

Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada

Northern Wolffish and Spotted Wolffish



2018



Recommended citation:

Fisheries and Oceans Canada. 2018. Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada [Proposed]. *Species at Risk Act* Action Plan Series. Fisheries and Oceans Canada, Ottawa. v + 23 p.

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Cover illustration: D. Kulka

Également disponible en français sous le titre
Pêches et Océans Canada. 2018. Plan d'action pour le loup à tête large (*Anarhichas denticulatus*) et le loup tacheté (*Anarhichas minor*) au Canada [Proposition]. Série de plans d'action de la Loi sur les espèces en péril. Pêches et Océans Canada, Ottawa. v + 26 p.

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ISBN

Catalogue no.

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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 the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of action plans for species listed as Extirpated, Endangered and Threatened for which recovery has been deemed feasible. They are also required to report on progress five years after publication of the final document on the Species at Risk Public Registry.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Northern Wolffish (*Anarhichas denticulatus*) and the Spotted Wolffish (*Anarhichas minor*) and has prepared this Action Plan to implement the Recovery Strategy, as per s. 47 of SARA. In preparing the Action Plan, the competent minister has considered, as per s. 38 of SARA, the commitment of the Government of Canada to conserving biological diversity and to the principle that, if there are threats of serious or irreversible damage to the listed species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty.

As stated in the preamble to SARA, success in the recovery of these species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions and actions set out in this Action Plan and will not be achieved by Fisheries and Oceans Canada, 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 this Action Plan for the benefit of the Northern and Spotted Wolffish and Canadian society as a whole.

Under SARA, an action plan provides the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. The plan outlines recovery measures to be taken by Fisheries and Oceans Canada and other jurisdictions and/or organizations to help achieve the population and distribution objectives identified in the recovery strategy. Implementation of this Action Plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

Fisheries and Oceans Canada (DFO) Newfoundland and Labrador Region is grateful to those who have participated in the development of the *Action Plan for the Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor) in Canada*. A number of DFO Regions have contributed to this document including Maritimes, Gulf, Quebec, and Central and Arctic regions as well as National Headquarters.

Executive Summary

In May 2001, the Northern Wolffish (*Anarhichas denticulatus*) and the Spotted Wolffish (*Anarhichas minor*) were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened (COSEWIC 2001a,b). A third species, the Atlantic Wolffish (*Anarhichas lupus*), was assessed by COSEWIC as Special Concern in November 2000 (COSEWIC 2000). All three wolffish species were included in Schedule 1 of the *Species at Risk* Act (SARA) at the time of the Act's proclamation in June 2003. In November 2012, COSEWIC reassessed the three species and recommended that their status remain unchanged (COSEWIC 2012a,b,c). Therefore, under SARA, the status of all three species also remained unchanged. While this Action Plan is focused specifically on Northern and Spotted Wolffish, the recovery actions will likely benefit the Atlantic Wolffish as well.

The "*Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada*" (DFO 2018), originally published in 2008, constituted the framework for development of recovery actions and established the scope of this Action Plan. The goal of the Recovery Strategy is to increase the population levels and distribution of Northern and Spotted Wolffish in Canadian waters such that the long-term viability of the species is achieved.

Five primary objectives from the Recovery Strategy were used to guide the formulation of the actions. The objectives are:

1. Enhance the understanding of the biology and life history of wolffish species;
2. Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities;
3. Reduce the potential for wolffish population declines by minimizing human impacts;
4. Promote wolffish population growth and recovery; and
5. Develop communication and education programs to promote the conservation and recovery of wolffish populations.

Actions, as a whole, are designed to act as a road map for recovery practitioners, to promote recovery and ongoing sustainability of Northern and Spotted Wolffish populations in eastern Canadian waters to the level where they are no longer considered Threatened. Recommended actions to achieve the objectives listed above are:

- Study population structure and life history;
- Identify biological reference points;
- Study ecosystem interactions;
- Habitat identification and conservation;
- Identify and mitigate impacts of human activity;
- Monitor wolffish spatial and temporal abundance patterns;
- Monitor spatial and temporal patterns in natural and human-induced mortality; and
- Undertake education and stewardship programs on wolffish conservation and recovery.

The Recovery Strategy pointed out deficiencies in our knowledge and management of Northern and Spotted Wolffish. The recovery actions are designed to improve knowledge of these species, reduce threats and monitor these species, thereby assisting in the recovery of wolffish. Since the publication of the Recovery Strategy in 2008, much progress has been made towards fulfilling the recovery objectives set out in the strategy. Several aspects of wolffish life history

have been studied including: food and feeding; population structure; and the effects of dissolved oxygen. Distribution and abundance has been examined for all regions and large scale habitat associations have been described. Bycatch was identified as an important cause of human induced mortality of wolffish and mandatory live release of Northern and Spotted Wolffish has been implemented. In addition, management and stewardship activities have increased awareness of wolffish and their status. This Action Plan addresses the issues believed to be affecting wolffish conservation and recovery and includes actions to mitigate them. It also promotes stewardship among stakeholders and the public as a means to facilitate and promote recovery.

Effective recovery for both wolffish species requires a commitment to the implementation of the recovery actions. It is acknowledged that there may be a need for adaptive management and the need to modify or revise the Action Plan when new information becomes available. Implementation of actions, including the mitigation of known threats, provides the best chance to conserve and restore wolffish species to a level where they are no longer considered at risk. However, it is also recognized that the implementation of recovery actions are constrained by available resources and that non-human elements (e.g., environmental influences) may have played a role in the decline of the species and these effects cannot be controlled or mitigated, but only monitored. This Action Plan delineates the steps required to move toward recovery.

Details on critical habitat and activities likely to destroy that habitat are included in Section 6 of the Recovery Strategy.

This document also contains a socio-economic evaluation that summarizes the potential cost and benefits of recovery. It was determined that the implementation of this Action Plan may have varying degrees of impacts on multiple stakeholders, but generally these impacts are assumed to be negligible. Generally, Action Plan activities would likely not have direct impacts on other individuals or groups beyond Fisheries and Oceans Canada (DFO), Non-Government Organizations (NGOs) and harvesters. The incremental costs of implementing this Action Plan are considered to be of a low economic magnitude and DFO would bear the bulk of the costs associated with the implementation of this plan. Canadians at large will be impacted by the extent to which non-market benefits are realized.

This Action Plan represents a collaborative and consultative effort by a multi-regional team (including the following DFO regions: Newfoundland and Labrador, Maritimes, Gulf, Quebec, Central and Arctic, and National Headquarters) with representation that included expert scientists, fisheries managers and economists who assisted in formulating a way forward for recovery of the wolffish species in Canadian waters. Consultation with the fishing industry, academia, NGOs and the government (federal, provincial and territorial) was also undertaken.

Table of Contents

Preface	i
Acknowledgments.....	ii
Executive Summary	iii
Table of Contents.....	v
1. Recovery Actions	1
1.1 Context and Scope of the Action Plan	1
1.2 Measures to be Taken and Implementation Schedule	2
1.2.1 Implementation Schedule for DFO-Led Activities.....	8
1.2.2 Implementation Schedule for Collaborative Activities.....	12
1.3 Critical Habitat	14
1.3.1 Identification of Northern Wolffish and Spotted Wolffish Critical Habitat.....	14
1.3.2 Examples of Activities Likely to Result in Destruction of Critical Habitat.....	14
1.4 Proposed Measures to Protect Critical Habitat.....	14
2. Evaluation of Socio-Economic Costs and Benefits	14
3. Measuring Progress	16
References	17
Appendix A: Effects on the Environment and Other Species.....	20
Appendix B: Record of Cooperation and Consultation.....	21

1. Recovery Actions

1.1 Context and Scope of the Action Plan

In May 2001, the Northern Wolffish (*Anarhichas denticulatus*) and the Spotted Wolffish (*Anarhichas minor*) were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened (COSEWIC 2001a,b). A third species, the Atlantic Wolffish (*Anarhichas lupus*), was assessed by COSEWIC as Special Concern in November 2000 (COSEWIC 2000). All three wolffish species were included in Schedule 1 of the *Species at Risk Act* (SARA) at the time of the Act's proclamation in June 2003. In November 2012, COSEWIC reassessed the three species and recommended that their status remain unchanged (COSEWIC 2012a,b,c). Therefore, under SARA, the status of all three species also remained unchanged.

Northern and Spotted Wolffish are the focus of this document, but recovery activities identified in this document may likely benefit Atlantic Wolffish as the distributions of the three species overlap over much of their range.

The "*Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada*" (DFO 2018) (hereafter referred to as the Recovery Strategy) was published in February 2008 and was updated in 2018. The Recovery Strategy identified several actual and potential threats to the species and their habitat including:

- Fishing
 - bycatch is thought to be the leading cause of human induced mortality
 - bottom trawling and dredging activities were identified as possible causes of habitat alteration
- Offshore oil and gas exploration and production
 - seismic activities
- Ocean dumping
 - sewage sludge
 - fish waste
 - dredging spoils
- Military activity
- Cables and pipelines
- Marine and land-based pollution
- Global climate change

The goal of the Recovery Strategy is to increase the population levels of Northern and Spotted Wolffish, as well as Atlantic Wolffish, in eastern Canadian waters such that the long term viability of those species is achieved. The Recovery Strategy identifies five objectives related to this goal:

1. Enhance understanding of the biology and life history of wolffish species;
2. Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities;
3. Reduce the potential for wolffish population declines by minimizing human impacts;
4. Promote wolffish population growth and recovery; and

5. Develop communication and education programs to promote the conservation and recovery of wolffish populations.

To achieve the five objectives noted above, five strategies were determined. The strategies are:

1. Conduct research;
2. Habitat conservation and protection;
3. Mitigate human activities;
4. Promote knowledge and stakeholder participation in the recovery of wolffish populations and habitat conservation and/or protection; and
5. Monitoring human activities and wolffish species.

These five recovery strategies constitute the basis of a framework for recovery of Northern and Spotted Wolffish populations (as well as Atlantic Wolffish populations), conservation and protection of their habitat and monitoring of human activities. Actions, as a whole, are designed to provide a road map for recovery practitioners and to promote recovery and ongoing sustainability of wolffish populations in eastern Canadian waters to the level where they are no longer considered threatened.

This Action Plan is a guide for those involved in the recovery of Northern and Spotted Wolffish. While it is not meant to prescribe and design specific projects, a number of projects have been presented. These broad based actions are directly related to the strategies and objectives elaborated in the recovery strategy (DFO 2018). In an effort to keep this Action Plan in line with the Recovery Strategy and the strategies and actions referenced therein, there may be some level of redundancy or overlap amongst the actions proposed in this plan.

Each of the five recovery strategies are taken from the Recovery Strategy document and are designed to achieve the goals of that strategy. As this plan is considered to be adaptive (i.e., a living document), objectives and strategies can be added or revised as new knowledge becomes available.

Activities are given a priority rating based on their importance in facilitating the recovery of Northern and Spotted Wolffish. Priorities are directly related to the Recovery Strategy (DFO 2018).

Northern and Spotted Wolffish did not decline in all parts of their range within Canadian waters; however, the actions apply to all marine Atlantic waters where wolffish occur because at present, they are considered to constitute single populations (single Designatable Unit (DU)) for each species. As well, while there is some evidence of a recent increase in abundance of the two species since the early 2000s (Simpson et al. 2012), it does not constitute recovery of the species. Thus, the activities outlined in this plan are required to promote further recovery.

1.2 Measures to be Taken and Implementation Schedule

Success in the recovery of this species is dependent on the actions of many different jurisdictions and it requires the commitment and cooperation of the constituencies that will be involved in implementing the directions and measures set out in this Action Plan.

This Action Plan provides a description of the measures that provide the best chance of achieving the recovery objectives for Northern and Spotted Wolffish, including measures to be

taken to address threats to the species and monitor its recovery, and to guide not only activities to be undertaken by Fisheries and Oceans Canada (DFO), but those for which other jurisdictions, organizations and individuals have a role to play. As new information becomes available, these measures and the priority of these measures may change. DFO strongly encourages all Canadians to participate in the conservation of Northern and Spotted Wolffish through undertaking measures outlined in this Action Plan.

Table 1 identifies the measures that will be led by DFO to support the recovery of Northern and Spotted Wolffish.

Table 2 identifies the recovery measures to be undertaken collaboratively between DFO and its partners, other agencies, organizations or individuals. Implementation of these measures will be dependent on a collaborative approach, in which DFO is a partner in recovery efforts, but cannot implement the measures alone. If your organization is interested in participating in one of these measures, please contact the Species at Risk, NL Region office at saranl-leptnl@dfo-mpo.gc.ca.

Implementation of this Action Plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Table 1. Measures to be led by Fisheries and Oceans Canada

#	Recovery Measures	Priority ¹	Threats or Concerns Addressed	Timeline
Recovery Strategy A: Conduct Research (associated with Recovery Objectives 1, 2, 4)				
1	Study population structure and life history to: <ul style="list-style-type: none"> a) Estimate size and age structure, growth, and reproduction. b) Determine population structure from distribution, morphology and meristic analysis and population genetics. 	High	Knowledge of population structure and life history processes is deficient; this is fundamental to the formulation of wolffish recovery goals and management.	<ul style="list-style-type: none"> a) Ongoing b) Ongoing
2	Identify biological reference points to: <ul style="list-style-type: none"> a) Define allowable human-induced mortality for a healthy recovered population. b) Define the biomass target for a recovered population. 	High	Reference points constitute the framework and guideposts to recovery; they are needed to determine when a population has achieved recovery. The species will be considered recovered when in the healthy zone of the Precautionary Approach Framework .	<ul style="list-style-type: none"> a) Ongoing b) Ongoing
3	Study ecosystem interactions to: <ul style="list-style-type: none"> a) Continue to examine diet. b) Continue to examine species associations. 	Medium	This will help determine if wolffish population status is affected by ecological associations and how population changes in other species may affect wolffish.	<ul style="list-style-type: none"> a) Ongoing b) Ongoing

¹ “Priority” reflects the degree to which the measure contributes directly to the recovery of the species or is an essential precursor to a measure that contributes to the recovery of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the recovery objective for the species. Medium priority measures may have a less immediate or less direct influence on reaching the recovery population and distribution objectives, but are still important for recovery of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the recovery objectives, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

#	Recovery Measures	Priority ¹	Threats or Concerns Addressed	Timeline
Recovery Strategy B: Habitat Conservation and Protection (associated with Recovery Objectives 2, 4, 5)				
4	Habitat identification and conservation. <ul style="list-style-type: none"> a) Refine what aspects of the environment (e.g., attributes and features) are important for wolffish survival. b) Examine habitat associations. c) Define distribution targets for a recovered population. 	Medium	There is a need for knowledge of wolffish habitat and how it is utilized.	<ul style="list-style-type: none"> a) Ongoing b) Ongoing c) Ongoing
Recovery Strategy C: Mitigate Human Activities (associated with Recovery Objectives 3, 4, 5)				
5	Identify and mitigate impacts of human activity. <ul style="list-style-type: none"> a) Quantify fishing mortality (bycatch) by determining removals of wolffish by Canadian and international fisheries. b) Determine and implement effective approaches to mitigate the effects of human activities. 	High	Bycatch mortality in many fisheries is a main anthropogenic threat identified by COSEWIC.	<ul style="list-style-type: none"> a) Ongoing b) Ongoing Methods of live release have been identified and are mandatory.
Recovery Strategy E: Monitor Human Activities and Wolffish Species Status (associated with Recovery Objectives 3, 4)				
6	Monitor wolffish spatial and temporal abundance patterns. <ul style="list-style-type: none"> a) Compile and analyze wolffish catch data from seasonal bottom trawl research surveys. b) Quantify changes in distribution. 	Medium	Monitor recovery throughout the species' range; population size and structure need to be monitored to discern trends, understand mortality patterns and identify recruitment problems.	<ul style="list-style-type: none"> a) Ongoing b) Ongoing
7	Monitor spatial and temporal patterns in natural and human induced mortality. <ul style="list-style-type: none"> a) Collect bycatch and discard information from 	High	Monitor threats to ensure effective and continued mitigation/management measures.	<ul style="list-style-type: none"> a) Ongoing b) Ongoing

#	Recovery Measures	Priority ¹	Threats or Concerns Addressed	Timeline
	Canadian and international fisheries. b) Quantify wolffish mortality due to fishing. c) Monitor changes in other potential sources of non-human induced mortality.			c) Ongoing

Table 2. Measures to be undertaken collaboratively between Fisheries and Oceans Canada and its partners, other agencies, organizations or individuals

#	Recovery Measures	Priority ²	Threats or Concerns Addressed	Timeline	Partners
Recovery Strategy D: Promote knowledge and stakeholder participation in the recovery of wolffish populations and habitat conservation and/or protection (associated with Recovery Objectives 3, 4, 5)					
8	<p>Undertake education and stewardship programs on wolffish conservation and recovery</p> <ul style="list-style-type: none"> a) Produce and disseminate promotional items and informational materials to raise awareness of wolffish conservation and recovery. b) Engage harvesters, processors, scientists, regulators, enforcement, observers, dockside monitors and other ocean users to inform and elevate public awareness of the condition of the species and its conservation and recovery. c) Educate stakeholders in the mitigation of wolffish threats. d) Identify opportunities to involve government, non-governmental organizations, industry and others in the process of recovery. 	Medium	<p>Stakeholder cooperation is essential to ensuring mitigation is implemented and effective.</p> <p>Mitigate anthropogenic threats to wolffish populations by engaging those who can assist in recovery actions.</p>	<ul style="list-style-type: none"> a) Complete/Ongoing Promotional and informational materials have been developed. The distribution of these materials is ongoing. b) Ongoing c) Ongoing d) Ongoing 	<ul style="list-style-type: none"> Non-government organizations Industry

² "Priority" reflects the degree to which the measure contributes directly to the recovery of the species or is an essential precursor to a measure that contributes to the recovery of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the recovery objective for the species. Medium priority measures may have a less immediate or less direct influence on reaching the recovery population and distribution objectives, but are still important for recovery of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the recovery objectives, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

The following sections elaborate on the previous implementation tables and provide a description of ongoing activities as well as planned activities to deliver on the actions outlined in this Action Plan. It should be recognized that the implementation of these activities is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Actions to support the recovery of Northern and Spotted Wolffish have been ongoing since both species were listed under SARA in 2003.

1.2.1 Implementation Schedule for DFO-Led Activities

Activity 1. Study population structure and life history

a) Estimate size and age structure, growth and reproduction

Data collection is the first stage in life history research and is long term in nature. It is fundamental to understanding population status, vulnerability and the path to recovery as data are limited for wolffish. Data are collected through annual DFO surveys in each region and include relative densities (number and weight per tow) and, where possible, length and sex data are collected from the sampled population. Size at maturity can change on an annual basis, so maturity studies require many years of data to be complete. The latest available information on Northern and Spotted Wolffish life history is available in Dutil et al. (2011), Simon et al. (2012) and Simpson et al. (2012).

b) Determine population structure from distribution, morphology and meristic analysis and population genetics

Distribution studies have been conducted. Mapping is done on an annual basis to investigate the changing distribution of wolffish populations. Genetic markers appropriate for wolffish species have been identified but the population structure in Canadian waters has not yet been defined. This work has been in part financed by DFO and done at Memorial University of Newfoundland and Dalhousie University (Carr et al. 2007; Johnstone et al. 2007; McCusker et al. 2008; McCusker and Bentzen 2011). At present, it is assumed that each species comprises a single population in Canadian waters, due to the limited or contrasting results in previous studies.

Several papers have been published containing distribution information (DFO 2018; Dutil et al. 2011; Kulka *et al.* 2004; Simpson and Kulka 2002; Simpson *et al.* 2012). Landings and bycatch data were also analyzed by NAFO Division (Ouellet *et al.* 2011; Scallon-Chouinard et al. 2007; Simpson et al. 2012). Changes in area occupied and other spatial indices have been examined. DFO studies include mapping of distribution and abundance (Dutil et al. 2011; Kulka and Simpson 2004; Simpson et al. 2012).

Morphometrics (body measurements) and meristics (counts) have been collected from specimens in the laboratory to study differences in relative measures and counts throughout the wolffish geographic range.

Recovery Activities:

- Continue existing levels and types of data collection; provide annual updates/reports as appropriate.
- Conduct interregional discussions to standardize and improve regional sampling protocols for wolffish.

- Preliminary genetic work has been conducted. However, additional work involving samples from all regions for Restriction Fragment Length Polymorphism (RFLP) analysis should be conducted.

Activity 2. Identify biological reference points

Typically, biological reference points for species are identified when the species undergoes a Recovery Potential Assessment (RPA) as part of the SARA listing process; however, an RPA has not been conducted and reference points have not yet been delineated. DFO demersal research survey data can provide information on the status of wolffish (relative abundance and population size). This information over the long term will help to identify biological reference points. DFO Science is investigating models to identify the biological reference points for both species of wolffish.

a) Define allowable human-induced mortality for a healthy recovered population (allowing for the population to grow and meet recovery objectives)

This activity depends on population studies (Actions 1a and 1b) which DFO Science is still completing.

b) Define the biomass target for a recovered population (allowing for the population to grow and meet recovery objectives)

This activity depends on population studies (Actions 1a and 1b) which DFO Science is still completing.

Recovery Activities:

- Continue to collect and analyze biological data on both species of wolffish to better understand population structure.
- As a component of a peer review process, investigate appropriate models to determine biological reference points for both species of wolffish.
- Conduct a modeling program testing various modeling approaches to determine biological reference points.
- Complete allowable harm reassessment.

Activity 3. Study ecosystem interactions

In their habitats, wolffish interact with other species both as prey and as predator. Continued research on wolffish diet and species assemblages may improve our understanding of important ecological requirements of wolffish.

a) Continue to examine diet

DFO Science has conducted food and feeding studies; preliminary diet analysis shows clear differences in diet and niche among the wolffish species.

Simpson et al. 2013 describes wolffish diet in Newfoundland and Labrador waters. Seasonal aspects of diet and age-sex related differences in diet have not been investigated. There is also a need to investigate the variation in diet in relation to the abundance of prey species. In addition to diet studies, wolffish as the prey of other species (e.g., seals, other fish) should be investigated.

b) Continue to examine species associations

Identify species of commercial importance associated with wolffish (thereby shedding light on potential mitigation and bycatch issues) and identify any key species in wolffish habitat whose abundance or variation in abundance may affect wolffish status, both as a prey or as a predator, particularly on juveniles.

Recovery Activities:

- Investigate variation in diet in relation to the abundance and distribution of prey species.
- Investigate wolffish as the prey of other species.
- Publish work to date on ecosystem interactions.

Activity 4. Habitat identification and conservation**a) Refine what aspects of the environment are important to wolffish for survival**

Work on habitat associations has been undertaken in some areas including at the center of their distribution. Kulka et al. (2004) examined depth, temperature and bottom type associations. Additional work is ongoing. Temperature was hypothesized as a possible habitat feature critical to wolffish survival. Dutil et al. (2011) have more recently defined a host of physical attributes in the Gulf of St. Lawrence (a fringe area for Northern Wolffish).

Overall work on describing habitat is in progress. Research related to field observations of live fish or their habitats has also been conducted. Studies include shelter use and habitat utilization (Kulka et al. 2004; Larocque et al. 2008) and habitat characteristics (Larocque et al. 2010). The work mainly involved Atlantic Wolffish, but some Spotted Wolffish were included. Juvenile Spotted Wolffish have been studied in the laboratory (Lachance et al. 2010).

b) Examine habitat associations

Habitat association work has been done at the center of wolffish distribution (Grand Banks to Labrador Shelf) by Kulka et al. (2004) and in the Gulf of St Lawrence (Dutil et al. 2011). Studies include shelter use (field studies on Atlantic Wolffish and lab studies on Spotted Wolffish (Lachance et al. 2010; Laroque et al. 2008, 2010), habitat use (Spotted and Atlantic Wolffish) and habitat characteristics, as well as historic and actual distribution and abundance mapping. Work was also carried out on habitat associations with respect to temperature and surficial features. Fish assemblages have been described based on annual surveys in the northern Gulf of St. Lawrence (Chouinard and Dutil 2011).

c) Define distribution targets for a recovered population

This activity depends on population studies (Actions 1a and 1b) which DFO Science is still completing.

Recovery Activities:

- Undertake field projects applying new technologies (e.g., data archival tags, receiver arrays) to study home range, movement patterns and habitat characteristics of individual juvenile and adult wolffish.
- Habitat analyses were conducted in the past and should be repeated in Newfoundland and Labrador Region using updated surveys and revised bottom type estimates as well as additional years of depth temperature data that are available.

- Expand habitat work in the whole Gulf of St. Lawrence to explore species and habitat interactions.
- Follow up on preliminary work conducted in Newfoundland and Labrador and the Gulf of St. Lawrence, using SCUBA, tagging and towed camera array.

Activity 5. Identify and mitigate impacts of human activity

a) Quantify fishing mortality (bycatch) by determining removals of wolffish by Canadian and international fisheries

Mortality due to fishing has been identified as an anthropogenic threat to wolffish. Bycatch of wolffish has been quantified for recent years in many of the fisheries where they have been captured and data continues to be collected by fishery observers. Commercial fish harvesters are required to complete logbooks and report bycatch of wolffish.

b) Determine and implement effective approaches to mitigate the effects of human activities

The main threat to wolffish was cited by COSEWIC as bycatch mortality in commercial fisheries. Conservation measures, in the form of live release, have been implemented since 2003 to mitigate this threat. This is currently a condition of license for commercial fisheries. Live release is considered to be effective since the majority of captured wolffish are very lively when first captured (DFO 2004). DFO has conducted various campaigns related to live release, targeting fishermen. Information related to the identification of the different wolffish species and methods for live release has been provided. Various sectors of DFO, including Science, and Conservation and Protection are active in promoting mitigation measures (e.g., live release) to offset the threats of human activities. Additionally, NGOs have been active in some regions, working with fish harvesters and promoting live release of wolffish in a stewardship capacity. See more details provided under Activities 7 and 8.

Fishery observers have gathered data on capture and release of wolffish since 2004. Logbooks have been distributed to fishermen. The data gathered were provided to DFO Science for distribution and abundance studies. Fishery Officers' conduct patrols, inspect vessels and cross-reference logbooks with observer records.

Modifications to gear and methods to avoid the catch of wolffish have not been fully explored.

Recovery Activities:

- Continue education activities related to the threats to wolffish and live release of wolffish, including public awareness campaigns by DFO and NGOs.
- Encourage educational institutions to continue investigation into the feasibility of alternative fishing gear options and the effectiveness of live release.
- Continue conservation and protection activities (e.g., conduct patrols to ensure that wolffish are being released in the least harmful manner possible, ensure that wolffish are not being retained for bait).

Activity 6. Monitor wolffish spatial and temporal abundance patterns**a) Compile and analyze wolffish catch data from seasonal bottom trawl research surveys**

Ongoing annual surveys by DFO provide data to quantify changes in wolffish status. To date, stage-based or age-based analyses have not been done. However, data collection is underway and modeling exercises will be undertaken. The latest information on abundance is contained in Simon et al. (2012) and Simpson et al. (2012).

b) Quantify changes in distribution

Based on survey data, changes in distribution of wolffish over time have been mapped and spatially analyzed to determine changes in area occupied. Survey abundance indices are calculated annually to monitor changes in the size of the population. This work is ongoing.

Recovery Activities:

- Continue collection of wolffish data as part of DFO annual surveys in various regions.
- Review survey data and examine changes in wolffish status at various life stages, to the extent possible based on availability of data, and review survey data to determine changes in distribution.

Activity 7. Monitor spatial and temporal patterns in natural and human-induced mortality**a) Collect bycatch and discard information from Canadian and international fisheries****b) Quantify wolffish mortality due to fishing****c) Monitor changes in other potential sources of non-human induced mortality**

The monitoring of activities related to mortality is ongoing and will continue. Fishery observers collect data on capture and release of wolffish; fish harvester logbooks record data which is provided to DFO Science.

Kulka and Pitcher (2001) mapped trawl fisheries off Atlantic Canada. That information was used to examine population decline in areas where fishing was high compared to non-fished areas (Kulka and Simpson 2004). The most recent information is available in Simpson et al. (2012).

Recovery Activities:

- Continue to collect, analyze and report on data in relation to wolffish mortality.

1.2.2 Implementation Schedule for Collaborative Activities**Activity 8. Undertake education and stewardship programs on wolffish conservation and recovery****a) Produce and disseminate promotional items and informational materials to raise awareness about wolffish conservation and recovery**

DFO and others, including NGOs, have been active in promoting awareness related to wolffish species. A number of promotional items have been developed and are continuously distributed, including factsheets, brochures, posters, DVDs, etc. In the past, there has been a targeted distribution; currently, such items are distributed on an

opportunistic basis, (e.g., Oceans Day events, school visits, trade shows). Wolffish are also included in general Species at Risk products, including school education kits, aquatic species calendars, SARA art project/show, portable displays and SARA identification cards. Species at Risk workshops have been delivered to industry, harvesters, fisheries observers, Fishery Officers and the general public. Such activities continue and discussions related to wolffish are often incorporated into other discussions.

b) Engage harvesters, processors, scientists, regulators, enforcement, observers, dockside monitors and other ocean users to inform and elevate public awareness of the condition of the species and its conservation and recovery

Wolffish have been the target of many outreach activities, particularly in the Newfoundland and Labrador Region.

Various sectors of DFO actively engage stakeholders and the general public (where appropriate) in public awareness and education related to wolffish. Targeted consultations, largely undertaken by DFO Science and Fisheries Management, have been conducted with stakeholders prior to the two species being placed on Schedule 1 of SARA and during the associated requirement for determining allowable harm. The continued cooperation of all parties involved with wolffish recovery is always encouraged and promoted, often through targeted sessions and generally on a routine basis by DFO staff at harvester meetings. NGOs have also been active in working with stakeholders and promoting awareness related to wolffish conservation and recovery. For example, a DVD entitled *Wolffish – A Balance of Life*³ has been produced, discussions with fish harvesters have been ongoing in the form of ‘dockside dialogues’ and Traditional Ecological Knowledge has been collected.

c) Educate stakeholders in mitigation of wolffish threats

Various targeted stewardship and education programs have been underway since 2002, now largely complete with respect to development; however, their usage continues. A number of factsheets designed to focus on wolffish identification and their handling and release in various fishing sectors have been developed and continue to be distributed. A DVD was produced on how to handle and release wolffish. Stewardship activities have been carried out by NGOs who have worked directly with fish harvesters to educate and create an awareness of threats to wolffish.

d) Identify opportunities to involve government, NGOs, industry and others in the process of recovery

DFO and NGOs have been, and continue to be, actively promoting and encouraging the recovery of wolffish. Fish harvesters are engaged in wolffish recovery through the live release program which is a condition of license for commercial fishing activities. The quick and safe release of incidentally caught wolffish and accurate reporting of wolffish bycatch has been promoted over the past several years in many fishing communities across Atlantic Canada. Information and awareness sessions have been conducted by DFO, NGOs and Indigenous groups. Numerous campaigns targeting the fishing industry, and others, were conducted on species at risk, including wolffish. Funds to support such activities are available from government sources such as the Habitat Stewardship Program and Aboriginal Fund for Species at Risk; additional resources to supplement these funds come from a variety of sources including industry, academia, and the private

³ Wolffish – A Balance of Life. Intervale Associates Inc. 2007

sector. Often in the form of in-kind support, all of these contributions are critical to implementing projects which support the recovery of wolffish. The cooperation of industry, especially fish harvesters, is extremely important with respect to implementing mitigation measures.

Recovery Activities:

- Continue public awareness and education efforts related to wolffish by DFO and NGOs to a variety of audiences as opportunities are available, especially to fish harvesters.
- Continue efforts on the part of DFO and others with respect to cooperation and collaboration with stakeholders.

1.3 Critical Habitat

1.3.1 Identification of Northern Wolffish and Spotted Wolffish Critical Habitat

Critical habitat for Northern and Spotted Wolffish is identified, to the extent possible, in Section 6 of the Recovery Strategy (DFO 2018).

1.3.2 Examples of Activities Likely to Result in Destruction of Critical Habitat

Examples of activities likely to result in destruction of critical habitat may be found in Section 6.5 of the Recovery Strategy (DFO 2018).

1.4 Proposed Measures to Protect Critical Habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a recovery strategy or action plan. For Northern and Spotted Wolffish critical habitat, it is anticipated that this will be accomplished through a SARA Protection Order made under subsections 58(4) and (5), which will invoke the prohibition in s.58(1) against the destruction of the identified critical habitat.

2. EVALUATION OF SOCIO-ECONOMIC COSTS AND BENEFITS

SARA requires that an action plan include an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation (SARA s. 49(1)(e), 2003). This evaluation addresses only the incremental socio-economic costs of implementing the Action Plan from a national perspective as well as the social and environmental benefits that would occur if the Action Plan were implemented in its entirety, recognizing that not all aspects of its implementation are under the jurisdiction of the federal government. It does not address cumulative costs of species recovery in general nor does it attempt a cost-benefit analysis. Its intent is to inform the public and to guide decision-making on implementation of the Action Plan by partners.

The protection and recovery of species at risk can result in both benefits and costs. The Act recognizes that “*wildlife, in all its forms, has value in and of itself and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological and scientific reasons*”. Self-sustaining and healthy ecosystems with their various elements in

place, including species at risk, contribute positively to the livelihoods and the quality of life of all Canadians. A review of the literature confirms that Canadians value the preservation and conservation of species in and of themselves. Actions taken to preserve a species, such as habitat protection and restoration, are also valued. In addition, the more an action contributes to the recovery of a species, the higher the value the public places on such actions (Loomis and White 1996; DFO 2008). Furthermore, the conservation of species at risk is an important component of the Government of Canada's commitment to conserving biological diversity under the *International Convention on Biological Diversity*. The Government of Canada has also made a commitment to protect and recover species at risk through the *Accord for the Protection of Species at Risk*. The specific costs and benefits associated with this Action Plan are described below.

Policy Baseline

Northern and Spotted Wolffish are protected under SARA's general prohibitions. Specifically, s. 32(1) of SARA states that "no person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species". Wolffish are also protected under the *Fisheries Act* under harvester's license conditions which dictate that harvesters are to return the fish "to the place from which it was taken, and where it is alive, in a manner that causes it the least harm". Harvesters are afforded this permission under the Recovery Strategy where it was determined that fishing activity would only have incidental harm to the species. A 2004 allowable harm assessment concluded that the current levels of mortality did not impair the ability of the species to recover. The species are not protected under analogous provincial or territorial legislation.

Socio-Economic Profile and Baseline

The implementation of this Action Plan may have varying degrees of impacts on multiple stakeholders but generally these impacts are assumed to be negligible. Research activities represent the primary focus of this Action Plan. DFO, and to a lesser extent NGOs, will be engaged in primary research on population structure, life history, and species distribution. Other DFO stakeholders to be engaged by this Action Plan include Resource Managers, Conservation and Protection Officers and Communications personnel.

Public awareness and education initiatives are often carried out by private and/or not-for-profit groups as well as DFO. Many of these activities have been ongoing since listing.

Generally, Action Plan activities would likely not have direct impacts on other individuals or groups beyond the stakeholders identified above (i.e., DFO, NGOs and harvesters).

Socio-Economic Costs of Implementing this r

The incremental costs of implementing this Action Plan are considered to be of a low economic magnitude. The primary costs are related to incremental or ongoing science research conducted by DFO. Many of the associated research activities are one year or less in duration with limited multi-year initiatives. There are no primary capital projects associated with this Action Plan.

Recovery actions for this species have been ongoing since 2003. Scientific research, along with public outreach and education, represented the largest expenditure categories. Public outreach and education expenditures have peaked, with scientific research making up the bulk of current or planned expenditures going forward.

Benefits of Implementing this Action Plan

It is envisioned that the implementation of Action Plan activities will directly or indirectly lead to greater wolffish abundance. The extent to which the species population improves will influence the magnitude of non-use benefits derived by Canadians including: a) knowledge that the species exists (existence value) and b) that the species will be available for future generations to enjoy (bequest value). However, given data limitations, monetary values of these benefits have not been estimated. If recovery actions have a spill-over effect, indirect benefits may accrue to other species and the ecosystem in general. For example, if wolffish education programs influence harvester interactions with other listed species or species assessed as at risk by COSEWIC, this may lead to a higher proportion of live returns. Again, these indirect benefits have not been estimated given the lack of data. If recovered, Spotted Wolffish could have potential commercial value. Therefore, an increase in abundance will also have potential economic benefits for harvesters in the future.

Distributional Impacts

There are no additional harvest or other activity restrictions associated with the implementation of this Action Plan. As such, there are no or minimal distributional impacts. DFO would bear the bulk of the incremental costs associated with the implementation of this Action Plan. Canadians at large will be impacted by the extent to which non-market benefits are realized.

3. Measuring Progress

Reporting on implementation of the Action Plan (under s. 55 of SARA) will be done by assessing progress towards implementing the broad strategies identified in the Recovery Strategy. In addition, carrying out Activity 6 (monitor wolffish spatial and temporal abundance patterns) as identified in this Action Plan will provide a way to measure progress toward achieving the recovery objectives. Activity 7 (monitor spatial and temporal patterns in natural and human-induced mortality) as identified in this Action Plan is also an indirect measure of progress toward achieving recovery objectives.

Reporting on the ecological and socio-economic impacts of this Action Plan (under s. 55 of SARA) will be done by assessing the results of monitoring the recovery of the species and its long term viability, and by assessing the implementation of this Action Plan.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals and the Species at Risk Act Policies: Overarching Policy Framework* (Government of Canada, 2009). The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the [Federal Sustainable Development Strategy's](#) (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of action plans may inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the action plan itself, but are also summarized below in this statement.

There is no negative effect on other species as wolffish are strictly bycatch. An increase in wolffish population should not have a significant negative effect on prey species as the population was at much higher levels of abundance in the past without any known effect.

Appendix B: Record of Cooperation and Consultation

The *Action Plan for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor) in Canada* was developed in consultation with multiple stakeholders. DFO provided the following groups with the opportunity to review and comment on the Action Plan:

Newfoundland and Labrador Region

Canadian Association of Petroleum Producers	Groundfish Enterprise Allocation Council/ Canadian Association of Prawn Producers	NunatuKavut Community Council Inc.
Department of Fisheries and Aquaculture		Parks Canada
Environment Canada	Innu Nation	Qalipu Mi'kmaq First Nation Band
Fish Food and Allied Workers Union	Miawpukek First Nation	Transport Canada
	Nunatsiavut Government	

Maritimes Region

Acadia First Nation	Guysborough Inshore Fishermen's Association	Nova Scotia Department of Natural Resources
Annapolis Valley First Nation	Indian Island First Nation	Nova Scotia Fish Packers
Atlantic Canadian Mobile Shrimp Association	Kingsclear First Nation	Oromocto First Nation
Atlantic Herring Co-op	Louisbourg Seafoods	Pabineau First Nation
Bear River First Nation	Maritime Aboriginal Peoples Council	Paq'tnkek Mi'kmaw Nation
Buctouche First Nation	Maliseet Nation	Pictou Landing First Nation
Canadian Council of Professional Fish Harvesters	Conservation Council	Potlotek First Nation
Canada-Nova Scotia Offshore Petroleum Board	Membertou First Nation	Premium Seafoods Group
Canadian Wildlife Federation	Metepenagiag Mi'kmaq Nation	Richmond County Inshore Fishermen's Association
Clearwater Seafoods	Millbrook First Nation	Scotia-Fundy Inshore Fishermen's Association
Connors Bros.	Native Council of Nova Scotia	Seafood Producers Association of Nova Scotia
Confederacy of Mainland Mi'kmaq	New Brunswick Department of Agriculture	Shelburne County Quota Group
Conservation Council of New Brunswick	New Brunswick Department of Aquaculture and Fisheries	Sipekne'katik Band
Dalhousie University	New Brunswick Department of Energy and Mines	

Eastern Fishermen's Federation	Glooscap First Nation	St. Mary's First Nation
Eastern Shore Fishermen's Protective Association	Grand Manan Fishermen's Association	The Lobster Council of Canada
Ecology Action Centre	New Brunswick Department of Natural Resources	The New Brunswick Aboriginal Peoples Council
Eel Ground First Nation	Northern Harvest Sea Farms	Tobique First Nation
Eel River Bar First Nation	North of Smokey Fishermen's Association	Unama'ki Institute of Natural Resources
Esgenoôpetitj First Nation	North Shore Micmac District Council	Wagmatcook First Nation
Eskasoni First Nation	Nova Scotia Department of Energy	Waycobah First Nation
Fort Folly First Nation	Nova Scotia Department of Fisheries and Aquaculture	Woodstock First Nation
Fundy North Fishermen's Association		World Wildlife Fund-Canada
Gespe'gewaq Mi'gmaq Resource Council		

Gulf Region

Abegweit First Nation	Mi'kmaq Confederacy of PEI	PEI Department of Aquaculture and Rural Development
Elsipogtog First Nation	Native Council of PEI	PEI Department of Fisheries
Lennox Island First Nation	PEI Department of Agriculture and Forestry	
Madawaska First Nation		

Québec Region

Agence Mamu Innu Kaikusseht	Conseil des Innus de Pakua Shipu	La Nation Micmac de Gespeg
Alliance des Pêcheurs Professionnels du Québec	Conseil des Innus de Pessamit	Listuguj Mi'gmaq Government
Association de gestion halieutique autochtone Mi'kmaq et Malécite	Conseil des Innus de Ekuanitshit	Makivik Corporation
Association des capitaines propriétaires de la Gaspésie	Conseil des Montagnais de Natashquan	Micmacs of Gesgapegiag
Association des pêcheurs de la Basse Côte-Nord	Conseil des Montagnais d'Unamen Shipu	Mi'gmawei Mawiomi Secretariat
	Conseil Innu Takuaikan	Pêcheries Shipék
	Uashat mak Mani-Utenam	Première Nation Malécite de Viger
		Professionnels du Québec

Association des pêcheurs de la Côte-Nord inc.	Fédération des pêcheurs semi-hauturiers du Québec (FPSHQ)	Regroupement des pêcheurs professionnels des Îles- de-la-Madeleine
Association des pêcheurs polyvalents de Old Fort à Blanc- Sablon	Institut de développement durable des Premières Nations du Québec et du Labrador	Regroupement des pêcheurs professionnels du Nord de la Gaspésie
Conseil de la Première Nation des Innus d'Essipit		

Central and Arctic Region

Amaruq Hunters and Trappers	Mayukalik Hunters and Trappers	Nunavut Offshore Allocations Holders Association
Arctic Fishery Alliance	Mittimatalik Hunters and Trappers	Nunavut Tunngavik Inc.
Baffin Fisheries Coalition	Nangmoutaq Hunters and Trappers	Pangnirtung Hunters and Trappers
Cumberland Sound Fisheries	Nattivak Hunters and Trappers	Qikiqtaaluk Corporation
Department of Fisheries and Sealing	Nunavut Inuit Wildlife Secretariat	Qikiqtaaluk Wildlife Board
Government of Nunavut		Umiat Corporation (Pangnirtung)