 7.3 | 4.6 | 4.5 | 7.3 | - | 25.7 | 1.5 | 27.1 |

* The fishery was suspended.

+ Small catches, < 0.5 t.

- No catch.

Table 4 Reported landings (tonnes) by landing category, the number of fishers reporting, and the total number of landing reports received for licensed and unlicensed fishers in 2015 and 2016. Empty cells identify categories with no reported landings and 0.0 entries represent reported values of < 0.5 t.

| NAFO/ICES | Licensed | No. of fishers | No. of reports | Comm. | Private | Factory | Total | Licensed | No. of fishers | No. of reports | Comm. | Private | Factory | Total |
|-----------|----------|----------------|----------------|-------|---------|---------|-------|----------|----------------|----------------|-------|---------|---------|-------|
| 2016 | | | | | | | | 2015 | | | | | | |
| 1A | NO | | | | | | | NO | 5 | 6 | | 0.1 | | 0.1 |
| 1A | YES | 9 | 19 | | 0.7 | | 0.7 | YES | 13 | 29 | 0.1 | 0.6 | | 0.7 |
| 1A | TOTAL | 9 | 19 | 0.0 | 0.7 | | 0.7 | TOTAL | 18 | 35 | 0.1 | 0.7 | | 0.8 |
| 1B | NO | 4 | 9 | | 0.2 | | 0.2 | NO | 3 | 5 | | 0.1 | | 0.1 |
| 1B | YES | 7 | 22 | 0.1 | 1.0 | | 1.0 | YES | 15 | 96 | 7.3 | 1.5 | | 8.7 |
| 1B | TOTAL | 11 | 31 | 0.1 | 1.1 | | 1.2 | TOTAL | 18 | 101 | 7.3 | 1.5 | | 8.8 |
| 1C | NO | 8 | 30 | | 1.0 | | 1.0 | NO | 16 | 58 | 0.1 | 1.7 | | 1.8 |
| 1C | YES | 23 | 113 | 4.1 | 2.1 | | 6.2 | YES | 42 | 181 | 2.9 | 3.9 | 1.5 | 8.2 |
| 1C | TOTAL | 31 | 143 | 4.1 | 3.1 | | 7.3 | TOTAL | 58 | 239 | 3.0 | 5.6 | 1.5 | 10.1 |
| 1D | NO | 8 | 13 | | 0.9 | | 0.9 | NO | 20 | 35 | | 0.8 | | 0.8 |
| 1D | YES | 8 | 42 | 1.2 | 2.5 | | 3.8 | YES | 11 | 161 | 14.3 | 0.5 | 2.4 | 17.1 |
| 1D | TOTAL | 16 | 55 | 1.2 | 3.4 | | 4.6 | TOTAL | 31 | 196 | 14.3 | 1.3 | 2.4 | 18 |
| 1E | NO | 13 | 22 | | 1.4 | | 1.4 | NO | 3 | 5 | 0.1 | 0.2 | | 0.2 |
| 1E | YES | 10 | 74 | 0.6 | 2.5 | | 3.1 | YES | 11 | 71 | 2.0 | 1.9 | | 3.9 |
| 1E | TOTAL | 23 | 96 | 0.6 | 3.9 | | 4.5 | TOTAL | 14 | 76 | 2.1 | 2.1 | | 4.2 |
| 1F | NO | 27 | 66 | 0.1 | 2.9 | | 3.0 | NO | 20 | 69 | | 2.4 | | 2.4 |
| 1F | YES | 13 | 46 | 2.6 | 1.7 | | 4.3 | YES | 21 | 173 | 7.1 | 4.6 | | 11.7 |
| 1F | TOTAL | 40 | 112 | 2.7 | 4.6 | | 7.3 | TOTAL | 41 | 242 | 7.1 | 7.0 | | 14.1 |
| 14 | NO | 9 | 46 | | 1.3 | | 1.3 | NO | 8 | 32 | | 0.6 | | 0.6 |
| 14 | YES | 1 | 1 | | 0.2 | | 0.2 | YES | 1 | 17 | 0 | 0.4 | | 0.4 |
| 14 | TOTAL | 10 | 47 | 0.0 | 1.5 | | 1.5 | TOTAL | 9 | 49 | 0 | 0.9 | | 1 |
| ALL | NO | 69 | 186 | 0.1 | 7.6 | | 7.7 | NO | 75 | 210 | 0.1 | 5.9 | | 6 |
| ALL | YES | 71 | 317 | 8.6 | 10.8 | | 19.4 | YES | 114 | 728 | 33.7 | 13.3 | 3.8 | 50.8 |
| ALL | TOTAL | 140 | 503 | 8.7 | 18.4 | | 27.1 | TOTAL | 189 | 938 | 33.8 | 19.2 | 3.8 | 56.8 |

Table 5 Summary of the 2014 to 2016 post-season telephone surveys conducted by the GFLK (Greenland Fisheries Control Authority), APNN (the fisheries department), and GINR (Greenland Institute of Natural Resources).

| | 2014 | 2015 | 2016 |
|---|------|------------------------|------------------------|
| Licensed fishers (total) | 321 | 310 | 263 |
| Number reporting catches by February the following year | 98 | 114 | 75 |
| Number reporting catches | 114 | 189 | 143 |
| Number not reporting catches | 207 | 196 | 188 |
| Number interviewed reporting catches | 88* | 0 | 19 |
| Number interviewed not reporting catches | 119* | 105 | 30 |
| Weighting | None | NAFO division-specific | NAFO division-specific |
| Estimated unreported catch (t) | 12.2 | 5.0 | 4.2 |

* Includes approximately 11 nonprofessional fishers.

Table 6 Reported landings and adjusted landings (tonnes) used for assessment, 2002 to 2016. Adjusted landings (sampling) refer to estimated harvests made by sampling teams during sampling periods that exceeded the corresponding community-specific reported landings for the season. Dashes '-' indicate that no adjustment was necessary. Adjusted landings (survey) refer to landings by licensed fishers that were not reported during the season but were declared during the telephone survey. No phone surveys were conducted from 2002 to 2013. Landings for assessment are the summation of reported and adjusted landings from both sampling and surveys.

| Year | Reported landings (West Greenland only; t) | Adjusted landings (sampling; t) | Adjusted landings (telephone survey; t) | Adjusted landings for assessment (t) |
|------|--|---------------------------------|---|--------------------------------------|
| 2002 | 9.0 | 0.7 | | 9.8 |
| 2003 | 8.7 | 3.6 | | 12.3 |
| 2004 | 14.7 | 2.5 | | 17.2 |
| 2005 | 15.3 | 2.0 | | 17.3 |
| 2006 | 23.0 | - | | 23.0 |
| 2007 | 24.6 | 0.2 | | 24.8 |
| 2008 | 26.1 | 2.5 | | 28.6 |
| 2009 | 25.5 | 2.5 | | 28.0 |
| 2010 | 37.9 | 5.1 | | 43.1 |
| 2011 | 27.4 | - | | 27.4 |
| 2012 | 32.6 | 2.0 | | 34.6 |
| 2013 | 46.9 | 0.7 | | 47.7 |
| 2014 | 57.7 | 0.6 | 12.2 | 70.5 |
| 2015 | 55.9 | - | 5.0 | 60.9 |
| 2016 | 25.7 | 0.3 | 4.2 | 30.2 |

Table 7 Summary of biological characteristics of catches at West Greenland in 2016 (NA – North America, E – Europe).

Table 1. Summary of biological characteristics of catches at West Greenland in 2010 (NA = North America; E = Europe).

| River-age distribution (%) by origin | | | | | | | | |
|--|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|
| Conti- nent | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| NA | 0.1 | 21.3 | 43.3 | 26.8 | 7.3 | 1.1 | 0 | 0 |
| E | 10.4 | 59.0 | 26.3 | 3.8 | 0.4 | 0 | 0 | 0 |
| Length and weight by origin and sea age | | | | | | | | |
| Conti- nent | 1 SW | | 2 SW | | Previous spawners | | All sea ages | |
| | Fork length (cm) | Whole weight (kg) | Fork length (cm) | Whole weight (kg) | Fork length (cm) | Whole weight (kg) | Fork length (cm) | Whole weight (kg) |
| NA | 65.2 | 3.18 | 85.1 | 7.77 | 72.2 | 4.03 | n/a | 3.32 |
| E | 62.6 | 2.79 | 76.0 | 5.18 | 70.9 | 4.12 | n/a | 2.89 |
| Continent of origin (%) | | | | | | | | |
| North America | | | | Europe | | | | |
| 66.4 | | | | 33.6 | | | | |
| Sea-age composition (%) by continent of origin | | | | | | | | |
| Conti- nent | 1SW | | 2SW | | Previous spawners | | | |
| NA | 93.5 | | 2.5 | | 4.0 | | | |
| E | 95.5 | | 3.5 | | 1.0 | | | |

NASCO 4.2 Describe the status of the stocks

Currently reliable estimates of stock status of salmon populations at West Greenland are not available. Stock status is inferred from the status of the populations in their homewaters.

Recruitment (pre-fishery abundance) estimates of non-maturing 1SW salmon suggest continued low abundance of North American (Figure 9 in ICES, 2017a) and southern North East Atlantic Commission (NEAC) (Figure 5 in ICES, 2017b) salmon at Greenland. The midpoints of the spawner abundance estimates for five out of the seven stock complexes exploited at West Greenland are below the conservation limits (CLs) and are therefore suffering reduced reproductive capacity (Figure 5). In 2016, North American 2SW spawner estimates were below CLs in five of the six regions (Québec, Gulf, Newfoundland, Scotia–Fundy, and the USA; Figure 5); the median estimate for Labrador was above the CL. Within each of the geographic areas there are individual river stocks that are failing to meet CLs. In the southern parts of the North American Commission (NAC) area (Scotia–Fundy and USA) numerous populations are in danger of extinction and are under consideration for, or receiving, special protection measures under federal legislation. The midpoint of the spawner abundance estimate for the Southern NEAC MSW stock complex was above the CL, but the stock complex is considered at risk of suffering reduced reproductive capacity (Figure 5). For individual countries within the Southern NEAC MSW stock complex, estimated spawners for two countries were considered at full reproductive capacity, whereas spawners for three countries were either at risk of, or suffering from reduced reproductive capacity.

The exploitation rate (catch at Greenland/PFA) on NAC fish in 2015 was 9.7%, which is slightly higher than the 2014 estimate (9.5%) and the previous five-year mean (8.4%, 2010–2014), but remains among the lowest in the time-series (Figure 6). The 2015 Southern NEAC exploitation rate was 1.0%, which is a decrease from the previous year's estimate (1.9%) and slightly above the previous five-year mean (0.8%, 2010–2014), but remains among the lowest in the time-series.

The abundance of salmon within the West Greenland area is thought to be low compared to historical levels. This is broadly consistent with the general pattern of decline in marine survival in most monitored stocks. Despite major changes in fisheries management in the past few decades and increasingly more restrictive fisheries measures since, returns in many of these regions have remained near historical lows. The continued low abundance of salmon stocks across North America and in the Northeast Atlantic, despite significant fishery reductions, further strengthens the conclusions that factors other than fisheries are constraining production.

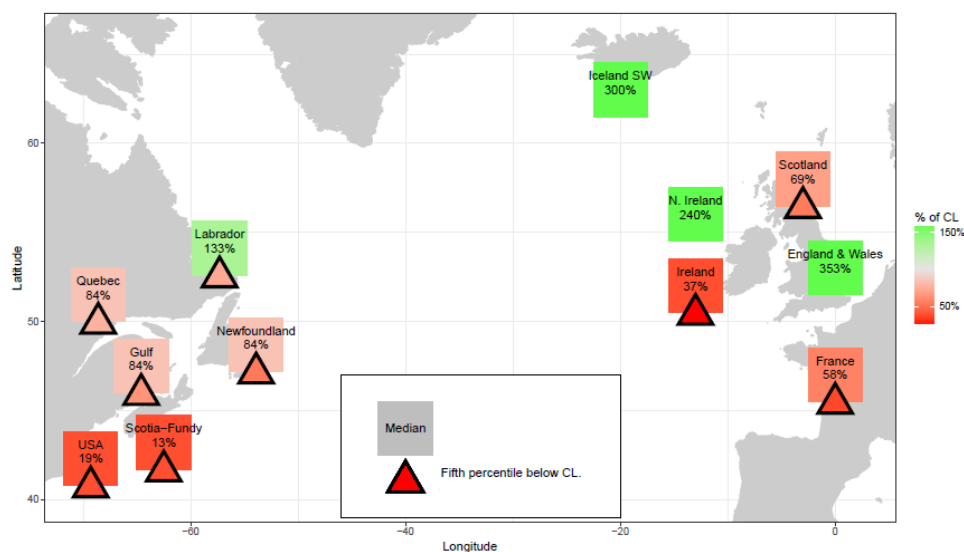


Figure 5 Summary of 2SW (NAC regions) and MSW (NEAC regions) spawner estimates in relation to CLs (or management objectives for USA and Scotia–Fundy in NAC). Median (squares) and the 5th percentile (triangles) refer to the values from the posterior distribution from Monte Carlo sampling. The colour shading of the symbols represents the percentage of the CL or management objective attained, with red indicating less than 100% and green greater than 100%. For squares, colours are in reference to the median as a percentage of CL or objective. For triangles, colours are in reference to the 5th percentile as a percentage of the CL or management objective. The triangles indicate when the 5th percentiles of the estimates are below the CLs or management objective, i.e. when the stocks are at risk of, or suffering from reduced reproductive capacity.

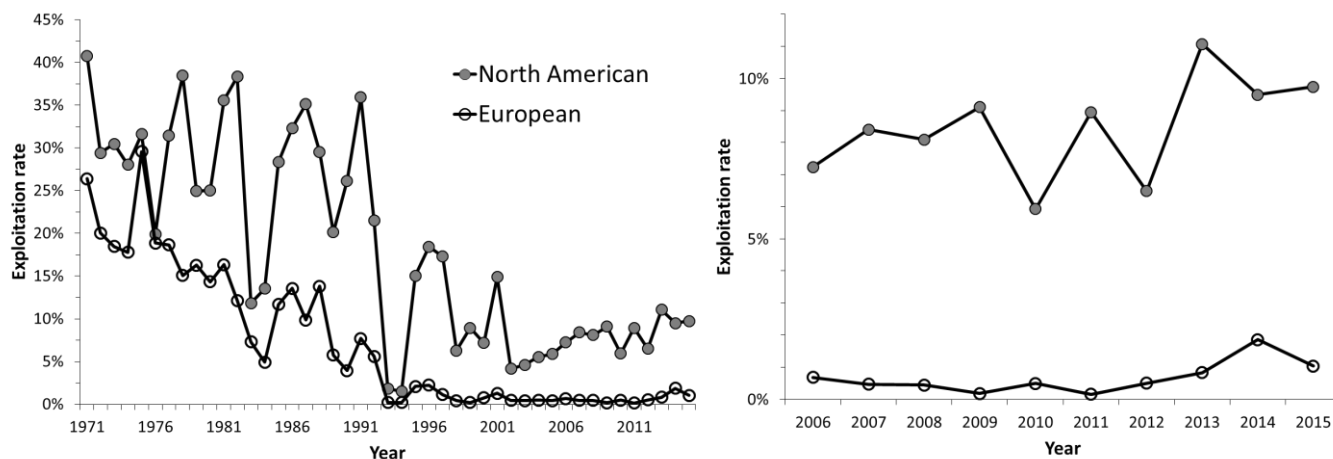


Figure 6 Exploitation rate (%) for NAC 1SW non-maturing and Southern NEAC non-maturing Atlantic salmon at West Greenland, 1971–2015 (left) and 2006–2015 (right). Exploitation rate estimates are only available until 2015, as the 2016 exploitation rates are dependent on 2017 returns.

NASCO 4.3 Identify relevant data deficiencies, monitoring needs, and research requirements

The following relevant data deficiencies, monitoring needs, and research requirements of relevance to the West Greenland Commission were identified.

- 1) Continued efforts to improve the reporting system for catches in the Greenland fishery, and to provide detailed statistics related to spatially and temporally explicit catch and effort data for analyses.
- 2) The continuation of the phone survey programme in Greenland according to a standardized and consistent annual approach, with consideration given to surveying a higher proportion of licensed fishers and the inclusion of the non-licensed fishers. Information gained on the level of total catches for this fishery will allow a more accurate assessment of the status of stocks and assessment of risk with varying levels of harvest.
- 3) The continuation and potential expansion of the broad geographic sampling programme, including the re-introduction of sampling in Nuuk (in multiple NAFO divisions, and including factory landings when permitted) to more accurately estimate continent and region of origin and biological characteristics of the mixed-stock fishery.
- 4) Progress to be made in assigning the European origin salmon from the West Greenland fishery to a sub-complex region of origin.

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Annex 1 Glossary of acronyms and abbreviations

1SW (*one-sea-winter*). Maiden adult salmon that has spent one winter at sea.

2SW (*two-sea-winter*). Maiden adult salmon that has spent two winters at sea.

CL, i.e. S_{lim} (*conservation limit*). Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries will be to ensure that there is a high probability that undesirable levels are avoided.

CPUE (*catch per unit of effort*). A derived quantity obtained from the independent values of catch and effort.

ICES (*International Council for the Exploration of the Sea*).

NAC (*North American Commission*). A commission under NASCO.

NAFO (*Northwest Atlantic Fisheries Organization*). NAFO is an intergovernmental fisheries science and management organization that ensures the long-term conservation and sustainable use of the fishery resources in the Northwest Atlantic.

NASCO (*North Atlantic Salmon Conservation Organization*).

NEAC (*North East Atlantic Commission*). A commission under NASCO.

PFA (*pre-fishery abundance*). The numbers of salmon estimated to be alive in the ocean from a particular stock at a specified time.

TAC (*total allowable catch*). TAC is the quantity of fish that can be taken from each stock each year.

Annex 3 General considerations

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach which stipulates that management measures should be aimed at maintaining all stocks above their CLs by the use of management targets. NASCO has adopted the region-specific CLs as limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability. Within the agreed management plan, a simultaneous risk level (probability) of 75% has been agreed for the provision of catch advice on the stock complexes exploited at West Greenland (non-maturing 1SW fish from North America and Southern NEAC). The management objectives are to meet the 2SW CLs for the four northern areas of NAC (Labrador, Newfoundland, Québec, and Gulf), to achieve a 25% increase in returns of 2SW salmon from the average returns in 1992–1996 for the Scotia–Fundy region, to achieve 2SW adult returns of 4549 fish or greater for the USA, and to meet the Southern NEAC MSW CL. A framework of indicators has been developed in support of the multi-annual catch options.

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northeast Atlantic area their current distribution extends from northern Portugal to the Pechora River in northwestern Russia and Iceland. In the Northwest Atlantic distribution ranges from the Connecticut River in USA (41.6°N) to the Leaf River in Ungava Bay (Québec, Canada; 58.8°N). Juveniles emigrate to the ocean at ages one to eight years (dependent on latitude) and generally return after one or two years at sea. Long-distance migrations to ocean feeding grounds are known to take place, with adult salmon from both the North American and Northeast Atlantic stocks migrating to West Greenland to feed during their second summer and autumn at sea.

Environmental influence on the stock

Environmental conditions in both freshwater and marine environments have a marked effect on the status of salmon stocks. Across the North Atlantic, a range of problems in the freshwater environment play a significant role in explaining the poor status of stocks. In many cases river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions. In the marine environment, return rates of adult salmon have declined through the 1980s and are now at the lowest levels in the time-series for some stocks, even after closure of marine fisheries. Climatic factors modifying ecosystem conditions and the impact of predators of salmon at sea are considered to be the main contributory factors to lower productivity, which is expressed almost entirely in terms of lower marine survival.

Effects of the fisheries on the ecosystem

The current salmon fishery uses nearshore surface gillnets. There is no information on bycatch of other species with this gear. The fisheries probably have no, or only minor, influence on the marine ecosystem.

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Catch reporting is considered to be incomplete.

Scientific basis

| | |
|--------------------------|---|
| ICES stock data category | 1 (ICES, 2016b). |
| Assessment type | Run reconstruction models and Bayesian forecasts, taking into account uncertainties in the data. |
| Input data | Nominal catches (by sea-age class and continent of origin) for internal use fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments). |
| Discards and bycatch | No salmon discards in the directed salmon fishery. |
| Indicators | A framework of indicators (FWI) is used to indicate whether a significant change has occurred in the status of stocks in intermediate years where multi-annual management advice applies. |
| Other information | Advice subject to annual review. Stock annex completed in 2014 and updated in 2017. |
| Working group | Working Group on North Atlantic Salmon (WGNAS) (ICES, 2017c). |