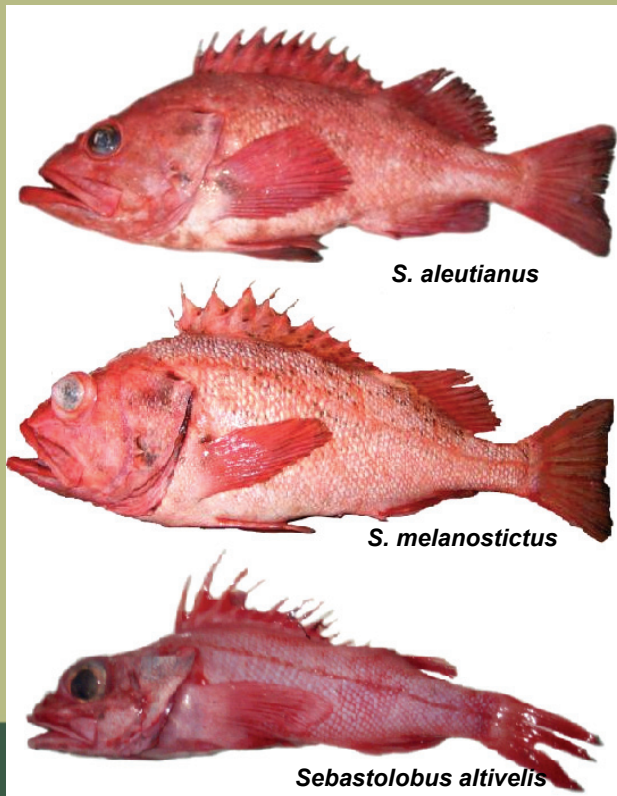


**MANAGEMENT PLAN FOR THE
ROUGHEYE/BLACKSPOTTED ROCKFISH
COMPLEX (*SEBASTES ALEUTIANUS* AND *S.*
MELANOSTICTUS) AND LONGSPINE
THORNYHEAD (*SEBASTOLOBUS ALTIVELIS*) IN
CANADA**

SEBASTES ALEUTIANUS; *SEBASTES MELANOSTICTUS*
SEBASTOLOBUS ALTIVELIS



2012

Photo Credit: DFO



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About the *Species at Risk Act* Management Plan Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is “*to manage species of special concern to prevent them from becoming endangered or threatened.*”

What is a species of special concern?

Under SARA, a species of special concern is a wildlife species that could become threatened or endangered because of a combination of biological characteristics and identified threats. Species of special concern are included in the SARA List of Wildlife Species at Risk.

What is a management plan?

Under SARA, a management plan is an action-oriented planning document that identifies the conservation activities and land use measures needed to ensure, at a minimum, that a species of special concern does not become threatened or endangered. For many species, the ultimate aim of the management plan will be to alleviate human threats and remove the species from the List of Wildlife Species at Risk. The plan sets goals and objectives, identifies threats, and indicates the main areas of activities to be undertaken to address those threats.

Management plan development is mandated under [Sections 65-72 of SARA](#)

A management plan has to be developed within three years after the species is added to the List of Wildlife Species at Risk. A period of five years is allowed for those species that were initially listed when SARA came into force.

What's next?

Directions set in the management plan will enable jurisdictions, communities, land users, and conservationists to implement conservation activities that will have preventative or restorative benefits. Cost-effective measures to prevent the species from becoming further at risk should not be postponed for lack of full scientific certainty and may, in fact, result in significant cost savings in the future.

The series

This series presents the management plans prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as plans are updated.

To learn more

To learn more about the *Species at Risk Act* and conservation initiatives, please consult the [Species at Risk \(SAR\) Public Registry](#).

**Management Plan for the Rougheyeye/Blackspotted Rockfish Complex
(*Sebastes aleutianus* and *S. melanostictus*) and Longspine
Thornyhead (*Sebastolobus altivelis*) in Canada**

2012

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Additional copies:

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Également disponible en français sous le titre
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PREFACE

The Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead are marine fish under the responsibility of the federal government. The *Species at Risk Act* (SARA, Section 65) requires the competent minister to prepare management plans for species listed as Special Concern. The Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead were listed as species of special concern under SARA in 2009. The development of this management plan was led by Fisheries and Oceans Canada – Pacific Region, in cooperation and consultation with many individuals, organizations and government agencies, as indicated below. The plan meets SARA requirements in terms of content and process (SARA sections 65-68).

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Fisheries and Oceans Canada or any other party alone. This plan provides advice to jurisdictions and organizations that may be involved or wish to become involved in activities to conserve this species. In the spirit of the Accord for the Protection of Species at Risk, the Minister of Fisheries and Oceans invites all responsible jurisdictions and Canadians to join Fisheries and Oceans Canada in supporting and implementing this plan for the benefit of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead and Canadian society as a whole. The Minister will report on progress within five years.

RESPONSIBLE JURISDICTIONS

Fisheries and Oceans Canada
Environment Canada
Parks Canada Agency

AUTHORS

The 2010-2011 Rougheye/Blackspotted Rockfish Complex and Longspine Thornyhead Technical Team developed this management plan for Fisheries and Oceans Canada. Section 6 ‘Contacts’ lists technical team members.

ACKNOWLEDGMENTS

Fisheries and Oceans Canada acknowledges all participants who attended the Rougheye/Blackspotted Rockfish Complex and Longspine Thornyhead Management Plan Technical Workshop (listed in Appendix II). The workshop proceedings provided valuable technical advice which supported the completion of this document.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

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*. 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.

Management planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that plans may also 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 plan itself, but are also summarized below.

This management plan will clearly benefit the environment by promoting the conservation of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead. The potential for the plan to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this plan will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the document in particular: ‘Section 1.4 Needs of the species’, ‘Section 1.5 Ecological role’, ‘Section 1.6 Limiting factors’ and ‘Section 2.3 Actions’.

EXECUTIVE SUMMARY

The Rougheye/Blackspotted Rockfish complex comprises two species, Rougheye Rockfish (*Sebastes aleutianus*) and Blackspotted Rockfish (*Sebastes melanostictus*). Both species belong to the family Scorpaenidae, and are possibly among the longest lived fish species on earth. In Alaska, scientists aged one specimen to 205 years. These species appear red with dark or dusky blotches of pigment in the back dorsal region, and generally do not exceed 80 cm in size. The two species have similar appearances with slight variations in colour. The complex occurs in the Pacific Ocean, with a range that extends from the northwestern Pacific to British Columbia and southern California. The relative distribution and abundance of these two species in Canadian waters is unknown.

Longspine Thornyhead (*Sebastes altivelis*) is a rockfish species belonging to the genus *Sebastes*, and is also in the Scorpaenidae family. Its scientific name ‘*altivelis*’ means “high sail”, which describes the tall dorsal fin that distinguishes it from the Shortspine Thornyhead (*Sebastes alascanus*). Longspine Thornyhead is a slow growing fish that lives in deep benthic waters where oxygen concentrations are minimal and water pressure is high. This species ranges from Cabo San Lucas, Baja California, to the Aleutian Islands.

Limiting factors are natural processes that limit population size or growth, whereas threats (both natural and anthropogenic) have caused, are causing, or may cause harm, death or behavioural changes to a species at risk or the destruction, degradation and/or impairment of its habitat to the extent that population level-effects occur. The Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead are limited by bottom-up and top-down processes that affect prey availability, recruitment success, and mortality rates.

The recently discovered existence of two species within what was formerly known as Rougheye Rockfish, and the resultant lack of biological knowledge of the Rougheye/Blackspotted Rockfish complex could constitute a threat in itself, due to the increased risk of loss of unrecognized biological diversity. At this time, aside from a discriminant function derived by Orr and Hawkins (2008), the only known method to distinguish the two species accurately is through DNA analysis. Currently, genetic samples of the complex are taken on some DFO Science surveys. Genetic sampling will necessarily become a regular feature of future DFO Science surveys, and subsequently observed species composition ratios may be used to estimate commercial catch composition.

The primary threat identified for these species is commercial fishing, which is the largest known source of mortality. The Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead are harvested by the commercial groundfish fishery in British Columbia. This fishery is managed by Total Allowable Catches (TACs), Individual Vessel Quotas (IVQs), as well as 100% at-sea and dockside monitoring programs. In addition, a plausible threat to these rockfish species is the temporal and spatial expansion of low-productivity regimes caused by climate change, which could influence prey availability and juvenile survival. However, the full impacts of this threat are unknown and further research will be required.

The Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead are listed under the Species at Risk Act as ‘special concern’ meaning that they are considered wildlife species that could become threatened or endangered because of a combination of biological characteristics and identified threats. This management plan’s goal is to maintain sustainable populations of these species, within each species’ known range in Canadian Pacific waters. The management objectives and resulting actions that have been identified in this plan aim to support the management goal. Five high priority actions have been identified to address threats as well as knowledge gaps, and seven low-to-medium priority actions identified to address lesser threats (Table 5). The activities implemented by Fisheries and Oceans Canada will be subject to the availability of funding and other required resources. Synchronization of activities recommended for the management, research, monitoring, and assessment will facilitate a multi-species approach to the conservation of these rockfish species in Canadian Pacific waters, and ensure the effective use of available resources.

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1. SPECIES INFORMATION

In April 2007, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed Rougheye Rockfish (*Sebastes aleutianus*) as a pair of sympatric species within the known *Sebastes aleutianus* complex. In the absence of a revised taxonomic classification, these species were named Rougheye Rockfish type I and type II (Gharrett *et al.* 2004, 2005). Section 1.1 below refers to Rougheye Rockfish types I and II, as originally stated in the original COSEWIC stock status report.

It is now recognized that ‘type I’ refers to *Sebastes melanostictus* (common name Blackspotted Rockfish), and ‘type II’ refers to *Sebastes aleutianus* (common name Rougheye Rockfish) (Orr and Hawkins 2008). At present, DFO Science recognizes these two species as distinct (See Section 1.2.1).

Due to the discovery of previously unrecognized species-level variation in what had been considered the Rougheye Rockfish (*S. aleutianus*), it is acknowledged that historical biological and catch information on the Rougheye Rockfish includes that of the Blackspotted Rockfish (*S. melanostictus*). Thus, this management plan will refer to the sympatric species pair as the ‘Rougheye/Blackspotted Rockfish complex’.

Also assessed by COSEWIC in April 2007, was the deep benthic rockfish Longspine Thornyhead (*Sebastolobus altivelis*). Directed commercial fishing on the species started in 1996, after which its population experienced a typical fishing-induced decline.

1.1. Species Assessment Information from COSEWIC

This section outlines species information from the 2007 COSEWIC assessment, written based on available knowledge of these species at the time, and does not necessarily reflect the views of Fisheries and Oceans Canada. The technical team acknowledges that this biological information is dated and no longer relevant. For updated species information, please refer to Sections 1.2 to 1.6 of this management plan.

1.1.1. Rougheye/Blackspotted Rockfish Complex COSEWIC Assessment Information

Date of Assessment: April 2007

Common Name (population): Rougheye Rockfish - type I

Scientific Name: *Sebastes sp.* type I

COSEWIC Status: Special Concern

Reason for Designation: This species is a relatively large (reaching 90 cm in length) rockfish species and among the longest-lived, estimated to approach 200 years. It is one of two sympatric species which have been identified within the described species *Sebastes aleutianus*. It ranges

from northern Japan to southern California in depths 200 to 800 + m along the shelf break. In Canadian waters, abundance information is derived from surveys and from the commercial fishery that has maintained a relatively constant reported catch of between 1000 and 2000 tonnes annually over the last two decades. Abundance indices and biomass estimates are uncertain, compromised by short time series and survey techniques not always appropriate for the species. No strong abundance trends are observed in the available indices. There is evidence of truncation of the age distribution over the last decade, suggesting that mortality from all sources may have doubled ($4.5\% y^{-1}$ to $9.1\%y^{-1}$). Long-lived, low-fecundity *Sebastes* species are particularly susceptible to population collapse, and recovery may be compromised when the age- and size-distribution is truncated (i.e., when the number of spawners declines) through fishing.

Canadian Occurrence: Pacific Ocean

COSEWIC Status History: Designated Special Concern in April 2007. Assessment based on a new status report.

Date of Assessment: April 2007

Common Name (population): Rougheye Rockfish - type II

Scientific Name: *Sebastes* sp. type II

COSEWIC Status: Special Concern

Reason for Designation: This species is a relatively large (reaching 90 cm in length) rockfish species and among the longest-lived, estimated to approach 200 years. It is one of two sympatric species which have been identified within the described species *Sebastes aleutianus*. It ranges from northern Japan to southern California in depths 200 to 800 + m along the shelf break. In Canadian waters abundance information is derived from surveys and from the commercial fishery that has maintained a relatively constant reported catch of between 1000 and 2000 tonnes annually over the last two decades. Abundance indices and biomass estimates are uncertain, compromised by short time series and survey techniques not always appropriate for the species. No strong abundance trends are observed in the available indices. There is evidence of truncation of the age distribution over the last decade, suggesting that mortality from all sources may have doubled ($4.5\% y^{-1}$ to $9.1\%y^{-1}$). Long-lived, low-fecundity *Sebastes* species are particularly susceptible to population collapse, and recovery may be compromised when the age- and size-distribution is truncated (i.e., when the number of spawners declines) through fishing.

Canadian Occurrence: Pacific Ocean

COSEWIC Status History: Designated Special Concern in April 2007. Assessment based on a new status report.

1.1.2. Longspine Thornyhead COSEWIC Assessment Information

Date of Assessment: April 2007

Common Name (population): Longspine Thornyhead

Scientific Name: *Sebastes altivelis*

COSEWIC Status: Special Concern

Reason for Designation: This slow growing rockfish has adapted to survive in deep waters where oxygen concentrations are minimal and productivity is low. Since the beginning of the fishery in the mid-1990s there has been an estimated decline in commercial catch per unit effort of over 50% in eight years. Fishing is the primary and probably sole cause of this decline. While the fishery is managed by catch limits and monitoring of fishing activities remains comprehensive, there is no management strategy in place that assures catches will be adjusted in response to abundance changes. The substantial decline in abundance indices over a short period taken together with the very conservative life history characteristics are cause for concern, but commercial catch per unit effort may not reflect abundance changes accurately, and there is a small potential for rescue from adjoining populations in the USA. The chief force that is “protecting” Longspine Thornyhead at present is economic.

Canadian Occurrence: Pacific Ocean

COSEWIC Status History: Designated Special Concern in April 2007. Assessment based on a new status report.

1.2. Description of the Species

1.2.1. Description of the Rougheye/Blackspotted Rockfish complex

Rougheye Rockfish belongs to the family Scorpaenidae and its name – rougheye – refers to a series of spines along the lower rim of the eyes. Blackspotted Rockfish also belongs to the family Scorpaenidae. It has recently been concluded through the use of genetic data that rougheye comprises two distinct species – Rougheye Rockfish (*Sebastes aleutianus*) and Blackspotted Rockfish (*S. melanostictus*) – with possibly different depth distributions. The two types have similar appearances with slight variations in colour. Hybridization between the two most likely occurs as well.

The archetypal Rougheye Rockfish appears red with dark or dusky blotches of pigment in the back dorsal region. It has a light red lateral line and all but the pectoral fins are usually marked with black ends. The appearance of Blackspotted Rockfish is similar to that of Rougheye Rockfish, but appears darker overall, and can exhibit discrete spots on its spiny dorsal fin, although these are occasionally obscured by dark blotching (Orr and Hawkins 2008).

The Rougheye/Blackspotted Rockfish complex generally does not exceed 80 cm; early records where maximum size was recorded at 97 cm could possibly represent mis-identified shorttraker

rockfish (*S. borealis*) (Love *et al.* 2002). The Rougheye/Blackspotted Rockfish complex are possibly among the longest lived fish species on earth. In Alaska, scientists aged one specimen to 205 years (Munk 2001).

1.2.2. Description of Longspine Thornyhead

Longspine Thornyhead, a rockfish species belonging to the genus *Sebastolobus* also in the Scorpaenidae family, is a slow growing fish that is adapted for survival in deep waters where oxygen concentrations are minimal and water pressure is high. In Canada's Pacific waters, Longspine Thornyhead can dominate the fish species that live in deep benthic habitats (> 800 metres below the surface), and likely plays a significant ecological role within this environment. This species has a reddish body and some black on its fins, grows to 39 cm in length, and features large eyes and strong, sharp head spines (Love *et al.* 2002).

1.3. Populations and Distribution

1.3.1. Rougheye/Blackspotted Rockfish complex

The Rougheye/Blackspotted Rockfish complex occurs in the Pacific Ocean north of Japan from the Kamchatka Peninsula to the Bering Sea, the Aleutian Islands, Gulf of Alaska, and the west coast of North America from British Columbia to southern California (Figure 1). Records from the northwestern Pacific are poorly documented (Froese and Pauly 2005).

In BC, the Rougheye/Blackspotted Rockfish complex occurs along the continental slope, and is typically captured at depths between 174 and 640 m. The estimated extent of occurrence in BC, expressed as the area encountered by the groundfish fleet, covers approximately 58,691 km² (Figure 2). There is difficulty in differentiating between the population distributions and abundance for Rougheye Rockfish and Blackspotted Rockfish. Thus, the relative distribution and abundance of the two species in Canadian waters is unknown.



Figure 1. North American distribution of the Roughey/Blackspotted Rockfish complex. Distribution adjacent to Asian countries is not well documented (Froese and Pauly 2005). Reprinted with permission (Love *et al.* 2002).

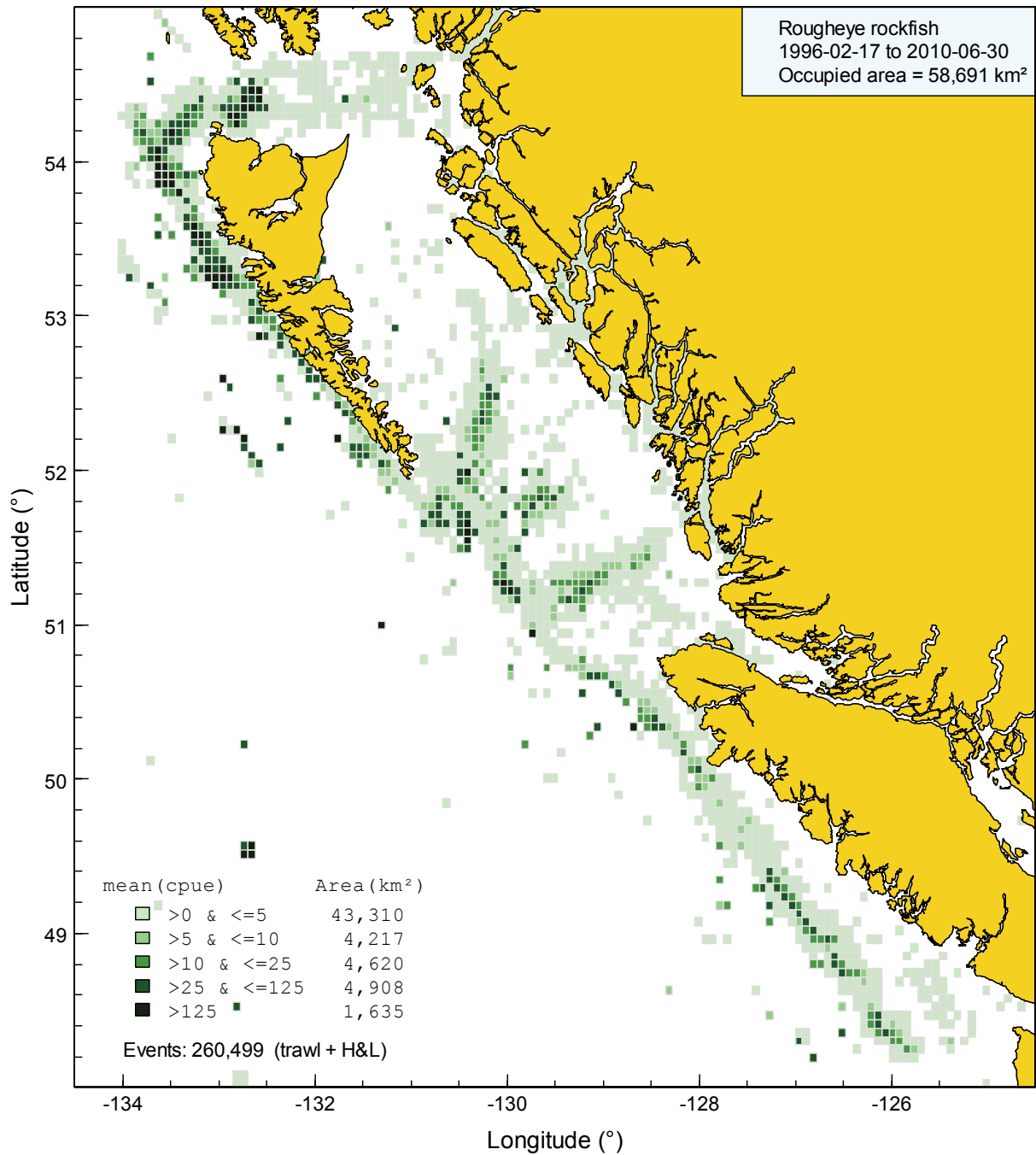


Figure 2. Mean CPUE (kg/h) of BC's Rougheye/Blackspotted Rockfish complex in grid cells 0.075° longitude by 0.055° latitude (roughly 32 km² each). The shaded cells give an approximation of the area of occupancy (58,691 km²) using fishing events from various fisheries (groundfish bottom trawl, halibut, sablefish, dogfish/lingcod, hook and line rockfish) from Feb 1996 to Jun 2010 (Source: Rowan Haigh, DFO, pers. comm., 2010).

1.3.2. Longspine Thornyhead

Longspine Thornyhead ranges from Cabo San Lucas, Baja California, to the Aleutian Islands (Figure 3) at depths recorded from 201 to 1,756 m but typically from 500 to 1,300 m (Love *et al.* 2002). It prefers soft sand or mud bottoms.

Longspine Thornyhead occurs along the continental slope of BC. The most likely 'extent of occurrence' lies between the 500 and 1,600 m isobaths with a flat surface area of 17,775 km² (Haigh *et al.* 2005b) (Figure 4); however, based on observed trawl tows, this area increases to 19,599 km² (Rowan Haigh, DFO, pers. comm., 2010).



Figure 3. North American distribution of Longspine Thornyhead. Distribution adjacent to Asian countries is not well documented (Froese and Pauly 2005). Reprinted with permission (Love *et al.* 2002).

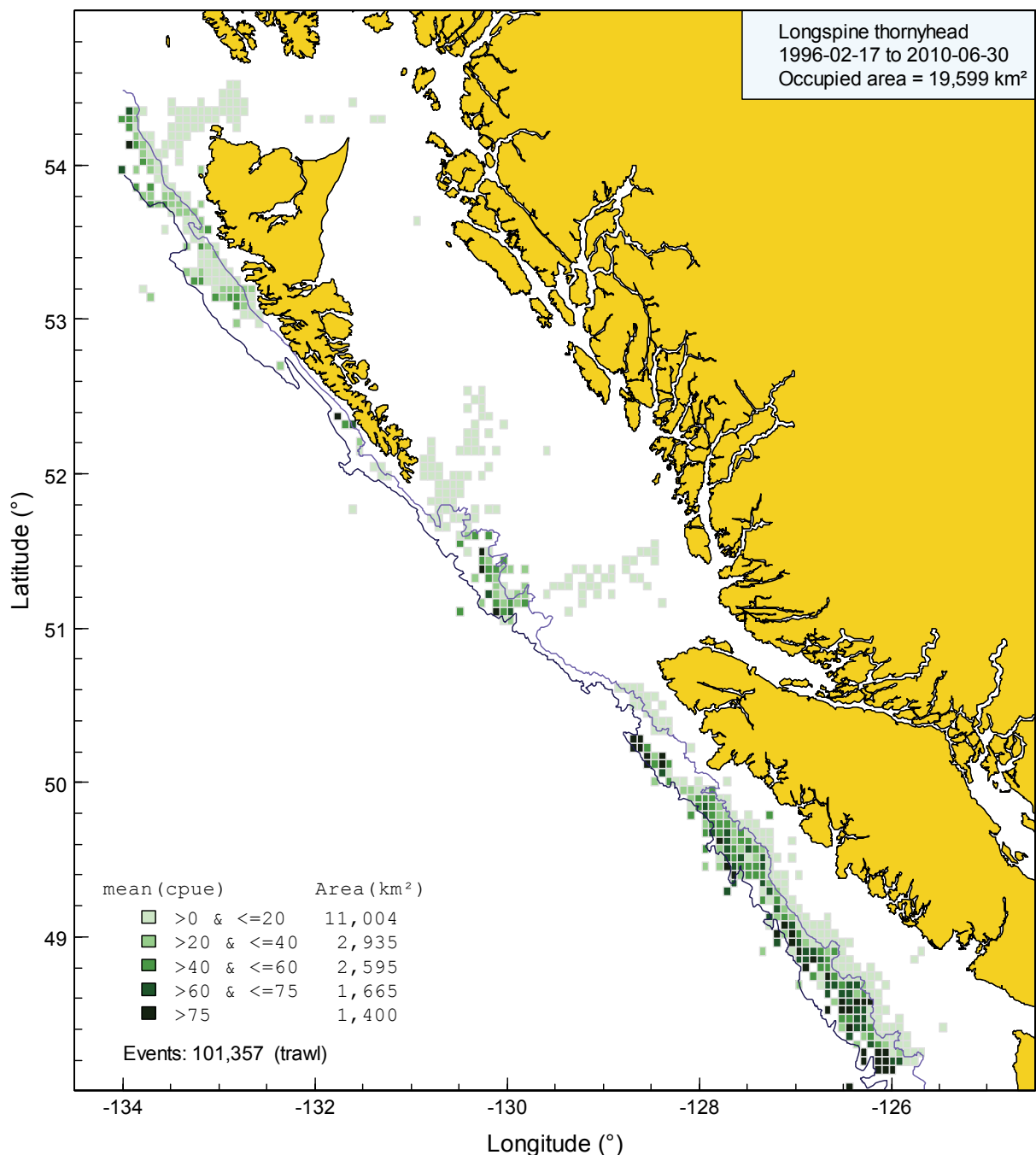


Figure 4. Mean CPUE (kg/h) of BC Longspine Thornyhead in grid cells 0.075° longitude by 0.055° latitude (roughly 32 km² each). The shaded cells give an approximation of the area of occupancy (19,599 km²) using fishing events from the groundfish bottom trawl fishery from Feb 1996 to Jun 2010 (Source: Rowan Haigh, DFO, pers. comm., 2010). Isobaths displayed are 500 m and 1,600 m; the approximate area between these two contours is 17,775 km² (Source: Haigh *et al.* 2005b).

1.4. Needs of the Species

1.4.1. Habitat and biological needs of the Rougheye/Blackspotted Rockfish complex

The highest densities of the Rougheye/Blackspotted Rockfish complex occurs on the sea floor with soft substrates, in areas with frequent boulders and on slopes greater than 20°. The association with soft substrate may be attributable to preferred prey items like pandalid shrimps (stomach content analyses, Yang and Nelson 2000). Boulders may act as territorial markers, current deflectors, or structures that help them hunt for prey (Krieger and Ito 1999). The complex co-occurs with numerous commercially harvested species, including Arrowtooth Flounder (*Atheresthes stomias*), Pacific Ocean Perch (*Sebastes alutus*), Dover Sole (*Microstomus pacificus*), Petrale Sole (*Eopsetta jordani*), Shortspine Thornyhead (*Sebastolobus alascanus*), and Sablefish (*Anoplopoma fimbria*).

The biology of the Rougheye/Blackspotted Rockfish complex remains poorly known. The life-span of these species appear to exceed that for most other *Sebastes* species (Chilton and Beamish 1982). A maximum age of 205 years was recorded for a specimen from southern Alaska (Munk 2001). Females are approximately 20 years old at 50% maturity (McDermott 1994). The principal spawning period off BC occurs in April. Like all ovoviviparous *Sebastes* species, fertilized eggs remain within the ovary until larval extrusion and may obtain at least some of their nutrition from the female parent during development (DFO 1999). *Sebastes* larvae occur near the surface where they feed opportunistically on invertebrate eggs, copepods, and euphausiids; juveniles occur at midwater depths where they feed on larger prey items (Moser and Boehlert 1991). Planktonic larvae of *Sebastes* can be found up to 500 km offshore from the BC coast, far from adult habitat; however, their midwater residency (200-250 m) as juveniles subjects them to shoreward geostrophic advection (Moser and Boehlert 1991). Currently, there is no evidence to show that larvae and juveniles of the Rougheye/Blackspotted Rockfish complex follow patterns different from those of other *Sebastes* species.

1.4.2. Habitat and biological needs of Longspine Thornyhead

This species prefers soft sand or mud bottoms in deep-water environments characterized by low productivity (Vetter and Lynn 1997), low diversity (Haigh and Schnute 2003), high pressure, and reduced oxygen concentrations. At these depths, where few species can survive, there is limited food available. Deep-water Longspine Thornyhead has adapted to this environment with extremely slow metabolisms and a sedentary nature that allows it to wait up to 180 days between feedings (Vetter and Lynn 1997).

Populations of Longspine Thornyhead off Oregon and California spawn primarily in the oxygen minimum zone between 600 and 1,000 m (Jacobson and Vetter 1996). Each female Longspine Thornyhead releases from 20,000 to 450,000 eggs (Wakefield 1990) in a buoyant gelatinous matrix. Moser (1974) determined that spawning generally occurs from February to May with a

peak in April. Recent data from the MOCNESS¹ program in southern California suggest that Longspine Thornyhead larvae move away from surface waters. Juveniles remain in the water column for approximately 1 year (Moser 1974). Smith and Brown (1983) noted the highest abundance of juvenile Longspine Thornyheads at 600 m in the vicinity of a deep-scattering layer. Thus, the chronology of the pelagic phase (18-20 months) can be generalized:

- i. eggs float to the surface (Feb-May) where they hatch and develop for 3-4 weeks;
- ii. larvae move away from the surface but remain in the upper 200 m for 6-7 months;
- iii. juveniles remain in the mesopelagic zone (~600 m) for another year.

After the pelagic phase, Longspine Thornyhead juveniles (55 mm average total length, Wakefield and Smith 1990) settle directly into the benthic adult habitat between 600 and 1,200 m, where they reportedly remain (Wakefield 1990).

1.5. Ecological role

1.5.1. Rougheye/Blackspotted Rockfish Complex

The Rougheye/Blackspotted Rockfish complex co-occurs with numerous commercially harvested species, including Pacific ocean perch (*Sebastes alutus*) and Arrowtooth Flounder (*Atheresthes stomias*) in the groundfish trawl fishery, and Redbanded Rockfish (*S. babcocki*) and Shortraker Rockfish (*S. borealis*) in the groundfish hook and line fisheries (Figure 5). Other than competition for food resources with these species, there is no current information on interactions that might limit the survival of the Rougheye/Blackspotted Rockfish complex.

In the Gulf of Alaska, individuals of the Rougheye/Blackspotted Rockfish complex have been reported to consume primarily shrimp (*Pandalus borealis*, *P. montagui tridens*, hippolytids, and crangonids), composing roughly 45-60% by weight of total stomach contents (Yang and Nelson 2000). They also consume fish species, including Walleye Pollock (*Theragra chalcogramma*), Pacific Herring (*Clupea pallasii*), Eulachon (*Thaleichthys pacificus*), Pacific Sandlance (*Ammodytes hexapterus*), myctophids, zoarcids, cottids, snailfish, and flatfish. In the Gulf of Alaska, fish make up roughly 15-20% of total stomach contents (Yang and Nelson 2000). Additional food items include Tanner Crab (*Chionoecetes bairdi*), cephalopods, amphipods, mysids, euphausiids, cumaceans, isopods, and polychaetes. While all size-classes of Rougheye/Blackspotted Rockfish complex primarily consume shrimp, fish less than 30 cm have a higher proportion of amphipods in their diet whereas fish larger than 30 cm consume more fish. Krieger and Ito (1999) note that individuals of the Rougheye/Blackspotted Rockfish complex will leave the bottom to capture various prey species.

Predators likely include Pacific Halibut (*Hippoglossus stenolepis*), Pacific Cod (*Gadus macrocephalus*), and Sablefish (*Amoplopoma fimbria*) (Shotwell *et al.* 2009).

¹ The [MOCNESS \(Multiple Opening/Closing Net and Environmental Sensing System\)](#) is a computer controlled net system used to collect zooplankton samples from specific depths in the water column. As the net system is towed through the water, individual nets can be opened within target depth zones (en anglais seulement).

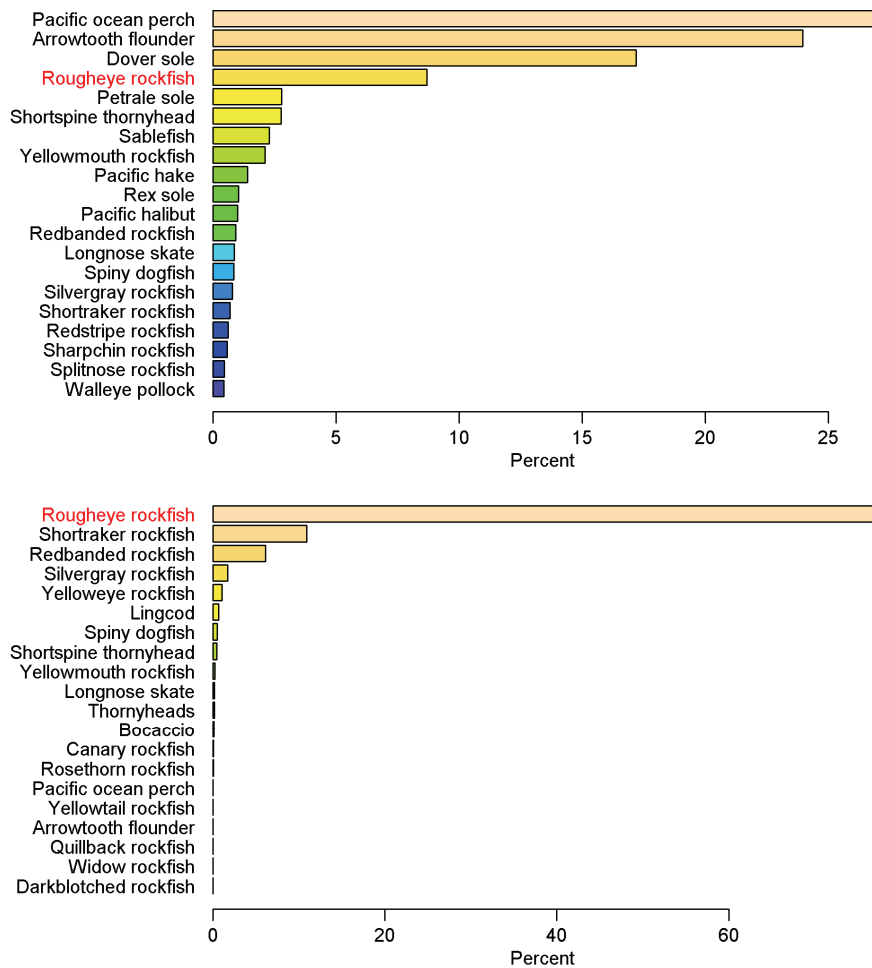


Figure 5. Abundance of the top 20 species in fishing events that captured at least one individual of the Rougheye/Blackspotted Rockfish complex in the preferred depth range (170–675m). TOP: trawl tows (1996-2006); BOTTOM: hook and line sets (2001-2006). Abundance is expressed as a percent of total weight of all species caught in tows and sets. Source: Haigh *et al.* (2005a).

1.5.2. Longspine Thornyhead

Longspine Thornyhead co-occur primarily with Shortspine Thornyheads (*Sebastolobus alascanus*) and Sablefish (*Anoplopoma fimbria*) (Figure 6). Shortspine thornyhead frequently consume Longspine Thornyhead. As depths increase from those where the two co-occur most densely (500-800 m) to those with oxygen minima and high pressures, *S. altivelis* gains a competitive advantage through physiological adaptation to extreme conditions, and eventually predominates.

The primary prey species of Longspine Thornyhead pelagic juveniles is probably euphausiids, while settled adults eat the Brittle Star (*Ophiophthalmus normani*) (Smith and Brown 1983). The adults also consume a variety of other benthic organisms including Grooved Tanner Crabs (small specimens < 30mm carapace width (CW), moulting adolescents < 70mm CW and moulting sub-

adults < 110mm CW), myctophids (lanternfish), and small thornyheads (Greg Workman², pers. comm., COSEWIC stock status report).

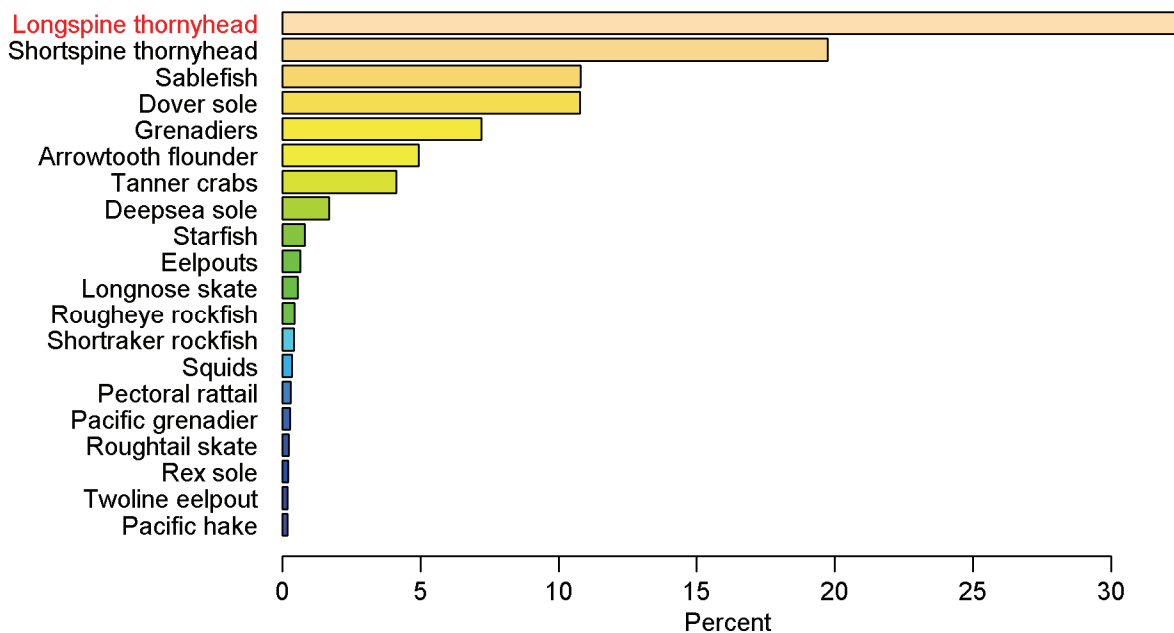


Figure 6. Abundance of the top 20 species in trawl tows (1996-2006) that captured at least one Longspine Thornyhead in the preferred depth range (500-1400 m). Abundance is expressed as a percent of total weight of all species caught in the tows. Source: Haigh *et al.* (2005b).

1.6. Limiting factors

Limiting factors are intrinsic to the biology of the species, and as such cannot be mitigated or managed. These natural bottom-up and top-down processes are influenced by factors like the availability and quality of prey and the abundance of predators, respectively. However, human activities may contribute pressures that alter these limiting factors, and affect the population or influence its conservation potential. Limiting factors for the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead include life history features such as late age of maturity, ocean current-reliant dispersal, cannibalism, vulnerability to capture and barotrauma.

Late age of maturity

Life history features such as late age of maturity (estimated at 20 years for the Rougheye/Blackspotted Rockfish complex and 18 years for Longspine Thornyhead) in these slow-growing, long-lived species could subject Rougheye Rockfish and Longspine Thornyhead to major demographic fluctuations when exposed to natural or anthropogenic (human-induced) disturbances.

² Groundfish surveys, Pacific Biological Station, 3190 Hammond Bay Road, Nanaimo, BC, V9T 6N7.

Ocean current-reliant dispersal

Rougheye/Blackspotted Rockfish larvae and Longspine Thornyhead eggs rise to and remain in the upper pelagic zone upon parturition. Thus, the three species' recruitment success is largely dependent on ocean currents and conditions in the pelagic zone. Pelagic conditions like primary/secondary production strength and timing, upwelling, downwelling, wind velocity and direction, temperature and salinity levels conceivably influence recruitment success. Large-scale atmosphere-ocean fluctuations such as the El Niño-Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) affect conditions in the pelagic zone and thus produce episodic patterns in year-class success. In addition, as the larvae and juveniles of Longspine Thornyhead and the Rougheye/Blackspotted Rockfish complex spends months in the upper pelagic zone, they are subject to factors like predation and environmental conditions in this zone for that period of time. This has significant implications on the recruitment success of the three species.

Competition and predation

Once the juvenile fish settle into their benthic habitat, they are subject to density dependent factors like competition for food and hiding places, and predation. The situation for Longspine Thornyhead is further aggravated by cannibalism because juveniles settle directly into adult habitat, where the larger fish eat the smaller (Love *et al.* 2002).

Vulnerability to capture

Larger and older rockfish contribute more to species' recruitment than smaller and younger rockfish. Large rockfish are known to produce more offspring, while older rockfish produce larvae with higher triglycerol lipid content (Berkeley *et al.* 2004, Bobko and Berkeley 2004). Higher triglycerol lipid content leads to faster growth rates and greater resistance to starvation, thereby increasing the level of recruitment. However, larger and older rockfish are more vulnerable to fishing gear; therefore, fishing activities may cause greater fluctuations in species recruitment.

Barotrauma

Similar to all *Sebastes* species, Rougheye and Blackspotted Rockfish have physoclastic swim bladders that cannot rapidly accommodate the sudden change in pressure as they are brought to the surface by fishing gear. The resulting barotrauma causes death for almost all rockfish. DFO Groundfish Management Unit (GMU) recognizes this limiting biological characteristic and as such, has implemented management measures to account for it (see Section 1.8). Longspine Thornyhead, genus *Sebastolobus*, does not have a swim bladder and thus, does not suffer from barotrauma when captured and brought to the surface. Its ability to survive temporary exposure to low pressure upon capture and release is unknown. These fish are more likely to die after confinement and compaction in fishing nets for long periods (up to 10 h) (Starr and Haigh 2000).

1.7. Threats

Assessment of threats to these populations (Table 1) allows for the prioritization of recommended management and other actions to prevent these populations from becoming threatened or endangered. Threats were assessed based on their current likelihood of occurrence and severity of effect to these populations. In addition, the certainty of a population-wide effect was incorporated to provide a measure of confidence in the rating of ‘level of concern’ and to identify threats where further monitoring or study may be useful in addressing uncertainties or knowledge gaps. Where certainty of effect is not demonstrated, weight of scientific evidence for other rockfish species may be deemed adequate to assess the level of concern for a threat.

Anthropogenic threats that cause stress to the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead include fishing [commercial, recreational, aboriginal FSC (food, social, ceremonial), and research], pollution and climate change. It should be noted that the threat of fishing is historical and current in nature, whereas the threat of climate change is anticipated. In addition, the threat of pollution is plausible, and could be a historical and/or current threat. The cumulative effect of any combination of these threats (Table 1), in conjunction with species-specific limiting factors (see Section 1.6), may result in consequences more serious than that of any single threat acting upon the population alone.

Threats in Table 1 are prioritized by level of concern, starting with the greatest threat (highest level of concern) to the survival of the species based on the strongest evidence. Each threat’s attributes, such as extent, occurrence, frequency, severity, local or range-wide extent and causal certainty, are all considered to determine the level of concern. Additionally, the ability to mitigate or eliminate the threat may influence the level of concern.

Refer to Appendix I for definitions on threat attributes and related terms used in Table 1.

1.7.1. Threat classification for Longspine Thornyhead and the Rougheye/Blackspotted Rockfish Complex

Table 1. Threat Classification Table ^a C = threat category; G = general threat; S = specific threat.

Threat ^a	Stress	Extent	Threat Attributes						Level of concern					
			Occurrence		Frequency		Severity		Causal certainty					
			Local	Range-wide	Local	Range-wide	Local	Range-wide	Local	Range-wide				
C: Biological Resource Use G: Fishing S: Commercial Fishing	Reduced population size/viability, local depletion	Widespread		Current		Continuous		Medium			High			Medium
C: Biological Resource Use G: Fishing S: Recreational Fishing	Reduced population size/viability, local depletion	Widespread		Current		Continuous		Unknown			Low			Low
C: Biological Resource Use G: Fishing S: Food Social Ceremonial (FSC) Fishing	Reduced population size/viability, local depletion	Widespread		Current		Continuous		Unknown			Low			Low
C: Biological Resource Use G: Fishing S: Research Harvest	Reduced population size/viability, local depletion	Widespread		Current		Recurrent		Low			Low			Low

Threat ^a	Stress	Extent	Threat Attributes						Level of concern			
			Occurrence		Frequency		Severity		Causal certainty			
			Local	Range-wide	Local	Range-wide	Local	Range-wide	Local	Range-wide		
<p>C: Climate and Natural Disasters G: Climate Change S: Expansion of low-productivity regimes (temporal and spatial)</p>	<p>Plankton larvae cannot find enough food; susceptible to increased predation; increasingly unsuitable deep habitat</p>	<p>Widespread</p>		Unknown		Unknown		Medium		Medium		Low
<p>C: Pollution G: Petroleum spills from tankers; petroleum leaks from sunken vessels; waste from ocean-going vessels S: Toxins, localized chemical imbalances, anaerobic conditions</p>	<p>Increased mortality and loss of reproductive success of the pelagic larval stage</p>	<p>Localized</p>	Anticipated		Recurrent		Unknown		Low		Low	

^a **C** = threat category; **G** = general threat; **S** = specific threat.

1.7.2. Description of threats

Fishing

Harvest of these species may result in reduced population size and viability, and in some circumstances, local depletion of the stock. A threat to the three SARA listed species includes the possibility of overfishing a long-lived species that inhabits a low-productivity environment. The following section further describes the threat of fishing by categorizing the harvest activity as: commercial, recreational, food, social and ceremonial, and research harvest.

i) Commercial Fishing

Directed commercial fisheries for the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead currently exist; with some historical Rougheye/Blackspotted Rockfish complex commercial fishery records dating back to the 1970s (see Section 1.8). Given the benthic nature of the complex, it is targeted by the commercial groundfish trawl and hook and line fleets. In contrast, Longspine Thornyhead is primarily targeted only by the commercial groundfish trawl fleet due to its depth range and distribution.

The commercial harvest for these species (Tables 2 and 3) are managed by DFO. The DFO establishes a commercial Total Allowable Catch (TAC) for the Rougheye/Blackspotted Rockfish Complex and Longspine Thornyhead, which sets the maximum amount of harvest permitted to be taken, as well as the area they may be taken from, in a given fishing season. These TACs are changed over time as new peer-reviewed science information becomes available. The coastwide TAC is currently 1,140 tonnes for the Rougheye/Blackspotted Rockfish complex and 425 tonnes for Longspine Thornyhead. In addition, these fisheries are managed using individual transferable quotas (ITQs), which allows the trading of quota within and between the various commercial groundfish fishing sectors. Furthermore, the commercial fishing sector is subject to a comprehensive 100% at-sea and dockside monitoring program.

Since the inception of the Longspine Thornyhead ITQ fishery in 1996, the commercial Catch per Unit Effort (CPUE) has declined 6.3 %/year, for a total decline of 60% over fourteen years (Rowan Haigh, DFO, pers. comm. 2010). Schnute *et al.* (2004) estimated similar declines for the WCVI region (which accounts for the majority of the BC population) using various models and assumptions (see their Table 9.1, p. 41). These numbers may indicate a fishing-induced decline of a previously unexploited species (removal of accumulated biomass, theoretically associated with increased productivity due to reduced density). Recent reports from the industry suggest that the Longspine Thornyhead fishery has become increasingly less attractive due to falling market prices for this species, increasing fuel costs and the high exchange rate for the Canadian dollar. Combinations of these factors have reduced the directed fishing effort on the species. This is reflected in the annual catch data (Table 3). Future conditions in the fishery, however, cannot be predicted. At this time, little is known regarding removals of rockfish species by commercial non-groundfish fisheries (e.g. prawn by trap, etc.).

In addition, misidentification for these rockfish species can be problematic, as they are morphologically similar to others in their genus. This phenomenon was possibly more prevalent

during the beginning years of the observer program (Haigh and Schnute 2003), suggesting that the accuracy of catch data has changed over time. However, once observers and dockside monitors gained experience, species identification is assumed to have stabilized. The current difficulty in distinguishing Blackspotted from Rougheye Rockfish will require genetic resolution. It appears unlikely that separation by visual cues will suffice.

Although commercial harvest is the highest known source of mortality, the severity and level of concern of this threat is ‘medium’ given that the actions to mitigate this threat have been implemented and catches are continuously monitored (see Section 1.8).

Table 2. Reported annual commercial catches (t), including discards, for Rougheye/Blackspotted Rockfish complex by the five principal groundfish fisheries. Entries marked ‘---’ indicate no reported catch; entries marked ‘0’ indicate catch less than 0.05 t. Catch records for 2010 are incomplete. DFO database sources: PacHarv3, GFCatch, PacHarvest, PacHarvHL, PacHarvSable, GFFOS.

Year	Trawl	Halibut	Sablefish	Dogfish Lingcod	Hook/Line Rockfish	Total
1971	8.6	---	---	---	---	8.6
1972	8.2	---	---	---	---	8.2
1973	---	---	---	---	---	---
1974	---	---	---	---	---	---
1975	---	---	---	---	---	---
1976	14	---	---	---	---	14
1977	77	---	---	---	---	77
1978	140	---	---	---	---	140
1979	218	---	1.4	---	0.5	220
1980	82	---	0.3	---	5.0	88
1981	117	---	---	---	2.1	119
1982	386	---	---	---	---	386
1983	214	---	---	---	0.3	214
1984	346	---	---	---	1.4	347
1985	616	---	---	---	1.9	618
1986	758	---	---	---	---	758
1987	490	---	1.5	---	---	491
1988	1,092	---	5.1	---	---	1,097
1989	1,039	---	---	---	1.7	1,040
1990	1,196	---	1.6	---	19	1,216
1991	997	---	18	---	33	1,048
1992	1,646	---	2.8	---	29	1,678
1993	1,886	---	5.1	---	23	1,915
1994	1,344	---	8.2	---	122	1,474
1995	1,147	1.6	6.1	---	673	1,828
1996	988	17	5.7	1.5	420	1,432
1997	366	23	16	0.2	622	1,027
1998	523	16	7.4	2.5	547	1,096
1999	477	27	14	11	825	1,355
2000	449	135	134	12	771	1,501
2001	498	184	27	0.5	341	1,051
2002	544	163	18	0	355	1,080

Year	Trawl	Halibut	Sablefish	Dogfish Lingcod	Hook/Line Rockfish	Total
2003	509	107	3.1	0.1	375	994
2004	448	143	5.0	0.2	305	901
2005	481	263	17	0.7	197	959
2006	584	178	48	0.2	24	834
2007	649	140	68	0.1	19	875
2008	848	137	50	0.3	72	1,107
2009	951	127	61	0.1	130	1,270
2010	499	79	33	0.1	96	708
Total	22,636	1,741	557	30	6,013	30,976

Table 3. Reported annual commercial catches (t), including discards, for Longspine Thornyhead by the five principal groundfish fisheries. Entries marked '---' indicate no reported catch; entries marked '0' indicate catch less than 0.05 t. Catch records for 2010 are incomplete. The year 1996 indicates the start of the directed Longspine Thornyhead fishery. However, Longspine Thornyhead has been historically caught with Shortspine Thornyhead as a thornyhead aggregate, prior to being recognized as a distinct species. DFO database sources: PacHarv3, GFCatch, PacHarvest, PacHarvHL, PacHarvSable, GFFOS.

Year	Trawl	Halibut	Sablefish	Dogfish Lingcod	Hook/Line Rockfish	Total
1996	876	0	---	---	---	876
1997	752	---	---	---	---	752
1998	876	---	---	---	---	876
1999	966	---	---	---	---	966
2000	847	---	---	---	---	847
2001	678	---	---	---	1.9	680
2002	696	0	---	---	0.5	696
2003	437	---	---	0	0	437
2004	327	---	---	---	---	327
2005	69	---	---	---	---	69
2006	291	0	---	---	---	291
2007	177	---	---	---	---	177
2008	63	---	---	---	---	63
2009	97	---	0	---	---	97
2010	76	---	---	---	---	76
Total	7,227	0	0	0	2.4	7,230

ii) Recreational Fishing

Where recreational fishing gear reaches depths at which the population resides, this activity can have an impact on these species. Given the benthic and offshore nature of Longspine Thornyhead, and the specialized gear necessary to harvest the species, it is assumed that recreational catch is minimal. On the other hand, interaction between recreational gear and the Rougheye/Blackspotted Rockfish complex may be more common given that it occurs at shallower depths.

Recreational rockfish catches are currently managed using daily and in-possession bag limits, which vary among statistical management areas and time periods. Although there are no records of Rougheye/Blackspotted Rockfish complex catch in the Department's recreational creel surveys, rockfish species identification is poor in this fishery and thus, catches of these species are not explicitly distinguished from those reported as "mixed rockfish" or "other rockfish". Anecdotal information confirms that rockfish species are often caught incidentally by some recreational fish harvesters while they target more popular species such as salmon or Pacific halibut (*Hippoglossus stenolepis*).

As it is difficult to assess the impact of the recreational fishing sector, the severity of the threat is unknown. However, given the depth range at which the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead reside, it is unlikely that the species is commonly encountered by recreational harvesters. The level of concern is therefore considered to be 'low.'

iii) First Nations Food, Social and Ceremonial (FSC) Fishing

First Nations FSC fisheries occur throughout the coastal waters of British Columbia. Detailed catch data for these fisheries are currently not available. Due to the lack of verified FSC catch for these species, the severity of the threat is unknown. However, given the depth range and distribution of these rockfish species, it is assumed that the impact of FSC fisheries and level of concern is considered to be 'low.' Anecdotal information suggests that neither species are of any significant social nor ceremonial value, as such, harvest is assumed to be minimal.

iv) Research Harvest

DFO Science, in conjunction with the commercial groundfish industry and the International Pacific Halibut Commission (IPHC), organizes and conducts a suite of research surveys to assess the status of groundfish stocks on the BC Coast. These surveys vary in duration, frequency, objectives, targeted species and methodology.

Catch of all species is recorded on most research surveys, and data (Table 4) are stored in a DFO electronic database (GFBio). A survey identifier table called 'C_Activity' lists most of the surveys in GFBio (there may be surveys entered but not identified by an explicit activity code). Currently, research survey catches are not included in the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead stock assessments because catch is considered minimal. The severity of this threat is considered to be 'low' in relation to existing continuous forms of harvest, resulting in a 'low' level of concern.

Table 4. Research surveys and their catches (t) of the Rougheye/Blackspotted Rockfish complex (RBC) and Longspine Thornyhead (LST). The ACTIVITY_CODE field in GFBIO's C_Activity table covers most, but not all surveys. Years indicate when surveys caught these species.

Activity Code	Activity Description	Years	RBC (t)	Years	LST (t)
1	TRAWL BIOMASS SURVEY		---		---
2	LARVAL SURVEY		---		---
3	HYDROACOUSTIC SURVEY	1997	0.008		---

Activity Code	Activity Description	Years	RBC (t)	Years	LST (t)
4	BIOLOGICAL SAMPLING SURV.	1997	0.008		---
5	SUBMERSIBLE SURVEY		---		---
6	NEARSHORE ROCKFISH SURVEY		---		---
7	OCEANOGRAPHIC SURVEY		---		---
8	SEAMOUNT SURVEY		---		---
9	TRAP BIOMASS SURVEY	1991-2001	4.913	1999-2001	0.012
10	DIVE SURVEY		---		---
11	TAGGING		---		---
12	HECATE STRAIT MULTISPECIES TRAWL SURVEY	1987,2002-03	0.020		---
13	GOOSE ISLAND GULLY POP TRAWL SURVEY	1966-1995	3.033		---
14	WEST COAST VANCOUVER ISLAND THORNYHEAD TRAWL SURVEY	2001-2003	0.074	2001-2003	12.330
15	STRAIT OF GEORGIA HAKE SURVEY	2001	0.044		---
16	WEST COAST VANCOUVER ISLAND HAKE SURVEY	1995-2001	0.062		---
17	HECATE STRAIT PCOD MONITORING TRAWL SURVEY		---		---
18	YELLOWEYE ROCKFISH CHARTER LONGLINE SURVEY	1997-2003	5.902		---
19	SABLEFISH RESEARCH AND ASSESSMENT SURVEY	1991-2010	17.040	1999-2010	0.050
20	JIG SURVEY		---		---
21	QUEEN CHARLOTTE SOUND SYNOPTIC TRAWL SURVEY	2003-2009	5.238	2004-2009	0.114
22	WEST COAST VANCOUVER ISLAND SYNOPTIC TRAWL SURVEY	2004-2010	3.457	2004-2006	0.030
23	INSHORE ROCKFISH LONGLINE SURVEY		---		---
24	IPHC LONGLINE SURVEY	2003-2009	4.323		---
25	SHELLFISH SECTION SHRIMP SURVEY	1976-2010	1.231	1994, 2008	0.383
26	HECATE STRAIT SYNOPTIC TRAWL SURVEY	2005-2009	0.443		---
27	WEST COAST QUEEN CHARLOTTE ISLAND SYNOPTIC SURVEY	2006-2010	48.124	2006-2010	1.422
28	PHMA LONGLINE SURVEYS	2007-2009	0.243		---
29	HECATE STRAIT JUVENILE FLATFISH SURVEY		---		---
30	HAKE STOCK DELINEATION	2008	0.018		---
31	JOINT CAN/US HAKE ACOUSTIC SURVEY	1995-2009	0.178	2009	0.007
TOTAL	Total species catch (t) using GFBIO codes	1966-2010	94.359	1994-2010	14.349

Note: There is a mirror database called `GFBIO_SQL`, which additionally contains a field called `SURVEY_SERIES_ID` for bootstrapping purposes.

Expansion of Low-Productivity Regimes (Temporal and Spatial)

The larvae of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead can spend months in the upper pelagic zone. Thus, species' survival is subject to conditions within that zone, which are affected by productivity drivers such as the El Niño-Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO). As juvenile dispersal of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead relies on ocean advection, changes in currents and upwelling may directly affect the recruitment levels, leading to episodic patterns in year-class success.

Climate change and large-scale regime shifts can affect north Pacific ecology (e.g., Beamish and Bouillon 1993, McFarlane *et al.* 2000, Benson and Trites 2002). Recent research suggests that a global decline in phytoplankton has been linked to increasing sea surface temperatures (Boyce *et al.* 2010). As rockfish larvae feed on zooplankton (that ultimately depend on phytoplankton) in the pelagic phase of their life cycle (Moser and Boehlert 1991), a reduction in phytoplankton would result in decreased prey availability, compromising the survival of juvenile Rougheye, Blackspotted Rockfish and Longspine Thornyhead.

It is also plausible that large-scale changes brought about by shifts in climate could have varying impacts on the habitat and geographical distribution of these fish species. For example,

declining ocean productivity possibly due to sea surface temperature increases could reduce the distribution of the Rougheye/Blackspotted Rockfish complex (current range extends as far south as Oregon). In addition, recent studies have suggested causal linkages between global warming and the vertical and horizontal expansion of oxygen minimum zones (OMZs) in the ocean. The OMZ is a regular feature of mid-depths. The expansion of OMZs in the past decade (Stramma *et al.* 2010) has led to increasing incursions of low oxygen water onto the productive continental shelves (e.g., Bograd *et al.* 2008, Chan *et al.* 2008).

Although the severity of this threat is considered to be ‘medium’, the occurrence of the phenomenon of climate change and its resultant threats are ‘unknown’. In addition, the ability to mitigate this threat is low. As such, further research may be necessary to identify and quantify the impacts on these rockfish species caused by climate change. In relation to the other existing identified threats to these rockfish populations, the level of concern is considered to be ‘low’.

Toxins, Localized Chemical Imbalances and Anaerobic Conditions

The threat of pollution could originate from petroleum spills from oil tankers, petroleum leaks from sunken vessels or waste from ocean-going vessels. Waste discharges from the latter are recurrent events along the BC coast, and the likelihood may increase with high densities of traffic. Ocean-going vessels are permitted to dump grey water and heated sewage, which affects water quality in the pelagic zone. In addition, primary production and prey availability of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead could be severely compromised by the introduction of synthetic and non-biodegradable pollutants in the environment.

Although measures to prevent and mitigate effects of spills are currently in place, once a spill occurs the effectiveness of clean up measures typically falls between 5 to 15% (Graham 2004), and is highly dependent on proximity to population centres with facilities and expertise for cleanup.

As the severity of this threat is largely ‘unknown’, further research may be necessary to identify its plausibility and severity. The level of concern of this threat is considered to be ‘low.’

1.8. Actions Already Completed or Underway

Commercial Groundfish Integration Program (CGIP)

Since 2003, the Department has focused on working with the commercial groundfish harvesters and others to address management and sustainability issues in the commercial groundfish fisheries. The Department identified five guiding principles³ for the commercial groundfish sector:

- a) All rockfish catch must be accounted for.

³ These principles were subsequently expanded at the request of industry to include all groundfish. For example, all groundfish catch must be accounted for, etc.

- b) Rockfish catches will be managed according to established rockfish management areas.
- c) Fish harvesters will be individually accountable for their catch.
- d) New monitoring standards will be established and implemented to meet the above three objectives.
- e) Species and stocks of concern will be closely examined and actions such as reduction of TACs, and other catch limits will be considered and implemented to be consistent with the precautionary approach for management.

Following significant work through the Commercial Groundfish Industry Advisory Committee (CGIAC) and the Commercial Industry Caucus (CIC), a three year pilot was introduced in the commercial groundfish fisheries in 2006. The reforms focus on 100% at-sea monitoring and 100% dockside monitoring, individual vessel accountability for all catch, both retained and released, individual vessel quotas (IVQs) and reallocation of these quotas between vessels and fisheries to cover catch of non-directed species.

The pilot program has now been completed and the 2010/2011 commercial groundfish fishing season marks the first year of full implementation. A comprehensive evaluation of the CGIP was conducted in 2009 and results show that the program is achieving the Department's conservation objectives and satisfies social concerns and economic performance (DFO 2009a).

The commercial groundfish industry plays an active role in fisheries management through scientific collaboration, including significant funding towards research surveys, observer coverage, electronic and dockside monitoring of vessels.

Groundfish Science Research Surveys

DFO Groundfish Science currently conducts four synoptic trawl surveys in collaboration with the Canadian Groundfish Research and Conservation Society (CGRCS). The initial synoptic survey was conducted in Queen Charlotte Sound in 2003 and has since collected data to generate five annual index values from 2003 to 2009. Following the success of this endeavour, similar synoptic surveys were initiated for the west coast of Vancouver Island in 2004; Hecate Strait and Dixon Entrance in 2005, and the west coast of Haida Gwaii in 2006.

The hook and line fisheries rely on a different set of surveys, the primary ones being (i) the jig surveys (1984-1993), (ii) Yelloweye Rockfish charter longline survey (1997-2003), (iii) inshore rockfish longline survey (2003-2008), (iv) IPHC longline survey (2003-2009), and (v) Pacific Halibut Management Association (PHMA) longline survey (2006-2009).

Additionally, there are the shrimp surveys off the west coast of Vancouver Island (1976-2010) and near shore in Queen Charlotte Sound (1998-2010). These sometimes prove useful for the shallower rockfish or juveniles of the deeper rockfish. Depending on the species, any combination of the surveys listed in Table 4 is potentially useful.

Consolidation of Databases

Harvest and research data are currently housed in numerous databases on various platforms. Oracle databases include PacHarv3, GFBIO, and GFFOS. SQL Server databases comprise GFCatch, PacHarvest, PacHarvHL, PacHarvSable, and GFBioSQL. Additionally, there are scattered databases that reside solely on individual work stations (e.g. Historical_Catch.mdb that includes data from manuscripts and spreadsheets (Haigh and Yamanaka in prep.), NFMS Triennial Survey data for the Vancouver Island region). It is anticipated that the consolidation of databases will allow effective management and access to fisheries data.

2000 – 2006 Exploratory Longspine Thornyhead Fishery – Management Actions

Prior to 2000, under the IVQ management program, DFO set a single coastwide Total Allowable Catch (TAC) for Longspine Thornyhead. While the quota was coastwide, the trawl industry concentrated its fishing effort to deep waters off the west coast of Vancouver Island (WCVI). In that area, Longspine Thornyhead catch accounted for more than 70% of the total combined shortspine and Longspine Thornyhead catch. It was thought by the industry that Longspine Thornyhead stocks in other areas of the coast contained significant abundance. However, these areas were not exploited due to difficult terrain, strong tides, high bycatch levels (e.g. sablefish) and high fishing costs.

In 2000, DFO reduced the coastwide TAC by more than 50% as a precautionary measure, due to a decline in commercial Longspine Thornyhead CPUE from initial levels in areas of catch concentration, as well as a lack of stock assessment advice. In addition, DFO (in conjunction with the industry) initiated an exploratory program to encourage a shift in fishing effort from the WCVI to fishing grounds further north, by providing additional fishing opportunities coupled with increased biological sampling requirements. The biological data collected was intended for use in analyses of population age structure, growth and reproduction. These analyses would then produce more reliable estimates of stock abundance and long-term productivity, since it was noted that the commercial CPUE data was influenced significantly by fishing behaviour

Further management actions were taken in 2002 with the creation of five management regions, and the implementation of a large area closure to provide refuge to a proportion of the population. The exploratory program was discontinued in 2006, and the fishery reverted back to the reduced coastwide TAC level as a result of a significant reduction in fishing effort.

Directed Rougheye/Blackspotted Rockfish Complex Seamount Fisheries – Management Actions

In 1992, the Department permitted a directed rockfish (by hook and line) fishery on Bowie Seamount. The Rougheye/Blackspotted Rockfish complex composed the bulk of the rockfish catch and was a targeted species for several years. In 2006, due to the introduction of ITQs, 100% catch monitoring requirements in the rockfish hook and line fleet, and interests by the Department to establish the Bowie Seamount as a Marine Protected Area (MPA), the directed fishing effort for the Rougheye/Blackspotted Rockfish complex at Bowie ceased.

At present, there is an active directed Sablefish fishery that occurs on the offshore seamounts (including Bowie). The Sablefish seamount fishery is monitored through 100% at-sea and dockside monitoring programs, and indirect catches of the Rougheye/Blackspotted Rockfish complex are permitted through monthly vessel limits. From 2007 to 2009, Rougheye/Blackspotted Rockfish complex landings averaged about 8000 pounds per year for all seamounts combined (Adam Keizer, DFO, Halibut and Sablefish coordinator, pers. comm. 2010).

Sponge Reef Closures, National Marine Conservation Areas (NMCAs) and Marine Protected Areas (MPAs)

In 2007, DFO, with support of the groundfish trawl industry, implemented three sponge reef closures with the intent of providing protection for four identified unique glass sponge reef ecosystems. These sponge reef closures are located in the waters (approximately 200 m deep) of the eastern Queen Charlotte Sound and Hecate Strait, and are closed year round to all bottom trawling. It is likely that the dense coverage of sponge reefs provides shelter to the juveniles and young adults of the Rougheye/Blackspotted Rockfish complex. Due to the depth range and offshore distribution of Longspine Thornyhead, it is less likely that this species seeks refuge here. A conservation strategy for coldwater corals and sponges has recently been approved by the Department.

The Canada *National Marine Conservation Areas Act* provides for the establishment of National Marine Conservation Areas (NMCAs). In 2010, the Gwaii Haanas NMCA was established as a joint initiative of Parks Canada, DFO, and the Council of Haida Nation. The development of an integrated fisheries management plan for this NMCA is currently underway.

Additionally, under Canada's *Oceans Act*, DFO has designated two Marine Protected Areas (MPAs) – the Endeavour Hydrothermal Vents and the Bowie Seamount – within the coastal waters of BC. NMCAs and MPAs are intended to protect and improve the resilience of ecosystems, and can contribute to local fishery sustainability through the enhanced survival of large productive females and potential future dispersal of young fish from the protected area to outside fishing areas. As such, these protected areas may help conserve slope rockfish species such as the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead.

Collaborative Research Projects

DFO regularly collaborates with individuals from related branches of academia on various research projects that facilitate a better understanding of the challenges facing fishery managers and research scientists today.

For example, NSERC (National Science and Engineering Research Council) recently initiated a project to assess the potential impacts of bottom-fishing gear on seafloor habitat. Physical and biological characteristics of benthic marine habitats often play an important role in supporting the production of marine species. Therefore, managing disturbances of bottom habitat is a necessary criterion for assessing fishery sustainability and will help the fishing industry design operational changes to mitigate these impacts.

1.9. Knowledge Gaps

Biological Information on the Rougheye/Blackspotted Rockfish Complex

The recently discovered existence of two species within what was formerly known as Rougheye Rockfish (Jordan and Evermann 1898), and the resultant lack of biological knowledge (including distribution and threats) of the Rougheye/Blackspotted Rockfish complex could constitute a threat in itself, since cryptic species of this kind increase the risk of losing unrecognized genetic diversity. Considerable additional scientific work will be required to describe the relative abundance of the two species in Canadian waters, their distribution, and the impacts of fisheries (and potentially other threats) on each.

Orr and Hawkins (2008) redefined the two species taxonomically and provided diagnostic markers for distinguishing *S. aleutianus* (Rougheye) and *S. melanostictus* (Blackspotted). Their findings suggest that the distribution of Rougheye Rockfish is confined to the eastern Pacific Ocean whereas that for Blackspotted Rockfish ranges across the North Pacific from Japan to California. The authors assert that although they are morphologically similar, there are consistent colour pattern differences on the body between the two species with Blackspotted Rockfish always exhibiting discrete spots on its spiny dorsal fin (though these are occasionally obscured by dark blotching) while Rougheye Rockfish has an overall pale colour with no discrete spots. Orr and Hawkins derived a discriminant function using morphometric and meristic characters, that claims to correctly classify the two species 97.8% of the time. At this time, aside from the discriminant function and DNA analysis, there are no other known methods for distinguishing the two species accurately.

Currently, DFO has little information on Rougheye Rockfish and Blackspotted Rockfish (*S. melanostictus*) in Canadian Pacific waters. Based on the diagnostics reported in the literature, DFO Science surveys initially tried to distinguish these species based on the presence and/or absence of discrete spots on the dorsal fin, but abandoned this practice due to high pattern variability between the two species. Currently, genetic samples of the complex are taken on some DFO Science surveys. A pilot study is underway to determine a cost-effective means for routinely identifying the catches, and the complexity of genetic analysis required to distinguish the two species and their hybrids (Rick Stanley, DFO, pers. comm., 2010). Genetic sampling will necessarily become a regular feature of all future surveys, and the additional cost will be ongoing. Sampling the commercial catch will likely be more complicated, but protocols should be developed if the two species need to be accurately identified in commercial catch removals. In the interim, species composition ratios derived from the genetic sampling of the complex on DFO Science surveys may be used to estimate commercial catch composition.

Difficulty in distinguishing Rougheye and Blackspotted Rockfish presents a challenge to the management of both species. In the absence of sufficient biological information on either species, the two can only be managed as a species complex, until sufficient research identifies a method to manage them separately.

It is anticipated that given time and resources, more will be known about the abundance and distribution of Rougheye/Blackspotted Rockfish complex.

2. MANAGEMENT

The main threat to the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead is population decline as a result of direct and indirect biological resource use. Although there is a lack of knowledge on the relative abundance and distribution of Rougheye and Blackspotted Rockfish, management actions that may reduce the risk of population-level threats should be considered. It is important that the management goal and objectives are set at the species level so as to mitigate the risk of losing unrecognized biological diversity of the Rougheye/Blackspotted Rockfish complex species pair.

2.1. Management Goal

The management goal for the Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead is to maintain sustainable populations within each species' known range in Canadian Pacific waters.

The purpose of the *Species at Risk Act (SARA)* is to manage species of Special Concern so as to prevent them from becoming listed as Threatened or Endangered. Thus, the management goal focuses on maintaining abundance levels within the species' known range. Stock status is currently based on relative abundance indices from DFO Science surveys or commercial CPUE to monitor trends in populations (see Section 2.3.3).

As commercial fishing has been identified as the primary threat to these rockfish species, it is important to manage this threat to achieve the management goal. In 2009, the Department began implementation of the Sustainable Fisheries Framework (SFF). The SFF is a toolbox of existing and new policies for DFO and other interests to sustainably manage Canadian fisheries to conserve fish stocks and support prosperous fisheries. One of these policies is the Precautionary Approach, which applies to key harvested stocks managed by DFO.

Applying the precautionary approach to fisheries management decisions entails establishing a harvest strategy that:

- Identifies three stock status zones – healthy, cautious, and critical – according to upper stock reference points (USR), limit reference points (LRP) and target reference points (TRP);
- Sets the removal rate at which fish may be harvested within each stock status zone; and
- Adjusts the removal rate according to fish stock status variations (i.e., spawning stock biomass or another index/metric relevant to population productivity), based on pre-agreed decision rules.

(DFO 2009b)

It will be necessary to address these requirements in future stock assessments (see sub-section 2.3.3.) for the Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead, as well as the identified knowledge gap (see Section 1.9) to achieve this management goal (see Section 2.3.3).

2.2. Management Objectives

The following statements are objectives (not listed in order of priority) to support the management goal of these rockfish species:

1. *Maintain the Rougheye Rockfish, Blackspotted Rockfish, and Longspine Thornyhead population ranges in Canadian Pacific waters.*
2. *Continue management under the Commercial Groundfish Integrated Program (CGIP), employing management tools when necessary, as indicated by monitoring and assessment of the stocks.*
3. *Account for total catch (retained and released) of Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead, and examine species removal trends in commercial fisheries, DFO Science surveys, recreational, and First Nations fisheries.*
4. *Enhance existing DFO Science research, where resources and funding are available, to gather more information on stock status, including relative abundance and distribution of each species.*
5. *Produce peer-reviewed stock assessments and harvest advice for the Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead.*
6. *Support and contribute to research that addresses knowledge gaps, as well as the effects of other identified (Table 1) and non-identified threats, on an ongoing basis.*

The current management regime (outlined in Section 1.8) regulates the commercial Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead fisheries through the use of ITQs, trip limits and a comprehensive catch monitoring program. Management tools that are available to DFO fishery managers include the use of area and time closures and adjusting species' TAC limits. In addition, fishery management objectives are reviewed every season and included in annual IFMPs, which are used to guide the management of the fishery (see Sections 2.3.3 and 4).

For example, if a significant decline in the population of Longspine Thornyhead were identified through monitoring and assessment, DFO may reduce the TAC limit for the species and/or implement time/area closures. These harvest guidelines would also be incorporated into annual IFMPs. This approach allows fishery managers to respond to changes in a timely manner, based on the results of monitoring and assessment activities.

Management objectives addressing threats of greatest concern aim to prevent undesirable population decreases and prevent significant alterations in distribution of the Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead populations in BC.

2.3. Actions

The following actions (not listed in order of priority) are in support of the management goal and objectives (outlined in Sections 2.1 and 2.2). Many of the actions listed below are currently underway (see Section 1.8).

Although management objective 3 includes First Nations fisheries, non-groundfish commercial fisheries and recreational fisheries, determining catch estimates for Rougheye and Blackspotted Rockfish (rather than for the complex) is more of a priority in the commercial groundfish fishery, as it is the known source of highest mortality for these species. As there are currently no verifiable catch estimates of the Rougheye/Blackspotted Rockfish complex in the First Nations, non-groundfish commercial and recreational fisheries; management actions for those fisheries focus on gathering catch estimates for the complex.

The synchronization of these listed activities for management, research, and monitoring and assessment will facilitate a multi-species approach to conservation of the Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead populations in Canadian Pacific waters and allow for the effective use of available resources. Actions have been recommended where implementation is deemed practical and feasible, and most likely to result in successful conservation of these rockfish populations in BC.

2.3.1. Management

Management actions (A) to address key threats are listed below. Although pollution through toxic spills and waste discharges from ocean-going vessels are listed as a threat to the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead populations, the management of bio-chemical contamination falls under the jurisdiction of Environment Canada and Transport Canada.

- A1. Continue the current management regime of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead, including 100% catch monitoring and other management tools (where necessary and applicable) in the commercial groundfish fishery, while working to develop methods to obtain catch estimates for Rougheye and Blackspotted Rockfish.
- A2. Work with other commercial fishing sectors to develop methodologies to account for bycatch of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead in commercial non-groundfish fisheries.
- A3. Incorporate all catch on research surveys into future DFO Science Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead stock assessments.

- A4. Continue existing work with DFO recreational fisheries management and stakeholders to improve catch monitoring and reporting methods, including species identification in BC recreational fisheries.
 - a. Include the Rougheye/Blackspotted Rockfish complex in the recreational creel survey.
 - b. Include species identification tools for the Rougheye/Blackspotted Rockfish complex in DFO's Tidal Waters Fishing Guide for recreational harvesters.
- A5. Improve catch monitoring and reporting methods in First Nations FSC fisheries.
 - a. Continue existing work with Aboriginal Fisheries Strategy (AFS) managers to improve catch monitoring and reporting methods.
 - b. Develop species identification tools to help First Nations identify the Rougheye/Blackspotted Rockfish complex among other rockfish catches.

2.3.2. Research

The following areas are those that have been identified as a priority for research actions to address key knowledge gaps in species biology and other identified and non-identified threats to the species. In addition, research efforts to address data deficiencies will assist management actions for these rockfish species. Other potential areas for research have been listed in previous sections of this management plan (See Section 1.9). Fisheries and Oceans Canada will lead the following research where feasible.

- A6. Improve existing DFO Science research surveys for Longspine Thornyhead, where funding and resources are available, by increasing the number of tows in deep strata (e.g., 500-1200 m).
- A7. Take genetic samples of the Rougheye/Blackspotted Rockfish complex on all DFO Science surveys that currently encounter these species. Samples should come from all area-depth strata in which the complex is caught.
- A8. Develop a set of protocols to acquire biological (including genetic) samples from commercial catch of the Rougheye/Blackspotted Rockfish complex.
- A9. Investigate further the potential impacts of climate change to the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead populations and their habitat in Canadian Pacific waters (e.g., habitat compression due to expansion of hypoxic zones).

2.3.3. Monitoring and assessment

- A10. Conduct an analysis to identify gaps in data that are necessary to conduct comprehensive stock assessments of the Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead; implement programs to rectify the data shortfalls.

- A11. Ensure that Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead stocks are prioritized for DFO Science assessments through the implementation of the groundfish science assessment strategic plan.
- A12. Review the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead abundance trends to monitor the status of the stocks on an annual basis and report in the Groundfish Integrated Fisheries Management Plan (IFMP).

2.3.4. Monitoring and assessment methods

The following highlights the methods that will be used to monitor the conservation of the species and the implementation of the management plan. The research, monitoring, and assessment actions identified in the previous sections (2.3.2 and 2.3.3) will assist in the monitoring of Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead population trends and abundance in Canadian Pacific waters.

Commercial Groundfish Integrated Fisheries Management Plan (IFMP)

The commercial groundfish IFMP, which is reviewed and issued annually or bi-annually, provides a management tool to communicate harvest guidelines to commercial groundfish harvesters. It identifies the main objectives and requirements for the Canadian Pacific groundfish fishery as well as the management measures used to achieve these objectives.

The management objectives for the Rougheye Rockfish, Blackspotted Rockfish and Longspine Thornyhead outlined above (see Section 2.2) will be incorporated into future annual commercial groundfish IFMPs to guide the management of these species. Through this process, fishery managers will be able to annually or bi-annually review and assess the implementation of the management objectives identified in this Management Plan.

Monitoring of Rougheye Rockfish and Blackspotted Rockfish Populations

Since the COSEWIC Stock Status Report for the Rougheye/Blackspotted Rockfish complex was published in 2007, DFO Science has added new index points to the various DFO Science research survey series.

DFO Science will continue to gather Rougheye Rockfish and Blackspotted Rockfish data from the various DFO Science surveys to monitor and assess population trends and abundance. In addition, when sufficient genetic samples of the rockfish complex are gathered, DFO Science should be able to determine proportions of Rougheye Rockfish and Blackspotted Rockfish in Canadian Pacific waters. These ratios might also be useful in disaggregating historic catches where only Rougheye Rockfish were reported.

Monitoring of Longspine Thornyhead Populations

Due to the deep, offshore distribution of Longspine Thornyhead, it is not economically feasible to conduct directed research surveys for this species alone. Where funding is available, survey

tows in deep strata (500-1200m) should be added or increased in existing DFO Science research surveys. The additional data in conjunction with commercial catch per unit effort (CPUE) can be used to monitor and assess stock abundance for Longspine Thornyhead.

Challenges in Ageing

The inability to easily and economically age Longspine Thornyhead may render assessments for this species more uncertain because they are limited to using production models. When age data are available, age structured models usually provide more reliable estimates of population status. For the Rougheye/Blackspotted Rockfish complex, ageing otoliths via break-and-burn results in a high degree of imprecision (± 5 y, Shayne MacLellan, DFO, pers. comm., supervisor of the PBS fish ageing laboratory, 2010). Ageing error won't disable an age structured model, but it probably increases the uncertainty of the results.

3. PROPOSED IMPLEMENTATION SCHEDULE

Fisheries and Oceans Canada encourages other agencies and organizations to participate in the conservation of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead through the implementation of this management plan. Table 5 summarizes those actions that are recommended to support the management goals and objectives. The activities implemented by Fisheries and Oceans Canada will be subject to the availability of funding and other required resources. Where appropriate, partnerships with specific organizations and sectors will provide the necessary expertise and capacity to carry out the listed action. However, this identification is intended to be advice to other agencies, and carrying out these actions will be subject to each agency's priorities and budgetary constraints.

Table 5. Proposed Implementation Schedule

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies	Timeline
Management					
A1. Continue current management regime in the commercial groundfish fisheries, while working to develop methods to obtain catch estimates for Rougheye and Blackspotted Rockfish.	1, 2	High	Commercial fishing; Lack of biological information on the Rougheye/Blackspotted Rockfish complex	DFO, Commercial fishing industry	Ongoing

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies	Timeline
A2. Work with other commercial fishing sectors to develop methodologies to account for bycatch of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead in commercial non-groundfish fisheries	3	Medium	Commercial fishing	DFO, Commercial fishing industry	3 years
A3. Incorporate all catch on research surveys into future DFO stock assessments of Rougheye, Blackspotted Rockfish and Longspine Thornyhead	3	Medium	Research harvest	DFO	Ongoing
A4. Continue existing work with DFO recreational fisheries management and stakeholders to improve catch monitoring and reporting methods, including species identification in BC recreational fisheries					
a. Include Rougheye/Blackspotted Rockfish complex in recreational creel survey	3	Medium	Recreational fishing	DFO, Recreational fishers	2 years
b. Include species identification tools for the Rougheye/Blackspotted Rockfish complex in DFO's Tidal Waters Fishing Guide	3	Medium	Recreational fishing	DFO, Recreational fishers	2 years
A5. Improve catch monitoring and reporting methods in First Nations FSC fisheries					
a. Continue existing work with AFS managers to improve catch monitoring and reporting methods	3	Medium	FSC fishing	DFO, First Nations	Ongoing
b. Develop species identification tools to help First Nations identify the Rougheye/Blackspotted Rockfish complex among other rockfish catches.	3	Medium	FSC fishing	DFO, First Nations	2 years
Research					
A6. Improve existing DFO Science research surveys for Longspine Thornyhead by increasing the number of tows in deep strata	4, 5, 6	Medium	Insufficient tows capturing Longspine Thornyhead to calculate an abundance index	DFO	Ongoing

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies	Timeline
A7. Take genetic samples (from all area-depth strata) of the Rougheye/Blackspotted Rockfish complex on all DFO Science surveys that currently encounter these species	4, 5, 6	High	Lack of biological information on the Rougheye/Blackspotted Rockfish complex	DFO	Ongoing
A8. Develop protocols to acquire biological (incl. genetic) samples from commercial catch for the Rougheye/Blackspotted Rockfish complex	5, 6	High	Lack of biological information on the Rougheye/Blackspotted Rockfish complex	DFO, Commercial fishing industry	3 years
A9. Investigate potential impacts of climate change to the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead populations and their habitat in Canadian Pacific waters	6	Low	Expansion of low-productivity regimes (temporal and spatial)	DFO, IOS	5 years
Monitoring and Assessment					
A10. Conduct an analysis to identify gaps in data that are necessary to conduct stock assessments and implement programs to rectify the data shortfalls	4, 5, 6	Low	Ensure monitoring and assessment for effective management of these species	DFO	3 years
A11. Ensure that the Rougheye, Blackspotted Rockfish and Longspine Thornyhead stocks are prioritized for DFO Science assessments	5	High	Ensure monitoring and assessment for effective management of these species	DFO	5 years
A12. Review Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead abundance trends to monitor the status of these stocks on an annual basis	1	High	Ensure monitoring and assessment for effective management of these species	DFO	Ongoing

4. ASSOCIATED PLANS

The commercial groundfish IFMP is an associated management plan that identifies objectives and guidelines for the management of the Pacific commercial groundfish fisheries. The IFMP currently does not identify threats, management objectives, or required actions for the conservation of the Rougheye/Blackspotted Rockfish complex and Longspine Thornyhead.

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6. CONTACTS

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Rowan Haigh	Fisheries and Oceans Canada
Barry Ackerman	Fisheries and Oceans Canada
Robert Tadey	Fisheries and Oceans Canada
Michelle Li	Fisheries and Oceans Canada (<i>past member</i>)
Cliff Robinson	Parks Canada Agency

APPENDIX I: Threat Attributes and Assessment Glossary

TERMS	RATING	DEFINITIONS
Threat category*	n/a	Broad category identifying the type of threat: i) Habitat loss or degradation ii) Exotic, invasive or introduced species/genome iii) Changes in ecological dynamic or natural processes iv) Pollution v) Accidental mortality vi) Biological resource use vii) Disturbance or harm viii) Climate and natural disasters ix) Natural processes or activities
General threat	n/a	General activity causing the specific threat
Specific threat	n/a	Specific factor or stimulus causing stress to the population
Stress	n/a	Indicated by harm to an individual or a population, in response to a threat that results in a reduction of species viability ⁺
Extent	Widespread	Across the entire species range
	Localized	Across a specific portion of the species range
	Unknown	Available information is insufficient to gauge the extent of the threat
Local	n/a	Threat information relates to a specific site or narrow portion of the species range
Range-wide	n/a	Threat information relates to the entire or large portion of the species range
Occurrence	Historical	Contributed to decline but no longer affecting the species
	Current	Affecting the species now
	Imminent	Is expected to affect the species very soon
	Anticipated	May affect the species in the future
	Unknown	Available information is insufficient to gauge the occurrence of the threat
Frequency	One-time	Occurring only once
	Seasonal	Occurs at only certain times of the year (could be due to migratory nature of the species)
	Continuous	On-going
	Recurrent	Reoccurs from time to time but not on an annual or seasonal basis
	Unknown	Available information is insufficient to gauge the frequency of the threat
Severity	High	Has a very large population-level effect

	Medium	Has a moderate population-level effect
	Low	Has a small population-level effect
	Unknown	Available information is insufficient to gauge the degree to which the threat may affect population viability ⁺
Causal certainty	High	Evidence causally links the threat to stresses on population viability ⁺
	Medium	Correlation between the threat and population viability ⁺
	Low	Assumed or plausible threat only
Level of concern [°]	High	High degree of concern for conservation of the species
	Medium	Moderate degree of concern for conservation of the species
	Low	Low concern of concern for conservation of the species

* Threat categories are fixed

[°] Level of concern takes into account all other threat attributes and the ability to mitigate or eliminate the threat

⁺ Population viability: The ability of a population to persist and to avoid an uplisted status (e.g. threatened or endangered)

APPENDIX II: Rougheye/Blackspotted Rockfish Complex and Longspine Thornyhead Management Plan Technical Workshop Participants

Barry Ackerman	Fisheries and Oceans Canada
Chuck Ashcroft	Sports Fishing Advisory Board
Sarah Busch	Fisheries and Oceans Canada
Dennis Chalmers	Ministry of Environment, BC Province
Ernie Cooper	World Wildlife Fund (WWF) Canada
Shawn Cowpar	Haida Fisheries, Council of the Haida Nation
Dave Dawson	Commercial Industry Caucus (CIC)
E. Irvin Figg	United Fishermen and Allied Workers' Union (UFAWU)
Jeff Johansen	Fisheries and Oceans Canada – <i>SARA</i>
Adam Keizer	Fisheries and Oceans Canada
Jim Lane	Nuu-chah-nulth Tribal Council (NTC)
Michelle Li	Fisheries and Oceans Canada – <i>SARA</i>
Tamee Mawani	Fisheries and Oceans Canada
Wanli Ou	Fisheries and Oceans Canada
Dave Renwall	Commercial Industry Caucus (CIC)
Cliff Robinson	Parks Canada Agency
Chris Sporer	Commercial Industry Caucus (CIC)
Rick Stanley	Fisheries and Oceans Canada – Science
Rob Tadey	Fisheries and Oceans Canada
Scott Wallace	David Suzuki Foundation

APPENDIX III: Record of Cooperation and Consultation

The Rougheye/Blackspotted Rockfish Complex and Longspine Thornyhead were listed as species of special concern under Schedule I of the *Species at Risk Act* (SARA). As an aquatic species, they fall under federal jurisdiction, and are managed by both Fisheries and Oceans Canada (DFO) and by the Minister of the Environment (as competent Minister for Parks Canada Agency under SARA). DFO established a small internal working group of technical experts to develop the initial draft of this management plan. See section 6 of this document for a list of technical team members.

In October 2010, DFO held a technical workshop with the Groundfish Integrated Advisory Board (GIAB) to develop the management goal and objectives for the conservation of these species. Participants included individuals from First Nations, the commercial groundfish industry, recreational sector, environmental non-governmental organization, Province of British Columbia, Parks Canada Agency, and internal DFO staff.

Letters were sent out to all coastal First Nations to solicit participation in the development of the Management Plan. The draft management plan was sent to Parks Canada Agency, Environment Canada, and the Province of British Columbia for review and comment.

This draft management plan was posted to the DFO Pacific Region Consultation website for a public comment period from March 25 to April 28, 2011. These consultations were web-based and included mail-outs to all coastal First Nations soliciting input and feedback on the draft management plan. The mail-outs to First Nations were followed up by email and fax; no comments on the document were received. An initial draft of the management plan, along with a discussion guide and feedback form was made available online. Notification of this consultation period was also sent by electronic mail to several Departmental advisory committees including GIAB, Halibut Advisory Board (HAB), Sablefish Advisory Committee (SAC), Groundfish Trawl Advisory Committee (GTAC), Groundfish Hook & Line Advisory Committee (GHLAC), and the Sports Fish Advisory Board (SFAB). A written response was received from the SAC. All feedback received during this consultation period has been incorporated into the final management plan.