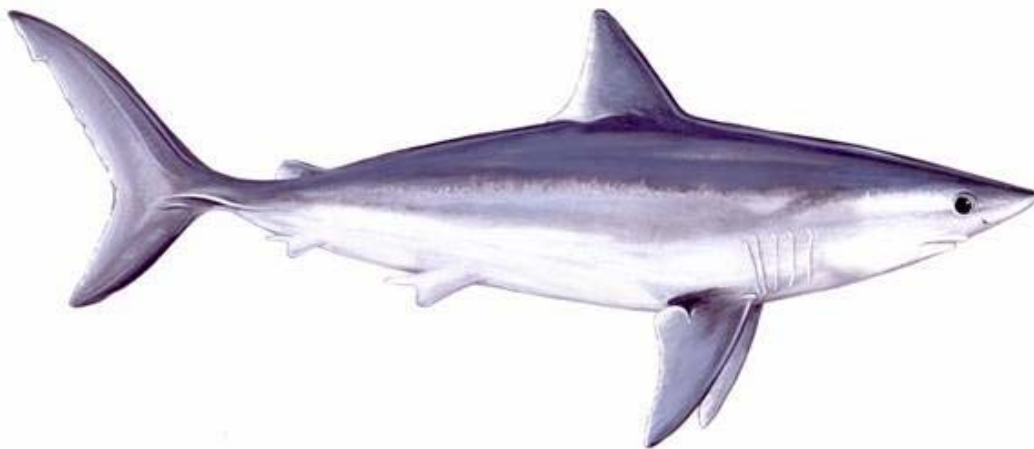




Potential Socio-economic Implications of Adding Porbeagle Shark to the List of Wildlife Species at Risk in the *Species at Risk Act (SARA)**

Fisheries and Oceans Canada
Policy and Economics Branch – Maritimes Region
Dartmouth, Nova Scotia

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*The purpose of this report is to provide an analysis of the considerations associated with the likely management strategies for porbeagle shark and to highlight the potential socio-economic impacts associated with a SARA listing of **endangered** for this species. The focus of this analysis is on fisheries, including the exploratory shark fishery, in the Maritimes, Gulf, Quebec, and Newfoundland and Labrador Regions under DFO jurisdiction.



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1 Introduction

1.1 **Background**

The porbeagle, *Lamna nasus*, is a large pelagic shark. In the northwest Atlantic, porbeagle are widely distributed, with the highest numbers found between Newfoundland and the Gulf of Maine. They are commonly found on continental shelves but are also known to inhabit inshore and offshore waters from the surface to at least 700 m in depth. They have been sought after by fishers in the northwest Atlantic since the early 1960s due to their high meat quality (Fleming and Papageorgiou 1997; Fowler et al. 2004). The main market for porbeagle meat is in Europe while fins are usually destined for Asian markets.

In 2004, porbeagle were designated as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and are being considered for listing on Schedule 1 of the *Species at Risk Act* (SARA). COSEWIC (2004) provides the following rationale for designating the porbeagle shark as endangered:

“This wide-ranging oceanic shark is the only representative of its genus in the North Atlantic. The abundance has declined greatly since Canada entered the fishery in the 1990s after an earlier collapse and partial recovery. Fishery quotas have been greatly reduced, and the fishery has been closed in some areas where mature sharks occur. The landings now are comprised mostly of juveniles. Its life history characteristics, including late maturity and low fecundity, render this species particularly vulnerable to overexploitation.”

The COSEWIC designation was based on the status of the porbeagle population to 2001. COSEWIC expressed uncertainty whether the quota reduction (to 250 mt), implemented in 2002 (see Campana et al. 2001, 2002), would be sufficient to allow recovery as there was no evidence to indicate that the decline in porbeagle abundance had ceased. Given the low productivity of this species, it could take several decades or more to recover.

Under the terms of the SARA, the Government of Canada must make one of only three possible choices concerning the porbeagle assessment put forward by COSEWIC:

1. Accept the assessment and add the species to Schedule 1;
2. Decide not to list the species to the list; or
3. Refer the matter back to COSEWIC for further information or consideration.

The purpose of this socio-economic analysis is to estimate the economic benefits and costs to Canadians of a SARA listing, the regional socio-economic impacts of listing, and how benefits and costs are distributed amongst stakeholders.

1.2 **Consultations**

Consultations on porbeagle shark were conducted with the general public and interested stakeholders in Nova Scotia (NS), New Brunswick (NB), Quebec (Que), Prince Edward Island and Newfoundland and Labrador (NL) from February to April, 2005. Additionally, bi-lateral meetings were held with the provincial governments of NS and NB. A consultation workbook and survey were developed and made available by mail and on the internet via the SARA Public Registry. Over 231 individuals or organizations with specific interests in species

conservation were provided with copies of the consultation workbook and survey. One bilateral meeting was requested and held with the Atlantic Shark Association.

Six participants attended a stakeholder consultation meeting in Halifax on the proposed addition of porbeagle shark to the list of Wildlife Species at Risk. Sixty-eight consultation surveys were completed. In addition, information sessions were conducted by staff of Resource Management in the Maritimes Region during meetings with the Groundfish Fixed Gear Advisory Council and the Atlantic Large Pelagic Advisory Committee (ALPAC).

All First Nations (FN) in NS, NB, PEI and NL along with three provincial Native Councils were sent and received consultation workbooks. The cover letter to those groups holding licenses offered an invitation to meet with DFO regarding this potential listing. Representatives of DFO Maritimes Region held four meetings with FN organizations/communities as requested.

The consultations provided information that was used to help DFO understand stakeholder concerns and perceptions regarding porbeagle shark conservation and utilization, and to provide information used in developing management scenarios.

1.3 Methodology

1.3.1 Management scenarios

Three specific management scenarios for porbeagle shark were considered in this analysis.

1. Porbeagle shark are **not listed as endangered under SARA** but continue to be managed under the current Integrated Fisheries Management plan. In this scenario, the total allowable catch (TAC) for porbeagle shark remains at **250 mt**, the same level that it has been since 2002. The shares of the TAC are 190 mt for the Maritimes exploratory shark fishery (i.e., exploratory shark license holders), 10 mt for the Gulf exploratory shark fishery and 50 mt for bycatch in other fisheries. Figure 1 shows the management scenario catch allocation relative to recent landings from 2002 to 2004.

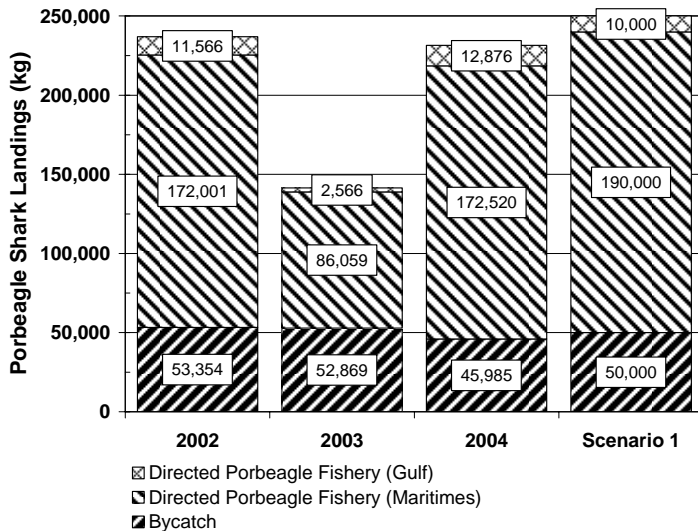


Fig 1. Management Scenario 1: Allocation of 250 mt TAC / No SARA Listing



- Porbeagle shark are **not listed as endangered under SARA** but are managed under an Integrated Fisheries Management with the TAC reduced to **185 mt**. The shares of the TAC would be reduced to 125 mt for the Maritimes exploratory shark fishery while remaining at 10 mt for the Gulf exploratory shark fishery and 50 mt for bycatch in other fisheries (Figure 2).

The status of porbeagle was recently assessed using data to 2004 from the commercial catch (DFO 2005a, 2005b). A population model was developed to estimate numbers-at-age and exploitation from 1961 to 2004 (Gibson and Campana 2005). Three variants of an age- and sex-structured, forward projecting population model were used for the assessment, each with a different productivity scenario. Estimates of the population size in 2005 from the three models range from 188,000 to 195,000 fish (21-24% of that present in the unexploited 1961 population), with about 36,000 of those being mature individuals. The number of mature females is 12-15% of unexploited levels. Based on population modeling results, a reduction of TAC to 185 mt¹ should promote recovery to 20% of the number of female spawners when the population is at an unfished equilibrium (SSN_{20%}) at all levels of productivity used in the model and to the number of female spawners at maximum sustainable yield (SSN_{msy}) under moderate or high productivity assumptions (the time period required to achieve recovery is sensitive to human-induced mortality²).

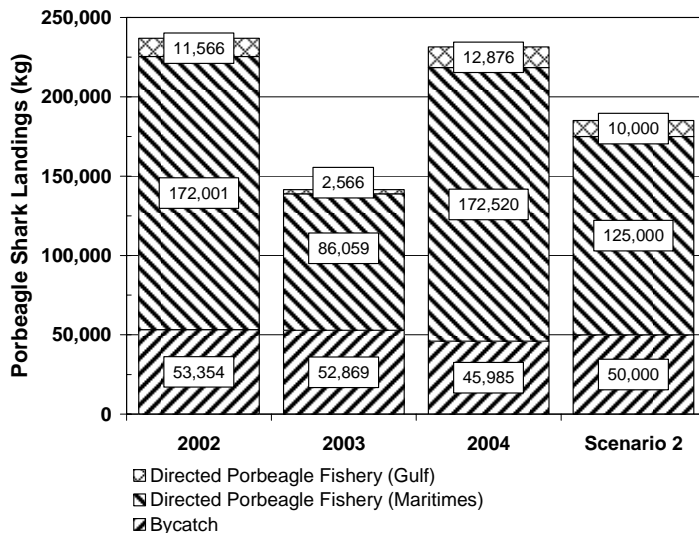


Figure 2. Management Scenario 2: Allocation of 185 mt TAC / No SARA Listing

- Porbeagle shark are **listed as endangered under SARA**. Under an endangered listing scenario, there would be restrictions on the purchase, sale and trade³ of porbeagle by the exploratory shark fishery and other fisheries that land porbeagle as bycatch. While it would not be illegal to catch porbeagle, they would have no market value under this management scenario. The exploratory shark fishery would not be able to sell porbeagle⁴, effectively reducing the TAC to zero (Figure 3). While we recognize some porbeagle mortality in other fisheries is inevitable, activities to minimize bycatch mortality would be important if porbeagle were listed as an endangered species under SARA.

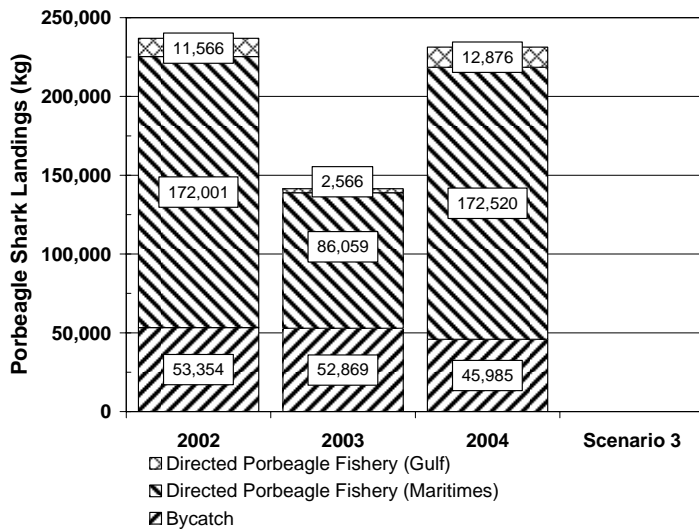


Figure 3. Management Scenario 3: Porbeagle Listed as Endangered / No Purchase, Sales or Trade

1.3.2 Socio-economic analysis

SARA requires socio-economic analyses for recovery planning and implementation of recovery measures. The Government of Canada’s Federal Regulatory Policy requires an analysis of benefits and costs for decisions whether or not to list a species under SARA. In broad terms, socio-economic analysis is necessary for informed decision making.

There is clear theoretical and pragmatic guidance regarding economic analysis of ecosystem goods and services for government analyses (e.g., TBS 1998; EPA 2000; National Research Council 2004) and for species at risk recovery for DFO specifically (Clark et al., 2005).

A complete socioeconomic analysis should focus on three issues: the society-wide costs and benefits (efficiency) of a management scenario (i.e., is it theoretically possible for the gainers to fully compensate the losers and still be better off?); the identification of regional economic impacts of the scenario; and consideration of how particular stakeholders or communities gain or lose as a result of the initiative. The three components – economic efficiency, regional impacts, and distributional impacts (equity) – can be compatible and complementary when conducted in a consistent manner.

The depth to which the three components can be addressed quantitatively depends critically on the availability of information on the changes in costs and benefits resulting from listing. When quantitative data is unavailable, the costs and benefits can be discussed in qualitative terms (TBS, 1998). In some cases, it may be possible to use the findings of economic research in other jurisdictions to make inferences about the costs and benefits of SARA management scenarios in Atlantic Canada.

Economic Efficiency

An analysis of the net costs and benefits should consider the changes in consumer and producer surpluses of listing scenarios as well as net changes in costs to government.



Producer surplus (e.g., in the fishing industry) is essentially a measure of producer profitability (i.e., revenues less the full costs of fishing tallied for all operators). It is the economic benefit arising from extractive use of the porbeagle resource. Detailed data on the cost and earnings in various fisheries potentially affected by porbeagle listing are not currently available⁵. Instead, in this report we make assumptions about profit margins in the fishing industry to develop a range of likely changes in producer surplus.

Consumer surplus is a more theoretically challenging concept but is essentially the sum of the willingness to pay of all individuals for the benefits that might arise under any particular management scenario. In a comprehensive cost-benefit analysis (CBA), one should consider benefits arising from non-extractive uses such as recreation, the role a species may play in ecosystem function (indirect values), the benefits arising from deferring consumption to some time in the future (option values), and the “non-use” values arising due to peoples’ willing to pay for conservation for future generations or for its own sake.

For this analysis, we assume that the benefits arising from all other sources except extractive use are negligible. Porbeagle sharks are distributed offshore and are not caught recreationally in the Maritimes, so have no non-extractive use value⁶. While porbeagles are a top predator in the northwest Atlantic, we have little information on their role in ecosystem function or regulation⁷ and assume, due to their relatively low population abundance, that their impact on the populations of other commercially valuable species is minimal. Given the very long time frame for porbeagle recovery (i.e., into the 22nd century under the moderate productivity population modeling scenario with a 4% exploitation rate), option values for future fisheries was assumed to be zero. That is, the economic benefits of increased fishing would happen so far in the future that the net present value would be near zero due to discounting⁸. Finally, it is possible that Canadians do hold non-use values for porbeagle but the magnitude is unquantified⁹ and likely much lower for porbeagle than high-profile ‘icon’ species such as whales or marine fish (e.g., Atlantic salmon).

The government may incur costs for consultations, negotiations, information gathering (including scientific research in support of fisheries management), monitoring, and enforcement activities. The changes in costs due to implementation of alternative management scenarios are the relevant costs for inclusion in a CBA. It should also be noted that government costs may often be considered transfers and will not enter the cost-benefit calculus: funds used for research may provide an incremental economic benefit regionally.

Regional Economic Impacts

The value of commercial fisheries in the Atlantic Provinces goes beyond the net economic profits accruing to fishing vessel owners. Each dollar in fish sales generates spin-off benefits for the region as fishing revenue circulates within the local economy. A reduction in fishing revenue can directly and indirectly impact suppliers and a reduction in fish supply can impact seafood buyers and their clients. In addition, a loss of wages earned in a regional economy will have its own impact on businesses.

In the fishing industry in Nova Scotia, the 2001 Statistics Canada multiplier effect is 3.1 for Gross Domestic Product (GDP). For each \$1 million generated directly by fishing and processing, an additional \$2.1 million in GDP is generated in the region through people



spending money on non-fishing supplies, ancillary services, etc (i.e., \$3.1 m total impact). In the absence of more recent economic models of the regional fishing industry, we use this figure throughout this analysis for all regions¹⁰.

It should be emphasized that measures of economic impact cannot be directly compared to measures of economic surplus as they are fundamentally different concepts. Regional multipliers provide information about the change in economic activity – direct and indirect expenditures and wages – in a regional economy over the short- to medium-term. Because people and firms adjust their behaviour as fishing regulations change, economic impacts cannot be considered as a long-term cost in situations where there are other employment and business opportunities available in the local economy.

From a regional perspective, changes in employment resulting from regulatory change are also important. There is no single ‘employment multiplier’ that allows us to translate changes in fishing revenue into changes in employment in the region. We use anecdotal information from people within the fishing / processing industry and government to discuss employment qualitatively.

Distributional Impacts

Socio-economic analyses also seek to identify the specific gainers and losers – individuals, firms, and communities – arising from regulatory change. In this analysis, we use historic harvest data to identify those fishers and communities that may be particularly impacted by the porbeagle management scenarios. We also examine their dependency on fisheries that could be impacted by regulation (i.e., how much do they depend on revenue from impacted fisheries as part of their overall fishing livelihood?).

2 Overview of the Porbeagle Fishery

Detailed information on the history of the porbeagle shark fishery in the northwest Atlantic (NAFO subareas 3 - 6) is outlined by Campana et al (2002). Vessels began exploratory fishing on a virgin population in 1961. Landings rose to more than 9000 mt by 1964 and then crashed to less than 1000 mt by 1970. After low landings through the 1970s and 1980s, an increase in effort by Faroese vessels in the early 1990s increased landings to 2000 mt. Faroese participation was phased out of the directed fishery by 1994; since that time, the fishery has been almost exclusively Canadian. Canada introduced a shark management plan in 1995 which defined a non-restrictive catch guideline of 1500 mt. Since 1997, a series of Shark Management Plans have imposed steadily decreasing annual TACs from 1000 mt to 250 mt (2002-2006 Plan).

Porbeagle sharks are landed by an exploratory Canadian directed longline fishery as well as by-catch in several other fisheries. Over 99% of porbeagle was historically taken by pelagic longline with less than 1% taken by gillnet and bottom otter trawl. Catches by foreign vessels fishing outside of Canadian waters are not well known¹¹.

Figure 4 shows reported porbeagle landings by nation for the period 1961-2004. Figure 5 shows the overall distribution of Canadian porbeagle landings between 1995 and 2002.

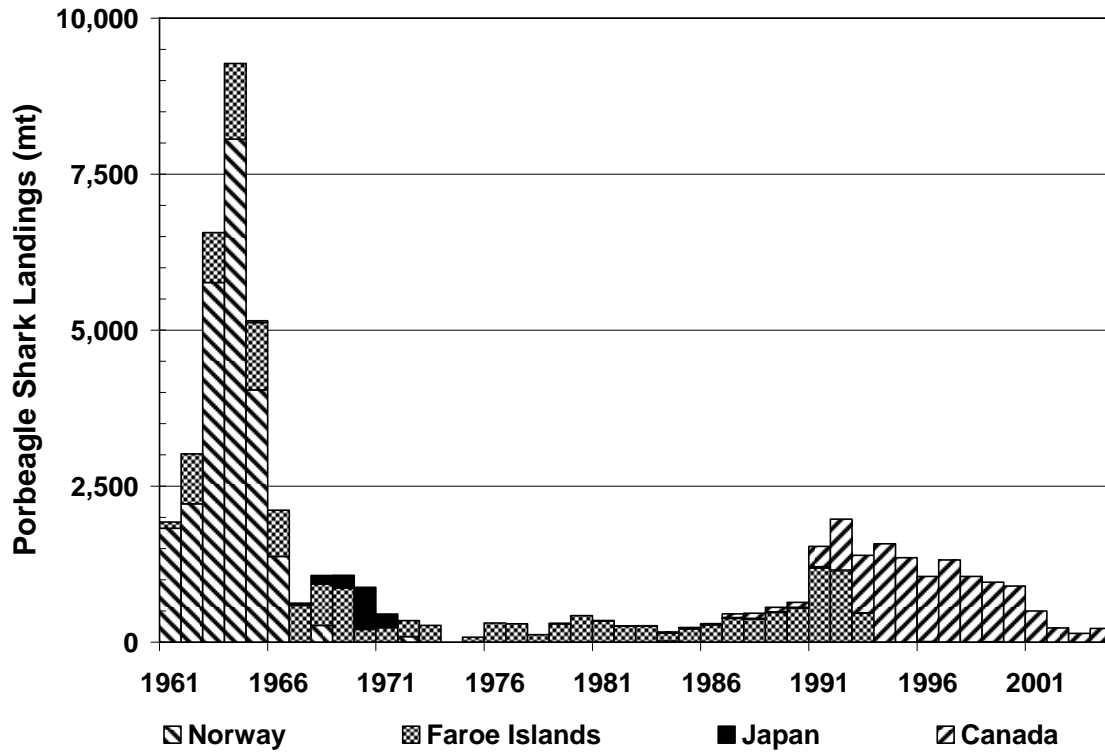


Figure 4. Northwest Atlantic porbeagle shark landings by primary fishing nations

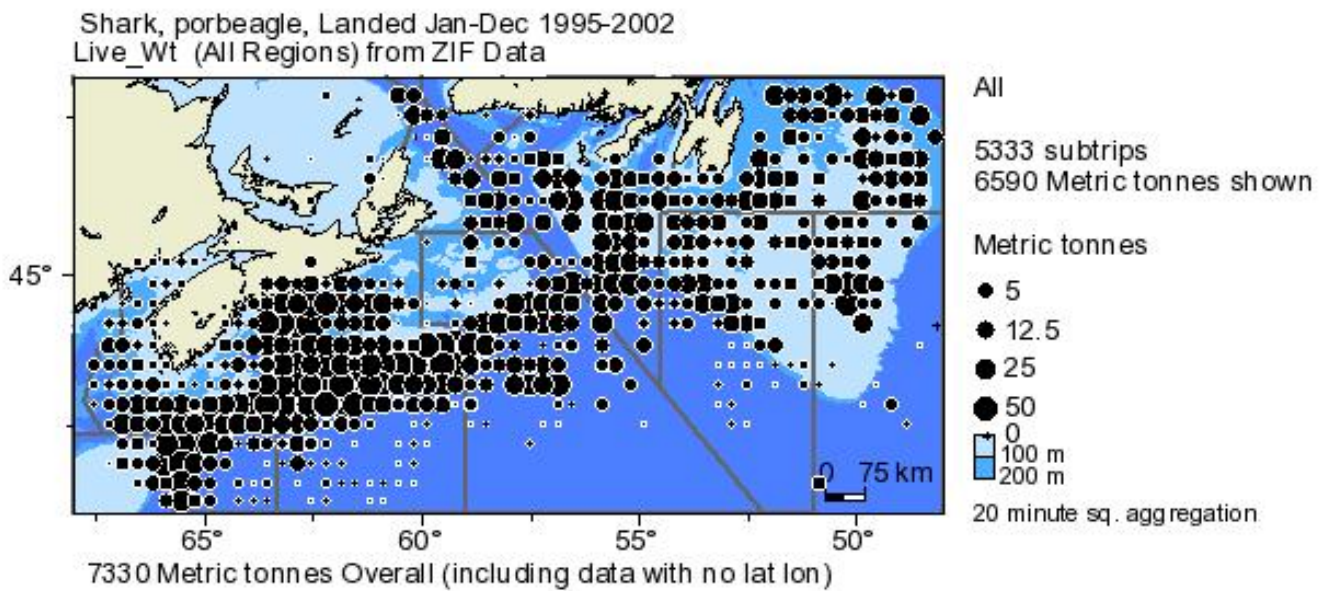


Figure 5. Geographic distribution of Canadian porbeagle shark landings, 1995-2002

Figure 6 shows the distribution of landings broken down by NAFO Division for the period 1995 to 2002. The directed porbeagle fishery in Newfoundland, Division 3, was phased out by 2001.

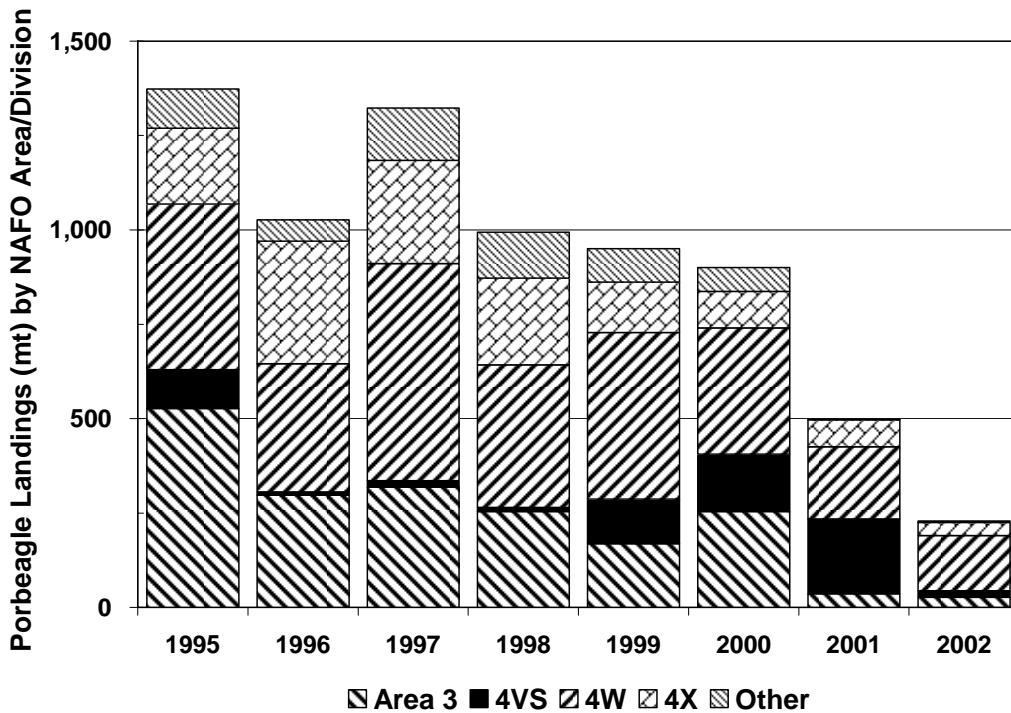


Figure 6. Canadian porbeagle shark landing by NAFO Division, 1995-2002

Since 2001, porbeagle have largely been taken in Scotia-Fundy region by exploratory shark license holders from the Maritimes and, to a lesser extent, the Gulf / Quebec Regions. Over the period 2000-2004, 1778 mt of porbeagle was landed by fishers holding exploratory shark licenses in the directed fishery (Table 1). This fishery accounted for 90.5% of total porbeagle landings over this period. Bycatch in other fisheries accounted for: 68 mt (3% total landings) by groundfish license holders; 85 mt (4% total landings) by swordfish license holders; 15 mt (1% total landings) by restricted tuna license holders; and 17 mt (1% total landings) by unrestricted tuna license holders. Fishers who hold directed shark licenses often hold other licenses as well. Between 2000 and 2004, they landed between 3.0 to 17.7 mt of porbeagle under other licenses in addition to the 86 to 871 mt that were landed under their exploratory shark licenses.

Approximately 60 to 100 groundfish license holders land some porbeagle shark bycatch each year. Over the past four years, 20 to 25 swordfish license holders land porbeagle bycatch as do 5 to 7 restricted tuna license holders and 2 to 4 unrestricted tuna license holders. Average bycatch by groundfish fishers is roughly 200 kg per year, by swordfish fishers about 1000 kg per year, by restricted tuna fishers about 700 kg per year, and by unrestricted tuna fishers about 100 kg per year (excluding an anomaly in 2002).

Since the phase out of a directed porbeagle fishery in Division 3 in 2001, porbeagle landings in the Newfoundland and Labrador Region have been limited to a minor amount of bycatch in groundfish and pelagic fisheries. Bycatch has decreased from 1,891 kg (\$2,773 value) in 2002 to 27 kg (\$21 value) in 2004. These levels are considered negligible in terms of overall porbeagle landings in Canadian waters.



Participation in the directed shark fishery has been falling over the past several years and the fishery now has 5 to 8 active vessels fishing each year. Reports from fishers in the Maritimes suggest that due to the small TAC, it does not make economic sense for all local exploratory shark license holders to fish for porbeagle each year but instead to engage in informal sharing arrangements to allow a handful of fishers to use their vessels more efficiently¹².

Licence Type	Porbeagle Shark Landings (kg)					Total Porbeagle Landings (kg)
	2000	2001	2002	2003	2004	
Groundfish Licence Holders	6,847	9,577	15,980	18,150	17,650	68,204
Number of Active Licenses	59	67	97	82	94	
Average Annual Landings (kg)	116	143	165	221	188	
Maximum Annual Landings (kg)	532	1,756	1,333	4,701	2,226	
Herring License Holders		256			23	279
Number of Active Licenses	0	3	0	0	2	
Average Annual Landings (kg)		85			11	
Maximum Annual Landings (kg)	0	145	0	0	23	
Shark License Holders	870,741	476,703	172,001	86,059	172,520	1,778,024
Number of Active Licenses	12	8	7	6	5	
Average Annual Landings (kg)	72,562	59,588	24,572	14,343	34,504	
Maximum Annual Landings (kg)	294,043	240,418	41,493	25,271	55,127	
Swordfish License Holders	5,482	9,582	18,939	29,160	22,155	85,319
Number of Active Licenses	10	25	21	26	24	
Average Annual Landings (kg)	548	383	902	1,122	923	
Maximum Annual Landings (kg)	3,000	3,223	2,551	7,887	5,241	
Tuna (restricted) License Holders	902	407	2,630	5,330	5,652	14,920
Number of Active Licenses	5	5	6	7	7	
Average Annual Landings (kg)	180	81	438	761	807	
Maximum Annual Landings (kg)	246	240	2,132	2,780	2,927	
Tuna (unrestricted) License Holders	364	170	15,805	229	504	17,072
Number of Active Licenses	2	3	3	2	4	
Average Annual Landings (kg)	182	57	5,268	114	126	
Maximum Annual Landings (kg)	364	133	15,658	229	478	
Total Porbeagle Landings (kg)	884,336	496,695	225,355	138,927	218,504	1,963,817

Table 1. Number of Maritimes license holders in various fisheries landing porbeagle , 2000-2004

In 2004, five Maritimes exploratory shark license holders landed a total of 178, 627 kg of porbeagle (from both exploratory shark licenses and on other licenses they hold) worth \$251,707. In addition, they landed a total of 147,793 kg of swordfish (\$1,393,426 value), 26,028 kg of tuna (\$167,631) and 12,112 kg of other species (\$54,580) using other licenses that they also hold. Of the five, four had substantial revenue from other fishing activities and one was quite dependent on porbeagle fishing for his overall livelihood.

In the Gulf of St. Lawrence, as many as 14 exploratory shark license holders from Quebec and New Brunswick landed porbeagle shark in 1998 (Figure 7). More recently, the number of

fishers landing porbeagle has steadily declined to 2 license holders in 2004. The overall volume of porbeagle landings has fluctuated, peaking near 25 mt in 1997. Recently landings have tended to be near the 10 mt TAC for the Gulf of St. Lawrence (including 3 license holders from Quebec). In Quebec, one of the exploratory shark licence holder is operating a shark charter fishing boat. His shark tourism revenue is above the value of its shark landings. However, Porbeagle represents a small share of its catches.

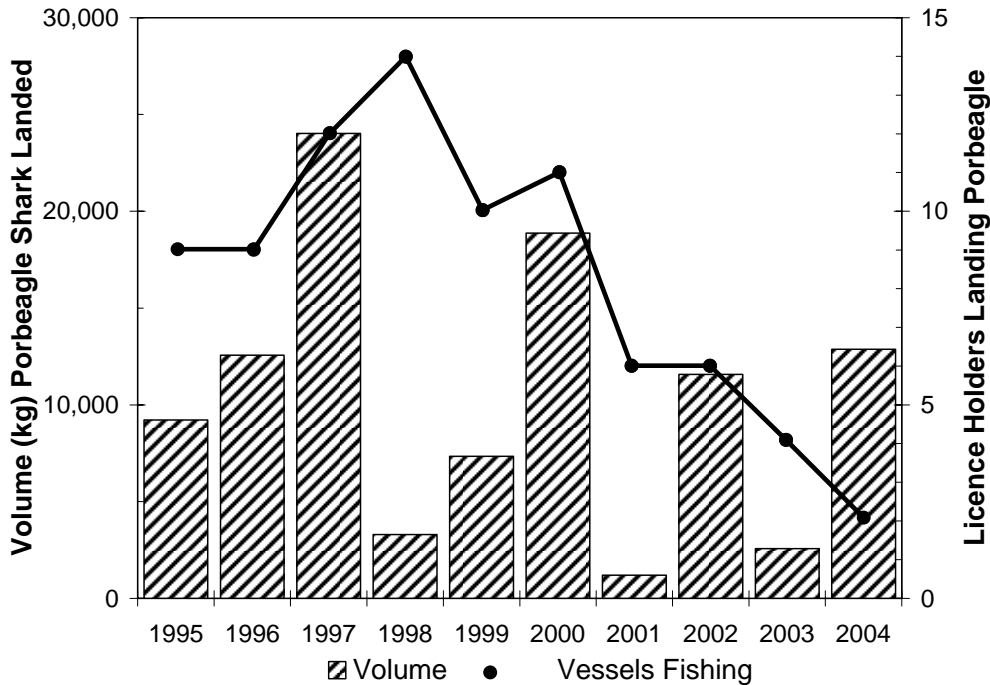


Figure 7. Gulf of St. Lawrence Region porbeagle shark landings and number of active vessels, 1995-2004

3 Socio-Economic Impacts of Management Scenarios

3.1 Scenario 1 – No Listing, Current Catch Limits

Based on recent population modeling (Gibson and Campana, 2005), recovery of the northwest Atlantic porbeagle shark population is not predicted at 250 mt landing level (DFO, 2005b). The 250 mt TAC would remain allocated as it is now with 190 mt for the Maritimes Region directed fishery, 10 mt for the Gulf of St. Lawrence directed fishery, and 50 mt for bycatch in other fisheries.

Under Scenario 1 (see Figure 1), there would be no incremental costs or benefits for industry or government as there would be no regulatory change.

Similarly, there are no regional economic or employment benefits, or distributional considerations as there would be no change in revenue as a result of regulatory change.



3.2 Scenario 2 – No Listing, Reduced Catch Limits

Porbeagle shark would not be listed as an endangered species under Scenario 2 (see Figure 2) but the TAC would be reduced from 250 mt to 185 mt. Based on population models, porbeagle shark populations would recover to $SSN_{20\%}$ or SSN_{msy} over varying time periods at a 4% exploitation rate (DFO, 2005b).

The 185 mt TAC would be allocated as: 125 mt for the Maritimes Region directed fishery; 10 mt for the Gulf of St. Lawrence directed fishery, and 50 mt for bycatch in other fisheries. The 65 mt reduction in TAC would be achieved entirely through a cut in the TAC for Maritimes Region.

3.2.1 Economic Efficiency

Directed Porbeagle Fishery

Given a 2004 average ex-vessel price of \$1.36 per kg for porbeagle shark, a reduction of the TAC by 65 mt would reduce fishing revenue by approximately \$88,000 per year for Maritimes exploratory shark license holders. Fishers in other fisheries who land porbeagle as bycatch would be unaffected, as would directed shark fishers in the Gulf Region and Quebec.

From an economic efficiency perspective, the net cost to Maritimes fishers can be calculated by summing the future stream of profits lost due to the implementation of Scenario 2. Profits occurring in the future need to be discounted to account for the impact of compounding interest over time. Net Present Value (NPV) is a financial indicator that sums a future income stream and reports it as a single value.

As we do not know the true cost of fishing or the net profit margin in the directed porbeagle fishery¹³, we examine a range of profit margins ranging from 5% to 20% and use NPV calculated with these margins as proxies for producer surplus. We also use three different interest rates that reflect reasonable assumptions about the degree to which future costs and revenues influence present values (i.e., a low interest rate places more emphasis on costs in the distant future while a high interest rate places more emphasis on short-term costs and benefits). Table 2 shows the NPV for a variety of combinations of profit margin and interest rate for the Maritimes directed porbeagle fishery. The net economic cost of the lost stream of profits for the directed fishery in the Maritimes ranges from \$46,626 to \$263,034, depending on assumptions.

		Profit Margin			
		5.0%	10.0%	15.0%	20.0%
Interest Rate	3.0%	\$65,758	\$131,517	\$197,275	\$263,034
	5.0%	\$55,083	\$110,166	\$165,249	\$220,332
	7.0%	\$46,826	\$93,651	\$140,477	\$187,302

Table 2. Economic cost (NPV) of Scenario 2 for Maritimes exploratory shark license holders

Costs to Government



The net costs to Government may increase slightly due to increased scientific and monitoring / enforcement activities (in conjunction with industry). The net cost to Government has not been quantified for this Scenario.

Benefits to Society

Consumer surplus is assumed to remain unaffected by a reduction in TAC under Scenario 2.

3.2.2 Regional Economic Impacts

Based on an \$88,000 loss in fishing revenue and a regional economic multiplier of 3.1, Scenario 2 implies a \$184,800 short-term reduction in spin-off economic activity in the Maritimes¹⁴. That is, there would be a reduction in regional business revenue due to fishers purchasing fewer supplies, crew having less wage earnings to spend in the local economy, processors selling less product, etc. There are no regional impacts in the Gulf, Quebec, or Newfoundland and Labrador.

A reduction of 65 mt in overall harvest is expected to have very few, if any, impacts on regional employment. While a reduction in landings from 185 mt to 125 mt in the directed porbeagle fishery may lead to one or two less vessels fishing, there are likely other employment opportunities available for crew that would be impacted by Scenario 2. Similarly, any impacts in the processing sector should be minimal and short-term in nature.

3.2.3 Distributional Impacts

Directed Porbeagle Fishery

By volume, porbeagle shark accounted for 16.7% of total fish landings for the 6 exploratory shark license holders active in 2003 and 30.9% in 2004 (i.e., exploratory shark license holders also had landings on other licenses that accounted for 83% and 69% of their total annual landings in 2003 and 2004, respectively) (Figure 8). On a value basis, porbeagle accounted for 5.8% of total landings value for these fishers in 2003 and 9.3% in 2004 (Figure 9).

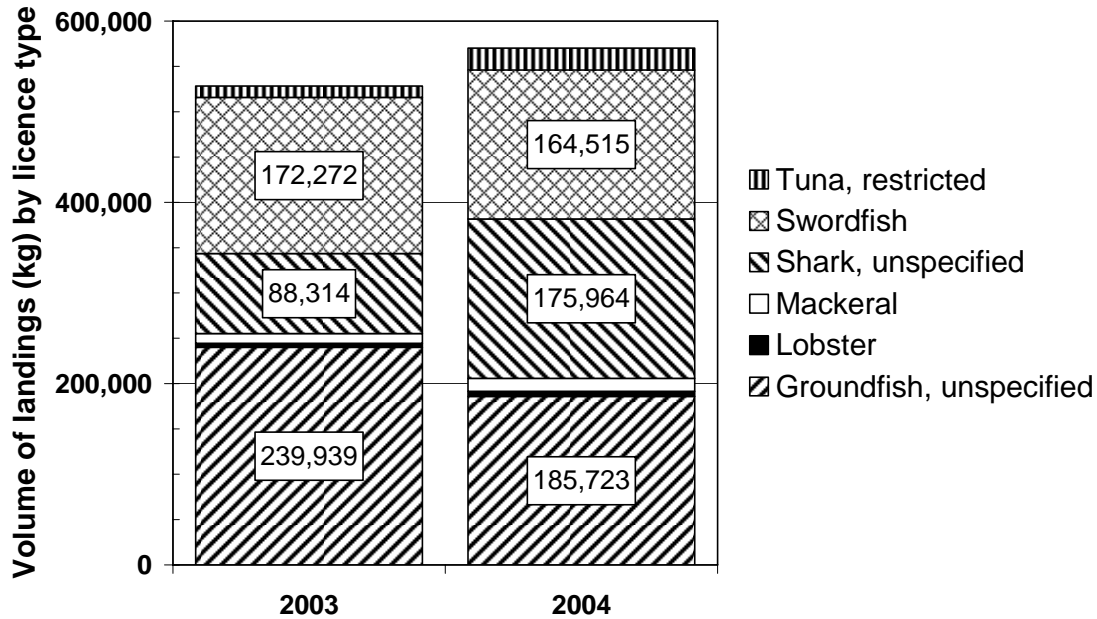


Figure 8. Landings (kg) of all species by fishers holding exploratory shark licenses, 2003-04

If we assume that the 65 mt reduction in TAC is distributed proportionally amongst the 5 license holders active in the Maritimes region in 2004, based on 2004 landings, then each license holder would lose 3.6 to 17.1 mt in porbeagle landings. At an average 2004 price of \$1.41 per kg for exploratory shark license holders, this would translate into a loss of revenue ranging from \$5,056 to \$24,046 for each fisher in the Maritimes region. This revenue accounts for 1.8% to 25.6% of total fishing revenue for these license holders.

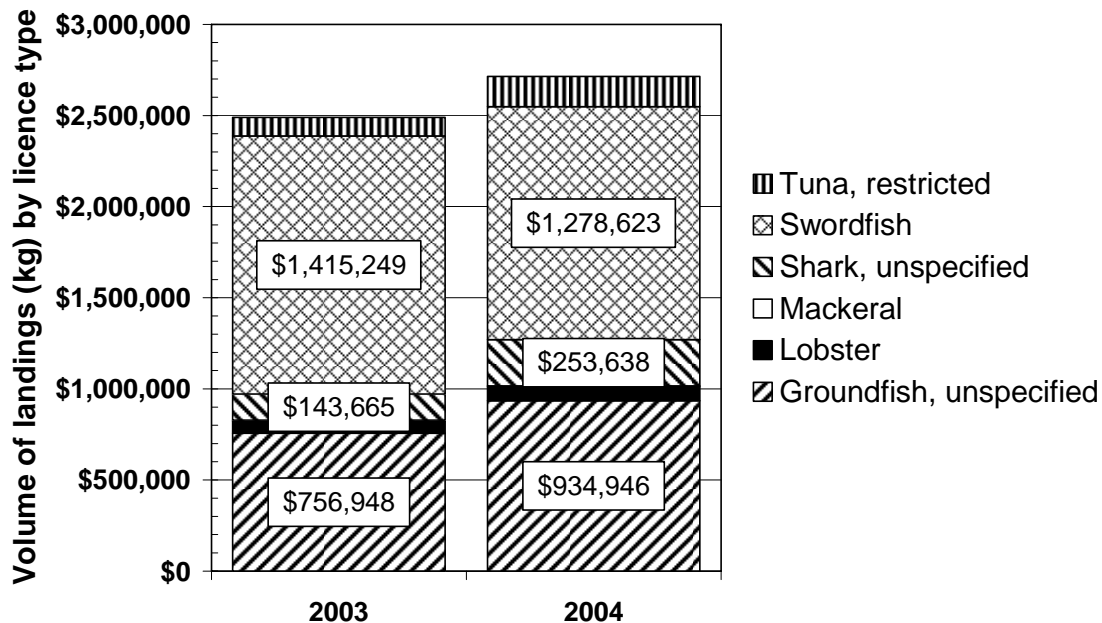


Figure 9. Value of all species landed by fishers holding exploratory shark licenses, 2003-04



3.3 Scenario 3 – Listing, No Harvest, Sales or Trade

Under Scenario 3 (see Figure 3), porbeagle would be listed as Endangered species. As a result, the directed fishery for porbeagle in the Maritimes, Gulf and Quebec regions would be closed¹⁵. When listed as Endangered, prohibitions on buying, selling or trading a species also come into effect¹⁶. For Scenario 3, this would mean that porbeagle would have zero market value for other fisheries that land porbeagle as bycatch, thus impacting their profitability as well.

Porbeagle will, obviously, still be caught by groundfish, swordfish and tuna fisheries. We assume for Scenario 3 that all porbeagle caught would be discarded. Some level of discard mortality is inevitable¹⁷ but overall mortality should decrease significantly from Scenario 2. Recovery of the porbeagle population is predicted at this level of interaction.

3.3.1 Economic Efficiency

Directed Porbeagle Fishery

Implementing Scenario 3 would cause a direct loss for exploratory shark license holders in the directed porbeagle fishery. The total 200 mt TAC would be lost (190 mt to Maritimes license holders, 10 mt to Gulf and Quebec license holders). Assuming an average price of \$1.36 per kg, profit margins ranging from 5% to 20%, and interest rates of 3.0% to 7.0%, the net present value of the stream of lost profits for all exploratory shark license holders would range from \$144,079 to \$809,335 (Table 3). Of the total loss, \$136,875 to \$768,868 would accrue to license holders in the Maritimes and \$7,294 to \$40,467 to license holders in the Gulf and Quebec.

		Profit Margin			
		5.0%	10.0%	15.0%	20.0%
Interest Rate	3.0%	\$202,334	\$404,667	\$607,001	\$809,335
	5.0%	\$169,486	\$338,972	\$508,458	\$677,944
	7.0%	\$144,079	\$288,157	\$432,236	\$576,314

Table 3. Economic cost (NPV) of Scenario 3 for all exploratory shark license holders

Other Fisheries

License holders in other fisheries (i.e., groundfish, swordfish, restricted tuna, unrestricted tuna) would lose 50 mt of porbeagle landings under Scenario 3. If, in the future, the issue of sale and trade of threatened and endangered species is resolved, bycatch of porbeagle shark in these fisheries would be permitted and the costs outlined below would not be incurred. Given the current restrictions on buy, sell and trade for listed species, we have assumed that all 50 mt of bycatch would be lost in order to put an upper limit on the economic costs to the industry due to lost porbeagle sales opportunities.

For these fisheries, it is not appropriate to consider the total value of porbeagle to be based on net profit margins of 5% to 20%, as was done with the directed fishery. In fisheries where



porbeagle is landed as bycatch, it is more appropriate to consider 100% of porbeagle revenues as lost profit. As one fisher put it, porbeagle landings are “cream” providing extra revenue for vessels that are out fishing for other species irrespective of the listing status of porbeagle. If these extra porbeagle revenues are lost, they subtract directly from the bottom line for the trip.

At an average ex-vessel price of \$1.36 per kg (2004 average price), a loss of 50 mt of porbeagle landings would have a gross sales value of \$68,000. Under various interest rate assumptions, the net present value of lost porbeagle bycatch ranges from \$720,393 at a 7% interest rate to \$1,011,668 at a 3% interest rate.

Government Costs

Current scientific population models rely on data from commercial fisheries. This data is gathered through fishing vessel logbooks and in cooperation with industry. Without commercial fishery data, DFO Science Branch would need to charter vessels to conduct periodic porbeagle population surveys. One survey would be needed in the near-term and surveys would need to be repeated periodically (e.g., every 5 years) to monitor recovery. The NPV of government costs would be \$822,416¹⁸.

Summary of Economic Costs

Table 4 summarizes the incremental increase in total economic costs of listing porbeagle as Endangered under SARA.

Costs to:	Economic Cost of Listing	
	Low	High
Exploratory Shark License Holders	\$144,079	\$809,335
Non-Shark License Holders	\$720,393	\$1,011,668
DFO Science (monitoring)	\$822,416	\$822,416
Total Economic Cost	\$1,686,888	\$2,643,419

Table 4 – Summary of Changes in Economic Cost as a Result of SARA Listing for Porbeagle

Economic Benefits to Society

Consumer surplus is assumed to remain unaffected by a fishery closure under Scenario 3.

3.3.2 Regional Economic Impacts

Based on a \$340,000 loss in fishing revenue and a regional economic multiplier of 3.1, Scenario 3 implies a \$714,000 short-term reduction in spin-off economic activity, primarily in the Maritimes.

A reduction of 250 mt in overall harvest is expected to have some impacts on regional employment, possibly in the range of 4-8 full time jobs¹⁹. It is possible that one or more of the exploratory shark license holders would find fishing unprofitable based solely on their other license holdings and exit the industry, reducing the number of jobs available for crew members. In the processing sector, any loss of employment should be very modest given porbeagle processing was spread amongst 53 processing plants in the Maritimes in 2003. For the two processing plants that handle the most porbeagle (see Section 3.3 on impacts in the community of Sambro), some loss of part-time employment is possible²⁰.



3.3.3 Distributional Impacts

Directed Porbeagle Fishery

Participation in the directed porbeagle fishery has been declining over the last five years (Figure 10). In 2004, five license holders in the Maritimes landed porbeagle while in the Gulf only two license holders landed any porbeagle.

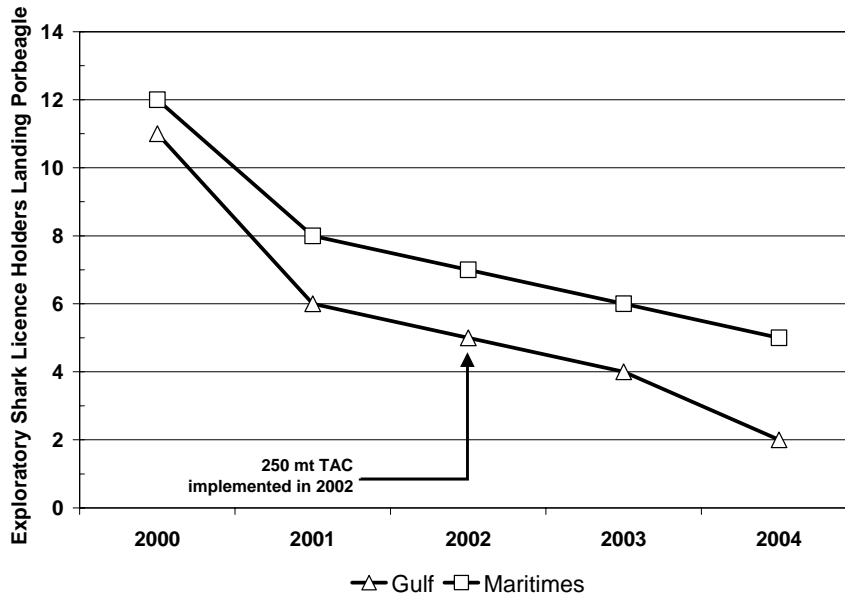


Figure 10. Number of exploratory shark license holders landing porbeagle shark

In the Maritimes, the five fishers who were active in 2004 varied in their dependence on porbeagle as a main component of their livelihood (Table 5). Porbeagle accounted for between 25.7% and 98.0% of their total landings, by volume, in 2004 and between 5.9% and 85.2% of their total fishing revenue. It is common to consider anybody who earns more than 25% of their total revenue from any given fishery as “dependent” on that fishery for their livelihood. In the case of exploratory shark license holders, two would be considered dependent.

	2003 Landings		2004 Landings	
	Weight	Value	Weight	Value
Licence Holder 1	34.2%	7.4%	25.7%	5.9%
Licence Holder 2	36.1%	8.3%	59.7%	19.2%
Licence Holder 3	97.6%	82.2%	98.0%	85.2%
Licence Holder 4	50.8%	13.6%	77.8%	34.3%
Licence Holder 5	9.3%	1.8%	45.0%	11.3%

Table 5. Dependency of Maritimes exploratory shark license holders on porbeagle

In the Gulf and Quebec, two fishers landed 12,876 kg of porbeagle with a gross value of \$11,803 (average price was lower than in the Maritimes). Both fishers had other licenses and derived substantial revenue from lobster and snow crab landings; the distributional impacts in the Gulf and Quebec are minimal.



Groundfish Fishery

In the Maritimes, groundfish license holders landed 17,650 kg porbeagle in 2004, worth approximately \$24,000 ex-vessel. These landings were distributed amongst 94 groundfish license holders. Distributional impacts are minimal for Maritimes groundfish fishers.

Swordfish and Tuna Fisheries

Swordfish and tuna license (restricted and unrestricted) holders landed 27,807 kg porbeagle in 2004, worth approximately \$38,000. Landings were distributed amongst 31 license holders (some individuals held both swordfish and tuna licenses, and reported porbeagle landings on both). On average, swordfish and tuna license holders landed porbeagle with an ex-vessel value of \$1,225 per license holder. While this amount is modest considered alone, it is possible that the costs of fishing could increase for swordfish and tuna vessels if they need to change fishing patterns to actively avoid areas with relatively high concentrations of porbeagle.

Impacts on Aboriginal Communities

No aboriginal fishers hold exploratory shark licenses.

Given the low impact of listing on groundfish fishers in general, there are no special considerations regarding Aboriginal food, social and ceremonial fisheries.

Eleven First Nations hold swordfish or tuna licenses under the Marshall Response Initiative²¹. Two swordfish licenses were active in 2003 and 2004, and activity increased in 2005²². In 2004, the two swordfish license holders landed approximately 56 mt of large pelagics, including 4 mt of porbeagle with an ex-vessel value of about \$5,500.

The Native Council of Nova Scotia also holds three swordfish licenses received under the Allocation Transfer Program. Their landings of porbeagle are reported as minimal to non-existent²³.

Impacts on Communities – the Case of Sambro

The fishers – exploratory shark and swordfish/tuna license holders – and shore-based fish plant workers most affected by porbeagle listing are largely based in a single community, Sambro.

In 2002, there were 106 vessels based in Sambro, including 70 vessels <35 ft; 30 vessels 35-45 ft; 5 vessels 45-65 ft; and 1 vessel >65 ft. Fishers from Sambro held 70 groundfish licenses (62 of which were for fixed gear <45 ft vessels), 62 lobster licenses, 35 swordfish licenses, plus various other licenses. Approximately 7,600 tonnes of fish were landed in the Sambro area in 2002 with a value of approximately \$12.5 million at the wharf. There are 26 buyers and 3 fish processors based in the Sambro area. The average revenue per fishing vessel was about \$110,000 in 2001 and median income per person (> 15 years) was \$22,628.

In 2004, 178.3 mt of porbeagle was landed by Sambro license holders. These were worth \$242,500 ex-vessel, or about 2% of total Sambro fisheries revenue.



4 Summary

Table 6 summarizes the economic costs, short-term regional impacts on regional economic activity and employment, and distributional considerations for the three porbeagle management Scenarios.

Based on recent population modeling, recovery of the northwest Atlantic porbeagle shark population is not predicted at the current landing level (250 mt). Under Scenario 1, where porbeagle are not listed and the TAC remains at 250 mt, there would be no incremental costs or benefits for industry or government, or regional short-term economic or employment impacts, as there would be no regulatory change.

Porbeagle would not be listed as Endangered under Scenario 2. The population is projected to recover to either $SSN_{20\%}$ or SSN_{msy} when subject to a 4% exploitation rate, depending on model productivity assumptions and time horizon. The reduction in the TAC would be achieved by reducing the Maritimes TAC allocation to 125 mt from 190 mt. The net present value (NPV) of the stream of lost profits for exploratory shark license holders in the Maritimes would range from \$46,626 to \$263,034, depending on assumptions about profit margin and interest rate. Additional costs to the Government of Canada should be modest. The reduction of TAC would cause an approximately \$185,000 reduction in economic activity in the Maritimes and there could be very modest employment impacts. The costs under Scenario 2 would be borne by five or more exploratory shark license holders in the Maritimes. If we assume that the 65 mt reduction in TAC is distributed proportionally amongst the 5 license holders active in 2004, each license holder would lose 3.6 to 17.1 mt in porbeagle landings valued between \$5,056 and \$39,776 per fisher (1.8% to 25.6% of total fishing revenue for these license holders).

Under Scenario 3, porbeagle sharks are listed as Endangered. The directed porbeagle fishery would be eliminated and buy, sell and trade prohibitions would effectively reduce market price for porbeagle to zero, eliminating landings in other fisheries (some discard mortalities would still be inevitable). The NPV of the stream of lost profits for all exploratory shark license holders would range from \$144,079 to \$809,335, depending on profit margin and interest rate assumptions. Of the total loss, \$136,875 to \$768,868 would accrue to license holders in the Maritimes and \$7,294 to \$40,467 to license holders in the Gulf and Quebec. Other license holders would lose 50 mt of porbeagle bycatch with a gross sales value of \$68,000. Under various interest rate assumptions, the net present value of lost porbeagle bycatch ranges from \$720,393 at a 7% interest rate to \$1,011,668 at a 3% interest rate. The NPV of the loss of 50 mt of bycatch is actually larger than the NPV for the directed porbeagle fishery because 100% of porbeagle revenue is considered to contribute directly to profitability for other license holders (if the Sale and Trade issue was resolved, other fisheries would still be allowed to sell porbeagle bycatch and this cost component of Scenario 3 would be eliminated). Costs for the Government of Canada arise because of the need to conduct periodic porbeagle population assessments without industry cooperation: the NPV of Government costs would be \$822,416.

Based on a \$340,000 loss in fishing revenue, Scenario 3 implies a \$714,000 short-term reduction in economic activity, primarily in the Maritimes. Some modest loss in employment is expected in both fishing and processing sectors. Two license holders were highly dependent on porbeagle (> 25% of their total fishing income was derived from porbeagle) in 2004.



There is, however, a complicating social factor with listing porbeagle as Endangered. The fishers – exploratory shark and swordfish/tuna license holders – and shore-based fish plant workers most affected by porbeagle listing are largely based in a single community, Sambro. In 2004, 178.3 mt of porbeagle was landed by Sambro license holders. These were worth \$242,500 ex-vessel, or about 2% of total Sambro fisheries revenue.

	Scenario 1	Scenario 2	Scenario 3
Scenario Summary	<ul style="list-style-type: none"> ▪ Do not list ▪ 250 mt TAC 	<ul style="list-style-type: none"> ▪ Do not list ▪ 185 mt TAC ▪ 125 mt - Maritimes 	<ul style="list-style-type: none"> ▪ List as Endangered ▪ No buy / sell / trade
Economic Cost to Industry (Net Present Value)	<ul style="list-style-type: none"> ▪ \$0 	<ul style="list-style-type: none"> ▪ Low - \$47k ▪ High - \$263k 	<ul style="list-style-type: none"> ▪ Low - \$865k ▪ High - \$1.82m
Changes in Costs for Government	<ul style="list-style-type: none"> ▪ \$0 	<ul style="list-style-type: none"> ▪ Possibly modest extra cost due to monitoring 	<ul style="list-style-type: none"> ▪ Scientific surveys (\$300k each 5 yrs; NPV = \$822,416)
Short- to Medium-Term Regional Economic Impact	<ul style="list-style-type: none"> ▪ \$0 	<ul style="list-style-type: none"> ▪ \$185k per year 	<ul style="list-style-type: none"> ▪ \$714k per year
Regional Employment Impact	<ul style="list-style-type: none"> ▪ Nil 	<ul style="list-style-type: none"> ▪ Negligible 	<ul style="list-style-type: none"> ▪ Some losses (up to 8 jobs) possible in fishing and processing
Distributional Considerations	<ul style="list-style-type: none"> ▪ Not Applicable 	<ul style="list-style-type: none"> ▪ Costs borne by Maritimes exploratory shark license holders ▪ Up to 26% loss of revenue for at least one fisher 	<ul style="list-style-type: none"> ▪ Costs mainly to shark license holders ▪ Up to 85% loss of revenue for at least one fisher ▪ The economic costs and impacts of listing are concentrated in the community of Sambro

Table 6. Summary of economic costs, regional impacts and distributional considerations for three management scenarios for porbeagle shark



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6 Endnotes

- ¹ An exploitation rate of approximately 4% of the vulnerable biomass annually.
- ² At on an assumption of moderate productivity and an exploitation rate of 4%, 80% of simulated populations recovered to SSN20% between 2016 and 2037, and to SSNmsy in the 22nd century or later (DFO, 2005b).
- ³ We have not explicitly included a Scenario in which porbeagle is listed as an Endangered species but where the Sale and Trade of porbeagle bycatch would be permitted. While there has not yet been a resolution to the Sale and Trade issue, DFO and Environment Canada are working collaboratively on long-term solutions to this issue. A relaxation of regulations prohibiting Sale and Trade, thereby allowing the sale of porbeagle bycatch in the swordfish, tuna, groundfish and other fisheries, would lessen the costs of listing developed in Scenario 3 in this analysis.
- ⁴ Exploratory shark licenses might still be used (e.g., for blue shark) and porbeagle shark caught would have to be released alive.
- ⁵ The first cost and earnings survey of Maritimes fishing fleets in over a decade is currently underway and will help clarify profitability in various fleets. At the time of writing this report, results from that survey were still unavailable.
- ⁶ Porbeagle are not landed in recreational shark derbies. In Quebec, one license holder is interested in converting his fishing vessel to a charter vessel for recreational shark fishing.
- ⁷ Porbeagle sharks do feed on mid-sized, pelagic schooling fish (Compagno, 2001), so it is possible that they do have some impact on commercially important species like mackerel.
- ⁸ Discounting is a method used to convert future costs and benefits to a single number, in current dollars. For instance, if a fisher receives \$1,000 per year each year for the next 20 years, the \$1,000 received in 20 years is worth less to that person than the \$1,000 in the first year. If a person had \$377 (the 'present value') in the first year and put it in the bank, earning 5% interest per year, that deposit would eventually be worth \$1,000 in Year 20. Net present value (NPV) is an equation that sums the present value of each future payment of \$1,000. At a 5% interest rate, \$1,000 per year for the next 20 years is only worth \$12,462 in current terms.
- ⁹ DFO is currently conducting a valuation survey that will further address the issue of non-use value of porbeagle, amongst other species, and quantify non-use values should they exist.
- ¹⁰ The 3.1 multiplier from Statistics Canada is quite consistent with multipliers derived from other longline fisheries. Cai et al (2005) found backward multipliers of 1.44 and forward multipliers of 1.04 for swordfish longliners in Hawaii. Radke and Davis (2000) estimated a multiplier of 3.44 for dockside swordfish sales in California. There is likely very little difference in the multiplier within Atlantic Canada given the similar input prices and final markets for porbeagle.
- ¹¹ Porbeagle landings may be substantial in international waters. For instance, the North Atlantic Spanish pelagic longline fishery landings consist of 85% sharks (unspecified species), by volume (Garza-Gil and Varela-Lafuente, 2005).
- ¹² Patrick Gray, personal communication – porbeagle socio-economic stakeholder review meeting, 4 October 2005.
- ¹³ Without detailed cost and earnings data for the exploratory shark fishers, it is difficult to assess the true costs of regulatory actions. Some pelagic longline fisheries have been only marginally profitable or even appear to lose money when all costs are factored in (c.f., Larkin et al., 2000; Porter et al. 2001). On the other hand, the North Atlantic Spanish pelagic longline fishery appears to be financially healthy (Garza-Gil and Varela-Lafuente, 2005) and the value of swordfish and tuna licenses in Canada imply license holders in those fleets enjoy a positive producer surplus. In this analysis, we use three levels of profit margin (revenues less operating costs, depreciation, and normal returns to management) to assess NPV. Note that if fishing was not profitable, the economic cost of closing that fishery would be zero from a strict cost-benefit analysis perspective.
- ¹⁴ Nova Scotia's ocean sector had an overall impact of approximately \$4-billion on the province's economy as measured in gross domestic product (GDP) in 2001. The contribution of fish harvesting and processing to that figure was \$986 million in 2001 (http://www.gov.ns.ca/econ/docs/2005_Ocean_Sector_Study_NS.pdf).
- ¹⁵ Exploratory shark licensees may still be able to direct for blue shark but would have to discard porbeagle. For license holders that conduct recreational fishing charters, it may still be possible for clients to take home porbeagle for personal use as no buy, sell or trade restrictions would be violated.
- ¹⁶ The restrictions on the purchase, sale, and trade of listed species caught as bycatch in commercial fisheries is recognized as major constraint. In some cases, SARA socio-economic analyses have assumed that some commercial trade would be permitted over the long term (e.g., northern cod analysis – www.dfo-mpo.gc.ca/species-especes/cod/cod_morue_e.pdf) but in this analysis, we assume that restrictions on commercial trade will be in place indefinitely. If we relax that assumption, the costs of listing porbeagle shark would drop sharply for fisheries that only land porbeagle as bycatch.
- ¹⁷ Discard mortality for porbeagle is unknown. It is likely safe to assume at least 50% survival of porbeagle that have been hooked, depending on handling procedures.
- ¹⁸ One survey would be needed in the first year to establish a baseline for future monitoring and then additional surveys would be conducted once every 5 years (i.e., Years 6, 11, 16, ...). Each survey would cost \$300,000 (50 days charter at



\$5,000 per day, plus \$50,000 in other expenses). Based on a 5% discount rate and 20 year time horizon, the NPV of the stream of costs to DFO would be \$822,416. If one assumed a 0% discount rate (i.e., survey expenses increased at the same rate as the discount rate over time), the NPV would be \$1.2 million. Note, however, that DFO expenses would be paid to the fishing industry: surpluses generated by vessel owners would mitigate the overall societal cost of surveys. In addition, local spending would have positive spin-off impacts in the regional economy. In addition, there may be opportunities to develop more cost-effective surveys in conjunction with vessels fishing for large pelagics, thereby reducing scientific monitoring costs further. Thus, the NPV of \$822,416 should be regarded as a generous upper limit to the overall economic costs of monitoring.

- ¹⁹ DFO Policy Branch (Maritimes Region) has used a ‘rule of thumb’ regarding employment impacts in the groundfish fishery in the past. In general, it was estimated that each 1,000 mt of groundfish landings supported a total of 30 fishing and processing jobs. This figure was commonly used when there was more processing and exporting activity in the groundfish sector than there is now. For the large pelagic fisheries that would be most affected by porbeagle listing, the ratio of jobs to landings is likely substantially lower. For a loss of 250 mt of porbeagle landings, one might reasonably expect job loss to be in the range of 4 to 8 full time jobs (i.e., 30 jobs per 1000 mt = 8 jobs per 250 mt as an upper bounds). This also depends on what other opportunities exist for porbeagle fishers and vessels – given almost all exploratory shark license holders also hold other types of fishing licenses, job losses might even be lower.
- ²⁰ Joyce (1999) noted that two crews of 6 people each worked dockside to process sharks once landed at one Sambro processing plant.
- ²¹ Acadia, Chapel Island, Fort Folly, Glooscap, Indian Brook, Membertou, Millbrook, St. Mary’s, Wagmatcook, Woodstock and Waycobah First Nations all hold at least one swordfish, swordfish (harpoon) or tuna licenses.
- ²² Final figures for 2005 are not yet available.
- ²³ Correspondence from Franz Kesick, Maritime Aboriginal Aquatic Resources Secretariat dated 5 October 2005.