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Recovery Strategy Report Series

Report on the Progress of Recovery Strategy Implementation for the Basking Shark (*Cetorhinus maximus*) in Canada for the Period 2011- 2016

Basking Shark

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Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under section 46 of the Species at Risk Act (S.C. 2002, c.29) (SARA), the competent ministers are responsible for reporting on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives within five years of the date when the recovery strategy was placed on the Species at Risk (SAR) Public Registry and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible.

Reporting on the progress of recovery strategy implementation requires reporting on the collective efforts of the competent minister(s), provincial and territorial governments and all other parties involved in conducting activities that contribute to the species' recovery. Recovery strategies identify broad strategies and approaches that will provide the best chance of recovering species at risk. Some of the identified strategies and approaches are sequential to the progress or completion of others and not all may be undertaken or show significant progress during the timeframe of a report on the progress of recovery strategy implementation (progress report).

The Minister of Fisheries and Oceans and the Minister responsible for the Parks Canada Agency, are the competent ministers under SARA for Basking Shark and have prepared this progress report.

As stated in the preamble to SARA, success in the recovery of species at risk depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in the recovery strategy and will not be achieved by Fisheries and Oceans Canada and the Parks Canada Agency, or any other jurisdiction alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the recovery strategy for the Basking Shark (*Cetorhinus maximus*) in Canadian Pacific waters, for the benefit of the species and Canadian society as a whole.

Acknowledgments

This progress report was prepared by Heather Brekke (Fisheries and Oceans Canada (DFO), with input from Jackie King (DFO), Sean MacConnachie (DFO), Paul Grant (DFO), and Jenn Yakimishyn (Parks Canada Agency). DFO would also like to express its appreciation to all individuals and organizations who have contributed to the recovery of the Basking Shark.

Executive summary

The Pacific population of Basking Shark (*Cetorhinus maximus*) was listed as Endangered under the Species at Risk Act (SARA) in 2010. The Recovery Strategy for the Basking Shark (*Cetorhinus maximus*) in Canadian Pacific Waters was finalized and published on the Species at Risk (SAR) Public Registry in 2011.

The Pacific population of Basking Shark is threatened by various anthropogenic sources. The main threats identified for the Basking Shark include entanglement, collision with vessels, harassment from marine-based activities, and prey availability. The key factors limiting the recovery and survival of Basking Sharks are their long-life (~50 years), slow growth and maturation, and low fecundity, which lead to overall low productivity. The decline of the Pacific population of Basking Shark is primarily due to human-caused mortality, which occurred predominantly between 40 and 70 years ago. Even in the absence of human-induced mortality, Basking Shark populations grow very slowly.

The population and distribution objectives for the Basking Shark within Canadian Pacific waters are: 1) maintain the current abundance of Basking Sharks; 2) attain positive population growth of Basking Sharks within 15-20 years; 3) attain increase in Basking Shark aggregations (two or more sharks); and 4) maintain distribution of Basking Sharks.

During the time period reported by this progress report, progress has been made toward increasing scientific knowledge and public awareness as well as threat mitigation, including:

- development of opportunistic tagging and biological sampling programs, aerial surveys, and a habitat features modeling study
- development of a tri-national working group to support collaborative approaches to recovery
- development, promotion, and maintenance of the Basking Shark Sightings Network (BSSN) and supporting Basking Shark Sightings Database (Database)
- development of shark and skate identification cards for improved identification by at-sea observers
- changes to recreational and commercial fisheries to avoid and mitigate interception of Basking Sharks within these fisheries
- development of Codes of Conduct for responsible practices of avoidance and mitigation efforts if intercepted in various fishing gears, as well as viewing Basking Sharks

The effects of the recovery effort on a long-lived species with a low rate of increase such as a Basking Shark, and a paucity of documented recent sightings in Canadian Pacific waters, are not likely to be immediately evident. It is estimated that approximately 200 years are needed before population numbers will return to their unexploited rates, even if a breeding population currently exists, and no further human-induced mortality or changes to existing habitat occur (McFarlane et al. 2009).

Although there has been significant progress made toward meeting many of the objectives and strategies outlined in the recovery strategy, ongoing work is required to better understand the threats to Basking Sharks within Canadian Pacific waters, and support the recovery of this population as well as to identify its critical habitat.

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1. Introduction

This progress report outlines the progress made towards meeting the objectives listed in the Recovery Strategy for the Basking Shark (*Cetorhinus maximus*) in Canadian Pacific Waters (DFO 2011) from 2011 to 2016 and should be considered as one in a series of documents for this species that are linked and should be taken into consideration together; including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessment and status report (COSEWIC 2007), a recovery potential assessment (DFO 2009), the recovery strategy (DFO 2011), and an action plan (in press).

Section 2 of this progress report summarizes key information on the threats to the species, population and distribution objectives for achieving its recovery, approaches to meeting the objectives, and performance measures to assess the progress of recovery. For more details, readers should refer back to the recovery strategy. Section 3 reports the progress of activities identified in the recovery strategy that support achieving the population and distribution objectives. Section 4 summarizes the progress toward achieving the objectives.

2. Background

2.1 COSEWIC assessment summary

The 2010 listing of the Basking Shark under the Species at Risk Act (SARA) led to the development and publication of the recovery strategy in 2011, which was based on the information provided in the COSEWIC assessment and status report.

Assessment Summary – April 2007

Common name
Basking Shark - Pacific population

Scientific name
Cetorhinus maximus

Status
Endangered

Reason for designation
Basking Shark is the only extant species in the family Cetorhinidae. It occurs circumglobally in temperate coastal shelf waters, and exists in Canada as two geographically isolated designatable units – Atlantic and Pacific. The species is vulnerable to incidental fishing mortality because of its low intrinsic productivity. Females do not mature until 16 to 20 years old, gestate between 2.6 and 3.5 years (the longest known gestation period for any vertebrate), and produce litters of only about 6 “pups”. These sharks are especially susceptible to entanglement in fishing gear and collision with boats because of their large size, surface behaviour and fearlessness around boats, and because their coastal distribution overlaps fishing and boating areas. Prior to 1970, large aggregations of these sharks were seasonally common in Pacific Canada, but only 6 sightings have been confirmed since 1996. This dramatic reduction in abundance is attributed to directed fisheries for liver oil (1941-1947) and an eradication program (until 1970) that killed hundreds, perhaps thousands of individuals between 1945 and 1970. The minimum historical population reconstructed from documented kills was at least 750 individuals, whereas the current population is virtually nil, implying a rate of decline exceeding 90% within < 2 generations. The species is believed to migrate seasonally between Canada and California, where regional aggregations

were also severely depleted by historic fisheries. Rescue from outside Canada is unlikely.

Occurrence
Pacific Ocean

Status history
Designated Endangered in April 2007. Assessment based on a new status report.

2.2 Threats

This section summarizes the information found in the recovery strategy on threats to survival and recovery of the Basking Shark within Canadian Pacific waters, as well as threats to its habitat.

2.2.1 Threats to the Basking Shark

Table 1 summarizes the threats to the Basking Shark. Please refer to section 4 of the recovery strategy for more information on these threats.

Table 1. Summary of the threats identified for the Basking Shark, based on the recovery strategy.

Threat	Level of concern[1]	Description
Entanglement	High	Known present day human-induced mortality of the Pacific population of Basking Shark is primarily from continued interactions with fishing gear. There have been three records of Basking Sharks entangled in fishing gear since 1996 (DFO, 2016). Because of their low and uncertain population size, historical susceptibility to entanglement, high mortality rates when entangled, and uncertainty around actual entanglement rates elsewhere in their range, this threat is considered a “high” level of risk.
Collision with vessels	Medium	Basking Sharks often feed by slowly moving along the surface, and therefore collisions between boats (hulls and propellers) and Basking Sharks are probable. There are no recent reported vessel strikes of Basking Sharks in Canadian Pacific waters or elsewhere in their range. The extent and population consequence of vessel collisions is unknown.
Harassment	Low	While the extent of this threat is currently unknown along the British Columbia (BC) coast, it is anticipated that if Basking Sharks increase in abundance, harassment in the form of vessel based disturbance by ecotourism operators or individuals may impact normal surface feeding behaviour, as has been observed in the northeast Atlantic (Gore et al. 2010). The impacts of acute underwater noise (e.g., seismic, explosives) on sharks in general have not been well documented. Overall, harassment is considered to be a “low” level of concern.
Prey availability	Low	At small spatial and temporal scales, Basking Shark distribution and occurrence appears strongly linked to zooplankton

[1] Level of concern indicates whether managing the threat is an overall high, medium, or low level of concern for conservation of the species, taking into account the extent, occurrence, frequency, casual certainty, and severity of the specific threat.

		abundance, particularly calanoid copepods (Sims 2008); however, diet preference and composition for the Pacific population of Basking Shark is unknown. A long-term downward shift in prey availability from either natural or human causes will certainly influence the behaviour of the Basking Shark and could threaten the population as a whole, considering their low abundance.

2.2.2 Threats to critical habitat

Critical habitat for the Basking Shark has not yet been identified. Section 7.2 of the recovery strategy includes a schedule of studies that outlines the research required to identify critical habitat that will help achieve the species' population and distribution objectives. Progress in undertaking the schedule of studies is reported in section 3.2 of this document.

2.3 Recovery

2.3.1 Population and distribution objectives and performance measures

This section summarizes the information found in the recovery strategy on the population and distribution objectives necessary for the recovery of the Basking Shark, and on the performance measures used to define and measure progress toward achieving the population and distribution objectives.

Section 5.2 of the recovery strategy identified the following population and distribution objectives necessary for the recovery of the Basking Shark within Canadian Pacific waters:

1. maintain the current abundance of Basking Sharks.
2. attain positive population growth of Basking Sharks within 15-20 years
3. attain increase in Basking Shark aggregations (two or more sharks)
4. maintain distribution of Basking Sharks

Section 9 of the recovery strategy includes the performance measures to define and measure progress toward achieving the population and distribution objectives. Table 2 describes these performance measures in relation to the population and distribution objectives.

Progress against some elements of recovery may not be measurable within the timeframe covered in this progress report. In such cases, the implementation of the recovery approaches and critical habitat studies will help report on the progress towards achievement of the performance measures. These are further described in Table 5 (section 3.3.1 of this report).

Table 2. Population and distribution objectives and corresponding performance measures for the Basking Shark, found in the recovery strategy.

Population and distribution objective	Performance measure
1. Maintain the current abundance of Basking Sharks	▪ Proven maintenance, promotion, and utilization of the Basking Shark Sightings Network and Database. ▪ Within five years, observe, at a minimum, the current annual average number of reliable sightings.
2. Attain positive population growth of Basking Sharks within	▪ Proven maintenance, promotion, and utilization of the Basking Shark Sightings Network and Database.

Population and distribution objective	Performance measure
15-20 years	▪ Within five years, observe an increase in annual average number of reliable sightings throughout species distribution range. ▪ Within15-20 years, established Canadian, American, and Mexican overflights observe higher numbers of Basking Sharks annually.
3. Attain increase in Basking Shark aggregations (two or more sharks)	▪ Proven maintenance, promotion, and utilization of the Basking Shark Sightings Network and Database. ▪ Within five years, see an increase in reliable sightings of aggregations of two or more sharks.
4. Maintain distribution of Basking Sharks	▪ Proven maintenance, promotion, and utilization of the Basking Shark Sightings Network and Database. ▪ Within five years, observe an increase in annual average number of reliable sightings throughout species distribution range.

3. Progress towards recovery

The recovery strategy divides the recovery effort into five broad strategies: 1) communications and outreach; 2) scientific research; 3) management; 4) monitoring and inventory; and 5) coordination of activities. Progress in carrying out these broad strategies is reported in section 3.1. Section 3.2 reports on the activities identified in the schedule of studies to identify critical habitat. Section 3.3 reports on the progress on meeting the performance measures and other commitments identified in the recovery strategy, as well as information obtained through implementing the recovery strategy.

3.1 Activities supporting recovery

Table 3 provides information on the implementation of activities undertaken to address the approaches and broad strategies identified in the recovery planning table of the recovery strategy. The table lists lead participants on top and in bold; other participants are listed alphabetically. Not all activities have specific participants identified.

Table 3. Details of activities supporting the recovery of the Basking Shark from 2011 to 2016.

Activity	Approach	Descriptions and results	Recovery objectives	Participants
Broad strategy 1: Communication and outreach				
1. Develop and maintain Basking Shark Sightings Network (BSSN)	Create public education and awareness program to: a) promote reporting of sightings to the BSSN; and b) encourage responsible boating and fishing practices (e.g., education program for fishing and aquatic recreation communities, industry, and aquaculture, including a web site, posters, presentations, video, and press releases)	The BSSN was established in 2008 to solicit and document sightings of and encounters with Basking Sharks in Pacific Canadian waters. The BSSN has been successful in engaging the public, given the annual number of likely or confirmed reported sightings has increased since 2011 as a result of continued promotion and media attention. There remains a lag time between encounters with Basking Sharks and reporting of the encounter to the Sightings Network, thereby reducing the likelihood that confirmed reports can be acted upon by DFO personnel to opportunistically tag or biosample a specimen. There were 36 confirmed or reliable Basking Shark sightings reported to the BSSN from 1996-2016 (King pers. comm. 2017). In addition, the BSSN received 66 additional reports for sightings of Basking Sharks within this period, of which 46 were deemed possible Basking Sharks, 11 were unknown, and 9 were deemed unlikely to be Basking Sharks. The number of sightings reported to the BSSN from 2008–2015 has ranged between 3 and 29 reports per year, with peak reporting occurring in 2008 (29 reports) and 2010–2012 (17–22 reports per year). It is not possible to know if any of these sightings are re-sightings of the same individual. Reports have also been gathered for sightings from 1945-2007. A series of themed printed outreach materials were created in 2013. Printed materials included posters, business cards with identification and contact information, brochures	All	**DFO**, **PCA**, general public (user groups on the water)

Activity	Approach	Descriptions and results	Recovery objectives	Participants
		advertising the program, and a large display banner. DFO staff gave oral presentations on Basking Sharks and the sightings network at community events, campgrounds, and marine festivals on Vancouver Island. Media interviews were conducted. An incentive program was also developed to help encourage the reporting of sightings. Parks Canada regularly promotes the BSSN through outreach and education programs.		
Broad strategy 2: Scientific research				
2. Habitat features modeling study	Further improve understanding of population structure, abundance, and seasonal distribution within Canadian Pacific waters. For example: a) characterize habitat used extensively by Basking Sharks that is essential for providing protection, and document how the areas are used (e.g., seasonal feeding, mating, pupping or rearing); and b) examine Basking Shark feeding ecology and the impacts of fluctuating food-web dynamics	A habitat features modeling study was completed in 2015, which used satellite-derived oceanographic data to identify potential habitat features for Basking Sharks in Canadian Pacific waters, summarized by foraging season (DFO 2016). This included the features of chlorophyll and sea surface temperature (SST) to create foraging season potential habitat maps for May-September. Potential foraging habitat maps based on satellite chlorophyll measurements provide an indication of productivity hotspots. However, low resolution zooplankton data and low frequency Basking Shark sightings data could not provide validation that these productivity hotspots represent characteristics that allow Basking Shark to successfully forage on zooplankton. Historical confirmed Basking Shark sightings (1945-2012) were compared with the foraging season habitat suitability class data to determine the sightings per habitat suitability category (DFO 2016). Results were the same for the linear and non-linear chlorophyll and SST combination models. The majority of Basking Shark sightings were in areas classified as high foraging season habitat suitability. When zooplankton classes are summarized by habitat suitability categories, no clear trend is apparent. The potential foraging habitat maps could not be validated by the available low-resolution zooplankton data, or with the low	All	**DFO**

Activity	Approach	Descriptions and results	Recovery objectives	Participants
		numbers of confirmed Basking Shark sightings. The modeling project was a preliminary study, and the utility of the approach, particularly using daily-scale data, could be reassessed when a greater number of confirmed sightings are available.		
3. Development of opportunistic tagging and biosampling programs	Coordinate opportunistic research and tagging program (e.g., with reported sightings and/or mortalities), providing sex, distribution, migration and movement information, stomach contents, vertebrae, and tissue samples for genetics and toxicity work	Opportunistic tagging and biosampling programs were developed in 2010; however, no Basking Sharks have been tagged or sampled within Canadian Pacific waters as no reports have been received within a timeframe that a tag could be administered and/or intercepted in commercial fisheries or DFO research surveys. A satellite tag equipped with a Global Positioning System receiver is available for deployment. The tag is capable of recording depth and temperature throughout the programmed deployment, and geolocation data while at the surface. All required permits have been approved, including approval of the Animal Use Protocol for the tagging methodology, and are renewed annually. Biological sampling protocols have already been developed and are in place for use by at-sea observers on commercial fishery vessels and by DFO research personnel on surveys. Information on size, sex, stock structure, and diet could be obtained from these opportunities, all of which would help fill gaps in knowledge of habitat usage by Basking Sharks in Pacific Canadian waters. Required permits for DFO research personnel and at-sea observers have been obtained and are renewed annually.	2,4	**DFO**, at-sea observers, NOAA
Broad strategy 3: Management				
4. Revise fishing and aquaculture practices to reduce and mitigate damage	Assess and, where practicable, revise fishing and aquaculture practices to reduce entanglement and	Changes were made to the BC Sport Fish Regulations, effective April 1, 2011 that includes “no fishing for” (no directed fishing, including catch and release of all shark species of concern, including the Basking Shark).	1,2,4	**DFO**, Aquaculture, harvesters commercial fishers, recreational fishers

Activity	Approach	Descriptions and results	Recovery objectives	Participants
from entanglement and incidental catch	incidental catch; where interactions occur, require mandatory reporting of collisions, entanglement and incidental catch Implement spatial and/or temporal fisheries closures in the event of Basking Shark aggregations	Changes were made in 2011 to conditions of licence within commercial fisheries that may intercept a Basking Shark, making commercial fishery licences compliant with SARA s.74. These included conditions to ensure measures are taken to avoid the incidental capture of a Basking Shark, and measures to take to ensure that an intercepted shark is released with the least harm possible. An elasmobranch Species at Risk Encounter Protocol was established in the 2011/2012 season for the Groundfish Trawl industry, which includes a prohibition on the selling and retention of Basking Shark, Tope, and Bluntnose Sixgill Shark within these commercial fisheries. No spatial and/or temporal closures were required or considered, as no aggregations of Basking Sharks have been reported within the period 2011-2016.		
5. Code of conduct developed to promote responsible boating and fishing practices for sharks	Implement a code of conduct (guidelines for marine users to minimize negative interactions and collisions, i.e. proper boating practices for commercial fisheries, recreational fisheries, and ecotourism)	In 2014, codes of conduct were created to promote responsible boating and fishing practices, one specific to Basking Shark encounters, and another for all other sharks (with the exception of Pacific Spiny Dogfish). The Basking Shark Code of Conduct is referred to in the Integrated Fishery Management Plans (IFMPs) for relevant fisheries, including groundfish. The code contains three parts: Part 1 introduces recommended boating practices to reduce mortality and harm during visual encounters; Part 2 provides recommended handling practices to increase the chances of survival of Basking Sharks during incidental entanglements; and Part 3 provides details for reporting encounters to the BSSN.	All	**DFO**, Aquaculture harvesters, commercial fishers, general public (viewing), PCA, recreational fishers
Broad strategy 4: Monitoring and inventory				
6. Conduct aerial surveys	Conduct aerial surveys for search and enumeration of Basking Sharks in historic areas	Twenty five aerial surveys for Basking Sharks were conducted between 2007–2011 on the west coast of Vancouver Island and in Rivers Inlet, British Columbia. In addition, one offshore aerial survey was conducted in 2011	All	**DFO**

Activity	Approach	Descriptions and results	Recovery objectives	Participants
	of abundance, and where possible, identify plankton blooms in real time, for targeted over-flights (May- September)	on the west coast of Vancouver Island. Methodology and results were documented by Surry and King (2015). No Basking Sharks were observed. Marine mammals and Blue Sharks (*Prionace glauca*) were observed, indicating that these surveys were effective for spotting animals.		
7. Provide training to at-sea observers, improve species identification, and reporting to the BSSN	Improve species identification and reporting in current observer programs, and expand monitoring programs (e.g., logbook observations) to all fisheries with the potential to entangle Basking Sharks; assess whether the calculated potential removal of 10-17 animals per annum is being exceeded	Species identification sheets, available on the DFO website, were created for shark and skate species in 2011, and shared with commercial, recreational, and aquaculture harvesters. Sampling protocols and identification sheets are provided to at-sea observers.	1,2,4	**DFO**, at-sea observers
8. Development and maintenance of BSSN database	Creation and maintenance of DFO-managed Basking Shark sighting reporting network and database	See description and results for the Basking Shark Sightings Network (BSSN) above. Database created and maintained by staff at DFO's Pacific Biological Station.	All	**DFO**
Broad Strategy 5: Coordination of activities				
9. Development of Basking Shark tri-national working group	Collaborate on international efforts (i.e. with the United States and Mexico) to research, monitor (including high seas fisheries) and manage activities for the Pacific population of Basking Shark	Ongoing collaboration with colleagues from the United States' National Oceanographic and Atmospheric Administration (NOAA) and Mexico's Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), including sharing of research and tagging, sighting, and biosampling data.	All	**DFO**, Mexico (CICESE), USA (NOAA)

Activities supporting the identification of critical habitat

Table 4 provides information on the implementation of the studies outlined in the schedule of studies to identify critical habitat (section 7.2. of the recovery strategy). The timelines shown have also been included from the recovery strategy. Each study has been assigned one of four statuses:

1) completed: the planned activity has been carried out and concluded
2) in progress: the planned activity is underway and has not concluded
3) not started: the activity has been planned but has yet to start
4) cancelled: the planned activity will not be started or completed

Current information on the species' habitat in Canadian Pacific waters is insufficient to identify critical habitat at this time. The Evaluation of Information Available to Support the Identification of Habitat Necessary for the Survival and Recovery of Basking Shark in Canadian Pacific waters Science Response Report (DFO 2016) provides detailed progress updates with respect to the schedule of studies summarized in Table 4. Lead participants are listed on top and in bold; other participants are listed alphabetically
Not all studies have specific participants identified.

Table 4. Status and details of the implementation of the schedule of studies outlined in the recovery strategy.

Study	Timeline	Status	Descriptions and Results	Participants
1. Maintain and promote the Basking Shark Sightings Network (BSSN)				
Develop the Basking Shark Sightings Database (2010); Maintain and promote the BSSN	2010-2015, ongoing	Completed, in progress	A summary of the sightings reported to the BSSN from 1996-2016 can be found in Table 3, broad strategy 1, activity 1. The BSSN was established in 2008 to solicit and document sightings of and encounters with Basking Sharks in Pacific Canadian waters. The Basking Shark Sightings Network has been successful in engaging the public. The annual number of likely or confirmed reported sightings has increased since 2011, as a result of continued promotion and media attention. There remains a lag time between encounters with Basking Sharks and reporting of the encounter to the Sightings Network, thereby reducing the likelihood that confirmed reports can be acted upon by DFO personnel to opportunistically tag or biosample a specimen. A database was developed in 2008 and is managed by staff at DFO's Pacific Biological Station. Reliability ratings for sightings of	**DFO**, general public (anyone on the water)

			Basking Sharks to the BSSN were established, which include the following levels: 1) confirmed (photos/video) 2) reliable (no photos/video, but a reliable or expert source) 3) possible (description suggests a Basking Shark, but there is insufficient detail for positive identification) 4) unlikely (description suggests it is not a Basking Shark) 5) unknown (insufficient information) The maintenance and promotion of the BSSN is ongoing.	
2. Basking Shark tagging program				
Opportunistic satellite tagging of Basking Sharks in Canadian Pacific waters	2010-2015, ongoing	In progress	A summary of the opportunistic tagging program can be found in Table 3, broad strategy 2, activity 3. Satellite tagging technology remains a viable means for obtaining detailed geolocation, depth, and temperature information for Basking Sharks in Pacific Canadian waters and throughout their geographic range, which would help fill information gaps on habitat use.	**DFO**, commercial fishery, vessel masters
3. Opportunistic sampling program				
Biological sampling from live sightings and mortalities	2010-2015, ongoing	In progress	A summary of the opportunistic biosampling program can be found in Table 3, Broad Strategy 2, activity 3. Biosampling may assist in filling information gaps for Basking Sharks in Canadian Pacific waters, including habitat usage.	**DFO**, commercial fishery vessel masters
4. Overflights				
Use of real time satellite imagery to identify high plankton blooms for targeted overflights (May-September)	2010-2015, ongoing	In progress	A summary of the overflights can be found in Table 3, Broad Strategy 4, activity 6. There have been no observations of Basking Sharks on the 25 flights conducted to date. These data do provide a baseline of information, and comparative flights would provide further data to measure against this baseline.	**DFO**
5. Definition of critical habitat				
Determine and characterize	2010-2015, ongoing	In progress	A summary of the habitat features modeling study can be found in the second row of Table 3, Broad Strategy 2, activity 2.	**DFO**, consultant

occupied high-use habitat and define potential critical habitat regions with similar characteristics			The potential foraging habitat maps could not be validated by the available low-resolution zooplankton data, or with the low numbers of confirmed Basking Shark sightings. The modeling project was a preliminary study, and the utility of the approach, particularly using daily-scale data, could be reassessed when a greater number of confirmed sightings are available.	

3.2 Summary of progress towards recovery

3.2.1 Status of performance measures

Table 5 provides a summary of the progress made toward meeting the performance measures outlined in Table 2. Each measure has been assigned one of four statuses:

1) not met: The performance measure has not been met, and little to no progress has been made
2) not met, underway: The performance measure has not been met, but there has been moderate to significant progress made
3) met: The performance measure has been met and no further action is required
4) met, ongoing: The performance measure has been met, but efforts will continue until such time the population is considered to be recovered (i.e. the measure will be reported against in the next five-year progress report)

Table 5. Progress and details of the progress toward meeting the performance measures outlined in the recovery strategy (2011-16).

Performance measure	Status	Details
Proven maintenance, promotion, and utilization of the BSSN and database	Met, ongoing	A summary of the sightings reported to the BSSN from 1996-2016 can be found in the first row of Table 3 on page 5 of this report. The Basking Shark Sightings Network was established in 2008 and has been successful in engaging the public, based on receipt of information regarding possible sightings from the general public. A Basking Shark Sightings Database was developed in 2008 and is managed by staff at DFO's Pacific Biological Station. Promotional efforts have included printed materials (posters, brochures, business cards, and banners distributed to aquatic user groups and at docks and marinas); presentations made in various locations on Vancouver Island at community events, festivals, and campgrounds; and media interest. The maintenance and promotion of the BSSN is ongoing and will continue until the population is considered recovered.
Within five years, observe, at a	Met	There have been 20 confirmed or reliable sightings since 2011 in Canadian Pacific

Performance measure	Status	Details
minimum, the current annual average number of reliable sightings		waters (DFO 2016). There were two confirmed sightings in 2011, four in 2012, six in 2013, three in 2014, two in 2015, and three in 2016.
Within five years, observe an increase in annual average number of reliable sightings throughout species distribution range	Met	The maximum annual average number of confirmed and reliable reported sightings within Canadian Pacific waters has increased from two sightings, in the period from 1996 until 2010, to 20 sightings between 2011 and 2016 (DFO 2016). There were two confirmed sightings in 2011, four in 2012, six in 2013, three in 2014, two in 2015, and three in 2016.
Within five years, see an increase in reliable sightings of aggregations of two or more sharks	Not met	There were no sightings of Basking Shark aggregations reported to the BSSN in the period 2011-2016.
Within 15-20 years, established Canadian, American, and Mexican overflights observe higher numbers of Basking Sharks annually	Not met, underway	This performance measure will be fully assessed in 2025-2030, 15-20 years from the first publication of the recovery strategy. There were no observations of Basking Sharks on the 25 over-flights conducted from 2007 to 2011 within Canadian Pacific waters.

3.2.1.1 Completion of action plan

A multi-species Action Plan for Pacific Rim National Park Reserve of Canada was completed in 2017, and considered Basking Shark. The Action Plan for the Basking Shark (*Cetorhinus maximus*) in Canadian Pacific Waters is currently being developed, and is expected to be posted to the Species at Risk Public Registry in 2018.

3.2.1.2 Critical habitat identification and protection

Critical habitat is not yet identified for the Basking Shark in Canadian Pacific waters. Detailed progress towards identifying critical habitat is summarized in section 3.2, and is described in greater detail in the Evaluation of Information Available to Support the Identification of Habitat Necessary for the Survival and Recovery of Basking Shark in Canadian Pacific waters (DFO 2016).

3.2.1.3 Recovery feasibility

As stated in the recovery strategy, Basking Sharks are particularly vulnerable to any human-induced mortality because of their late age of maturity, low fecundity, long gestation period, long periods between gestations, low productivity, sex segregated populations, use of habitat that supports commercial fisheries, lack of fear of vessels, and current small population size (COSEWIC 2007). It is difficult to accurately assess the feasibility of recovery for the Pacific population of Basking Shark due to the lack of understanding of the factors affecting the survival and productivity of the species. The recovery feasibility is also linked to recovery efforts undertaken in the southern portion of their range (i.e., within the United States and Mexico). Nevertheless, based on the best current available information, recovery of the Pacific population of Basking Shark is determined to be feasible. The studies and initiatives outlined in sections 3.1 and 3.2 of this report demonstrate progress toward better understanding of this species and their presence within Canadian Pacific waters.

4. Concluding statement

Significant progress has been made toward meeting many of the objectives and approaches outlined in the recovery strategy, including increased scientific knowledge and public awareness, as well as threat reduction and mitigation. Progress on increased scientific knowledge has been made through the results of the BSSN reports; development of opportunistic tagging and biological sampling programs; completion of the habitat features modeling study; completion of aerial surveys; and development of a tri-national working group to support collaborative approaches to recovery. Progress on increased public awareness has been made through the development, promotion, and maintenance of the BSSN and supporting database and development of shark and skate identification cards for at-sea observers. Progress on threat reduction and mitigation has largely focused on changes to recreational and commercial fisheries to avoid and mitigate interception of Basking Sharks within these fisheries, development of codes of conduct for responsible practices of viewing Basking Sharks, as well as avoidance and mitigation efforts if intercepted in various fishing gears, amongst other studies outlined in sections 3.1 and 3.2 of this report.

The effects of the recovery effort on a long-lived species with a low rate of increase such as a Basking Shark, and a lack of documented recent sightings in Canadian Pacific waters, are not

likely to be immediately evident. It is estimated that approximately 200 years are needed before population numbers will return to their unexploited rates, even if a breeding population currently exists, and no further human-induced mortality or changes to existing habitat occur (McFarlane et al. 2009).

5. References

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