

Management Plan for the Harlequin Duck (*Histrionicus histrionicus*) Eastern Population, in Atlantic Canada and Québec

Harlequin Duck, Eastern Population



February 2007



Environment
Canada

Environnement
Canada

Canada

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 (www.sararegistry.gc.ca/the_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 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 SARA Public Registry (www.sararegistry.gc.ca/) and the Web site of the Recovery Secretariat (www.speciesatrisk.gc.ca/recovery/default_e.cfm).

**Management Plan for the Harlequin Duck (*Histrionicus histrionicus*)
Eastern Population, in Atlantic Canada and Québec [Proposed]**

February 2007

Recommended citation:

Environment Canada. 2007. Management Plan for the Harlequin Duck (*Histrionicus histrionicus*) Eastern Population, in Atlantic Canada and Québec [Proposed]. *Species at Risk Act* Management Plan Series. Environment Canada. Ottawa. vii + 32 pp.

Additional copies:

Additional copies can be downloaded from the SARA Public Registry (www.sararegistry.gc.ca/)

Cover illustration: Harlequin Duck pair © Peter Thomas, CWS-NL, 2004

Également disponible en français sous le titre
« Plan de gestion de l'Arlequin plongeur (*Histrionicus histrionicus*), population de l'Est, au
Canada atlantique et au Québec [Proposition] »

© Her Majesty the Queen in Right of Canada, represented by the Minister of the Environment,
2007. All rights reserved.

ISBN *To come*

Cat. no. *To come*

*Content (excluding the illustrations) may be used without permission, with appropriate credit to
the source.*

DECLARATION

This management plan has been prepared in cooperation with the jurisdictions responsible for the Harlequin Duck, Eastern population, in Atlantic Canada and Québec. Environment Canada has reviewed and accepts this document as its management plan for the Harlequin Duck, Eastern population, as required under the *Species at Risk Act*. This management plan also constitutes advice to other jurisdictions and organizations that may be involved in recovering the species.

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 Environment Canada or any other jurisdiction alone. In the spirit of the Accord for the Protection of Species at Risk, the Minister of the Environment invites all responsible jurisdictions and Canadians to join Environment Canada in supporting and implementing this plan for the benefit of the Harlequin Duck, Eastern population and Canadian society as a whole. The Minister will report on progress within five years.

RESPONSIBLE JURISDICTIONS

Environment Canada:

Canadian Wildlife Service – Atlantic Region (lead)
Canadian Wildlife Service – Québec Region

Parks Canada:

National Office, Gatineau
Parks Canada, Mainland Nova Scotia Field Unit

New Brunswick:

Renewable Resources Division
Department of Natural Resources

Newfoundland & Labrador:

Department of Environment and Conservation
Inland Fish and Wildlife Division

Nova Scotia:

Wildlife Division
Department of Natural Resources

Prince Edward Island:

Dept. of Environment, Energy and Forestry

Québec:

Ministère des Ressources naturelles et de la Faune
Direction générale du Développement de la faune

AUTHOR

The Management Plan was prepared by Peter W. Thomas.

ACKNOWLEDGMENTS

I would like to thank all the jurisdictional representatives from the five eastern Provinces that contributed to the development of this Management Plan. Additionally, thank you to Parks Canada and the NGOs and participating aboriginal groups that include the Innu Nation, the Nunatsiavut Government, and the Mi'kmaq of Maritime Canada who contributed to the development and writing of this document.

PREFACE

The Harlequin Duck is a migratory bird covered under the *Migratory Birds Convention Act, 1994* and is under the management jurisdiction of the federal government. The Species at Risk Act (SARA, Section 65) requires the competent minister to prepare management plans for listed special concern species. The Harlequin Duck was listed as Special Concern in May 2001. Canadian Wildlife Service – Atlantic Region, Environment Canada led the development of this Management Plan. All responsible jurisdictions reviewed and approved the plan. The proposed plan meets SARA requirements in terms of content and process (Sections 68-70). It was developed in cooperation or consultation with:

- Responsible jurisdictions - Environment Canada (Atlantic and Québec Regions), Parks Canada, Newfoundland and Labrador Department of Environment and Conservation, Nova Scotia Department of Natural Resources, New Brunswick Department of Natural Resources, Prince Edward Island Department of Environment, Energy and Forestry, and the Ministère des Ressources naturelles et de la Faune du Québec.
- Aboriginal groups throughout Newfoundland and Labrador, and Maritime Canada.
 - Nunatsiavut Government
 - Innu Nation
 - Mi'kmaq of Maritime Canada
- Private Sector - Representatives from local naturalists
 - Ian Goudie
 - Paul Linegar
 - Bruce Mactavish

This will be the first Management Plan posted on the SARA Public Registry for the Harlequin Duck. At this time the long term conservation of the species will be implemented in a single-species approach, as there are no other listed species at risk that occupy comparable habitat and a multi-species approach would not be appropriate. However, the conservation and long-term health of the Harlequin Duck population may enhance conservation and awareness of other species.

This Management Plan contains actions toward Harlequin Duck conservation for Atlantic Canada and Québec only. No management actions have been included for Nunavut Territory due to the need for further consultation. A modified Management Plan will be issued to incorporate Nunavut management actions once further consultation is completed.

EXECUTIVE SUMMARY

In 1990 the Harlequin Duck - Eastern population (*Histrionicus histrionicus*) was designated as an Endangered Species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This designation was based on low population estimates and localized decreases in the number of birds at several of the known wintering areas in eastern North America. Since its listing in 1990, our knowledge of the species has improved through increased research, inventory and monitoring. In 2001, the Harlequin Duck (Eastern population) was reassessed by COSEWIC and was downlisted to a species of Special Concern. COSEWIC cited the increasing population at 4 key wintering locations (Thomas and Robert 2001), and the identification of another wintering population in southwest Greenland that had North American affiliations as the reason for downlisting. The eastern North American wintering population of Harlequin Duck is considered by the Species at Risk Act (SARA) legal species list to be one population.

Harlequin Ducks are now listed under the Species at Risk Act Schedule 1 legal species list as a species of Special Concern. Harlequin Ducks are listed as Endangered in New Brunswick, Endangered in Nova Scotia, and Vulnerable in Newfoundland and Labrador under their respective Endangered Species Acts. Québec listed the Harlequin Duck as a species susceptible to listing as endangered or vulnerable under Québec's *Loi sur les espèces menacées ou vulnérables*. The Harlequin Duck is presently not listed in Prince Edward Island.

In 1995, a Harlequin Duck Recovery Plan was completed to provide guidance on recovery priorities for the eastern population of Harlequin Duck. The plan's initial goal was to achieve a sustained population of 2000 individuals wintering within eastern North America for at least three of five consecutive years (Montevecchi et al. 1995). Although population levels are increasing at four key wintering locations in eastern North America (Thomas and Robert 2001), the eastern North American wintering population has still not met the goals outlined in the 1995 Recovery Plan. The generally accepted population estimate for the eastern North American wintering population is 1800 individuals (Mittelhauser 2000, Thomas and Robert 2001, Robertson and Thomas *in press*). Winter surveys in 2005 would seem to suggest that the population for the eastern North American wintering population is above 2000 individuals (A. Boyne and P. Thomas, pers. comm.).

In following with the priorities of the original Recovery Plan, the goal for the Management Plan is to maintain a wintering population of 3000 Harlequin Ducks in eastern North America for three consecutive years. To meet this goal, the Management Plan has established a series of objectives and actions meant to address maintaining population levels and protecting important habitat.

Assessing population numbers is regarded as a high priority for this Plan. Refining present monitoring programs to ensure they reflect a comprehensive view of the Harlequin Duck population is a priority. Additionally, a more complete understanding of the threats to the species will be imperative. The threats to Harlequin Ducks are wide ranging, and the impact of these threats may vary from one part of the Harlequin Duck's range to another. This plan recommends that a comprehensive threat assessment be completed to more definitively assess these threats and to develop an approach for addressing and mitigating their impacts.

SARA requires that Management Plans, which outline conservation measures, be developed for Special Concern species and their habitat. It specifies that such plans are to be developed in collaboration and consultation with all levels of government, aboriginal groups and stakeholders. This plan reflects the document requirements as indicated by section 65 of the Species at Risk Act.

This plan is a cooperative document that has benefited from the input of multiple jurisdictions, stakeholders and interested groups. While the federal government has primary legislative jurisdiction over the species, most of the habitat is under the legislative jurisdiction of provincial governments. The Canadian Wildlife Service will function in a coordination role to maximize benefits from the efforts of programs and participants towards the management of the Harlequin Duck.

TABLE OF CONTENTS

DECLARATION	i
RESPONSIBLE JURISDICTIONS.....	i
AUTHOR.....	ii
ACKNOWLEDGMENTS.....	ii
PREFACE.....	iii
EXECUTIVE SUMMARY	iv
TABLE OF CONTENTS	vi
SPECIES INFORMATION	1
1. INTRODUCTION	1
2. BACKGROUND	2
2.1 Population Ecology	2
2.2 Threats to populations and their habitats.....	4
2.2.1 Pollution:	5
2.2.2 Habitat Loss or Degradation	5
2.2.5 Accidental Mortality:.....	6
2.2.6 Aquaculture.....	6
2.2.7 Disturbance and Persecution:.....	7
2.2.8 Consumptive Use:	7
2.3 Monitoring history	7
2.4 Knowledge gaps	9
2.5 Recommended approach / Scale for management	9
3. MANAGEMENT	10
3.1 Population Goal	10
3.2 Objectives	10
4. MANAGEMENT ACTIONS.....	11
4.1 Population Management.....	11
4.1.1 Issue explanation and description	11
4.1.2 Actions	12
4.2 Habitat protection.....	12
4.2.1 Issue explanation and description	12
4.2.2 Actions	13
4.3 Research	14
4.3.1 Issue explanation and description	14

4.3.2 Actions..... 14

4.4 Socio-politics and Communications..... 14

4.4.1 Issue explanation and description 14

4.4.2 Actions..... 15

5. EVALUATION 16

6. SUMMARY TABLE - MANAGEMENT 17

7. IMPLEMENTATION SCHEDULE 23

8. REFERENCES 26

9. RESPONSIBLE JURSDICTIONS - CONTACTS 30

APPENDIX 1 - MAP..... 32

SPECIES ASSESSMENT INFORMATION FROM COSEWIC

Date of Assessment: May 2001

Common Name: Harlequin Duck (eastern population)

Scientific Name: *Histrionicus histrionicus*

COSEWIC Status: Special Concern

Reason for Designation: The population size of this sea duck is relatively small, but substantially larger than previously thought. Their tendency to congregate in relatively large groups when moulting and wintering makes them susceptible to catastrophic events such as oil spills.

Canadian Occurrence: Nunavut, Québec, New Brunswick, Nova Scotia, Newfoundland and Labrador.

COSEWIC Status History: The Eastern population was designated Endangered in April 1990. Status re-examined and designated Special Concern in May 2001. Last assessment based on an update status report.

1. INTRODUCTION

Status: In 2001 the Harlequin Duck (*Histrionicus histrionicus*) was downlisted from Endangered to Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). While the western Canadian population of the Harlequin Duck persists with a larger population size, concern was raised for the eastern population in the 1980s, based around a reduced population size (Goudie 1990). Subsequent study of the species' movement patterns and population distribution determined that the numbers were higher and the species more widely distributed than originally believed. Due to their wide distribution during the breeding season, it has been determined that population monitoring is more effective at moulting and wintering locations where Harlequin Ducks are known to regularly and consistently congregate. Research efforts over the past 15 years have determined two primary wintering areas for the eastern Canadian breeding population of the Harlequin Duck – the southwest coast of Greenland to be hereby referred to as the Greenland wintering population, and the eastern coast of North America ranging from Maryland, USA to southern Newfoundland to be hereby referred to as the eastern North American wintering population.

Reason for Status: Despite the downlisting in 2001 to Special Concern, the population of the eastern North American wintering population is still low relative to other waterfowl species. Considering the gregarious nature of the species, these relatively low population numbers warrant the recognition of a species of Special Concern.

Further information: The most comprehensive summary to date on the status of the Harlequin Duck is found in the 2001 COSEWIC status report (Thomas and Robert 2001). For the purposes of this Management Plan status information will only be referenced in a limited manner within this document to allow more concentration on management issues. For more comprehensive status information, refer to Thomas and Robert (2001).

2. BACKGROUND

2.1 Population Ecology

The Harlequin Duck (Eastern population) breeds on inland rivers and streams from northern New Brunswick north to Nunavut, and winters in coastal areas from Newfoundland, south to Maryland, as well as southwest Greenland. Breeding habitat includes fast flowing river systems that may vary in width across the species range. In northern Labrador narrower, warmer and less acidic rivers are preferred (Rodway 1998). Multiple factors may impact river selection including acidity, physical features, food availability (Rodway 1998), and predator distribution (Heath 2001). Wintering habitat consists of rocky coastline, exposed headlands, and subtidal ledges (see Robertson and Goudie 1999). Harlequin Ducks are also regularly associated with offshore islands.

Population trends are not available for the breeding population of eastern North America. The population has not been consistently nor systematically surveyed for a sufficient period to provide trends. Local aboriginal knowledge from Innu elders of Davis Inlet (N55° 53.3', W 60° 54.5') suggested that Harlequin Duck populations in central Labrador declined considerably in the 1980s and early 1990s (Ryan 1994, Thomas 2001). Additionally, the Greenland wintering population trend is also unknown. Only one completed survey has been conducted at Greenland moult sites in July and August of 1999. No previous or subsequent surveys were completed. The data is insufficient to generate a population size estimate, however a series of extrapolations estimated 5000–10 000 moulting individuals (Boertmann and Mosbech 2002). The extent of the affiliation with Harlequin Ducks breeding in Canada is unknown, but may be important.

Satellite telemetry studies determined that Harlequin Ducks that bred in northern Québec and northern Labrador migrated to the southwest coast of Greenland to moult and winter (Brodeur et al. 2002). Also, Robert et al. (*in press*) determined that some individuals wintering along the coast of Maine are known to moult in Greenland and return to Maine for the winter season. However, of the estimated 5000 – 10 000 individuals moulting along the southwest coast of Greenland (Boertmann and Mosbech 2002), it is unknown how many are Canadian breeders.

Continued surveys in Labrador and northern Québec have led to a greater understanding of Harlequin Duck distribution in northeastern Canada. None of the northern breeding Harlequin Ducks tracked and/or banded by Brodeur et al. (2002), and Chubbs (*in press*) have been observed at moulting or wintering locations in eastern North America (Thomas et al. *in press*). However, one Harlequin Duck banded in Hebron Fiord, Labrador (N 58° 06.9', W 63° 00.2') was observed at the Gannet Island moult site (N 53° 56.6', W 56° 30.9') that is closely associated with the eastern North American wintering location (Thomas et al. *in press*). It is uncertain if this was anomalous.

In eastern North America Harlequin Duck affiliations to their breeding, moulting and wintering sites are varied (Thomas et al. *in press*). A series of banding and telemetry studies since 1997 have better defined some of the movement patterns of Harlequin Ducks throughout eastern North America. As an example, a Harlequin Duck banded at Fig River/Lake (N 53° 06.8', W 63° 12.5') was resighted at its moulting site in Labrador - the Gannet Islands - and later at its wintering location along the coast of Maine (N 44° 8.2', W 68° 33.3'), and was subsequently recaptured at another moulting location along the southwest coast of Greenland (N 64° 12.5', W 51° 41'). Additionally, Robert et al. (*in press*) found that wintering individuals along the coast of Maine moulted in Greenland only to return to Maine for the winter. It is not known if these individuals changed moult locations between years. The level of uncertainty associated with the Greenland/North America Harlequin Duck connection prompts the need for improved communication and collaboration on Harlequin Duck monitoring and research initiatives. This is of particular importance as most of the Harlequin Ducks breeding in northern Québec and northern Labrador likely moult and winter in Greenland, and thus face different stresses than wintering North American individuals.

The eastern North American wintering population has been surveyed with more success and regularity over the past 10 years. Regular surveys at four strategic winter locations in eastern North America has indicated population increases at all sites since 1994 (Thomas and Robert 2001). Similarly, Christmas Bird Counts (CBC) during this time period recorded higher numbers in many areas throughout Atlantic Canada and coastal Maine, USA (Thomas and Robert 2001). The reliability of CBC data will vary throughout eastern North America. While CBC surveys at Cape St. Mary's, Newfoundland and Labrador have been conducted along the same route by comparable and competent surveyors for 25 years, other areas have received less frequent and inconsistent efforts. As a result, CBC data for some areas must be interpreted guardedly.

The Harlequin Duck wintering population in eastern North America was once estimated to be less than 1000 individuals (see Montevecchi et al. 1995). However, in recent years there have been indications of population increases in parts of their range. The Eastern Shore Management Area of Nova Scotia has experienced a substantial increase in population. In 2001 there were an estimated 317 Harlequin Ducks observed during Canadian Wildlife Service (CWS) surveys. In 2005, this number increased to an estimated 651 individuals (A. Boyne pers. comm.). Surveys at Cape St. Mary's Ecological Reserve in Newfoundland and Labrador have determined an increase in this area as well. In 2001 a CWS boat survey estimated 91 individuals in the area, but that increased to 242 in 2005 (P. Thomas, pers. comm.), up from a low of approximately 20 individuals observed in 1990 (Montevecchi et al. 1995). However, population levels in other

areas of their range have remained relatively stable such as The Wolves, New Brunswick and Jericho Bay, Maine.

Despite the localized population increases, the whole of the eastern North American wintering population is still estimated to be less than 3000 individuals, and probably well below historic levels for Atlantic Canada and coastal United States (Palmer 1949, Goudie 1989, Montevecchi et al. 1995). Boardman (1903) reported 500 Harlequin Ducks at The Wolves, New Brunswick during the winter of 1875. Peterson and Fisher (1955) reported hundreds of Harlequin Ducks at Cape St. Mary's, and Downs (1888) considered Harlequin Ducks rather common in Nova Scotia during the winter months. However, the Mi'kmaq of Nova Scotia have stated that they believe the Harlequin Duck to have always occurred in low numbers (M. Cox pers. comm.).

Harlequin Ducks require fast moving streams with abundant invertebrate life during the breeding season (see Robertson and Goudie 1999). The specific factors that make a river attractive to a Harlequin Duck will vary among regions, but moulting and wintering habitat requirements tend to be similar (see Robertson and Goudie 1999). In eastern areas, moulting and wintering Harlequin Ducks congregate near exposed headlands and over subtidal ledges (Mittelhauser 2000). Winter locations are determined largely by prey availability (Robertson and Goudie 1999), and they often stay close to shore (Hirsch 1980, Goudie and Ankney 1986).

2.2 Threats to Populations and their Habitats

The threat level to the eastern Harlequin Duck varies across its range. The more northern breeders are generally faced with fewer threats during the breeding season than the eastern North America wintering population that breeds, by and large, in southern Labrador, the Gaspé Peninsula of Québec, the Québec North Shore, insular Newfoundland, and northern New Brunswick (Thomas and Robert 2001). Additionally, some individual Harlequin Ducks may cross through northern and southern sections of the species' range within any given year. As a result, it is difficult to assign threat severity without assessing all occupied regions for each specific threat.

Land use practices in some areas of the Harlequin Duck range could adversely impact the species. Harlequin Ducks are susceptible to disturbance on their wintering, moulting, and breeding grounds (Robertson and Goudie 1999). On breeding sites logging and hydroelectric development may pose threats to the habitat of the species (see Robertson and Goudie 1999). In the wintering and moulting locations, fishing nets (see Robertson and Goudie 1999), aquaculture development, illegal/accidental harvesting, boating activities, and chronic and catastrophic oiling are potential threats (Thomas and Robert 2001).

Hunting was a major factor that led to the low population estimate in the 1980s (Goudie 1990). The legal hunt for the Harlequin Duck has been closed in the Atlantic Flyway since 1990. While Harlequin Duck numbers are increasing at key wintering locations, consistent loss of Harlequin Ducks due to hunting is reported annually and remains a concern of management agencies. Much of this loss may be attributed to misidentification. Insufficient hunter education is the key component contributing to this activity. In Greenland, hunting of Harlequin Ducks has been

banned since the 1960s, however periodically small numbers of Harlequin Ducks have been observed at local markets. There is no quantitative data to further illustrate this threat.

The wide distribution of Harlequin Ducks across eastern North America is an indicator that habitat is available for this species. The breeding range is large and difficult to survey accurately for population size and trend. However we are aware that there are multiple issues potentially affecting Harlequin Duck breeding habitat throughout their breeding range. Moreover, their primary wintering sites are still limited to less than 10 key locations in eastern North America (Thomas and Robert 2001). As a result, a **primary recommendation of this plan will be the development of a comprehensive threat assessment(s)** to properly quantify the impacts of the possible threats to these sites, as well as the relative significance of these threats among the various regions.

2.2.1 Pollution

Oil/Bilge contamination and Shipping

Perhaps the most significant threat to the North American wintering population of Harlequin Duck in eastern Canada is the potential for oil contamination. To date only a few incidents of oiled Harlequin Ducks have been reported in eastern Canada. However there are substantial shipping routes along eastern Canada's coastline that are in close proximity to Harlequin Duck wintering locations. Potential for a large spill near an important Harlequin Duck wintering population is a possibility. Illegal oil discharge in eastern Canadian waters have negative impacts on local bird populations. It has been estimated that up to 300,000 individual seabirds may die every year due to offshore oil discharge from tankers, cargo and container vessels (Wiese et al. 2004). Oiling events in southeastern Newfoundland in 2005 and 2006 were known to kill many Long-tailed Ducks, Common Eiders and seabirds (G. Robertson and S. Gilliland, pers. comm.). In March 2005, a spill of unknown origin killed an estimated 1100 Common Eiders (S. Gilliland, pers. comm.), and in 2006 dozens of Long-tailed Ducks were also observed as oiled as a result of a spill of unknown origin (S. Gilliland, pers. comm.). Harlequin Ducks often share wintering habitat with both these species.

Invertebrate Control

Harlequin Ducks are known to feed on aquatic insects during their breeding season. As a result, any insect control programs on breeding rivers may have deleterious impacts on the Harlequin Duck. There is little documentation on this type of disturbance, and it is likely not a substantial threat in eastern North America. However, with increasing recognition of the West Nile virus in eastern Canada, there is a higher likelihood of expanded spray programs.

2.2.2 Habitat Loss or Degradation

Hydro Development

Hydroelectric development has the potential to greatly alter water dynamics over large areas. During the development of the Churchill Falls hydroelectric project, 1400 km² of land was

flooded by the now Smallwood Reservoir. This in turn was estimated to have displaced 3740 pairs of diving ducks, including Harlequin Ducks (Gilliland 2001). Negotiations are ongoing for expanding the Churchill River hydroelectric program into the Lower Churchill River Valley. Additionally, there is hydroelectric development within Québec, however it is not certain how previous hydroelectric projects may have impacted the population in that Province. The possibility of reactivating the Great Whale hydroelectric project in Québec has been discussed in recent years. If this project were to go ahead there is a high potential to displace Harlequin Ducks from traditional breeding areas (Morneau et al. *in press*). Additionally, there is the potential for small scale hydro development within the Harlequin Duck breeding range. These projects may impact Harlequin Duck breeding habitat, and each proposal should be reviewed and mitigated accordingly.

Forestry

Forestry operations continue to expand into known Harlequin Duck breeding areas. Logging activities are known to remove suitable breeding habitat and also increase stream siltation that may affect food availability (Breault and Savard 1991, Crowley and Patten 1996). It is difficult to fully assess the impact of forestry across the range of the Harlequin Duck due to the fact that the majority of breeding occurs in areas that are not presently exploited by the forest industry.

Resource extraction

Mining exploration continues to increase in eastern Canada, most notably in Newfoundland and Labrador, and may impact on Harlequin Duck breeding locations (see Robertson and Goudie 1999). For example, breeding site surveys conducted in 2005 counted 59 adult Harlequin Ducks on 10 rivers in the area of the Voisey's Bay mining site. Siltation, pair displacement and habitat loss are anticipated for this area that may displace some of these individuals (Voisey's Bay Environmental Assessment Panel 1999).

2.2.5 Accidental Mortality:

By-catch

Gill nets are a potential source of mortality for the Harlequin Duck (see Robertson and Goudie 1999). However due to a decrease in inshore fishing activities in eastern Canada, it is not expected to be a substantial threat. Gill net by-catch may be a more substantial issue in Greenland.

2.2.6 Aquaculture

Aquaculture activities continue to increase in Atlantic Canada, in places conflicting with known wintering locations for the Harlequin Duck. Aquaculture operations established on or near Harlequin Duck wintering or moulting sites may cause the abandonment of these locations. Also, Harlequin Ducks could potentially become entangled in gear and/or the machinery needed to run the operation. As the potential for overlap increases with time, there is a greater need for improved understanding and research of these activities on the species. These types of limiting factors are more relevant to Maritime Canada.

2.2.7 Disturbance and Persecution:

Aircraft Disturbance

The effects of low-level flying military aircraft on Harlequin Ducks were studied in Labrador (Goudie 2003). Results from this study indicated a behavioural response to low-level flying aircraft in southern Labrador. However, there was insufficient data to definitively determine any population level impact on the species.

Human disturbance

Harlequin Ducks are tolerant of moderate levels of disturbance (Savard 1988, Clarkson 1994, Brodeur et al. 1998), but they will abandon a site when the disturbance becomes chronic (Cassirer and Groves 1991, Clarkson 1994, Hunt 1998). Most of the breeding locations for this species in eastern Canada are remote and free from human disturbance. However for some areas in the southern extent of their breeding range (i.e. northern Newfoundland, southern Québec and New Brunswick) disturbance may play a role in reducing breeding success. Disturbance events may include recreational boating, angling, and chronic human presence. Wintering and moulting locations may be impacted by boating and shipping traffic. Recreational boating may play a role in disturbance on breeding rivers in more southern areas such as Newfoundland, the Gaspé Peninsula, and northern New Brunswick. Rivers in these areas are more accessible and therefore more susceptible to recreational activities. Large scale rafting is known to be disruptive to Harlequin Ducks (Hunt 1998), and recreational fisherman may present a problem due to the fact that they remain along the streams and rivers for long periods of time (Wallen 1987).

2.2.8 Consumptive Use:

Illegal hunting

Hunting of the Harlequin Duck was thought to be the primary reason for their noted decline in the 1970s and 1980s that ultimately led to their endangered status rank in 1990 (Goudie 1990). As a result, hunting of Harlequin Ducks was restricted in 1989 when the hunt was banned in the Atlantic Flyway. However, Harlequin Ducks are annually reported to be illegally and accidentally hunted (see Thomas and Robert 2001). Hunting is still thought to be a threat to the Harlequin Duck population.

Harlequin Duck behaviour also plays a role in the accidental hunting of Harlequin Ducks. The species often mixes with other seaduck species and are sometimes misidentified due to these affiliations. Again, there is little quantitative data, however, further elaboration on the subject could be highlighted in the proposed threat assessment for the species.

2.3 Monitoring History

There has been limited long-term survey effort of Harlequin Ducks in eastern North America. The following is a summary of monitoring and survey efforts conducted throughout eastern Canada.

Labrador

- Rodway (1998) did surveys and habitat assessment for the Harlequin Duck in northern Labrador.
- Gilliland et al. (2002) conducted aerial surveys of the Labrador coast in 1994 for moulting and staging Harlequin Ducks.
- Extensive survey efforts were conducted at the Voisey's Bay mine site as part of their Environmental Assessment for the project (Voisey's Bay Environmental Assessment Panel 1999).
- The Department of National Defence conducted survey efforts and research projects to assess movement patterns within south-central area of Labrador (JWEL 1998, JWEL 1999, and Chubbs et al. *in press*).
- In southern Labrador, the Canadian Wildlife Service has been conducting regular surveys of the Gannet Island moult site since 1998 (Adams et al. 2000) and Trimper et al. (*in press*).
- Heath (2001) monitored several river systems in northern Labrador.
- Joint surveys were conducted with the Provincial government, CWS and other partners in the late 1980s and early 1990s along multiple river systems in Labrador.

Québec

- Two intensive satellite telemetry projects have been conducted in Québec to determine movement patterns and distribution of Harlequin Ducks (Brodeur et al. 2002, Robert et al. *in press*, Savard et al. *in press*).
- Helicopter surveys of the Québec North Shore, Anticosti Island and Gaspé Peninsula watersheds (Robert 2000, Robert et al. 2001), as well as in the James and Hudson Bays (Morneau et al. *in press*).
- Study of the habitats used and the movements of females and young Harlequins in the Gaspé Peninsula (Brodeur et al. *in press*).
- Surveys and studies during the moulting stage in the Gaspé Peninsula and Anticosti Island (Gilliland et al. 2002, Langlois 2005).
- Christmas Bird Counts in Québec.
- Hydro-Québec monitoring Harlequin Ducks and general waterfowl surveys (Consortium Gauthier-Guillemette-GREBE 1993a and 1993b)

Newfoundland

- Gilliland et al. (2002) conducted moult and stage site surveys in the northern part of insular Newfoundland.
- Periodic survey effort of breeding rivers on Great Northern Peninsula by CWS and Parks Canada (S. Gilliland pers. comm.).
- Regular surveys at Cape St. Mary's Ecological Reserve wintering site by the CWS and the Provincial government.
- Christmas Bird Counts in Newfoundland

Maritime Canada

- Long standing surveys have been conducted on islands off the coast of New Brunswick by CWS and the Provincial government.
- Intensive survey effort in 2000 and 2001 at White Head Island and less intensively along the remainder of the southern coast of New Brunswick.
- Incidental and dedicated ground, air and boat surveys in Nova Scotia and New Brunswick by CWS staff (A. Boyne and P. Hicklin pers. comm.).
- Christmas Bird Counts in Nova Scotia and New Brunswick.

2.4 Knowledge Gaps

Definitive demographic parameters required for accurate population projection and survival models have yet to be determined. Multiple sources of data are available, and must be compiled, combined, and analyzed. Data analysis of completed mark-recapture studies will provide some demographic values representative of the eastern North American population. There are also questions with regard to genetic relationships among Greenland and eastern North American populations of Harlequin Ducks which speak to population structure and management units. The extent of threat and the potential impact of those threats to the Harlequin Duck population are not known. A threat assessment would provide insight into the threats to the population and their potential impact in the various regions of Atlantic Canada and Québec. There is a lack of available baseline information regarding Harlequin Duck habitat making it difficult to develop a predictive habitat model.

2.5 Recommended Approach / Scale for Management

Harlequin Ducks use a variety of habitat types throughout their annual cycle. The threats impacting the species are substantial and ubiquitous throughout much of their range. As a result, conservation of the species must be focused at the population level as focusing on only a few locations would not suffice. Maintaining population monitoring, better quantifying threats, and protecting habitat locations known for high concentrations of Harlequin Ducks is important.

At this time, Harlequin Duck management and conservation is being conducted independent of other Species at Risk in Atlantic Canada and Québec. There are few other species and no Species at Risk that share a similar habitat and life cycle as the Harlequin Duck, and therefore a multi-species approach is not applicable. In the event that another species becomes listed that shares Harlequin Duck habitat, a multi-species approach to conservation and management could be considered.

3. MANAGEMENT

3.1 Population Goal

The goal of this plan is to recover the Harlequin Duck population in eastern Canada by increasing the population to have at least 3000 individuals wintering in eastern North America for three of five consecutive years with at least 1000 breeding aged females.

This reflects the goal of the original Recovery Plan for the Harlequin Duck (Montevecchi et al. 1995). If it is determined that 3000 individuals does not constitute a sustainable population then the alternate goal will be to increase the population to allow for removal from the Species at Risk Act legal species list, and related Provincial species at risk lists.

3.2 Objectives

1. Clarify possible threats to the species and outline a regime(s) to address these issues.
2. Assess population status.
3. Identify, protect and manage important areas for breeding, moulting, wintering, and staging habitat.
4. Work with governments, industry, aboriginal groups, and private citizens to identify the threats to the Harlequin Duck, and work toward eliminating or reducing these threats.
5. Identify targeted groups for education and stewardship initiatives on Harlequin Duck issues, and develop appropriate campaigns and programs.
6. Conduct gap analysis to determine shortcomings in knowledge of the Harlequin Duck.
7. Engage Greenland in further collaboration with Canada regarding Harlequin Duck conservation.

4. MANAGEMENT ACTIONS

In an effort to meet the objectives of the management plan, four key ‘issues and actions’ will be addressed. These actions encompass the strategies required to properly protect, maintain and improve the eastern North American Harlequin Duck population and its habitat.

The primary issues to be addressed in this plan will include the development of a comprehensive threat assessment for the Harlequin Duck within eastern North America, and the establishment of an acceptable Harlequin Duck monitoring program for wintering, moulting, and breeding locations to adequately evaluate overall population parameters. See Sections 6 and 7 for further implementation information.

Management priorities for the Harlequin Duck population of Atlantic Canada and Québec have been assigned to four key categories as follows:

1. Population Management
2. Habitat Management and Threats
3. Research
4. Socio-politics and Communication

4.1 Population Management

4.1.1 Issue explanation and description

Understanding the population dynamics of the eastern Harlequin Duck is important to properly managing the species. A demographic model is a common management tool for the decision making process regarding species at risk (Beissinger and Westphal 1998). An assessment of the data quality is required before embarking on this process. Gaps in knowledge can be identified during this assessment process.

Population numbers in eastern North America are probably still low relative to historic levels (Palmer 1949, Goudie 1989, Montevecchi et al. 1995). Monitoring projects for the eastern North American wintering population have proved successful for assessing this population, however other areas of the range have little or no monitoring effort. As a result the status of the population outside of what we observe during winter in eastern North America is not well known. Confounding this issue is the relative inaccessibility of the more northern population and the Greenland wintering population. Appropriate and statistically valid monitoring programs must be established for known breeding, moulting, and wintering locations. Monitoring is ongoing at some moulting locations and periodically at breeding sites. Winter monitoring for the eastern North American population is the most consistent, with four locations being monitored annually in February/March by comparable methods and observers. This methodology needs to be revisited to ensure statistical validity. Overall, a consistent and acceptable survey methodology should be developed to address this need based on the appropriation of resources as well as program priorities of jurisdictions with management accountability.

While much effort has gone into surveying Harlequin Ducks over the last 15 years, there is still potential breeding habitat that has not been surveyed for the presence of Harlequin Ducks.

The identification of “management units” is an important component of effective conservation programs (Moritz 1994). In this case, a management unit can be defined as a group of individuals of a species that demonstrate a level of reproductive isolation from other conspecifics. Only through a more comprehensive assessment of our Harlequin Duck population through monitoring and research will we be in a position to effectively and accurately delineate management units.

4.1.2 Actions

1. Using current estimates of productivity and survivorship from the eastern North American population, develop a dynamic population model to assess current population trends and the acceptable population level for long term viability.
2. Continue monitoring the eastern North American wintering population at important locations across their range.
3. Statistically assess the monitoring program as it stands to determine the need for a more comprehensive monitoring program.
4. Implement a survey program for previously unsurveyed areas that have the potential to be breeding grounds for Harlequin Ducks, and may be impacted by development and human disturbance.
5. Develop consistent protocols for surveying and monitoring the population across all jurisdictions, as well as how this information is presented to the public and the scientific community.
6. Work toward a monitoring strategy with the Greenland Government for southwest Greenland that may offer more definitive insight into population size and trend in that area.
7. Limit hunting to the extent possible.
8. Promote and facilitate the exchange and publication of Harlequin Duck information from countries of the Northwest Atlantic that may assist with the management of the species.
9. Delineate “management units”.
10. Maintain databases.

4.2 Habitat Protection

4.2.1 Issue explanation and description

As has already been discussed at length, Harlequin Ducks are widely distributed across the landscape, and are exposed to a variety of threats throughout their range. As a result, a key recommendation of this plan will be the development of a comprehensive threat assessment to properly quantify the impacts of the possible threats.

In eastern North America there are presently several protected areas utilized by Harlequin Ducks for breeding, wintering, moulting and staging sites:

Newfoundland

- Gros Morne National Park of Canada: breeding, moulting and staging site
- Cape St. Mary's Ecological Reserve: wintering and a few moulting individuals in addition to small numbers of non-breeders that maintain a year-round residency

Labrador

- Gannet Islands Ecological Reserve: moult site
- Torngat Mountains National Park Reserve of Canada: breeding, staging and possibly moulting site

Québec

- Forillon National Park of Canada: moult site
- Mingan Archipelago National Park Reserve of Canada: staging site
- Parc national de l'île-Bonaventure-et-du-Rocher-Percé: moult site
- Parc national de la Gaspésie: potential breeding site

Nova Scotia

- Eastern Islands Management Area (EIMA): wintering site
- Port Hebert Migratory Bird Sanctuary: wintering site
- Kejimikujik National Park Seaside Adjunct: wintering site
- Port Joli Migratory Bird Sanctuary: wintering site

Maine, USA

- Acadia National Park¹: wintering site

Rhode Island, USA

- Sachuest Point National Wildlife Refuge¹: wintering site

4.2.2 Actions

1. Refine a habitat protection strategy for important breeding, moulting, staging, and wintering Harlequin Duck locations.
2. In accordance with the Federal Species at Risk Act, determine where Harlequin Ducks breed, moult and winter on federal property.
3. Establish communication with forestry companies to develop and adopt forestry management strategies intended to minimize impacts on Harlequin Ducks.
4. Foster relationships with hydroelectric companies in areas of the Harlequin Duck breeding range to ensure proper management and mitigation of both large and small scale hydro development impacts on Harlequin Ducks.
5. Develop a proactive relationship with the aquaculture industry. Information sharing as to where potential aquaculture sites may be established.

¹ No associated marine component to this protected area.

6. Continue to work in a preventative capacity to reduce chronic oil pollution off the coast of eastern North America.
7. Monitor and mitigate use of pesticides to control Diptera populations due to increasing threats from West Nile Disease in watersheds known to host breeding and/or staging Harlequin Ducks.
8. Train Environmental Assessment officers and biologists in the various federal government departments, as well as in other jurisdictions, organizations, and industry that may be involved with environmental assessment.

4.3 Research

4.3.1 Issue explanation and description

Demographic parameters required for accurate population projection models and survival have yet to be determined. Analysis is ongoing that will allow for more accurate demographic information in the future. There are also questions with regard to genetic relationships among Greenland and eastern North America, which speak to population structure and management units. Additionally, habitat data both in regard to preferred parameters and available baseline habitat information is limited or not available.

4.3.2 Actions

1. Complete the ongoing genetic studies to determine individual and population level affiliations within the Northwest Atlantic.
2. Complete analysis of mark – recapture studies that will add to demographic knowledge of this species in eastern North America.
3. Determine if present known habitat is sufficient to maintain a viable and sustainable Harlequin Duck population in eastern North America.
4. Determine the possible long-term consequences of human encroachment on breeding, moulting and wintering habitat in eastern North America.
5. Conduct a comprehensive threat assessment that would allow for greater insight into the possible threats to the species and to the species' habitat at multiple geographic scales.
6. Complete impact assessment studies of ecotourism, aquaculture, forestry practices, hydroelectric development, chronic and catastrophic oiling, near shore commercial fishing, and the impacts of low-level flying military aircraft.

4.4 Socio-politics and Communications

4.4.1 Issue explanation and description

In many areas of the Harlequin Duck range in eastern North America there are long standing traditions of seaduck hunting. Despite a complete hunting ban on Harlequin Ducks in the Atlantic Flyway since 1990, the Harlequin Duck is often mistaken for other species of seaduck at various times of the year, and is hunted accidentally. Current Canadian Wildlife Service policy provides for complete prohibition of hunting of Harlequin Ducks; a policy that has received wide

support from native and non-native organizations. Complete protection of the Harlequin Duck will be important for their conservation.

Management scenarios for the species may be viewed locally in terms of the possible economic gain for the community. It is important that management strategies recognize the need for potential economic opportunities within these communities and work, to the extent possible, toward helping achieve them without jeopardizing the continued survival of the species.

Despite its listing on the Species at Risk Act legal list, the Harlequin Duck is not widely known. Communication and education materials available on the Harlequin Duck are limited. Improved and targeted communications with hunters, communities, aboriginal groups, industry, enforcement agencies, conservation groups etc. is vital for ensuring protection for the species.

4.4.2 Actions

1. Development of educational materials.
2. Promote Habitat Stewardship Programs and other stewardship initiatives for the Harlequin Duck.
3. Assemble information packages on the Harlequin Duck for distribution to all pertinent law enforcement agencies in eastern North America.
4. Conduct public information sessions in areas of known concentrations of Harlequin Ducks.
5. Promote the established codes of practice and standards with Environmental Assessment officers.
6. Enforce regulations and promote education in local areas to reduce the level of accidental/illegal hunt of the species.

5. EVALUATION

Ideally, the evaluation of Harlequin Duck population recovery would be done on a population level, however their wide-spread breeding range and association with wintering populations in other countries restricts the quality and quantity of data that can be collected on a population level. As a result, evaluation of management success will be through long-term monitoring programs that assess trends at wintering, moulting, and breeding sites.

In order to properly assess the continued improvement of the Harlequin Duck population and the level of adherence to the Management Plan, evaluations must be conducted on a regular basis. A management plan should never be considered a static document but rather a process that is modified with new information. It is recommended that the Canadian Wildlife Service develop a report every three years on the status of the species in eastern Canada to be distributed among the jurisdictions to obtain their comments on the state of the eastern Harlequin Duck conservation efforts. The report should contain the following:

1. Monitoring survey effort and results.
2. Changes in population size and trend from available data.
3. Success in understanding, eliminating, reducing or mitigating threats to the population.
4. Summary of public outreach and stewardship actions concerning the Harlequin Duck in eastern North America.
5. Level of habitat protection for the Harlequin Duck population in eastern North America.
6. Pertinent research results.
7. Needed monitoring and research efforts.
8. Updated information on the status of the Harlequin Duck population in Greenland, and a summary of ongoing cooperative efforts to protect and conserve Harlequin Ducks.
9. Gap analysis and revision of directions.

6. SUMMARY TABLE - MANAGEMENT

Table 1. Each item has corresponding text within the plan. Priorities are defined as: Legal = a legal requirement as dictated by legislation; Urgent = top priority action; Necessary = needed to evaluate and guide conservation actions; Secondary = beneficial if urgent actions are already underway; Ongoing = action that has been started in the past and is presently still ongoing; Beneficial = action would be beneficial to our understanding of Harlequin Ducks but is not a priority.

Population Management

Requirement	Obj.	Action Item	Specific steps	Notes
Legal	1	Maintain and enforce hunting ban	<ul style="list-style-type: none"> • Maintain and enforce the ban on hunting Harlequin Ducks. • Maintain communication with CWS Waterfowl Committee and counterpart in the USA • Maintain communication with the enforcement organizations associated with migratory bird hunting 	Hunting ban is in effect in the Atlantic Flyway. There are no indications that this ban should be removed
Urgent	2	Develop a monitoring strategy, and data presentation format.	<ul style="list-style-type: none"> • Work with scientists and statisticians to assess present monitoring structure and determine statistical validity in assessing population status in eastern North America • Consultation with scientists and jurisdictions to determine optimal structure of the strategy if changes are deemed necessary • Work with other jurisdictions and groups to implement the monitoring program 	CWS-NL to lead this initiative
Necessary	2	Develop a dynamic population model	<ul style="list-style-type: none"> • Determination of available population data • If there are knowledge gaps, attempt to fill those gaps with scientific investigation • Compile data and develop model • Present model in peer reviewed journal 	
Necessary	3	Delineate management units	<ul style="list-style-type: none"> • Based on current scientific knowledge of the species, attempt to delineate management units • Based on knowledge gaps determined in step 1, complete all necessary research to definitively outline management areas in eastern North America and Greenland • Combine that effort with the creation of element of occurrences (Eos) 	

Population Management (continued)

Requirement	Obj.	Action Item	Specific steps	Notes
Necessary	6	Ensure publication and/or distribution of relevant data	<ul style="list-style-type: none"> • Promote the publication of shelved data • Promote the publication of studies • Work with other jurisdictions to ensure that data and studies relevant to Harlequin Duck recovery and conservation get published in some capacity 	
Ongoing	2, 6	Maintain databases and share with Conservation Data Center (CDC) or CDC equivalent organization	<ul style="list-style-type: none"> • Continued collection of data on Harlequin Duck sightings and surveys • Maintain relationship with local CDCs or CDC equivalent organization • Work with CDC or CDC equivalent organization to determine Harlequin Duck element occurrences (EOs) in eastern Canada 	
Ongoing	2	Continue winter monitoring	<ul style="list-style-type: none"> • Continuation of wintering monitoring at established sites: 1) Cape St. Mary's, NL; 2) Ile au Haut, ME; 3) The Wolves, NB; and 4) Sachuest Point, RI • Revisit methods to determine that the number of sites and the methods used are adequate for assessing the status of the wintering population • Compile and distribute the data annually 	
Beneficial	2	Plan and implement Harlequin Duck surveys	<ul style="list-style-type: none"> • Compile survey and incidental sighting information • Collect anecdotal information • Based on these data and knowledge of the landscape, determine areas of potential habitat that would benefit from additional and focussed survey efforts • Attempt to survey these indicated areas over time 	
Beneficial	2, 7	Develop Greenland monitoring strategy	<ul style="list-style-type: none"> • Discuss possible monitoring programs with Greenland and Dutch biologists 	Not relevant to Canadian legislation

Habitat Protection

Requirement	Obj.	Action Item	Specific steps	Notes
Legal	3	Protect Harlequin Ducks on federal property	<ul style="list-style-type: none"> • Overlay present knowledge of Harlequin Duck locations with the federal lands database to determine key areas on federal lands where Harlequin Ducks are found. • Consult with jurisdictions to determine protective status of the area. • Work with the other federal departments to ensure these sites are recognized and appropriate protocols are put in place to protect/conservate the locations. 	CWS-NL, AC CDC, and Parks Canada are already pursuing this in the Atlantic Region. PCA is also pursuing this in Québec
Necessary	5	Work with forestry companies to minimize impacts on Harlequin Duck breeding habitat	<ul style="list-style-type: none"> • Establish stronger ties with the forestry industry regarding SAR issues. • Share data where and when possible to inform companies of areas used by Harlequin Ducks. • Develop codes of conduct for forestry activities in known Harlequin Duck habitat. • Work with the forest companies and the applicable government departments to implement these codes of conduct and standards regarding Harlequin Ducks. 	
Necessary	5	Maintain and improve relations with hydroelectric companies to protect Harlequin Ducks	<ul style="list-style-type: none"> • Maintain a strong working relationship with hydro companies where such a relationship already exists. • Regular communication with the biologists from hydro companies that have limited experience with Harlequin Ducks to inform them of where Harlequin Ducks are located and how they are utilizing the area. • Continued vigilance with proponents of small scale and local hydro development projects. 	Small scale hydro power may become an issue in parts of the region. Future large scale hydro projects are pending in some areas
Necessary	5	Develop relationship with aquaculture industry to protect Harlequin Ducks	<ul style="list-style-type: none"> • Establish formal connection with aquaculture industry in the region. • Develop codes of practices and standards near known Harlequin Duck habitat. • Work with the aquaculture companies and the applicable government departments to implement these codes of conduct and standards regarding Harlequin Ducks. • Provide the industry representatives with key locations for Harlequin Ducks. 	

Habitat Protection (continued)

Requirement	Obj.	Action Item	• Specific steps	Notes
Necessary	1, 4	Prevent offshore oil dumping	<ul style="list-style-type: none"> • Maintain efforts in offshore programs of CWS and other jurisdictions. • Regularly survey Harlequin Duck concentrations for oil contamination in areas with busy shipping lanes. • Improve the profile of the Harlequin Duck within the shipping industry and within local communities in areas where ship traffic is high and there are known concentrations of Harlequin Ducks: <ul style="list-style-type: none"> ○ Targeted education programs ○ Community or industry based stewardship initiatives 	
Necessary	1, 4	Monitor and work to mitigate pesticide use	<ul style="list-style-type: none"> • Establish the network to determine where spraying programs will be initiated and conducted. • Develop codes of practice and standards regarding the use of pesticides in areas with Harlequin Ducks. • Mitigate effects on Harlequin Ducks where overlap exists. 	
Beneficial	3	Refine a habitat protection strategy	<ul style="list-style-type: none"> • Determine key habitat locations based on survey and incidental Harlequin Duck data. This can be done in conjunction with EO analysis with local CDCs. • Determine amount of required habitat to ensure long term conservation of Harlequin Ducks. • Work with other jurisdictions and NGOs to ensure proper protection for these areas. 	
Beneficial	3, 4, 5	Train Environmental Assessment officers and biologists in multiple departments, jurisdictions, and organizations	<ul style="list-style-type: none"> • Relevant to all species at risk • Prepare a training program • Educate on codes of practice and standards • Program to include EA officers and biologists in addition to private sector biologists and industry. 	

Research

Requirement	Obj.	Action Item	Specific steps	Notes
Urgent	1, 4	Develop Threat Assessment	<ul style="list-style-type: none"> • Consultation is required with the Provinces. • Literature review. • Ensure threats are differentiated per geographic area. 	Threat assessment is considered a priority with jurisdictions and may guide management decisions
Necessary	1, 4	<ol style="list-style-type: none"> 1. Study impacts of threats 2. Study impacts of human encroachment 	<ul style="list-style-type: none"> • Completion of a detailed Threat Assessment for each area of their range in eastern North America. • Using the assessment, determine the most relevant threats to Harlequin Ducks. • Determine knowledge gaps associated with the threats • Develop a schedule of studies to address improved knowledge of the impact of the threat and the possible mitigation. • Details of the development of the impact studies will need to be developed and may vary among locations. 	
Necessary	6	Analyze gaps	<ul style="list-style-type: none"> • Identify the short-comings in the conservation efforts based on the threat assessment, monitoring program, and education • Develop programs and studies to address our knowledge gaps. 	
Ongoing	2, 6	Complete mark-recapture study	<ul style="list-style-type: none"> • Use this data to generate a population model for eastern Harlequin Ducks. • Such a model will provide insight into population viability, extinction probability, and minimum viable population values. 	Analysis nearing completion. Results to be published in CWS Occasional Paper in 2007.
Ongoing	2, 6	Complete genetic analyses	<ul style="list-style-type: none"> • Continued communication with geneticists to establish most up to date information. • Interpretation of the data to better delineate distribution, overlap and potential metapopulations of Harlequin Ducks in the east. • Develop a schedule of studies if required. 	Analysis is ongoing. This will be relevant to the determination of Management Units
Beneficial	3, 6	Study habitat	<ul style="list-style-type: none"> • If possible, create a habitat model for Harlequin Ducks based on known river and coastal habitat parameters • Use this information to predict carrying capacity for Harlequin Ducks. 	Will be difficult to accomplish due to a lack of information at the river and coastal areas

Socio-Politics and Communications

Requirement	Obj.	Action Item	Specific steps	Notes
Necessary	5, 7	Develop and deliver educational materials	<ul style="list-style-type: none"> • Deliver targeted education to hunters and aboriginal groups • Consultation required to determine effective education tools • Development of general distribution materials. • Educational materials needed for Greenland to address the hunting issue. This is contingent upon support and cooperation from Greenlandic officials. • Publicize conservation programs and progress in the local and national media in multiple forms. 	
Necessary	5, 6	Develop and promote codes of practice	<ul style="list-style-type: none"> • Compile a list of relevant jurisdictions and people • Develop Environmental Assessment standards of information that need to be considered when assessing projects that may impact Harlequin Ducks. • Develop codes of practice and standards regarding activities that may impact Harlequin Ducks that can be used in environmental assessments. • Work with these other jurisdictions to ensure proper training on SARA issues and species. • Ensure that Harlequin Ducks are properly represented within all Provincial and Federal Environmental Assessment laws. 	
Necessary	2, 5, 6	Prepare and distribute report	<ul style="list-style-type: none"> • To be completed every three years. 	
Beneficial		Stewardship promotion	<ul style="list-style-type: none"> • Communicate with local NGOs, community groups, and local development associations to educate them on Harlequin Ducks and Harlequin Duck conservation. • Facilitate and foster communities and NGOs to take an active role in Harlequin Duck conservation especially in areas where there are known concentrations of Harlequin Ducks. • Continue to work with partners in ongoing Harlequin Duck stewardship initiatives. • Implement Coastal Stewardship Initiative with NL Provincial Government. 	
Beneficial	4	Conduct public information sessions	<ul style="list-style-type: none"> • Conduct local presentations and information sessions in communities and schools. • Maintain contact with organizations, schools, and NGOs in areas where Harlequin Ducks are common. 	
Beneficial	4	Educate law enforcers	<ul style="list-style-type: none"> • Develop educational and information packages for law enforcement agencies on Harlequin Ducks. • Conduct training sessions on Harlequin Ducks and other species at risk to ensure that issues are clear and that the species are known. 	

7. IMPLEMENTATION SCHEDULE

Table 2. Implementation schedule of the action items listed in Table 1. Shaded boxes indicate proposed year of implementation.

Population Management - Action Items	Section/ Lead	Other	2006	2007	2008	2009	2010
Maintain and enforce hunting ban	CWS	Provinces	Ongoing				
Development of a monitoring strategy, and data presentation format	CWS	All jurisdictions	Develop Strategy	Implement Strategy			
Dynamic population model	CWS			Determine Data Gaps	Develop model		
Delineation of management units	CWS		Ongoing				
Ensure publication and/or distribution of relevant data	CWS	Provinces Researchers	Ongoing				
Maintain databases and share with CDC or a CDC equivalent			Ongoing				
Winter monitoring	CWS Provinces		Ongoing				
Plan and implement Harlequin Duck surveys	CWS	Provinces Researchers	Unknown – contingent upon funding and timing				
Develop Greenland monitoring strategy	CWS		Undetermined				

Implementation schedule (continued)

Habitat Protection - Action Items	Section/ Lead	Other	2006	2007	2008	2009	2010
Protect Harlequin Ducks on federal property	CWS	Other Federal Departments	Outline protected areas	Determine potential sites	Work with department to protect		
Work with forestry companies to minimize impacts on Harlequin Duck breeding habitat	CWS	Provinces		Begin consultation with forest companies			
Maintain and improve relations with hydroelectric companies to protect Harlequin Ducks	CWS	Provinces	Undetermined				
Develop relationship with aquaculture industry to protect Harlequin Ducks	Provinces	CWS	Undetermined				
Work in a preventative capacity to reduce offshore oil dumping	CWS		Ongoing				
Monitor and work to mitigate pesticide use	CWS Provinces		Undetermined				
Refine a habitat protection strategy	CWS	Provinces		Develop strategy			
Protect important habitat	CWS Provinces			Contingent upon habitat protection strategy			
Train Environmental Assessment officers and biologists in multiple departments, jurisdictions, and organizations	CWS	Provinces	Initiate Program	Develop more comprehensive approach	Implement on larger scale		

Implementation schedule (continued)

Research - Action Items	Section/ Lead	Other	2006	2007	2008	2009	2010
Develop Threat Assessment	CWS Provinces		Initiate discussion	Complete Threat Assessment			
1. Impact studies 2. Human encroachment impacts	CWS Provinces Researchers			Complete Threat assessment	Develop schedule of studies	Unknown	
Gap analysis	CWS	Provinces	Contingent upon completion of threat assessment, monitoring strategy, and habitat protection strategy.				
Complete mark-recapture study	CWS		Complete	Published			
Complete genetic analyses	CWS		Undetermined				
Habitat model	CWS	Researchers	Undetermined				

Socioeconomic - Action Items	Section/ Lead	Other	2006	2007	2008	2009	2010
Develop educational materials	CWS Provinces NGOs		Ongoing				
Develop and promote codes of practice	CWS Provinces		Initial development	Complete			
Stewardship promotion	CWS Provinces	NGOs	Ongoing				
Conduct public information sessions	CWS		Ongoing				
Educate law enforcers	CWS Provinces		Ongoing				
Annual report	CWS			Complete			Complete

8. REFERENCES

- Beissinger, S.R. and M.I. Westphal. 1998. On the use of demographic models of population viability in endangered species management. *J. Wildl. Manage.* 62(3): 821-841.
- Boardman, G.A. 1903. *The naturalist of the Saint Croix*. Privately printed, Bangor, Maine. 351 pp.
- Boertmann, D. and A. Mosbech. 2002. Molting Harlequin Ducks in Greenland. *Waterbirds* 25(3): 326-332.
- Breault, A. and J.-P. L. Savard. 1991. Status report on the distribution and ecology of Harlequin Ducks in British Columbia. *Can. Wildl. Ser. Tech. Rep. Ser. no. 110*, Pacific and Yukon Region, Delta.
- Brodeur, S., J.-P. L. Savard, M. Robert, P. Laporte, P. Lamothe, R.D. Titman, S. Marchand, S. Gilliland and G. Fitzgerald. 2002. Harlequin duck *Histrionicus histrionicus* population structure in eastern Nearctic. *J. Avian Biol.* 33: 127-137.
- Brodeur, S., J.-P. L. Savard, M. Robert, A. Bourget, G. Fitzgerald & R. D. Titman (in press). Abundance and movements of Harlequin Ducks breeding on rivers of the Gaspé Peninsula, Québec. Pages 00-00 in Robertson, G.J.; Thomas, P.W. (eds.), *Harlequin Ducks in the Northwest Atlantic*. Canadian Wildlife Service Occasional Paper No. 000. Ottawa.
- Cassirer, E.F. and C.R. Groves. 1991. Harlequin Duck ecology in Idaho: 1987-1990. Idaho Dept. of Fish Game, Boise, ID.
- Chubbs, T.E., P.G. Trimper, G.W. Humphries, P.W. Thomas, L.T. Elson, and D.K. Laing. In Press. Tracking seasonal movements of adult male Harlequin Ducks from central Labrador using satellite telemetry. Pages 00-00 in Robertson, G.J.; Thomas, P.W. (eds.), *Harlequin Ducks in the Northwest Atlantic*. Can. Wildl. Occ. Pap. No. 000. Ottawa.
- Clarkson, P. 1994. Managing watersheds for Harlequin Ducks. *American River Manage. Soc.*, Grand Junction, CO.
- Consortium Gauthier-Guillemette-GREBE 1993a. Complexe Grande-Baleine. Avant projet Phase II. Étude de l'avifaune et du castor : dénombrement de l'effectif reproducteur du Canard arlequin, 1992 ; Rapport présenté à Hydro-Québec, Vice-présidence Environnement. Montréal, 22 p.
- Consortium Gauthier-Guillemette-GREBE 1993b. Étude de l'avifaune et du castor : acquisition de connaissances sur l'écologie du Canard arlequin. Rapport présenté à la vice-présidence Environnement de Hydro-Québec dans le cadre d'études d'avant-projet du complexe Grande-Baleine, 38 p.
- Crowley, D.W. and S.M. Patten, Jr. 1996. Breeding ecology of Harlequin Ducks in Prince William Sound, Alaska. Exxon Valdez Oil Spill State / Federal Natural Resource Damage Assessment Final Report (Restoration Study no. 71), Alaska Dept. Fish Game. Anchorage, AK.
- Downs, A. 1888. Birds of Nova Scotia. *Proceedings of the Nova Scotia Institute of Natural Science* 7: 142-178.

- Gilliland, S.G. 2001. Discussion Paper: Possible factors that may have affected recent population trends of the Harlequin Ducks in eastern North America. Unpublished Report 19 pp.
- Gilliland, S.G., G.J. Robertson, M. Robert, J-P L. Savard, D. Amirault, P. Laporte, P. LaMothe. 2002. Abundance and distribution of Harlequin Ducks molting in eastern Canada. *Waterbirds* 25: 333-339.
- Goudie, R.I. 1989. Historical status of Harlequin Ducks wintering in eastern North America – A reappraisal. *Wilson Bull.* 101(1): 112-114.
- Goudie, R.I. 1990. The Status of the Harlequin Duck (*Histrionicus histrionicus*) in eastern North America. Unpublished report to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ottawa.
- Goudie, R.I. and I.L. Jones. 2003. Effects of aircraft disturbance on Harlequin Ducks breeding in central Labrador – Project Report 2002. Unpublished report to the Atlantic Cooperative Wildlife Ecology research Network, St. John's. 60 pp.
- Goudie, R.I. and C.D. Ankney. 1986. Body size, activity budgets, and diets of sea ducks wintering in Newfoundland. *Ecology* 67: 1475-1482.
- Heath, J. 2001. Factors influencing breeding distribution of Harlequin Ducks (*Histrionicus histrionicus*) in northern Labrador: a multi-scale approach. Master's thesis, Memorial University of Newfoundland, St. John's, NL.
- Hirsch, K.V. 1980. Winter ecology of sea ducks in the inland marine waters of Washington. Master's Thesis, University of Washington, Seattle, WA.
- Hunt, W.A. 1998. The ecology of Harlequin Ducks (*Histrionicus histrionicus*) breeding in Jasper National Park, Canada. Master's Thesis, Simon Fraser University, Burnaby, BC.
- JWEL: Jacques Whitford Environment Limited 1997. Voisey's Bay 1996 Environmental Baseline Technical Data Report. Unpublished Report 57 pp.
- JWEL: Jacques Whitford Environment Ltd. 1998. Distribution of breeding Harlequin Duck within the low-level training area of Labrador and northeastern Québec, 1997. Study # GB575_03. Unpublished Report.
- JWEL: Jacques Whitford Environment Limited 1999. Summary of Harlequin Duck survey data in Labrador and Northeastern Québec. Environmental Mitigation Program Supporting Military Flying Activity in Goose Bay, Labrador. Goose Bay Office, National Defence Headquarters, Ottawa, ON.
- Langlois, A. 2006. Écologie de la mue et de la migration automnale chez l'Arlequin plongeur (*Histrionicus histrionicus*). Mémoire de maîtrise, Département de biologie, Université Laval, Québec.
- Mittelhauser, G. 2000. The winter ecology of Harlequin Ducks on the coast of Maine. Master's thesis, University of Maine, ME.
- Montevecchi, W.A., A. Bourget, J. Brazil, R.I. Goudie, A. E. Hutchinson, B. C. Johnson, P. Kehoe, P. Laporte, M. A. McCollough, R. Milton, and N. Seymour. 1995. National Recovery Plan for the Harlequin Duck in eastern North America. Report No. 12. Recovery of Nationally Endangered Wildlife Committee, 30 pp.

- Morneau, F., M. Robert, J.-P. L. Savard, P. Lamothe, M. Laperle, N. D'astous, S. Brodeur & R. Décarie (in press). Abundance and distribution of Harlequin Ducks in the Hudson Bay and James Bay area, Québec. Pages 00-00 in Robertson, G.J.; Thomas, P.W. (eds.), Harlequin Ducks in the Northwest Atlantic. Canadian Wildlife Service Occasional Paper No. 000. Ottawa.
- Palmer, R.S. 1949. Maine birds. Bull. Mus. Comp. Zoology (Harvard) 102: 110-117.
- Peterson, R.T. and J. Fisher. 1955. Wild America. Houghton Mifflin, Boston, Massachusetts.
- Robert, M. 2000. Inventaire hélicoptéré de l'Arlequin plongeur sur des rivières de la Côte-Nord et du Labrador, mai 2000. Unpubl. report, Canadian Wildlife Service, Québec Region, Sainte-Foy, QC.
- Robert, M., F. Morneau, C. Marcotte & P. Lamothe 2001. *Inventaires hélicoptérés de l'Arlequin plongeur sur des rivières du Québec et du Labrador aux printemps de 1999 et 2000*. Série de rapports techniques No 375, Environnement Canada, Service canadien de la faune, 33 p.
- Robert, M., G.H. Mittelhauser, B. Jobin, G. Fitzgerald and P. Lamothe. In Press. New insights on Harlequin Duck population structure in eastern North America as revealed by satellite telemetry. Pages 00-00 in Robertson, G.J.; Thomas, P.W. (eds.), Harlequin Ducks in the Northwest Atlantic. Can. Wildl. Occ. Pap. No. 000. Ottawa.
- Robertson, G.J. and P. Thomas (eds.). In Press. Harlequin Ducks in the Northwest Atlantic. Can. Wildl. Occ. Pap. No. 000. Ottawa.
- Robertson, G.J. and R.I. Goudie. 1999. Harlequin Duck (*Histrionicus histrionicus*). In The Birds of North America, No. 466 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Rodway, M.S. 1998. Habitat use by Harlequin Ducks breeding in Hebron Fiord, Labrador. Can. J. Zool. 76: 897-901.
- Ryan, P. 1994. Innu Nation – Canadian Wildlife Service Harlequin Duck (Nutshipaustukueshish) conservation initiative – report on communication at Sheshashit and Mud Lake, April 1994. Unpublished CWS Report, April 1994. 12 pp.
- Savard, J.-P. L. 1988. A summary of current knowledge on the distribution and abundance of moulting sea ducks in the coastal waters of British Columbia. Can. Wildl. Serv. Tech. Rep. Ser. No. 45, Pacific and Yukon Region, Delta.
- Savard, J.-P. L., M. Robert, and S. Brodeur. In Press. Status of Harlequin Ducks in Québec. Pages 00-00 in Robertson, G.J.; Thomas, P.W. (eds.), Harlequin Ducks in the Northwest Atlantic. Can. Wildl. Occ. Pap. No. 000. Ottawa.
- Thomas, P.W. 2001. Conversations in Davis Inlet, Labrador. Unpublished CWS Report, May 2001. 4 pp.
- Thomas, P.W., G. Mittelhauser, T. Chubbs, P. Trimper, R.I. Goudie, G.J. Robertson, S. Brodeur, M. Robert, S.G. Gilliland and J.-P. L. Savard. In Press. Movements of Harlequin Ducks in eastern North America. Pages 00-00 in Robertson, G.J.; Thomas, P.W. (eds.), Harlequin Ducks in the Northwest Atlantic. Can. Wildl. Occ. Pap. No. 000. Ottawa.

- Thomas, P.W. and M. Robert. 2001. The Updated Status of the Harlequin Duck (*Histrionicus histrionicus*) in eastern North America. Unpublished report to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ottawa, Ontario.
- Trimper, P., G.J. Robertson, T. Chubbs, and P. Thomas. In Press. Status of the Harlequin Duck in Labrador. Pages 00-00 in Robertson, G.J.; Thomas, P.W. (eds.), Harlequin Ducks in the Northwest Atlantic. Can. Wildl. Occ. Pap. No. 000. Ottawa.
- Voisey's Bay Environmental Assessment Panel. 1999. Report on the proposed Voisey's Bay Mine and mill project. 211 pp.
- Wallen, R.L. 1987. Habitat utilization by Harlequin Ducks in Grand Teton National Park. Master's thesis, Montana State University Bozeman.
- Wiese, F.K., Robertson, G.J. and Gaston, A.J. 2004. Impacts of chronic marine oil pollution and the murre hunt in Newfoundland on thick-billed murre *Uria lomvia* populations in the eastern Canadian Arctic. Biol. Conser. 116: 205-216.

9. RESPONSIBLE JURISDICTIONS - CONTACTS

Environment Canada:
Canadian Wildlife Service – Atlantic Region (lead)
6 Bruce Street
Mount Pearl, NL A1N 4T3

Contact: Peter Thomas
Tel: 709-772-4297 email: peter.thomas@ec.gc.ca

Service canadien de la faune – Québec Region
1141 Route de l'Église
C.P. 10100
Sainte-Foy, QC G1V 4H5

Contact: Michel Robert
Tel : 418-649-8071 Email : michel.robert@ec.gc.ca

Parks Canada :
Parks Canada
25 Eddy St., 4th Floor, Room 355
Gatineau, Québec K1A 0M5

Parks Canada
Mainland Nova Scotia Field Unit
P.O. Box 9080, Station A
Halifax, NS B3K 5M7

New Brunswick:
Renewable Resources Division
Department of Natural Resources
Hugh John Flemming Forestry Centre
Room: 310, Floor: 3
1350 Regent Street
Fredericton, New Brunswick E3C 2G6

Contact: Michael Sullivan
Tel: 506-453-2440, E-mail: Mike.Sullivan@gnb.ca

Newfoundland & Labrador:
Department of Environment and Conservation
Inland Fish and Wildlife Division
Government of Newfoundland and Labrador
P.O. Box 2007
Corner Brook, NL A2H 7S1

Contact: Jim Hancock
Tel: 709- 637-2008, E-mail: jimhancock@gov.nl.ca

Nova Scotia:
Wildlife Division
Department of Natural Resources
Government of Nova Scotia
Provincial Building
136 Exhibition Street
Kentville, NS B4N 4E5

Contact: Barry Sabean
Tel: 902-679-6091, E-mail: sabeanbc@gov.ns.ca

Prince Edward Island:
Dept. of Environment, Energy and Forestry
Jones Building, 4th Floor
11 Kent Street
PO Box 2000
Charlottetown, PE C1A 7N8

Contact: Kate MacQuarrie, Acting Director
Tel: (902) 368-4705, E-mail: kemacquarrie@gov.pe.ca

Québec:
Ministère des Ressources naturelles et de la Faune
Direction générale du Développement de la faune
Édifce Marie-Guyart, 10^e étage
675, boulevard René-Lévesque Est
Québec (Québec) G1R 5V7

Contact: Michel Damphousse
Tel.: (418) 521-3875 ext 8745
Courriel : michel.damphousse@fapaq.gouv.qc.ca

APPENDIX 1 - MAP.

Figure 1. Map of the breeding, wintering and moulting locations of the Harlequin Duck in eastern North America and Greenland.

