

Management Plan for the Banded Killifish (*Fundulus diaphanus*), Newfoundland Population, in Canada

Banded Killifish (Newfoundland Population)



May 2011



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 (http://www.sararegistry.gc.ca/approach/act/default_e.cfm).

A management plan has to be developed within three years after the species is added to the List of Wildlife Species at Risk. 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 preventive 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

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PREFACE

The Banded Killifish, Newfoundland population, is a freshwater fish and is 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 Banded Killifish, Newfoundland population, was listed as a species of special concern under SARA in 2005. The development of this management plan was led by Fisheries and Oceans Canada – Newfoundland and Labrador Region, and the Newfoundland and Labrador Department of Environment and Conservation, in cooperation and consultation with many individuals, organizations and government agencies, as indicated below and in Appendix 2. 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 Banded Killifish, Newfoundland population, and Canadian society as a whole. The Minister will monitor the implementation of this management plan and assess its implementation five years after the plan is included in the Species at Risk Public Registry, and in every subsequent five-year period until its objectives have been achieved.

RESPONSIBLE JURISDICTIONS

Fisheries and Oceans Canada

Government of Newfoundland and Labrador: Department of Environment and Conservation

AUTHORS

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and Communications. From the Government of Newfoundland and Labrador, reviewers included the Departments of Environment and Conservation, and Natural Resources. Other reviewers included Parks Canada, the Federation of Newfoundland Indians (FNI) and the Miawpukek First Nation (MFN).

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STRATEGIC ENVIRONMENTAL ASSESSMENT

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.

Recovery 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 on 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 Newfoundland population of Banded Killifish. 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: description of the species' habitat and biological needs, ecological role, and limiting factors; management and implementation schedule.

EXECUTIVE SUMMARY

The Newfoundland population of Banded Killifish (*Fundulus diaphanus*) has been listed as a species of special concern under the federal *Species at Risk Act* (SARA) and as a vulnerable species under the *Newfoundland and Labrador Endangered Species Act* (NL ESA). While there is no evidence to suggest that this species' range or population numbers have decreased on the Island of Newfoundland, the Banded Killifish's limited area of occupancy, and clustered distribution pattern makes the species particularly sensitive to catastrophic events or localized perturbations.

In 2003, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified potential impacts from forestry activities in the Indian Bay watershed and barriers to migration as the primary threats and limiting factors for this species in Newfoundland. Since that assessment, post-forest harvest data suggest the abundance and distribution of Banded Killifish have increased in Indian Bay. Established buffer zones help minimize the risks to Banded Killifish associated with forest harvesting. Additional potential threats and limiting factors include introduction of invasive predators, and land use activities such as road development, mineral exploration and urban/cabin development. COSEWIC also identified issues, such as water temperature and availability of suitable habitat, but indicated that these are not likely limiting factors to Banded Killifish throughout most of the region.

The goal of this management plan is to maintain existing Banded Killifish population levels and distribution, and protect habitat within watersheds in which the species is found. This will be accomplished through surveys and monitoring on an opportunistic basis, development of site specific best management practices to protect habitat, reduction of by-catch mortality in the American eel fishery and increased public awareness and stewardship. Conservation and management measures for Banded Killifish in Newfoundland will be delivered through the cooperative efforts of Fisheries and Oceans Canada (DFO), the Government of Newfoundland and Labrador and their associates.

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1. SPECIES INFORMATION

1.1. Species Assessment Information from COSEWIC

Date of Assessment: May 2003

Common Name (population): Banded Killifish (Newfoundland Population)

Scientific Name: *Fundulus diaphanus*

COSEWIC Status: Special Concern

Reason for Designation: The population is separated from others by a major barrier to movement, i.e. 200 km of ocean. The Newfoundland population has a very limited area of occupancy. The possibility of range expansion is limited by steep gradients and impassible rapids and/or falls. Habitat degradation resulting from proposed logging would negatively impact the population in some areas.

Canadian Occurrence: Newfoundland

COSEWIC Status History: Last assessment based on updated status report

1.2. Description

The Banded Killifish is a member of the family Fundulidae, which contains five genera and approximately 48 species (Nelson, 1994). Of these, only *Fundulus diaphanus* and *F. heteroclitus* (Mummichog) are native to Newfoundland (Scott and Crossman, 1964, 1973; Houston, 1990). The Banded Killifish is divided into two subspecies; *Fundulus diaphanus diaphanus* (Lesueur), the eastern Banded Killifish, and *F. diaphanus menona* (Jordan and Copeland), the western Banded Killifish (Chippett, 2003), the former of which is found in Newfoundland.

The Banded Killifish has olive coloured sides with numerous vertical bands and a contrasting dark colouration across the dorsal region (see cover illustration). These vertical bands in females usually appear black in colour, are thin and distinct, and often do not appear to span the full width of the body. Males have pale, grey bands that are less distinct and closer together. Adult Banded Killifish are usually small, with mean length ranging from 73.2 mm (Freshwater Pond) to 91.9 mm (Loch Leven) within the Newfoundland population sampled (Chippett, 2004). A measurement of 128 mm taken from the Indian Bay watershed is likely the largest recorded length for the species (Chippett, 2003).

Banded Killifish can live to a maximum of 4 years of age and reach maturity at an age of 1+ years and at a length of approximately 60 mm (Carlander, 1969). These fish fertilize eggs

externally and spawn on plants. Females lay eggs equipped with adhesive threads that adhere to aquatic vegetation once released. Banded Killifish in the Indian Bay watershed were observed exhibiting spawning behaviour in late June through to the middle of August, when water temperatures reached 19-23°C (Chippett, 2003).

It should be noted that there are two species of Killifish in Newfoundland waters, the Banded Killifish (*Fundulus diaphanous*) and the Mummichog (*F. heteroclitus*). They are very similar in appearance and size and are often found schooling together. Due to these factors, it may be difficult to distinguish between them, leading to misidentification of the Banded Killifish species. This could potentially alter the results of surveys and population monitoring.

1.3. Populations and Distribution

Banded Killifish are distributed throughout eastern North America, extending as far south as South Carolina and as far north as the provinces of Atlantic Canada. Their westward distribution extends through the states of New York, Pennsylvania, and to southern Canada in the Great Lakes region as far west as the Yellowstone River in eastern Montana (Scott and Crossman, 1973; Houston, 1990). The Newfoundland population represents the easternmost extent of this species' range. The known locations where Banded Killifish occur in Newfoundland have been documented (Chippett, 2003) (Appendix 3, Fig. 1). The majority of these are clustered on the south and southwest coasts, with an outlier in the Indian Bay watershed in the northeast (Chippett, 2003). Genetic investigations indicate that the Newfoundland population does not differ genetically from mainland populations (Chippett, 2004).

Banded Killifish in Newfoundland are scattered over a wide range, but are frequently restricted to very confined regions within their respective watersheds. They appear to be locally abundant in the representative locations that were sampled (i.e. Indian Bay watershed, Loch Leven and Freshwater Pond). Although multi-year data is not available, population estimates from 1999 indicate that over 20,000 individuals exist in the Indian Bay watershed. Estimates are not available for other locations (Chippett, 2003). Additional population information, including catch per unit effort in three sites is outlined in Chippett (2004).

1.4. Needs of the Banded Killifish, Newfoundland population

1.4.1. Habitat and biological needs

Banded Killifish are a euryhaline species and are relatively poor swimmers with limited sustained and burst swim speeds (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.). Their preferred habitats are lakes, slow current areas of larger streams or rivers (Fritz and Garside, 1974, 1975), and quiet areas of estuaries (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.). Banded Killifish are most often observed in the shallows and quiet areas of clear lakes and ponds with a muddy or sandy substrate, high detrital content and abundant submerged aquatic vegetation (Trautman, 1957; Scott and Crossman, 1964, 1973; Houston, 1990). Qualitative examinations of lakes where this species occurs in Newfoundland are consistent with accounts describing Banded Killifish habitat

elsewhere. A full quantitative and qualitative description of Banded Killifish habitats sampled in Newfoundland is available in Chippett (2004). More recent observations of Banded Killifish indicate that their use of estuarine habitat in Newfoundland may be more important than previously thought (Chuck Bourgeois, Section Head, Salmonids, DFO, Newfoundland and Labrador Region, Pers. Comm.).

1.4.2. Ecological role

The Banded Killifish can feed at all levels within the ecosystem (Keast and Webb, 1966), but generally feed on benthos and to a lesser extent on flying insects (Chippett 2003, Scott and Crossman 1973). When locally abundant, Banded Killifish can be an important food source for piscivorous fish and birds. In Newfoundland, this would make them an important forage fish for larger species including Brook Trout (*Salvelinus fontinalis*), Atlantic Salmon (*Salmo salar*), American Eel (*Anguilla rostrata*), Brown Trout (*Salmo trutta*) and Rainbow Trout (*Onchoryncus mykiss*). Other predators include the Belted Kingfisher (*Megaceryle alcyon*) and Common Merganser (*Mergus merganser*) (White, 1953, 1957; Scott and Crossman, 1973).

1.4.3. Limiting factors

Documented locations of Banded Killifish in Newfoundland are fragmented and therefore there is little or no interaction among these groups. The nature of this distribution suggests that the Newfoundland population may be especially vulnerable to long-term catastrophic events or localized perturbations. However, Banded Killifish appear to have very high reproductive rates and relatively short population doubling times (Jones et al., 2008). This suggests that they may be resilient to short-term perturbations or catastrophic events such as heat or ice kills (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.).

Obstacles, such as steep river gradients and physical barriers (both natural and anthropogenic), prevent inland migration and access to additional suitable habitat. Suitable habitat, in terms of substrate type and aquatic vegetation, is thought to be abundant in Newfoundland (particularly in the central region) but may be inaccessible to this species due to these difficult migration routes. However, in some locations where Banded Killifish were restricted in distribution to one or two lakes (e.g. Indian Bay watershed), abundant suitable habitat in adjacent lakes linked by easily passable brooks and streams showed no evidence of Banded Killifish presence (Chippett, 2003).

Banded Killifish are often found in estuaries, using both brackish and fully marine habitats. This suggests some capacity for dispersal and migration between watersheds and along the coast (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.). Chippett (2003) suggests that this species has had little success in dispersing throughout the watersheds due to long stretches of deep, open water where predation by larger fish species would be substantially higher than would be the case in the weedy shallows.

COSEWIC (2003) indicated that suggested limiting factors, such as low water temperatures and the availability of suitable habitat (Gibson et al., 1984; Houston, 1990), are likely not limiting to Banded Killifish in Newfoundland. Spawning has been observed in the Indian Bay watershed at

temperatures of 19-23°C, a range which is available throughout most of the island (Chippett 2003). Chippett (2004) noted that suitable habitat, in terms of both substrate type and aquatic vegetation, is readily available throughout most regions of Newfoundland. However, while freshwater habitat may be abundant it lacks connectivity and this impacts distribution (Chuck Bourgeois, Section Head, Salmonids, DFO, Newfoundland and Labrador Region, Pers. Comm.). Banded Killifish can move along the coast but their ability to inhabit many watersheds is going to be determined by the velocity in the lower reaches of streams and whether there is suitable habitat in the estuaries. There are few estuaries around the coast of Newfoundland with low velocity, vegetation and a detritus bottom. This may therefore be a limiting factor for the species (Chuck Bourgeois, Section Head, Salmonids, DFO, Newfoundland and Labrador Region, Pers. Comm.).

1.5. Threats

1.5.1. Threat classification

Table 1 summarizes all known and suspected threats to the Banded Killifish, Newfoundland population. Assessment of threats allows for prioritization of recommended management and other actions to prevent this population from becoming threatened or endangered, and provides an indication of the feasibility for mitigation of a threat. Definitions of the terms used in the threat classification table are available in Appendix 1. It should be noted that although some activities may occur on a local basis, the specific threat associated may also have influence range-wide (relating to the whole distribution or a large portion of the range of the species). Further information related to the threats, stresses and mitigation measures is provided in Section 1.5.2 and Section 2.3.

Table 1. Threat Classification Table

Activity: Forest Harvest				
Threat Category	Habitat Loss or Degradation	Extent	Local	Range-wide
		Occurrence	Current	Current
Specific Threat	Increased Suspended Sediment Loads	Frequency	Continuous	Continuous
		Causal Certainty	Low	Low
		Severity	Low	Low
		Level of Concern	Low	
Stress	Decreased primary production; decreased feeding success for sight feeding species; increased mortality; damage to gills; increased susceptibility to disease and predation	Mitigation Potential	High	

Activity: Other Land Use/Development (road development/maintenance)				
Threat Category	Habitat Loss or Degradation	Extent	Local	Range-wide
		Occurrence	Current	Current
Specific Threat	Increased Suspended Sediment Loads	Frequency	Continuous	Continuous
		Causal Certainty	High	High
		Severity	High	High
		Level of Concern	High	
Stress	Decreased primary production; decreased feeding success for sight feeding species; increased mortality; damage to gills; increased susceptibility to disease and predation	Mitigation Potential	High	
Activity: Other Land Use/ Development (road development/maintenance)				
Threat Category	Habitat Loss or Degradation	Extent	Local	Range-wide
		Occurrence	Current	Current
		Frequency	Continuous	Continuous
		Causal Certainty	High	Medium
Specific Threat	Altered Water Flow Regime	Severity	High	Medium
		Level of Concern	Medium-High	
Stress	Increased mortality; increased susceptibility to disease, prey availability	Mitigation Potential	High	
Activity: Other Land Use/ Development (road development/maintenance)				
Threat Category	Habitat Loss or Degradation	Extent	Local	Range-wide
		Occurrence	N/A	Current
		Frequency	N/A	Continuous
		Causal Certainty	N/A	Low- Medium
Specific Threat	Impediments to Migration	Severity	N/A	Low- Medium
		Level of Concern	Low	
Stress	Habitat fragmentation; habitat conversion; isolation; increased susceptibility to predation	Mitigation Potential	Medium	

Activity: Other Land Use/ Development (road development/maintenance)				
Threat Category	Pollution	Extent	Local	Range-wide
		Occurrence	N/A	Current
		Frequency	N/A	Continuous
		Causal Certainty	N/A	Low-Medium
Specific Threat	Contamination (e.g. fluids from equipment, oil spills, run-off, etc.)	Severity	N/A	Low-Medium
		Level of Concern	Low-Medium	
Stress	Lower reproductive rates; increased mortality; increased susceptibility to disease and predation	Mitigation Potential	Medium-High	
Activity: Other Land Use/ Development (mineral exploration, urban/cabin development)				
Threat Category	Pollution	Extent	Local	Range-wide
		Occurrence	Current	Current
		Frequency	Recurrent	Recurrent
		Causal Certainty	Medium-High	Low
Specific Threat	Contamination (e.g. fluids from equipment, oil spills, run-off, etc.)	Severity	Low-Medium	Low
		Level of Concern	Medium	
Stress	Lower reproductive rates; increased mortality; increased susceptibility to disease and predation	Mitigation Potential	Medium-High	
Activity: Harvest for Bait				
Threat Category	Biological Resource Use	Extent	Local	Range-wide
		Occurrence	Current	N/A
		Frequency	Seasonal	N/A
		Causal Certainty	Low	N/A
Specific Threat	Direct Catches; Use as Bait	Severity	Medium	N/A
		Level of Concern	Low	
Stress	Mortality	Mitigation Potential	Unknown	
Activity: Commercial Fishing				
Threat Category	Accidental Mortality	Extent	Local	Range-wide
		Occurrence	Current	N/A
		Frequency	Seasonal	N/A
		Causal Certainty	Medium	N/A

Specific Threat	By-catch in American Eel Fishery	Severity	Low	N/A
		Level of Concern	Low-Medium	
Stress	Mortality	Mitigation Potential	High	
Invasive Species				
Threat Category	Invasive Species – Brown Trout, Rainbow Trout	Extent	Local	Range-wide
		Occurrence	Unknown	Unknown
		Frequency	Unknown	Unknown
		Causal Certainty	Unknown	Unknown
Specific Threat	Predation	Severity	Unknown	Unknown
		Level of Concern	Unknown	Unknown
Stress	Mortality	Mitigation Potential	Unknown	Unknown

1.5.2. Description of threats

COSEWIC (2003) identified potential forestry impacts as a primary anthropogenic threat to Banded Killifish in Newfoundland. While little in the way of forest harvesting is currently occurring on the south and southwest coasts in the areas around Banded Killifish locations, much of the area surrounding several lakes in the Indian Bay watershed was scheduled for clear cutting (Chippett, 2003). Such activities (including associated forest road construction), if not properly mitigated, have the potential to increase suspended sediment loads in adjacent waterbodies. Associated impacts of increased suspended sediment include reductions in invertebrate abundances, decreased feeding success for sight-feeding species, and dislocation and mortality of early life stages (Miller, 1981). Sediments can suffocate aquatic vegetation, thus decreasing primary production (Waters, 1995). Suspended sediments can also damage fish gills causing injury, mortality and increased susceptibility to disease and predation (Gosse et. al., 1998). Desgagne and Lalancette (1984) indicated that Banded Killifish forage based on visual perception, while Richardson (1939) stated that this species makes use of aquatic vegetation in their reproductive cycle. As such, forestry activities that result in increased sedimentation in adjacent waterbodies may have a negative impact on Banded Killifish if not properly mitigated. In the Indian Bay watershed, substantial buffers have been established on most of the watershed and lakes of primary Banded Killifish locations have 500m-1km buffers (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.).

Banded Killifish are rarely found in first and second order streams (even those with a low to moderate gradient) and the interaction between forest harvest activities and aquatic ecosystems occurs primarily in first to third order streams. Thus, most forest harvest activities in the province of Newfoundland and Labrador do not interact with Banded Killifish habitat (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.). The limited short-term studies of forest harvest activities, as practiced in the province of Newfoundland and

Labrador, indicate that these activities do not seem to create a sustained change in water quality (Scruton et al., 1995; Wells, 2002). Existing buffer zone guidelines as specified in Environmental Protection Plans and DFO habitat policy help ensure that any aquatic impacts are minimal and short-term (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.).

Many land use activities have the potential to negatively impact Banded Killifish habitat. These include road developments (especially those that involve watercourse crossings), mineral exploration and urban/cabin development. Such activities can result in direct habitat destruction, increased sedimentation, contamination, altered water flow regimes and impediments to migration, if not properly mitigated.

A potential, yet unquantified, threat to this species includes recreational fishing, which may impact the population through direct catches or use as bait. However, this threat is not considered to be significant. Banded Killifish are also caught as by-catch in commercial American Eel fisheries, particularly in southwest Newfoundland (Derek Tobin, Resource Management, DFO, Newfoundland and Labrador Region, Pers. Comm.). In 2006, the Mi'kmaq Alsumk Mowimsikik Koqoey Association (MAMKA) attempted to quantify this threat for both eel fyke nets and baited eel pots in the Bay St. George region. While this research confirmed that Banded Killifish are a common by-catch species in the commercial Eel fishery, observed mortality for the species was below 1%. As such, MAMKA (2006) concluded that the Eel fishery did not pose a major threat to the conservation of Banded Killifish.

The presence of two invasive predator species, i.e. the Brown Trout (*Salmo trutta*) and Rainbow Trout (*Onchoryncus mykiss*), has been documented and these species appear to be expanding their distributions (Brown Trout on the east coast and Rainbow Trout on the west coast) (Van Zyll de Jong et al. 2004; Westley et al. 2007). Both species make heavy use of estuarine habitat during anadromous migrations and may have an impact on Banded Killifish in brackish and freshwater areas. The presence of these species represents a permanent change to the ecosystem (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.).

1.6. Actions Already Completed or Underway

The only focused monitoring program for Banded Killifish in Newfoundland was initiated by the Government of Newfoundland and Labrador Wildlife Division in 1994, and was conducted in partnership with Memorial University of Newfoundland and the Indian Bay Ecosystem Corporation. These efforts produced an indication of Banded Killifish presence and some critical information on habitat and distribution. In 1998, these same three organizations partnered to support a graduate research project, which applied a more intensive sampling program to provide necessary information to answer several key questions concerning the biology of all Newfoundland populations. Details regarding the methodology and results of this research are outlined in Chippett (2004).

1.7. Knowledge Gaps

Chippett (2003) documented locations of Banded Killifish in Newfoundland (Appendix 3, Fig. 1). However, recent findings suggest a more extensive distribution. Banded Killifish surveys carried out by MAMKA in Bay St. George during 2006 identified additional sites where Banded Killifish were present (MAMKA, 2006). While many of these sites may be considered part of a single catchment, these surveys suggest a wider distribution than that previously documented. MAMKA (2010) also reports further findings of Banded Killifish in the Bay St. George's area as well as the Bay of Islands and Exploits Bay areas.

In 2006, Banded Killifish were identified in coastal lagoons near the community of York Harbour, in the Bay of Islands (Derek Osborne, SARA Coordinator, DFO, Newfoundland and Labrador Region, Pers. Comm.). Photos and samples support the presence of additional locations in both Garnish Pond (Jerry Walsh, Chief of NAFO Compliance and Offshore Operations, DFO, Newfoundland and Labrador Region, Pers. Comm.) and Spanish Room (Laura Park, Oceans Biologist, DFO, Newfoundland and Labrador Region, Pers. Comm.) on the Burin Peninsula. Anecdotal information also suggests potential sites in the Main Brook area on the Great Northern Peninsula, First Pond in the Port aux Basques region and Star Lake in Central Newfoundland (Chippett, 2004). Banded Killifish have also been reported from Burton's Pond in St. John's and are likely an introduced population (Chuck Bourgeois, Section Head, Salmonids, DFO, Newfoundland and Labrador Region, Pers. Comm.) Further surveys throughout the island may reveal other previously undocumented locations.

Fish surveys carried out in Notre Dame and Beothuk Provincial Parks, various sites on the Avalon Peninsula (including the Winterton and Hants Harbour areas), Mint Brook (Gambo), various lakes in Gros Morne and Terra Nova National Parks, Millertown, Main Brook and several additional lakes in the Indian Bay Watershed did not result in any observations of Banded Killifish (Chippett, 2004).

Chippett (2003) noted anecdotal evidence which suggests that the Banded Killifish located in the Indian Bay watershed may be the result of an introduction by anglers using Banded Killifish as bait. Indeed, anglers from the Maritime Provinces using "minnows" as live bait have traditionally fished in Backup and Third Ponds, where Banded Killifish have been recorded. While this may be impossible to substantiate, this potential introduction may explain the presence of a disjunct location in the northeast.

2. MANAGEMENT

Section 65 of the *Species at Risk Act* states that "The [management] plan must include measures for the conservation of the species that the competent minister considers appropriate..." The goal, objectives and actions for this management plan are described below.

2.1. Goal

The Newfoundland population of Banded Killifish has been designated as special concern under SARA and vulnerable under the NL ESA due to its limited area of occupancy, separation from other populations and limited potential for range expansion. The Newfoundland population is vulnerable to long-term catastrophic events or localized perturbations. However, three areas surveyed (Indian Bay, Loch Leven and Freshwater Pond) indicate that Banded Killifish are locally abundant (Chippett, 2003).

Given that this species has been listed by both federal and provincial legislation because of limited natural distribution patterns rather than documented population decrease, the primary goal for the management of the Newfoundland population of Banded Killifish is:

- **Maintain existing Banded Killifish population levels and distribution, and protect habitat within watersheds in which this species is found.**

2.2. Objectives

This management plan includes the following objectives:

- 1) **Conduct surveys and population monitoring;**
- 2) **Develop site-specific best management practices to ensure habitat protection;**
- 3) **Reduce by-catch mortality in the American Eel fishery; and**
- 4) **Increase public awareness and stewardship.**

2.3. Actions

2.3.1. Protection

The federal *Fisheries Act* provides for the protection of Banded Killifish habitat through Section 35 (1), which states “*No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat*”. Fish habitat is defined by Section 34 (1) as “*spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes*”.

Similarly, Section 28 of the NL ESA allows the Minister, by order, to set aside and specify prohibited activities within an area of land defined as “recovery habitat” (which is defined in s. 2 (j) as *habitat that is necessary for the recovery of a species*) or “critical habitat” (which is defined in s.2 (c) as *habitat that is critical to the survival of a species*) for a vulnerable species.

The full utilization of such legislative prohibitions for the protection of this species requires the delineation of known Banded Killifish habitat in Newfoundland. Indeed, Section 28 (2) of the NL ESA specifies that “*the boundaries of the area shall be set out in the order by publishing a description of the area*”. For these legislative tools to be fully effective, population distribution information must be known and distributed to the appropriate jurisdictional authorities (i.e. DFO and the Government of Newfoundland and Labrador) to ensure Banded Killifish habitat needs are addressed through appropriate land use planning and federal and provincial permitting mechanisms.

Banded Killifish management concerns will be addressed on a case by case basis. Once development or harvesting activities are identified within a watershed known to contain this species, federal and provincial governments will be responsible for identifying concerns regarding the Banded Killifish and informing the proponent, pursuant to their respective legislative requirements. These governments will work with the proponent to develop site-specific best management practices to ensure that the viability of the Banded Killifish population is maintained. Gosse *et. al.* (1998) provides a summary of potential best management practices that may be implemented to protect Banded Killifish habitat. For certain routine projects that pose little risk to Banded Killifish habitat, DFO has developed Operational Statements that outline recommended mitigative measures. These low risk projects may proceed without a DFO review when all the conditions and *Measures to Protect Fish and Fish Habitat* found within the applicable Operational Statement are met. Refer to Appendix 4 for a complete list of Operational Statements developed for low risk habitat-related activities in the Newfoundland and Labrador Region.

In the case of the Indian Bay watershed, where forest harvesting activities are of greater concern than in other locations, DFO in collaboration with the Forestry sector will ensure best management practices (e.g. appropriate buffer zones) are included within the Sustainable Forest Management Plans prepared by landholders with tenure in the watershed. As the Indian Bay watershed is also a public protected water supply area, buffer zones widths and pesticide use are subject to more stringent policy guidelines [i.e. Policy for Land and Water Related Developments in Protected Public Water Supply Areas (Khan 1995)] as compared to other forested lands. Also, the buffers identified in Gosse *et. al.* (1998) are the minimum allowed by the provincial Department of Natural Resources (DNR) Environmental Protection Plans. As noted in Section 1.5.2., substantial buffers have been established on most of the Indian Bay watershed and lakes of primary Banded Killifish locations have 500m-1km buffers (Blair Adams, Regional Ecologist, Department of Natural Resources, Pers. Comm.).

2.3.2. Management

As noted in Section 1.5.2, Banded Killifish are a by-catch species in commercial American Eel fisheries. MAMKA (2006) concluded that the Eel fishery did not pose a major threat to the conservation of Banded Killifish. They did, however, recommend that four steps be taken to ensure low mortality in those Banded Killifish taken as by-catch:

- Remove by-catch from gear and return it to the water as soon as possible;

- Minimize exposure to air;
- Avoid touching the gills and eyes; and
- Avoid handling the fish with dry hands/gloves.

Working cooperatively with MAMKA, DFO and the Government of Newfoundland and Labrador will promote the conservation of Banded Killifish. This will include efforts to reduce by-catch in the Eel fishery and encouraging best management practices in fishery management activities.

2.3.3. Research

Surveys to identify additional Banded Killifish locations will be conducted opportunistically as part of other aquatic species survey and monitoring work within DFO and the Government of Newfoundland and Labrador. Researchers and field staff will be encouraged to look for and report Banded Killifish whenever possible. Data collected on Banded Killifish, particularly distribution and population information, will be shared among jurisdictions for their specific management purposes.

2.3.4. Monitoring and assessment

Known locations of Banded Killifish will be monitored opportunistically as part of other aquatic species survey and monitoring work within DFO and the Government of Newfoundland and Labrador over time to better determine long-term population trends. A standardized, practical and cost-effective monitoring protocol will be developed by the Government of Newfoundland and Labrador Wildlife Division (with the cooperation of DFO where applicable) that will be utilized by management agencies and others to track the population.

Any surveys conducted to identify and monitor Banded Killifish should include provisions for the identification and reporting of Mummichog, given the close similarity between the two species and the potential for misidentification.

2.3.5. Outreach and communication

Increased public awareness of the Banded Killifish will play a vital role in the conservation of this species. Public education programs administered through DFO, the provincial government, and others are being utilized to heighten awareness of the Banded Killifish throughout the region. A Communications Strategy has been developed and implementation of outreach activities has already started.

3. PROPOSED IMPLEMENTATION SCHEDULE

DFO encourages other agencies and organizations to participate in the conservation of the Banded Killifish through the implementation of this management plan. Table 2 summarizes those actions that are recommended to support the management goals and objectives. The activities implemented by DFO will be subject to the availability of funding and other required resources. Where appropriate, partnerships with specific organizations and other sectors will be encouraged. Such collaboration may provide the necessary expertise and capacity to implement the suggested actions. Further discussions with potential partners are needed. This management plan recognizes that participating in the implementation of recommended activities is subject to each agency's priorities and budgetary constraints.

Table 2. Proposed Implementation Schedule

Action	Priority	Threats or concerns addressed	Participating Agencies	Timeline
Obj 1: Surveys and population monitoring				
<u>Monitoring</u> <ul style="list-style-type: none"> Development of monitoring protocols. 	Moderate	Increased sediment loads; Contamination; Altered water flow regime; Impediments to migration.	Dept. of Environment and Conservation, Fisheries and Oceans Canada	To be determined by the Dept. of Environment and Conservation
<u>Survey</u> <ul style="list-style-type: none"> Population surveys to identify additional Banded Killifish locations. 	Moderate	Knowledge of distribution	Fisheries and Oceans Canada, Dept. of Environment and Conservation	To be implemented as part of other aquatic species surveys and monitoring

<u>Obj 2: Development of site specific best management practices to ensure habitat protection</u>				
<u>Threat assessment and mediation</u> <ul style="list-style-type: none"> • Circulate Banded Killifish distribution information to jurisdictional authorities and land managers. • Develop site-specific best management practices as necessary. 	High	Increased sediment loads; Contamination; Altered water flow regime; Impediments to migration; Direct catches; Use as bait; Knowledge of distribution	Fisheries and Oceans Canada, Dept. of Environment and Conservation, Dept. of Natural Resources	Ongoing
<u>Obj 3 : Reduce by-catch mortality in the American Eel fishery</u>				
<u>Threat mediation</u> <ul style="list-style-type: none"> • Include mandatory by-catch release in Eel license conditions and future fisheries management plans. 	Moderate	By-catch in American Eel fishery.	Fisheries and Oceans Canada, Dept. of Environment and Conservation, MAMKA	Ongoing
<u>Obj 4: Increase public awareness and stewardship</u>				
<u>Outreach</u> <ul style="list-style-type: none"> • Distribute Banded Killifish ID cards. • Develop Factsheet. • Promote Banded Killifish conservation during outreach events. • Implement Communications Strategy. 	High	Need for public awareness and targeted outreach.	Fisheries and Oceans Canada, Dept. of Environment and Conservation, MAMKA	Ongoing

The success of the management actions will be reviewed annually, while the goals, objectives and actions outlined herein will be reported on within five years of posting the Management Plan on the Species at Risk Public Registry. The following performance measures will be used to assess the effectiveness of the objectives and management actions:

- Where opportunities have been present, have surveys and monitoring of Banded Killifish been completed?
- Has information regarding the biology, threats and distribution of Banded Killifish been shared with those responsible for land use planning and project referral reviews?
- Have Banded Killifish concerns been incorporated into land use planning and the project referral review process?
- Has information regarding the impact of by-catch in American Eel fisheries been considered in fisheries management plans, license conditions and fisher educational programs?

- Has a communications strategy been implemented?

4. ASSOCIATED PLANS

In 2002, the Newfoundland Population of Banded Killifish were listed as vulnerable under the *Newfoundland and Labrador Endangered Species Act*. As a result of this listing, a draft provincial Management Plan for Banded Killifish in Newfoundland (Osborne *et al*, 2006) was written and has been posted on the provincial website.

There are numerous watershed-based management plans and initiatives that could have an impact on the Banded Killifish including site-specific best management practices, Sustainable Forest Management Plans prepared by landholders with tenure in a watershed and the provincial Policy for Land and Water Related Developments in Protected Public Water Supply Area.

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6. CONTACTS

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APPENDIX 1: TERMINOLOGY USED IN THREAT CLASSIFICATION TABLE

The attributes of each threat are important for understanding how the threat acts upon the Banded Killifish Newfoundland population and provides an indication of where measures may be used to manage or mitigate the threat. Terms were adapted from the Environment Canada ‘Guideline for identifying and mitigating threats to species at risk’ (Environment Canada 2008).

Extent – Indicate whether the activity is local (indicates threat information relates to a specific site or narrow portion of the range of the species) or range-wide (indicates threat information relates to the whole distribution or large portion of the range of the species).

Occurrence – Indicate whether the activity is historic (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 (no known information) or N/A (not applicable). If applicable, also indicate whether the occurrence differs between ‘local’ populations, or smaller areas of the range, and the full ‘range-wide’ distribution.

Frequency – Indicate whether the activity is a one-time occurrence, seasonal (either because the species is migratory or the threat only occurs at certain times of the year – indicate which season), continuous (on-going), recurrent (reoccurs from time to time but not on an annual or seasonal basis), or unknown. If applicable, also indicate whether the frequency differs between ‘local’ populations, or smaller areas of the range, and the full ‘range-wide’ distribution.

Causal certainty – Indicate whether the best available knowledge about the specific threat and its impact on population viability is high (evidence causally links the threat to stresses on population viability), medium (correlation between the threat and population viability, expert opinion, etc), or low (assumed or plausible threat only). This should be a general reflection of the degree of evidence that is known for the threat, which in turn provides information on the risk that the threat has been misdiagnosed. If applicable, also indicate whether the level of knowledge differs between ‘local’ populations, or smaller areas of the range, and the full ‘range-wide’ distribution.

Severity – Indicate whether the level of severity of the specific threat is high (very large population-level effect), medium, low, or unknown. If applicable, also indicate whether the severity differs between ‘local’ populations, or smaller areas of the range, and the full ‘range-wide’ distribution.

Level of concern – Indicate whether managing the specific threat is an overall high, medium, or low concern for recovery of the species, taking into account all of the above factors. This may take into account the ability to mitigate or eliminate the threat.

Mitigation Potential – Indicate whether mitigation for the specific threat in relation to the activity is high (mitigation measures are already in place and/or mitigation measures are known), medium (there is a possibility of mitigation measures and/or mitigation measures are

recommended), low (no known mitigation measures and/or no mitigation measures in place), or unknown (data deficient).

APPENDIX 2: RECORD OF COOPERATION AND CONSULTATION

The management plan for Banded Killifish in Newfoundland was developed through the cooperative efforts of DFO and the Government of Newfoundland and Labrador to meet both federal and provincial legislative requirements.

Several drafts of the document have been reviewed by various DFO sectors in the Newfoundland and Labrador Region, staff from the Government of Newfoundland and Labrador's Departments of Environment and Conservation and Natural Resources and staff from Parks Canada Agency.

This management plan was also provided to the Federation of Newfoundland Indians and Miawpukek First Nation for their review and comments. The Federation of Newfoundland Indians indicated that they had no issues or concerns with the management plan. The Miawpukek First Nation indicated that they fully support the plan and have no comments or suggestions with respect to its contents.

All input received was taken into consideration during the development of the proposed management plan.

APPENDIX 3: FIGURE

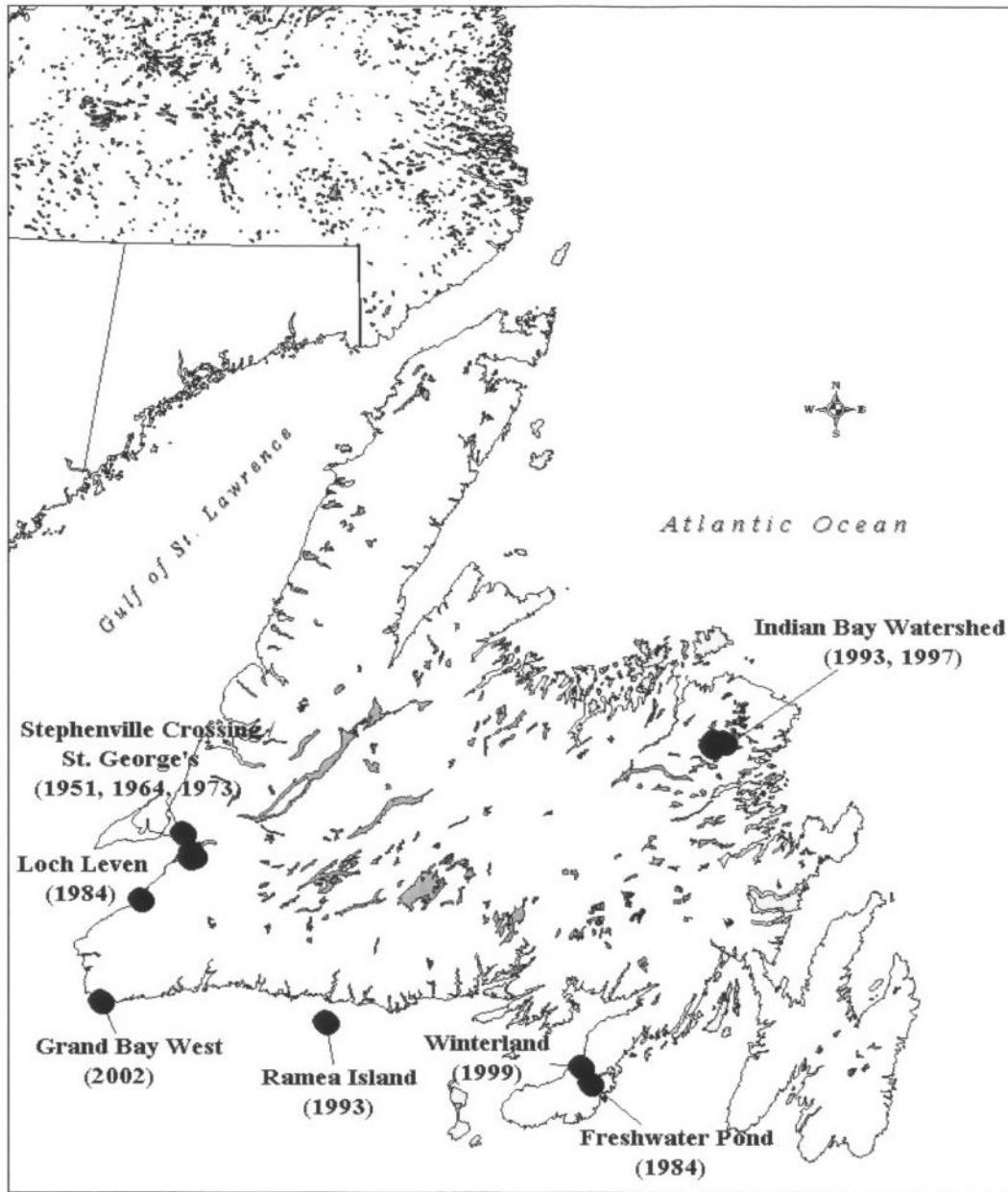


Figure 1, Newfoundland distribution of Banded Killifish (year of record in parentheses) (Chippett, 2003)

APPENDIX 4: OPERATIONAL STATEMENTS

The following is a list of Operational Statements which have been developed for certain low risk fish habitat related activities in Newfoundland and Labrador. These Operational Statements may be downloaded from the DFO internet site at: www.dfo-mpo.gc.ca/oceans-habitat/habitat/modernizing-moderniser/epmp-pmpe/nl/index_e.asp

Aquatic Vegetation Removal

Beach Creation

Beaver Dam Removal

Bridge Maintenance

Clear Span Bridges

Cottage Lot Development

Culvert Maintenance

Dock and Boathouse Construction

High Pressure Directional Drilling

Ice Bridges and Snow Fills

Isolated Pond Construction

Maintenance of Riparian Vegetation in Existing Rights-of-Way

Moorings

Overhead Line Construction

Public Beach Maintenance

Punch and Bore Crossing

Routine Maintenance Dredging

Submerged Log Salvage

Temporary Stream Crossing

Underwater Cables