9.17 POR - Porbeagle

This document contains the information on stock assessments conducted in different years. Three of the porbeagle stocks (Northwest, Southwest and Southeast) were assessed by the ICCAT SCRS in 2020. The Northeast stock was assessed in 2022 in a joint process with the International Council on the Exploration of the Sea (ICES). The Porbeagle Executive Summary updated catch information from all stocks. However, stock status elements for the southern and western stocks use the information from the 2020 ICCAT Porbeagle Stock Assessment Meeting (Anon., 2020f). The Northeast stock information has been updated with both new information from the catch and new information from the 2022 assessment. The decision was to keep results for all porbeagle stock together because the information from the Northwest and southern stocks was not updated in the 2022 assessment.

The latest information on the status of the porbeagle (*Lamna nasus*) stock is available in the Report of the 2020 ICCAT Porbeagle Stock Assessment Meeting (Anon., 2020f). In 2022 a joint ICES/ICCAT stock assessment was conducted for the northeast stock of porbeagle, for which results are included herein.

POR-1. Biology

Porbeagle is a large pelagic shark that shows a wide geographic distribution associated with cold-temperate waters. Porbeagle is an aplacental viviparous shark, with oophagy, which limits their fecundity to an average litter size of around four but increases the probability of survival of their young. Gestation period is 8 to 9 months. Median size at maturity is about 174 cm FL (fork length) or 8 years for males and 218 cm FL or 13 years for females, with mating taking place between September and November in the North Atlantic. Breeding frequency was determined to be annual, but a recent study found that at least a portion of the Northwest Atlantic population is biennial or possibly even triennial based on the finding of a resting stage. Although uncertainty regarding their biology remains, available life history traits (slow growth, late maturity and small litter size) indicate that it is vulnerable to overfishing. A behavioral characteristic of this species is its tendency to segregate temporally and spatially by size and/or sex during feeding, mating-reproduction, gestation and birth processes. Tagging studies have suggested that the species exhibits large-scale migratory behaviour and periodic vertical movement, but the lack of information on some components of the populations precludes a complete understanding of their distribution/migration patterns by ontogenetic stage and in some cases identifying their pupping/mating grounds. Numerous aspects of the biology of this species are still poorly understood or completely unknown, particularly for some regions, which contributes to increased uncertainty in quantitative and qualitative assessments.

The stock structure for porbeagle shark was first addressed in 2009 at the Joint ICCAT/ICES Porbeagle Stock Assessment Meeting (Copenhagen, Denmark, June 22 to 27, 2009) (Anon., 2010). Data at that time supported the view of restricted movements between the NE and NW Atlantic individuals. Therefore, it was concluded that in the North Atlantic there were two stocks. Regarding the South Atlantic, it was understood that there were two stocks, SW and SE, although the possibility was raised that both southern stocks would extend to the bordering oceans (Pacific and Indian). Since 2009, a number of mark-recapture, pop-up archival satellite tag (PSAT) studies have further examined the movements of porbeagle particularly in the North Atlantic Ocean. Nearly all of the long-term satellite tagging, conventional tagging, and survival tagging supports that porbeagle stocks in the Northeast Atlantic are separate from the Northwest. There is little tagging information from the South Atlantic. In addition to tagging studies, a study of genomic DNA suggests there is strong genetic subdivision between the North Atlantic and Southern Hemisphere populations but found no differentiation within these hemispheres. New information derived from fishery and research data from the South Atlantic, Pacific and Indian Oceans indicates that there is a continuous distribution of the species in the three oceans and that it ranges from 20° to 60° South latitude. Overall, there is insufficient data to define the appropriate number of stocks in the Southern Hemisphere.

POR-2. Fishery indicators

The Committee considered that, based on the most recent and best available information, there are two stocks in the North Atlantic (NW, NE) and likely a single stock in the South Atlantic. However, two areas (SW and SE) are considered for catch data reporting purposes in the South Atlantic (**POR-Table 1** and **POR-Figure 1**).

Few CPUE series were presented during the 2020 porbeagle assessment as management measures led to changes in the fishery that resulted in lack of sufficient data on porbeagle catch rates or changes in management that could not be accounted for in the CPUE standardization procedure.

Two standardized CPUE series were presented for the NW Atlantic stock: a Canadian fishery-independent survey and a Japanese pelagic longline fishery series based on observer data. The Canadian survey showed a decline from 2007 to 2017 but was deemed not to reflect abundance; the Japanese series showed a stable trend during 2000-2014 and an increase from 2014 to 2018, which could be attributable to an increase in juvenile sharks. A standardized CPUE series was presented for the SW stock based on data from Uruguayan longliners from 1982 to 2012. The Uruguayan tuna fleet can be divided into two well-defined periods: 1982-1992 Japanese-style longline (deep sets), and 1993-2012 American-style longline (shallow sets). The first period had higher standardized CPUE values, suggesting that fishing method factors such as set depth or bait type may have an effect on porbeagle catch rates.

For the 2022 NE Atlantic porbeagle assessment, 3 standardized CPUE indices were considered: a Norwegian longline CPUE series from 1950 to 1972, that shows a downward trend in the second half of the 1950s, but this trend seems to have stabilized in the early 1960s, followed by a slight increase in the late 1960s and early 1970s; a French longline CPUE series from 1972 to 2009, that shows that the relative abundance index obtained decreases in the 1970s, but thereafter varies without trend; a Spanish longline CPUE series from 1986 to 2007, that presents higher values in the 2000s, with large interannual variations. This index was previously used in the 2009 ICCAT-ICES assessment. Also, it was considered in the assessment a composite survey CPUE series constructed by combining CPUEs of a French commercial vessel, from 2000 to 2009, with CPUEs of a survey carried out in 2018-2019.

POR-3. State of the stocks

Due to changes in management practices that would have affected the development of CPUE series and potentially length composition data, in 2020 the Committee was constrained to use non-traditional stock assessment methods. Overfished stock status could only be determined for the NW stock and overfishing stock status, for the combined stocks in the North Atlantic and the South Atlantic. The Committee formally assessed the NE stock together with the ICES Working Group of Elasmobranch Fishes (WGEF) in 2021-2022.

Two modelling approaches were used to assess the status of porbeagle shark in the Atlantic and two additional methods were also explored. The Sustainability Assessment for Fishing Effects (SAFE) was used to evaluate whether the combined North and combined South Atlantic stocks were experiencing overfishing. The Incidental Catch Model (ICM) was used to evaluate whether the NW Atlantic stock was currently overfished and to determine the stock's capacity for future removals. Exploratory analyses that were not used to derive advice for the current assessment included the ICM fit to the South Atlantic stock, length-based approaches fit to the NW, SW, and SE stocks, and input control management options explored in a preliminary MSE approach for the NW stock. All of the exploratory approaches showed promise and could be further explored in future assessments.

Results of the SAFE approach indicated that neither the North Atlantic nor the South Atlantic stocks are undergoing overfishing. It was noted that while this is a data-limited approach, the overfishing status results were robust to the selectivity curve assumed and the post-release mortality value used in the computation of post-capture mortality. The Committee noted that for the South Atlantic results are in line with those found in the 2017 Southern Hemisphere (SH) porbeagle Areas Beyond National Jurisdiction (ABNJ) stock status assessment, with F/F_{MSY} values from both studies being of relatively similar magnitude (annual mean=0.063, range: 0.046 to 0.083 for 2006-2014 in the SH assessment vs. annual mean=0.113, range: 0.107-0.119 for 2010-2018 in the SAFE analysis).

An equal mix of annual and biennial reproduction was considered the most likely scenario for the porbeagle population in the NW Atlantic, so these productivity assumptions were used for the base case formulation of the ICM. Two alternate parameterizations of the ICM were evaluated to determine the model's sensitivity to life history assumptions as well as to the assumed population size in 2018. The first sensitivity analysis assumed a reproductive periodicity of only one year (annual reproduction), consistent with productivity assumptions in the 2009 assessment. The second assumed larger population size in 2018, so that predicted abundance in 2009 matched the value of 200,000 animals from the Canadian Statistical-Catch-at-Age model presented at the 2009 assessment. In all formulations, the stock was predicted to be overfished in 2018

with > 70% probability, even though abundance has been increasing since 2001. The scenarios differed in how far 2018 abundance was below the MSY proxy for biomass, with both sensitivity analyses suggesting that the population was closer to the reference point. The base case formulation of the ICM estimated biomass in 2018 to be 57% of the MSY proxy reference point (353,000 animals), giving a 98% probability of the stock being overfished.

Due to a lack of reporting, the magnitude of dead discards remains uncertain and post-release mortalities are not incorporated in this assessment, so there remains considerable uncertainty in the assessment of status. If actual total removals (unreported landings, dead discards, and post-release mortalities) do not largely exceed what has been estimated, then with the large reduction in recent reported removals, the Committee considers it unlikely that the stock is undergoing overfishing, but it considers that the stock remains overfished.

The Northeast Atlantic porbeagle stock has the longest recorded history of commercial exploitation for ICCAT sharks. During the 2009 assessment, a lack of CPUE data for the peak of the fishery was considered to add uncertainty in identifying the status relative to virgin biomass. This issue has been resolved in the 2022 assessment with the availability of the Norwegian longline CPUE series which begins in 1950, thus when catches were still above 3,000 t. The 2022 stock assessment was carried out using the Surplus Production Model in Continuous Time (SPiCT) model with priors agreed for the final benchmark assessment. The exploited biomass decreases below B_{MSY} in the early 1950s. Despite an increase in the 2010s due to the fishing restriction in place since 2010, B/B_{MSY} = 0.5 in 2022. The stock remains overfished, but overfishing is not occurring, consistent with the low values of current F.

POR-4. Outlook

Projections conducted with the ICM for the NW stock indicated that removals of less than 7,000 sharks (214 t) would allow rebuilding with a 60% probability by 2070 (a projection interval of 2.5 generations) and removals of less than 8,000 sharks (245 t) would allow rebuilding with a 50% probability by 2060 (**POR-Table 2** and **POR-Figure 3**). If removals remained similar to 2014-2018 (mean = 47 t), the stock was predicted to rebuild with at least a 50% probability between 2030 and 2035). However, the Committee emphasized that recent removals are very likely underestimated because few CPCs report dead discards, and post-release mortality of live discards was not taken into account.

During the 2022 porbeagle northeast stock assessment, long-term projections using constant catch were not presented because technical issues prevented projections from being carried out during the assessment. So, Kobe Strategy matrix was not created. Projections will be produced during the next porbeagle stock assessment.

POR-5. Effect of current regulations

In 2013 Uruguay prohibited retention of porbeagle sharks and Canadian directed fisheries for porbeagle have also been closed since 2013. From 2010–2014, successive EC Regulations had established a zero TAC for the Northeast porbeagle in EU waters of the ICES area and prohibited EU vessels to fish for, to retain on board, to transship and to land porbeagle in international waters. Since 2015 it has been prohibited for EU vessels to fish for, to retain on board, to transship or to land porbeagle, with this applying to all waters. Since 2021 porbeagle is also included on the list of prohibited species in UK waters. It has been forbidden to catch and land porbeagle in Sweden since 2004; and in 2007, Norway banned all direct fisheries for porbeagle. In 2017, a regulation was issued to ban all targeted fishing in Icelandic waters for spurdog, porbeagle and basking shark and stipulating that all viable catch in other fisheries must be released.

Estimated catches (based primarily on landings data) for the NE stock have steadily decreased since the species became prohibited in 2010 (21 t) to 15 t in 2022; for the NW stock catches of 284 t were estimated for 2013 but have decreased to 7 t in 2022; catches for the SE and SW stocks are insignificant, less than 4 t annually since 2015 for the SE and 0 t for the SW since 2013. Captures in the Mediterranean have historically been very low, less than 1 t since 1980 (**POR-Table 1** and **POR-Figure 1**). However, the Committee noted that these catches likely underestimate total removals because they do not include dead discards in many cases and reporting of post-release mortality of live releases is not required. Furthermore, the magnitude of porbeagle removals in non-ICCAT coastal fisheries is unknown but likely high.

The proportion of catches released alive has increased since 2015 following the implementation of Rec. 15-06, which obligates that CPCs require their vessels to promptly release unharmed, to the extent practicable, porbeagle sharks caught in association with ICCAT fisheries when brought alive alongside for taking on board the vessel.

Porbeagle was listed under Appendix II of the Convention on International Trade in Endangered Species (CITES) in 2013. Among other things, CITES Appendix II carries a requirement that Parties issue export and import, as well as introduction from the sea, permits based on findings that the take is legal and sustainable. Development of these "non-detriment findings" and related permitting processes is underway.

Parties to the Convention on Migratory Species (CMS) have listed 29 elasmobranch species under its Appendices. Appendix II, which includes porbeagle, signals a commitment to international cooperation toward conservation.

Under current regulations, 2020 NW assessment and 2022 NE assessment indicate that both stocks have increased in the last 10 years, showing in the case of the NW a rebuilding trend since 2001.

POR-6. Management recommendations

The following management recommendations were agreed upon and included in the Executive Summary based on the 2020 ICCAT porbeagle stock assessment. During the 2022 SCRS meeting, section 1a was updated with the information reported by CPCs, and section 7 was discussed and agreed based on the results of the NE porbeagle stock assessment conducted during 2022 in a joint process between ICCAT and ICES.

The Committee recommends that the Commission work with countries catching porbeagle and relevant Regional Fisheries Management Organization (RFMOs) to ensure recovery of North Atlantic porbeagle stocks (e.g., ICES, Northwest Atlantic Fisheries Organisation (NAFO)). In particular, porbeagle fishing mortality should be kept at levels in line with scientific advice and with removals not exceeding the current level. New targeted porbeagle fisheries should be prevented, porbeagles retrieved alive should be released following best handling practices to increase survivorship, and all catches should be reported. Management measures and data collection should be harmonized as much as possible among all relevant RFMOs dealing with these stocks, and ICCAT should facilitate appropriate communication.

1. The SCRS needs cooperation from all CPCs to improve catch statistics, which is critical to advancing the assessments of all porbeagle stocks.

    a) Three CPCs have reported live discards of porbeagle for 2021. The Committee underlines that the reporting and quantification of live discards is critical, especially for a stock where all live animals must be released (Rec. 15-06); the Commission should find ways to encourage improved reporting of live discards.
    b) There is a need for CPCs to strengthen their monitoring and data collection efforts, including but not limited to improved estimates of dead discards and the estimation of CPUEs using observer data.
    c) The Committee requests CPCs revise their porbeagle catch series (landings, live discards, and dead discards) including incidental captures from their other non-ICCAT fisheries (gillnet, trawling, purse seiner, etc.) to allow the SCRS to incorporate all mortality sources into future assessments and reduce the uncertainty in stock status and projections.
    d) In addition, the Committee recommends that the ICCAT liaise with parties (e.g., other RFMOs) and engage in data mining to determine the total capture from non-ICCAT parties.

2. The Committee notes that management recommendations for porbeagle stocks under ICCAT responsibility are drafted for ICCAT fisheries. However, porbeagle stocks are subject to mortality from CPCs' coastal fisheries and countries that are not ICCAT Parties. Therefore, the Committee recommends that CPCs implement a live release requirement for all porbeagle caught in their waters and that ICCAT develop integrated management approaches (with other countries, other Regional Fisheries Bodies, United Nations Food and Agriculture Organization (FAO)) to assure the sustainability of Atlantic porbeagle stocks.

3. The Committee notes that some landings and the majority of discards go unreported, meaning that total mortality of porbeagle from all sources (i.e., landings, dead discards and live releases that subsequently die as a result of gear interactions) is underestimated. For the purposes of this assessment, the Committee estimated unreported landings and dead discards preliminarily that were 89% higher than reported but did not estimate mortality following live release. The Commission should be aware that actual removals are higher than what is being reported and Kobe matrices will be optimistic to the extent that removals are underreported.

4. Considering the underreporting of removals, and the current low stock status of the NW Atlantic stock (B_{2018}/B_{MSY}=0.57), the Committee recommends that total removals (i.e., the sum of landings, dead discards, and post-release mortality of live releases) do not exceed current levels (including unreported removals) to allow for stock recovery. Although the Kobe matrix might suggest that some increases in total removals could allow for potential recovery in the long term, the assessment suggests that the stock is productive enough to recover in a much shorter time frame if total removals are maintained at a lower level. This is consistent with Rec. 11-13 that overfished stocks be recovered in as short a period as possible. However, the Commission should be aware that actual removals (particularly dead discards and post-release mortalities of live releases) are higher than what is being reported and the Kobe matrix is overly optimistic to the extent that removals are underreported.

5. While there is large uncertainty in southern stock structure, new information suggests a single stock of porbeagle in the South Atlantic; the Committee had, until now, considered two stock units, SW and SE. Indeed, there may be a southern stock that extends across Indian and Pacific Ocean basins. More research on stock structure needs to be undertaken to determine an appropriate unit stock. Until this research is done, the Committee recommends leaving the management units as currently defined.

6. The Committee was not able to draw any conclusions on the overfished status of the southern stock(s). It noted that indeed, conventional data (e.g., landings, representative length compositions) cannot be collected for any northern or southern porbeagle stocks, so the Committee concluded that alternative (e.g., fishery independent) data collection methods that allow CPUE or length-frequency data (or other altogether different forms of data) to be collected are required to provide more reliable estimates of stock status in the North and in the South Atlantic.

7. Considering the underreporting of removals, the current stock status of the NE Atlantic stock B_{2022}/B_{MSY}=0.464 (0.15-1.43), and the lack of reliable projections to build Kobe II Strategy Matrix (K2SM), the Committee recommends that total removals (i.e., the sum of landings and estimated dead discards) at the very least shall not exceed the average reported ICCAT catch since the implementation of the zero TAC recommendation (i.e., 2010-2021 which current estimates would be 9.3 tons) to allow for stock recovery. Lower levels of removals will accelerate such recovery.

NORTHWEST ATLANTIC PORBEAGLE SUMMARY

Current Yield (2022)		7 t[1]
Relative Biomass	B_{2018}/B_{MSY}	0.57[2]
Fishing Mortality at MSY	F_{MSY}	0.049[3]
Relative fishing mortality	$F_{2010\text{-}2018}/F_{MSY}$	0.413[3]
Stock Status (2018)	Overfished Overfishing	Yes Not likely
Management Measures in Effect		Rec. 04-10, Rec. 07-06, Rec. 15-06

[1] Estimated catch for the Northwest stock as of 21 September 2023. Catch does not include all dead discards and includes no mortalities resulting from live releases.
[2] Value obtained with the ICM model. The reference point used (SPR_{MER}) is a proxy for B_{MSY}.
[3] Value obtained with the SAFE approach for the North Atlantic.

NORTHEAST ATLANTIC PORBEAGLE SUMMARY

ICES-ICCAT Yield in 2021[1]		7.95 t[2]
Relative Biomass	B_{2021}/B_{MSY}	0.464 (0.15-1.43)[2]
Fishing mortality at MSY	F_{MSY}	0.051 (0.0217-0.120)[2]
Relative fishing mortality	F_{2021}/F_{MSY}	0.013 (0.0024-0.073)[2]
Stock Status (2021)	Overfished Overfishing	Yes No
Management Measures in Effect		Rec. 04-10, Rec. 07-06, Rec. 15-06

[1] The value reported represents the total catches determined at the ICES-ICCAT Working Group on Elasmobranch Fishes (WGEF). While the Task 1 reported catch for the Northeast stock was 15.4 t, the catch shown does not include all dead discards and includes no mortalities resulting from live releases.
[2] Range obtained from reference case SPiCT with 95% Bayesian credibility intervals.

SOUTH ATLANTIC PORBEAGLE SUMMARY

Current Yield (2022)		0 t[1]
Relative Biomass	B_{2018}/B_{MSY}	Unknown
Fishing mortality at MSY	F_{MSY}	0.062[2]
Relative fishing mortality	$F_{2010\text{-}2018}/F_{MSY}$	0.113[2]
Stock Status (2018)	Overfished Overfishing	Undetermined Not likely
Management Measures in Effect		Rec. 04-10, Rec. 07-06, Rec. 15-06

[1] Sum of the estimated catch for the Southwest and Southeast Atlantic stock areas as of 21 September 2023.
[2] Value obtained with the SAFE approach for the South Atlantic.

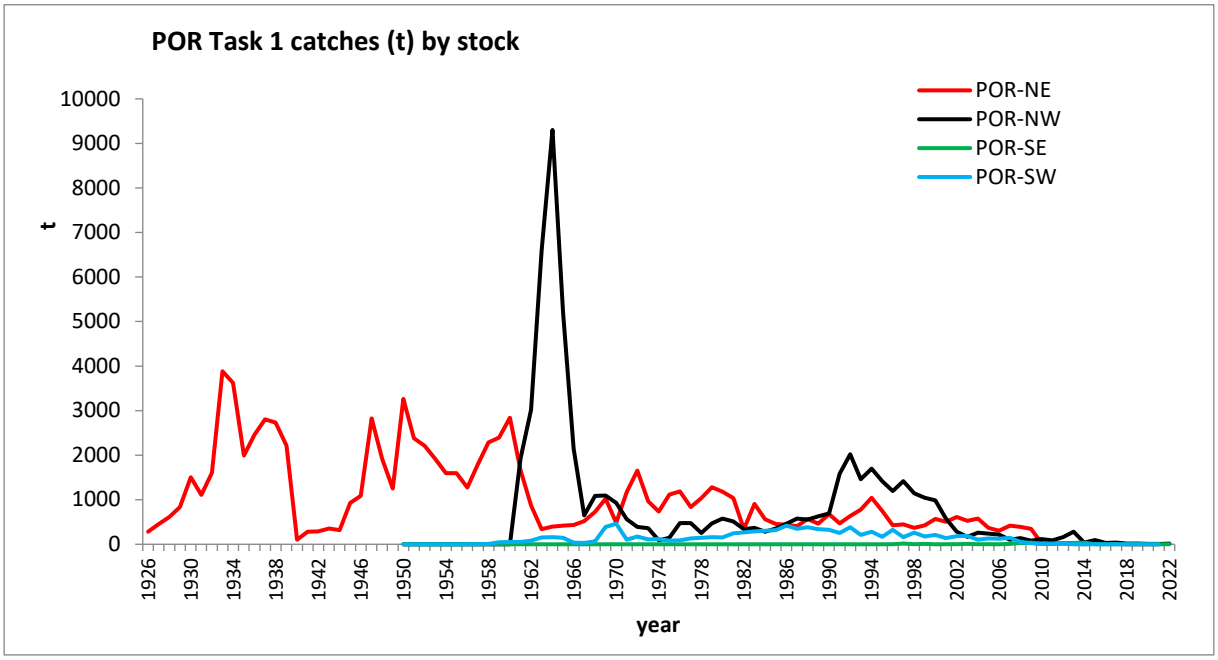
POR-Table 1. Estimated catches (t) of porbeagle (*Lamna nasus*) by area, gear and flag.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TOTAL				2453	3027	2334	1951	2041	1776	1648	1769	1223	1074	887	954	740	642	671	619	495	152	120	225	323	78	104	41	48	27	16	14	15	22
	ANE			777	1045	749	428	444	371	424	567	506	610	527	578	367	302	421	391	349	21	14	25	10	5	8	9	8	4	0	3	5	15
	ANW			1462	1698	1415	1192	1418	1141	1046	988	574	282	164	264	237	217	101	141	84	114	85	162	284	35	93	30	39	19	16	11	10	7
	ASE			0	0	0	3	19	1	6	0	1	1	9	3	1	0	5	30	37	6	7	26	29	38	3	1	0	4	0	0	0	0
	ASW			213	284	170	327	159	261	172	214	141	181	187	105	133	122	143	55	26	10	14	12	0	0	0	0	0	0	0	0	0	
	MED			0	0	0	1	0	1	0	1	1	0	0	3	2	1	0	2	1	1	0	1	0	0	0	1	1	0	0	0	0	0
Landings	ANE		Longline	23	101	64	55	39	33	28	33	41	83	142	275	63	62	301	229	143	9	2	1	1	0	5	3	1	0	0	0	0	0
			Other surf.	754	943	685	373	405	338	396	533	465	527	385	303	305	240	120	162	206	13	12	24	9	5	3	6	7	4	0	3	5	9
	ANW		Longline	1462	1697	1413	1186	1406	1124	1034	985	566	269	151	252	226	208	91	131	67	83	68	134	248	14	15	10	10	6	0	0	0	
			Other surf.	0	0	2	6	12	18	12	3	8	13	13	12	12	8	11	9	12	20	15	23	30	7	9	5	8	3	12	5	1	0
	ASE		Longline	0	0	0	3	15	1	2	0	1	1	9	3	1	0	5	30	36	6	7	25	29	13	3	1	0	4	0	0	0	
			Other surf.	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	
	ASW		Longline	213	282	170	326	159	259	170	213	141	181	187	105	133	122	143	55	26	10	14	12	0	0	0	0	0	0	0	0	0	
			Other surf.	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED		Longline	0	0	0	1	0	1	0	1	1	0	0	2	2	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Discards	ANE		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
	ANW		Longline	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	11	2	5	6	14	67	13	19	7	0	1	2	4
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	3	4	6	3
	ASE		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ASW		Longline	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings	ANE	CP	EU-Denmark	91	93	86	72	69	85	107	73	76	42	21	20	4	3	2	1	0	0	0	2	0	0	0	0	0	0	0	0	0	**0**
			EU-España	21	52	19	41	25	25	18	13	24	54	27	11	14	34	8	41	77	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-France	633	820	565	267	315	219	240	410	361	461	303	413	276	194	354	311	228	0	2	4	0	0	3	0	1	0	0	0	0	2
			EU-Germany	1	0	0	0	0	2	0	17	1	3	5	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Ireland	0	0	0	0	0	0	8	2	6	3	11	18	3	4	8	7	3	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Portugal	1	1	1	1	1	1	0	7	4	10	101	50	14	6	0	3	17	7	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Sweden	3	2	2	1	1	1	1	1	1	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Great Britain	0	0	0	0	0	1	6	8	12	10	25	24	24	11	26	15	11	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Iceland	3	4	6	5	3	4	2	2	3	2	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	
			Japan	0	0	0	5	4	0	0	0	0	0	0	0	0	0	12	0	3	2	1	1	0	0	0	2	0	0	0	0	0	**0**
			Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**0**
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	**0**
			Norway	24	24	26	28	17	27	32	22	11	14	19	24	8	27	10	12	10	12	11	17	9	5	4	6	6	3	0	3	5	8
			Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCO	Faroe Islands	0	48	44	8	9	7	10	13	8	10	14	5	19	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ANW	CP	Barbados	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	3	13	1	2	1	1	1	0	0	0	**0**
			Canada	919	1575	1353	1051	1334	1070	965	902	499	237	142	232	202	192	93	124	62	83	30	33	19	9	4	2	2	1	0	0	0	**0**
			FR-St Pierre et Miquelon	0	0	7	40	13	20	0	13	2	1	2	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	35	29	15	10	9	19	41	47	52	21	7	20	27	18	5	10	10	11	13	48	98	0	0	0	0	0	0	0	0	**0**
			Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	13	20	3	0	0	0	0	0	0	0	0	**0**
			Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			USA	38	79	26	58	41	9	2	1	1	1	0	0	0	0	0	0	0	2	9	19	27	6	8	4	8	3	12	5	1	0
			Venezuela	2	4	1	7	2	8	9	6	2	0	0	0	0	0	0	1	3	3	9	19	69	4	6	4	8	4	0	0	0	**0**
		NCC	Chinese Taipei	4	10	12	27	18	13	27	19	18	22	12	8	7	5	3	2	2	3	7	15	50	1	5	4	0	0	0	0	0	**0**
		NCO	Cuba	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Faroe Islands	465	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ASE	CP	EU-España	0	0	0	0	2	1	2	0	1	1	9	3	0	0	0	1	11	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Portugal	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

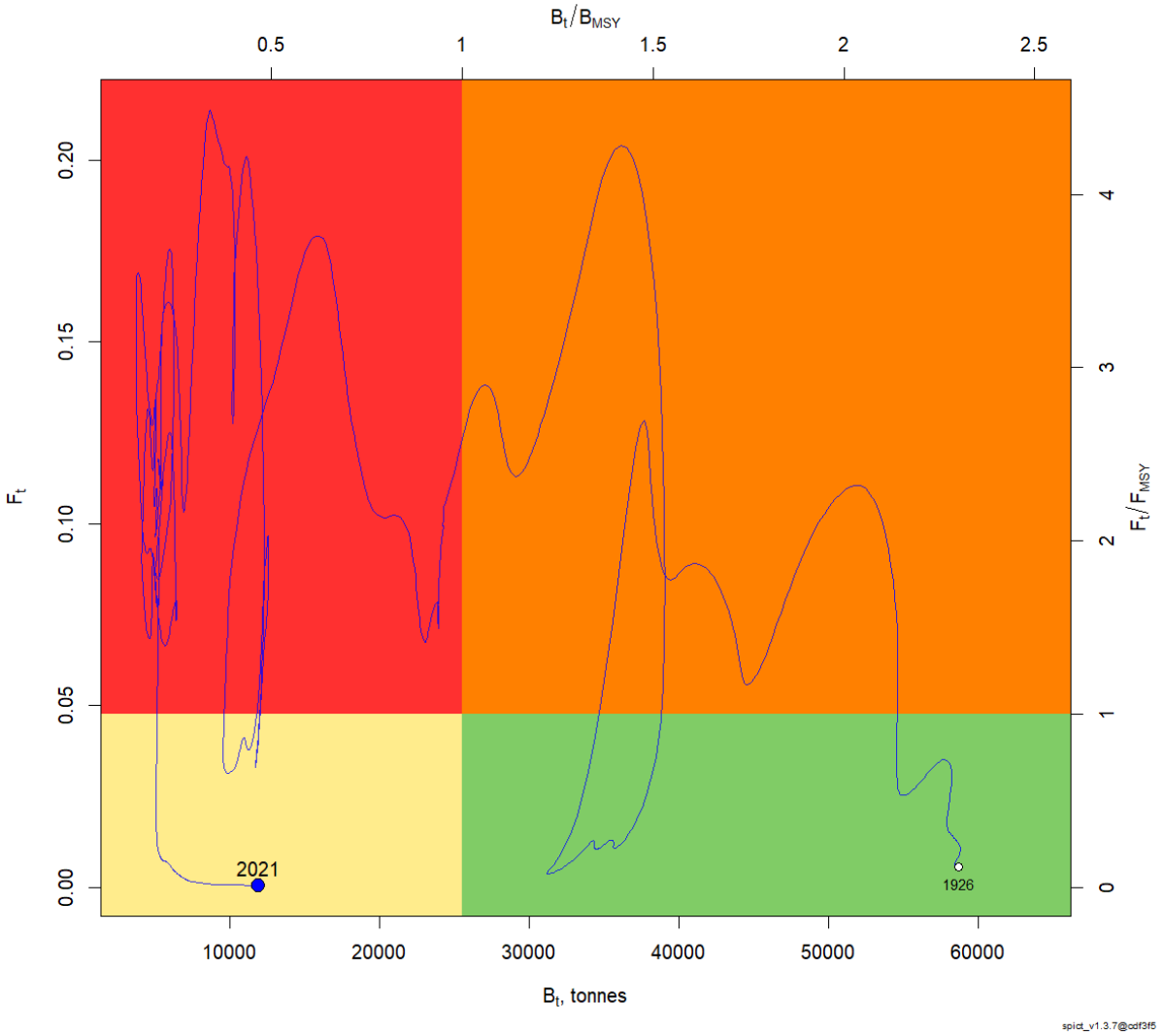
				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
			Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	**0**
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	0	0	0	3	13	0	0	0	0	0	0	0	0	0	5	29	25	6	7	25	15	13	3	1	0	0	0	0	0	**0**
			Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	4	0	0	0	**0**
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0**
		NCO	Benin	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ASW	CP	Brazil	60	32	49	33	36	38	58	60	67	74	49	37	52	32	23	0	0	0	2	0	0	0	0	0	0	0	0	0	0	**0**
			China PR	0	1	0	0	0	0	13	36	4	0	5	4	2	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-España	32	35	43	28	25	1	12	7	13	1	0	0	0	3	5	3	2	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Poland	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-Portugal	0	0	0	0	1	0	0	0	1	1	1	4	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	13	14	6	6	1	1	2	7	4	3	2	11	3	3	4	12	10	2	0	0	0	0	0	0	0	0	0	0	0	**0**
			Korea Rep	1	2	1	6	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Panama	6	24	4	21	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Philippines	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Uruguay	7	5	3	19	5	13	2	4	20	8	34	8	28	34	3	40	14	6	12	12	0	0	0	0	0	0	0	0	0	**0**
			Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCC	Chinese Taipei	85	146	57	168	65	170	73	84	29	93	95	39	43	47	99	0	0	2	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Chile	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Falklands	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	10	22	8	46	23	37	11	15	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED	CP	EU-Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			EU-Italy	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	2	0	0	0	0	0	0	0	1	1	0	0	0	0	**0**
			EU-Malta	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	**0**
Discards	ANE	CP	EU-Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
			EU-Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	ANW	CP	Barbados	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	1	1	1	0	0	0	**0**
			Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	2	3	3	5	8	6	
			Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	1	1	1	5	1	1	0	0	0	0	**0**
			Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0**
			UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			USA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	1	2	7	34	1	9	1	0	0	0	**0**
			Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	1	3	14	4	7	4	0	0	0	**0**
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	11	4	0	0	0	0	0	**0**
	ASE	CP	Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU-España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ASW	CP	El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Uruguay	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

POR-Table 2. Kobe II strategy matrix showing the probability of being above the overfished reference point (a proxy for B_{MSY}) by 5-year time period for removals scenarios ranging from 0 to 24,000 individuals (0-734 t) for porbeagle in the Northwest Atlantic.

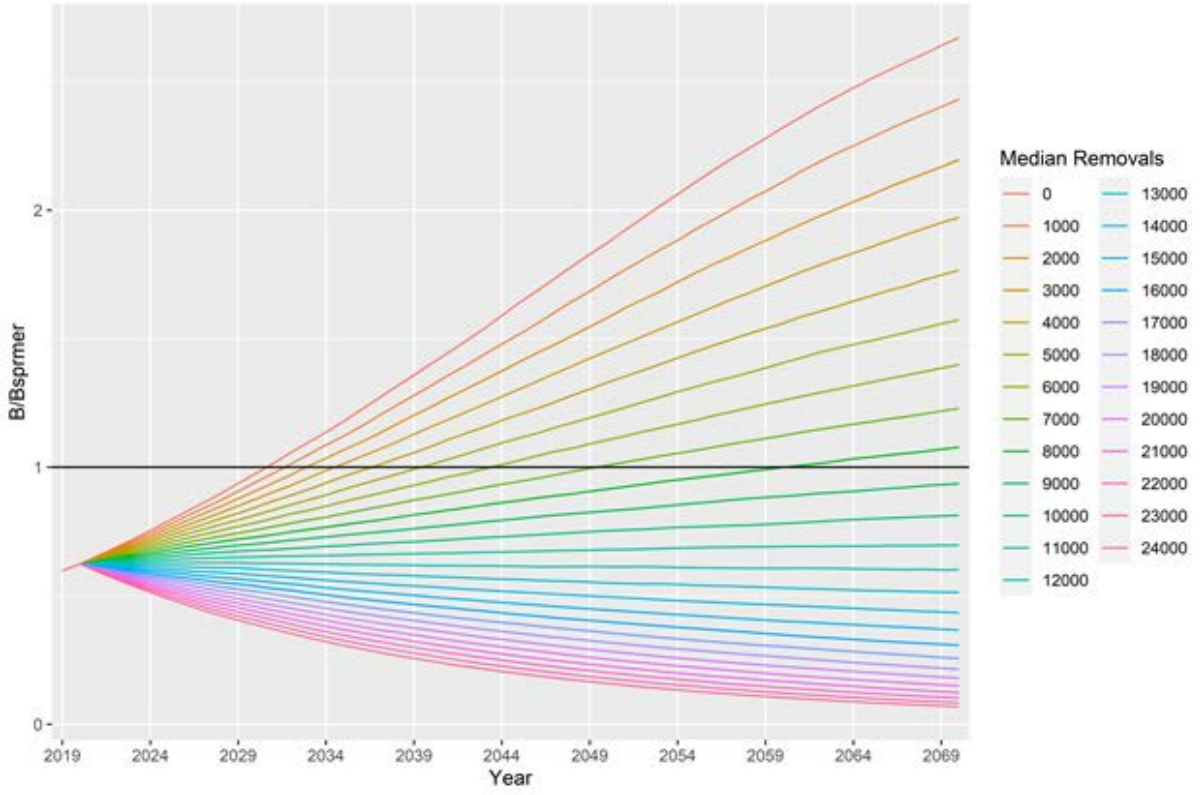
Animals (#)	Ton (mt)	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
0	0	2%	21%	47%	68%	83%	92%	96%	98%	99%	99%	100%
1000	31	3%	21%	44%	63%	77%	87%	92%	95%	97%	98%	99%
2000	61	2%	19%	40%	57%	71%	81%	87%	91%	94%	95%	96%
3000	92	1%	16%	35%	50%	62%	72%	79%	85%	88%	90%	92%
4000	122	2%	15%	32%	47%	58%	66%	73%	78%	82%	84%	87%
5000	153	2%	13%	27%	41%	50%	58%	64%	68%	72%	76%	78%
6000	183	1%	12%	25%	37%	45%	52%	57%	62%	65%	67%	70%
7000	214	2%	10%	22%	32%	39%	46%	50%	54%	57%	60%	62%
8000	245	2%	10%	19%	27%	34%	39%	44%	47%	50%	53%	55%
9000	275	2%	8%	17%	23%	30%	34%	38%	41%	43%	45%	47%
10000	306	2%	8%	14%	20%	25%	29%	31%	34%	36%	38%	39%
11000	336	1%	6%	13%	17%	21%	25%	27%	29%	31%	32%	33%
12000	367	2%	7%	11%	15%	18%	21%	23%	24%	26%	27%	28%
13000	398	2%	5%	9%	12%	14%	16%	18%	19%	20%	21%	22%
14000	428	2%	5%	7%	9%	12%	13%	14%	15%	16%	17%	18%
15000	459	1%	3%	5%	6%	8%	9%	10%	11%	11%	12%	12%
16000	489	2%	3%	4%	5%	6%	7%	8%	9%	9%	10%	10%
17000	520	2%	2%	3%	4%	5%	5%	6%	6%	6%	7%	7%
18000	550	2%	2%	2%	3%	3%	4%	4%	4%	5%	5%	5%
19000	581	2%	1%	2%	2%	3%	3%	3%	3%	3%	3%	4%
20000	612	2%	1%	1%	2%	2%	2%	2%	2%	2%	3%	3%
21000	642	2%	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%
22000	673	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
23000	703	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
24000	734	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%



POR-Figure 1. Porbeagle estimated catches by management unit.



POR-Figure 2. NE Atlantic porbeagle - Plot showing current status of northeast Atlantic porbeagle for the base case Surplus Production model in Continuous Time (SPiCT) model. Note that the step for the model is 1/16th of a year (0.0625).



POR-Figure 3. **NW Atlantic porbeagle** - Predicted relative abundance for annual removals ranging from 0 to 24,000 animals for the northwest stock, expressed as the biomass/biomass at SPR_{MER} ratio (a proxy for B_t/B_{MSY}) for the base case of the ICM. The horizontal line shows the reference point, and the projections extend for 50 years. Average removals from 2016-2018 were assumed for 2019 and 2020 and the projection starts in 2021.