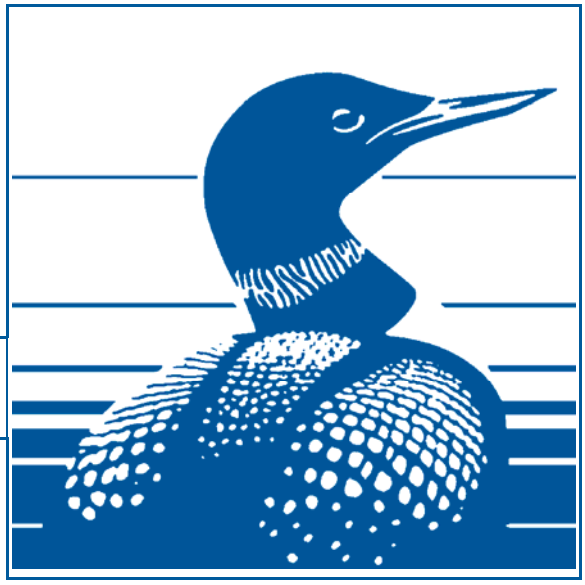
# Harlequin Duck Threat Assessment, Eastern Population

**Colleen E. Soulliere and Peter W. Thomas**

Atlantic Region 2009



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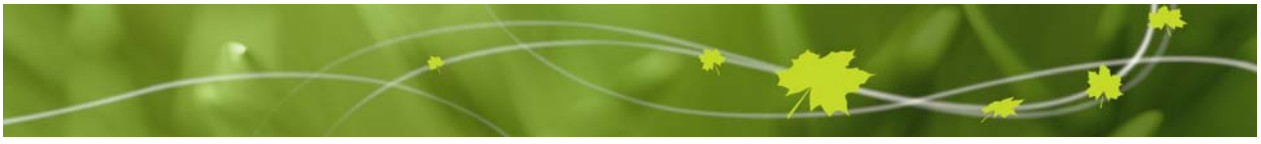

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# Harlequin Duck Threat Assessment, Eastern Population

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## Abstract

Seasonal changes in habitat use and behaviour, and the wide geographic range of Harlequin Ducks in eastern North America result in diverse threats to population viability, which vary across regions and across seasons. In Part I of the Threat Assessment, potential and plausible threats to Harlequin Duck in eastern Canada are evaluated; those causing disproportionate stress to breeding females and those with the potential to affect aggregations of ducks at sea are of greatest concern. As the relevance, timing, and intensity of threats differ between the political boundaries of the Provinces in Atlantic Canada, analysis of the status of threats for each Atlantic Province is provided in Part II. Recommendations for threat management and avenues for threat mitigation are discussed within the provincial analyses. This document is intended to be used as a resource and guide for population and habitat managers, environmental assessment officers, and other individuals, agencies, or organizations with a practical interest in the minimization of threats to Harlequin Ducks.

## *Résumé*

Les changements saisonniers concernant l'utilisation de l'habitat et les comportements ainsi que la vaste aire de répartition géographique de l'Arlequin plongeur dans l'est de l'Amérique du Nord entraînent diverses menaces qui pèsent sur la viabilité de la population, laquelle varie par région et au cours des saisons. La partie I de l'évaluation des menaces renferme l'évaluation des menaces éventuelles et plausibles qui pèsent sur l'Arlequin plongeur dans l'est du Canada. Ainsi, les menaces causant un stress inadmissible aux femelles reproductrices et les menaces qui peuvent avoir des incidences sur les rassemblements de canards au large soulèvent le plus de préoccupations. Puisque la pertinence, la période et l'intensité des menaces diffèrent d'une frontière politique à l'autre dans les provinces du Canada atlantique, l'analyse de l'état des menaces pour chaque province de l'Atlantique est donnée dans la partie II. Les analyses provinciales abordent des recommandations en ce qui a trait à la gestion des menaces et des solutions pour l'atténuation des menaces. Le présent document a pour but de servir d'outil et de guide à la population et aux gestionnaires de l'habitat, aux agents d'évaluation environnementale et à d'autres personnes, agences ou organismes ayant un intérêt visant la réduction au minimum des menaces qui pèsent sur les Arlequins plongeurs.

## *Acknowledgments*

This Threat Assessment has been prepared by Environment Canada (EC) in cooperation with the Provincial jurisdictions responsible for the Harlequin Duck in Atlantic Canada. We would like to thank all the Provincial representatives who contributed to the development of this document and provided valuable insight into the socio-political and wildlife management environments of their respective Provinces:

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## *Preface*

Seasonal changes in habitat use and behaviour and the wide geographic range of Harlequin Ducks in eastern North America result in diverse threats to population viability, which vary across regions and across seasons. During the development of the Harlequin Duck Management Plan (Environment Canada 2007), the need for a comprehensive document evaluating and addressing threats to Harlequin Duck as they vary across Provincial management jurisdictions was identified. To address this need, the Harlequin Duck Threat Assessment, including a series of provincially-relevant Threat Analyses, was created.

This document is intended to provide a useful guide to population and habitat managers, environmental assessment officers, and other individuals, agencies, or organizations with an interest in the mitigation, minimization, and elimination of threats to Harlequin Ducks.

## *About this Document*

The Harlequin Duck Threat Assessment, Eastern Population contains two sections: *Part I: Threats and Limitations to Harlequin Duck, Eastern Population*, and *Part II: Threat Analyses for the Atlantic Provinces*. An appendix providing a brief summary of the Environment Canada (2005) guidelines for identifying and mitigating threats (Appendix I) is provided to describe the structure of threat identification and define specific terminology used within this document.

Part I is an overview and evaluation of known and potential threats to the eastern population of Harlequin Ducks. In Part I, a Threat Classification Table for the whole of the Harlequin Duck's eastern Canadian population is provided. The Threat Classification Table summarizes those threats evaluated to be high, medium, or low in their potential effect on population viability; possible threats evaluated to be negligible or not a threat are excluded from the Table. The evaluation of the severity of threats to the whole population will vary from the severity of threats within Provincial boundaries. For analysis of the importance of particular threats within the political boundaries of each Atlantic Province, reference should be made to the summary tables in Part II.

Part II is a province-by-province analysis of identified threats relevant to Harlequin Ducks within the political boundaries of each Atlantic Province. In each Provincial Analysis, keywords identified as *Threat Categories* are provided in section 3.0 in order to cross reference with the threat evaluation provided in Part I. Keywords identified as *Avenues for Mitigation* reference subject headings in section 4.0 within each Provincial Analysis.

The discussion of distribution and abundance of Harlequin Ducks, within both Part I and Part II, are purposefully brief. The eastern population of Harlequin Duck is expected to change in distribution and abundance, to some extent, over time, so the maps provided are for illustrative rather than definitive purposes. For further information about distribution and abundance, it is advisable to consult the most recent Status Report (available from the Species At Risk Public Registry, *www.sararegistry.gc.ca)*. Canadian Wildlife Service, Atlantic Region (CWS-ATL) maintains a database which includes Harlequin Duck survey results and incidental sighting reports. Contents of this database are available as discussed in section 4.1.3 of each Provincial Analysis, and are the best source of current distribution and abundance data.

# Part I:

# Limitations and Threats to Harlequin Duck, Eastern Population

**Limitations and Threats to Harlequin Duck, Eastern Population**

## *Introduction*

Seasonal changes in habitat use and behaviour and the wide geographic range of Harlequin Ducks in eastern North America result in diverse threats to population viability. Limitations and threats discussed in this report were identified in the updated Status Report (Thomas and Robert 2001), the proposed Management Plan (Environment Canada 2007), and through informal discussions with biologists and resource managers at both provincial and federal jurisdictional levels. The following evaluation describes intrinsic limitations, as well as known and plausible threats to the eastern North American population of Harlequin Ducks that may contribute to its vulnerability for population decline.

Some of the identified threats are speculative, as cause-effect or correlative evidence does not always exist to support or refute plausible threats; an effort has been made to evaluate identified threats with respect to existing evidence. Identified possible threats which, upon evaluation, are thought to pose negligible or non-existent effects on Harlequin Duck populations are maintained in order to document their unlikelihood of posing real threats. The following eastern population assessment is organized as recommended by Environment Canada (2005). Threats are identified and discussed by Threat Category; General and Specific threats are discussed within Threat Categories (Appendix I). Some specific threats, like aquaculture or resource extraction, have multiple effects on Harlequin Duck populations and are discussed under multiple Threat Categories.

A threat classification table summarizing identified threats expected to affect viability of the Harlequin Duck (eastern population) is available in Appendix II. The severity of these threats and the actual risk to the population posed by them is largely dependent on the specific areas and time of year they occur relative to occupation of these areas by Harlequin Ducks. This assessment is intended to provide the theoretical and empirical evidence from which the severity of identified threats can be determined; the Threat Assessment for the eastern population provides essential background for understanding the Provincial Threat Analyses (Part II).

## *Distribution and Abundance in Eastern Canada*

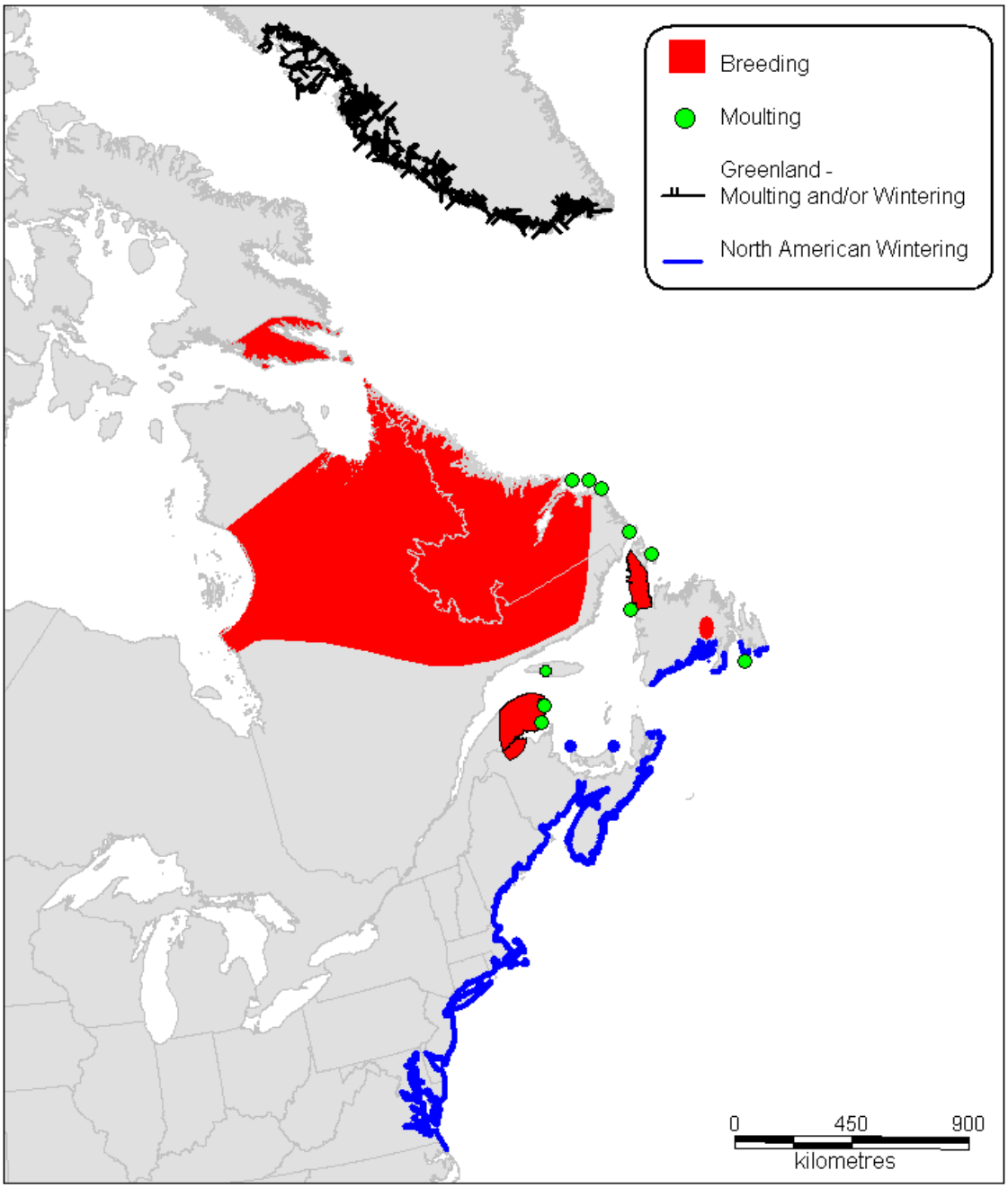


**Figure 1. Distribution of the eastern Harlequin Duck population by ecological season.**

The Harlequin Duck, eastern population, winters in coastal areas from Newfoundland south to Maryland, U.S.A and along the southwest coast of Greenland. They breed from northern New Brunswick north to Nunavut and from Newfoundland east to Hudson's Bay. Moulting aggregations in North America occur in coastal areas from northern Labrador south to southern Newfoundland and along the Québec North Shore (Gilliland *et al.* 2002). There are also substantial Harlequin Duck moulting populations along the southwest coast of Greenland

(Boertmann and Mosbech 2002); the affinities between these moulting, breeding, and wintering areas in eastern North American are poorly documented.

As Harlequin Duck display a high fidelity to wintering areas (Robertson and Goudie 1999) and pair-bonding occurs during the winter, it is believed that geographic segregation during the winter produces two relatively distinct demographic populations of Harlequin Duck. Harlequin Ducks wintering along the southwestern coast of Greenland are thought to breed primarily in northern Labrador and northern Québec (Chubbs *et al. in press*, Robert *et al. in press*), and in Nunavut. The North American wintering groups likely comprise the more southern breeders. A detailed description of eastern Harlequin Duck distribution and population estimates and trends is available in the Updated Status Report (Thomas and Robert 2001) and the Management Plan (Environment Canada 2007).

In Atlantic Canada, wintering groups occur primarily along the southern coasts of New Brunswick and Nova Scotia, with some stable wintering groups along the south coast of Newfoundland and occasional groups around the Gaspé Peninsula of Québec (Thomas and Robert 2001). Wintering habitat consists of rocky coastline, exposed headlands and subtidal ledges (Robertson and Goudie 1999). Harlequin Ducks wintering in Maine display habitat preference for high wave-exposure, little intertidal gravel and beach boulder, and ledge (Mittelhauser 2000). A substantial portion of the North American wintering population occurs in Atlantic Canada (Mittelhauser 2000), the remainder wintering along the U.S. eastern seaboard.

Breeding pairs primarily occur throughout Labrador (Trimper *et al. in press*), northern Québec and the Gaspé Peninsula of Québec (Savard *et al. in press*), and the Northern Peninsula of Newfoundland (Gilliland *et al. in press*). There are confirmed reports of localized breeding in northern New Brunswick (Boyne *in press*), southeastern Newfoundland (Goudie 1990, Thomas *in press*), the North Shore of the Gulf of St. Lawrence (Savard *et al. in press*), and southeastern Baffin Island (Mallory *et al. in press*). The core of known breeding for the eastern Harlequin Duck within Atlantic Canada and Québec extends from south-central to northern Labrador.

Harlequin Ducks require fast moving streams with abundant invertebrates for breeding and but also will use slower moving streams with abundant invertebrates for brood rearing (Robertson and Goudie 1999). Specific habitat preferences, such as stream width, vegetative cover and acidity vary among regions (Robertson and Goudie 1999) and may include characteristics like avoidance of raptor activity (Heath *et al.* 2006). Harlequin Duck tend to breed in remote areas and, as a result, breeding density and abundance are difficult to determine. Approximately 1 000 pairs of Harlequin Duck breed in western and southeastern Greenland (Boertmann *in press*), but the remainder of the individuals wintering in Greenland are thought to breed in northern Labrador and northern Québec. Harlequin Ducks wintering in eastern North American are thought to breed in Atlantic Canada and Québec.

Moulting aggregations have been documented in northern and southern Labrador, Newfoundland, and Québec. Moulting habitat tends to have similar characteristics to wintering habitat (Gilliland *et al.* 2002, Robertson and Goudie 1999). Satellite telemetry studies indicate that some individuals wintering in Greenland may moult in northern Labrador (Brodeur *et al.* 1999) and some individuals wintering in eastern North America may moult in Greenland (Robert *et al. in press*), but most of the birds wintering in eastern North America are thought to moult in Atlantic Canada.

## *Intrinsic Limitations to Population Growth and Viability*

### Life History Traits

Like other sea ducks, Harlequin Ducks have delayed sexual maturity, low annual production, variable reproductive success and live long lives (Robertson and Goudie 1999).

Although females may nest as early as 2 years of age, breeding success is low until they are at least 5 years of age (Reichel *et al.* 1997); males often do not pair until they are 3 years of age or older (Robertson *et al.*1998). Harlequin Ducks typically lay one clutch per year and it is unknown whether replacement clutches are laid in the case of clutch or brood loss (Robertson and Goudie 1999). Little information on clutch size in eastern North America is known, but reports of individual nests have indicated clutch sizes of four and seven eggs (Brodeur *et al.* 1999), six eggs (Rodway *et al.* 1997), seven eggs (Goudie and Gilliland 2008) and six eggs. Survival from hatch to migration was estimated as 0.89 (Smith *et al. in prep.*) in western North America. The apparent survival[1] rate of moulting juvenile males (0.466) is lower than that of adult males (0.744) at the Gannet Island, NL moult site (Robertson and Thomas *in press*). Apparent survival rates for Harlequin Ducks wintering at Isle au Haut, Maine indicate that winter survival is similar for adult males and females, but that adult females have lower summer survival rates (Mittelhauser *in press*). The reduced relative survival for adult females is likely due to events during the breeding season, indicating vulnerability to them during that time of year. The low apparent survival of juveniles relative to adults may indicate interactive effects of higher dispersal and higher mortality in juveniles.

Reproductive success appears to be variable and has been reported to correlate with food availability in Iceland (Gardarsson and Einarsson 2004). Little information exists on the life span or lifetime reproductive success of Harlequin Ducks. Given that reproductive success is highest in older (>5 years old) females, they may contribute disproportionately to population growth.

Delayed sexual maturity, low annual production and variable breeding success limit the growth rate of Harlequin Duck populations. This may be of particular concern during population decline as the recovery of populations may be slow due to intrinsic life history traits. Extrinsic conditions which result in adult female mortality should be considered a greater threat to population viability than those resulting primarily in juvenile or adult male mortality.

### Energetics

Harlequin Ducks are relatively small sea ducks (adult males, 490-760g; adult females, 470-670g: Robertson and Goudie 1999) and hence have a relatively high mass-specific metabolic rate. Energy requirements are likely to be particularly high during cold stress due to the added costs of thermoregulation. Wintering Harlequin Duck show little flexibility in the proportion of their activity budget dedicated to feeding regardless of changes in environmental conditions (Goudie and Ankney 1986) suggesting that energetic requirements limit activity patterns. Evidence that Harlequin Ducks do not feed nocturnally (Rizzolo *et al.* 2005, Rodway 1998) suggests a constraint on the ability to compensate for lost foraging opportunities. This daylight constraint on available foraging time will be more pronounced at the northern extent of the wintering range and the southern extent of the breeding range. Those wintering in Greenland, some of which breed in Canada, will be at an elevated risk of energetic stress due to lost foraging opportunities than those wintering further south, simply due to differences in winter day length.

High energetic requirements and inflexibility of the feeding portion of their activity budget could lead to increased mortality following any event which substantially decreases time available for feeding (e.g. chronic disturbance) leading to a reduced ability to maintain metabolic

[1] "apparent survival" is used due to the inability to distinguish between permanent emigration and death in simple mark-recapture studies; the rate likely underestimates actual survival rates

demands or a reduced ability to form stores of nutrient reserves. Reproductive success can be reduced as a result of disturbance to the winter feeding regime, as the condition of birds arriving at the breeding grounds is determined by nutrient acquisition and storage prior to migration (Bond and Esler 2006). Daylight limitation of foraging opportunity would not be expected to additively affect breeding success as Harlequin Duck use local nutrients for breeding rather than stored reserves from winter (Bond 2005) and day length is relatively long during the breeding season. Frequent or intense disturbance during nutrient acquisition for breeding has the potential to delay nest initiation (more time needed to reach breeding condition threshold), and may affect southern breeders more adversely than northern breeders.

### Social Behaviour

Harlequin Ducks are gregarious, especially in the non-breeding season, and are known to congregate in haul-out groups on preferred rock shoals and also form large groups at areas rich in food concentrations (Bengtson 1966, Bengston 1972, Robertson and Goudie 1999). Harlequin Ducks will form mixed-species flocks with other sea ducks such as Black Scoters (*Melanitta nigra*) (Environment Canada 2007) and Common Eiders (*Somateria mollissima*) (Robertson and Goudie 1999).

Harlequin Ducks have a high site fidelity to wintering areas, which is where pair formation occurs. Genetic differentiation of wintering groups of Harlequin in eastern Canada is undetermined, but molecular analysis from a small sample of individuals from eastern North America indicates likely genetic structure in the east (Scribner *et al. in prep*). Winter movement of females between adjacent sites and occasional emigration of females to distant sites likely contribute to the lack of genetic structuring in the west (Iverson and Esler 2006). In western North America, females accompany their broods to wintering areas during the first year (Regehr *et al.* 2001); if this behaviour is similar in the east, it may increase the likelihood that wintering sub-populations are genetically distinct from each other, although immature fidelity to wintering sites is unknown.

The gregariousness of Harlequin Ducks during moulting, wintering and, to some extent, staging increases the risk of catastrophic mortality from single events. Their tendency to form mixed-species flocks is thought to elevate their risk of incidental hunting mortality (Environment Canada 2007).

Low genetic exchange between wintering areas would increase the threat of catastrophic mortality at wintering sites by additively causing a loss of genetic diversity in the eastern North America population. Additionally, in periods of local population declines, there is the potential for bottleneck effects reducing genetic diversity within the traditional wintering areas.

## *Identified Potential Threats*

## Threat Category: Pollution

### General Threat: Oil and Chemical Pollution

*Chronic Oiling*

Chronic oiling refers to marine oil pollution entering the environment from ship sources other than wreckage, accounting for over 400 000 tonnes of oil introduced annually into Canadian waters (Brander-Smith *et al.* 1990). These sources include illegal discharge of contaminated bilge or ballast water, boat and ship accidents other than oil tanker accidents, and spills during fuelling of vessels. Negligent and intentional actions cause almost twice the pollution of tanker

accidents (Brander-Smith *et al.* 1990). The risk of chronic oil pollution is high in areas with high shipping traffic.

Chronic oil pollution is of major concern for many seabird species along Atlantic shipping routes and has been documented in Newfoundland since 1956 (Tuck 1961) with Newfoundland having some of the highest oiling rates in the world (Wiese and Ryan 2003). Recent analyses are encouraging and rates may be finally starting to decline (Wilhelm *et al.* 2007). Although the winter oiling rate of birds along the shores of southeastern Newfoundland was unchanged between 1984 and 2006, and actually increased during the summer period (Wilhelm *et al.* 2008), the actual number of oiled birds per kilometer showed a significant decline in both summer and winter in the same time period. This discrepancy was attributed to reduced numbers of unoiled birds (Wilhelm *et al.* 2008). In spite of these declines, three onshore spills occurred on the Avalon Peninsula between 2004 and 2006, two of which were in areas frequented by Harlequin Duck. Chemical analysis of oily residue from beaches and from stranded birds revealed that 90% of it contained heavy fuel oil, the type used by large ocean-going vessels (Wiese and Ryan 1999). Little documentation of the extent of chronic oiling and its impact on Harlequin Ducks is available outside of information gathered in Newfoundland. Since 2002, there have been five known incidents of oiled Harlequin Ducks in the vicinity of Newfoundland's south coast: two recovered from Newfoundland beaches, one on the water at Cape St. Mary's (Environment Canada Pollution Incident Reports), one additional bird found on a beach (S. Wilhelm *pers. comm.*), and one recovered in St. Pierre and Miquelon.

Chronic oiling can affect Harlequin Duck both through direct contact and by bioaccumulation of toxins in prey species. Direct contact generally results in plumage oiling, although if the contact is severe enough, it can lead to immediate mortality through lethal-dose ingestion of hydrocarbons or by smothering.

Oil is readily absorbed by plumage, decreasing the insulative efficacy of feathers and interfering with natural waterproofing, thereby increasing the energetic costs of thermoregulation. This energetic stress can lead to mortality due to hypothermia or starvation. For Harlequin Ducks, which display inflexibility in the allocation of energy resources (Goudie and Ankney 1986), the additive stress of plumage oiling may be especially pronounced.

Ingestion of oil by contact in the water column or by preening of oiled feathers may cause oil toxicity. It is not known whether damage to the liver or kidneys of Harlequin Ducks results from direct ingestion of oil. Harlequin Duck specimens collected after the Exxon Valdez oil spill in Alaska did not show elevated levels of aromatic hydrocarbons in their livers (Patten *et al.* 2000). In an oil-feeding experiment, Rizzolo (2003) found that ingestion of weathered crude oil caused rapid defecation in captive Harlequin Ducks, suggesting they may void ingested oil prior to absorption, or be able to minimize absorption; however, chronic diarrhea from oil exposure could lead to severe dehydration. Ingestion of oil from preening has been correlated with reduced reproductive success (Hartung 1965, Holmes 1984) and reduced feeding (captive Harlequin Ducks; Rizzolo 2003).

Oil toxicity from ingestion may be more severe from contaminants bioaccumulated in prey; aromatic hydrocarbons incorporated into prey tissue may be more readily absorbed as ingestion of prey would not be expected to induce a voiding response (Rizzolo 2003). Many marine invertebrates, because of their reduced motility relative to vertebrates, are adapted to withstand environmental stress; invertebrates are capable of avoiding acute oil contamination by burrowing, reducing metabolism, closing their shells or shifting to anaerobic metabolism, but long-term exposure to oil results in bioaccumulation of toxins (Moles 1998). Chronic introduction of oil into an area, or residual oil from a catastrophic spill, would likely result in elevated levels of contaminants in invertebrate prey tissue.

Despite the lack of direct evidence of oil toxicity from ingestion, female Harlequin Duck near the area of the Exxon Valdez spill showed a reduced survival rate for up to 9 years following

the oil spill relative to those in unaffected areas (Esler *et al.* 2002). The effects of chronic oiling are likely similar to those of persistent residual oil in a system.

*Oil and Chemical Spills*

Harlequin Ducks aggregate nearshore during moult, staging periods and at wintering sites. In eastern Canada, these sites are largely known and, due to the fidelity of Harlequin Duck to these areas, are static between years. Oil spills or slicks affecting moulting and wintering sites can threaten Harlequin Ducks by causing high mortality, loss of genetic diversity and reduced reproductive success.

The long-term effects of residual oil and chemical contamination at wintering or moulting sites are expected to be the same as those associated with plumage oiling and bioaccumulation of toxins in prey species, as described for chronic oiling. In addition to these, nearshore spills can potentially cause immediate mortality (either from lethal dose ingestion of chemicals or from smothering by oil). A single large oil spill at a wintering or moulting site could cause substantial mortality and a loss of genetic diversity. Additionally, due to the fidelity of Harlequin Ducks to their wintering sites, local recovery may not occur if a wintering or moulting group is extirpated.

Brander-Smith *et al.* (1990) estimated that Canada can expect at least 111 oil spills of small to major magnitude (< 1 tonne – 10 000 tonnes) annually; and that a catastrophic oil spill (>10 000 tonnes) should be expected approximately once every 15 years. The severity of spills will depend on the characteristics of the spill (amount of oil, speed of dispersal, proximity to Harlequin Duck aggregations, efficacy of clean-up, and the chemical composition and persistence of toxins in the environment). The possibility of a catastrophic oil or chemical spill in Atlantic Canada is relatively high due to the large amount of ship traffic in close proximity to areas known to be frequented by aggregations of Harlequin Ducks (Thomas and Robert 2001). As many of the Harlequin Duck breeding in eastern Canada winter in the northeast United States and in Greenland, catastrophic nearshore spills in either of these areas could have substantial population effects.

*Chronic and Acute Oil and Chemical Spills*

Threats to Harlequin Duck posed by marine oil and chemical pollution, both chronic and catastrophic, are moderate to high in severity although the probability of occurrence is low to moderate. The cumulative threat of the multiple aspects of oil pollution is of great concern, having the potential to affect population viability through a broad range of mechanisms.

**General Threat: Acidification of Streams**

Anthropogenic acidification of streams occurs both through acid rain caused by industrial air pollutants and exposure of sulphide-containing rock to air and water during mining operations. Although boreal streams tend to be naturally acidic, additive anthropogenic acidification reduces both abundance and diversity of benthic invertebrates (Dangles *et al.* 2004).

Acidification is a challenge in eastern Canada because the soil and underlying rock is largely incapable of neutralizing acid depositions. New Brunswick and Nova Scotia, despite the trend of reduced acid concentrations in precipitation since the 1980s, still receive acid deposition above critical loads (Federal/Provincial/Territorial Ministers of Energy and Environment 1999). In eastern North America, Harlequin Duck abundance correlates with anthropogenic acidification of lakes and streams; abundance of Harlequin Duck was low when pollutant-related acidification was high but subsequently increased during reductions in acid rain and subsequent improvements in water quality (Gilliland *et al. in press*). It is important to note that the relationship is

correlative only; other factors, such as the implementation of a hunting ban and increased survey effort, occurred simultaneously with the increase in Harlequin Ducks.

Acid concentrations in precipitation have steadily decreased since 1985 and are expected to continue to decrease under the Canada-Wide Acid Rain Strategy for Post-2000 (Federal/Provincial/Territorial Ministers of Energy and Environment 1999), however, acidification by acid mine run-off may continue to contribute substantially to high acidity in the breeding streams of Harlequin Ducks when mining operations are situated in breeding area watersheds. Mining operations may produce localized acidification, but since breeding densities are low and Harlequin Ducks tend to be widespread over the breeding range, the threat to the population is not severe.

The threat of stream acidification to Harlequin Duck is moderate but likely declining in severity overall.

**General Threat: Heavy Metals and Other Toxins**

*Lead Shot, Leads and Plastics from Fishing Gear*

Ingestion of lead and plastic debris may occur, but the preference of Harlequin Duck for mobile prey may minimize this (Robertson and Goudie 1999) during moulting and wintering. Incidental ingestion of lead or plastic may pose a greater threat in breeding areas than moulting or wintering areas. Feeding habits in breeding streams include scraping of rocks by ducklings and to some degree by adult females in order to acquire insect larvae and pupae still attached to substrate (Rodway 1998). Areas occupied by Harlequin Duck during breeding tend to be remote and likely receive little hunting activity as a source of lead shot (Robertson and Goudie 1999). Salmonid sport fishing season temporally coincides with brood rearing but the extent of geographic overlap of salmon fishers and Harlequin Duck brood-rearing streams is unknown. Lost or derelict fishing gear and related debris may pose an ingestion risk to Harlequin Duck in nearshore feeding areas during moulting and wintering, but there is no evidence of this occurring.

The threat of bioaccumulation from lead or other contaminants associated with shot or fishing gear is low.

*Mining Activity*

Bioaccumulation of heavy metals is of increasing concern for sea ducks (Henny *et al.* 1995). Mining activity can increase heavy metal concentrations in nearby aquatic systems, thereby increasing the potential for heavy metal toxicity threatening Harlequin Ducks. Stream acidification, also associated with mining activity, can accelerate heavy metal leaching. Direct evidence of toxic heavy metal effects in Harlequin Ducks does not exist, but the Ducks are known to be sensitive to the water quality of their breeding streams (Robertson and Goudie 1999). In addition to direct contact with heavy metal enriched water, common prey of Harlequin Ducks, such as Simulidae, Trichoptera, and Plecoptera (Robert and Cloutier 2001), bioaccumulate heavy metals (Goodyear and McNeill 1999). Eggs are produced from resources acquired at the breeding site (Bond 2005) rather than from stored reserves; heavy metal contamination of breeding streams may result in toxic effects to the embryo causing developmental abnormalities or reducing hatch success. Developmental abnormalities, increased embryonic mortality and reduced hatchling survival have been documented in other duck and seabird species with high levels of heavy metal concentrations in eggs (Scheuhammer *et al.* 2001).

Heavy metal contamination may affect Harlequin Ducks directly through toxic effects, by increasing developmental abnormalities, by reducing hatch success, by causing behavioural

change or indirectly by affecting prey populations and reducing the availability or quality of food items.

The current threat to Harlequin Duck from heavy metal enrichment of breeding streams is unknown, but may be moderate to high in severity in localized areas.

## Threat Category: Habitat Loss or Degradation

### General Threat: Resource Exploitation

Activities associated with resource extraction, power generation, and other activities which alter watersheds and riparian habitat may have multiple effects on Harlequin Duck habitat. Logging, mining and hydro-electric operations, among others, and associated infrastructure can alter breeding areas. Infrastructure associated with shipping of raw materials may interfere with occupation of traditional moulting and wintering sites.

*Habitat Removal*

Habitat can be lost during mining and forestry operations when suitable riparian habitat is removed. Additionally, the construction of road networks or power lines which cross waterways may also contribute to direct habitat loss. Forestry regulations vary somewhat between provincial jurisdictions in Atlantic Canada, but vegetative buffers are required to be left along the edges of water bodies, protecting nesting habitat within these. Nests tend to be located near stream edges but females may wander >20 m from stream edges in search of suitable sites (Robertson and Goudie 1999). Cassirer *et al.* (1996) recommend buffers of 100 m from breeding stream edges in order to effectively protect breeding habitat. Currently, provincial regulations are insufficient to provide adequate buffering. In Newfoundland and Labrador the standard buffer-zone along a waterway is 20 m (NL Dept. of Forest Resources & Agrifoods 2003), but there are allowances for extensions if data is available to indicate a reason. In New Brunswick the watercourse buffers range from 30 m to 150 m depending upon the characteristics of the watercourse (NB Dept. of Natural Resources & Energy 1999). There are no indications of wildlife related reasons for buffer-zone extensions.

In the case of hydro-electric development, loss of habitat can occur during the initial dam building; resultant flooding removes upstream habitat. For example, when Churchill Falls was developed for hydroelectric generation, approximately 1 400 $km^2$ of land space was flooded in an area that was likely historically important for breeding Harlequin Ducks.

Habitat loss could result in the displacement of breeding pairs to less preferable habitat which may result in reduced reproductive success. Actual habitat loss will be largely dependent on the size of the project, and the cumulative effects of multiple projects throughout the breeding range. The severity of the threat of habitat loss is moderate to high in localized areas and low to moderate across the breeding range.

*Modification of Watersheds, Manipulation of Water Levels*

Harlequin Ducks tend to be sensitive to water levels in their breeding streams. Increased water levels can cause flooding of established nests; reduced water levels are correlated with reduced breeding success (Goudie *et al.* 1994) and may alter aquatic invertebrate abundance through reduced emergence, reduced survival, or changes to species diversity (Bunn and Arthington 2002).

Manipulation of water levels by water control structures, such as dams, during breeding season may adversely affect reproductive success. Hill and Wright (1999) observed a reduction

(albeit insignificant due to small samples sizes) in Harlequin Duck breeding pairs downstream of a hydroelectric dam discharge in British Columbia. Movement of broods from areas upstream of hydroelectric dams may be impeded by reservoirs and associated water control structures (AGRA Earth and Environmental and Harlequin Enterprises 1999).

Construction of hydroelectric dams can displace peak flooding in time (Nilsson and Berggren 2000). Delayed or unusual timing of spring flooding may adversely affect Harlequin Duck productivity, either by affecting food resources or flooding established nests. Construction of dams also generally results in lower downstream discharge overall, resulting in reduced stream depth (Nilsson and Berggren 2000).

Increased water runoff associated with vegetation removal, particularly with intensive logging, can increase water levels such that nests may be abandoned or washed away (Cassirer *et al.* 1996).

The severity of the threat from water level manipulation is moderate to high in localized areas and low to moderate across the breeding range.

*Modification of Watersheds, Siltation*

Siltation changes water quality and may reduce the abundance of prey or alter species composition of invertebrate communities (Robertson and Goudie 1999). Additionally, increased turbidity may reduce the ability of Harlequin Ducks to locate food (Cassirer *et al.* 1996). During the construction of infrastructure associated with resource-exploitation, such as access roads, water control structures, and power lines, siltation may occur. Abandoned or out-of-use infrastructure can contribute to increased siltation as it degrades. Regulations regarding no-cut buffers around water bodies minimize the risk of siltation which is likely to be greatest where infrastructure crosses rivers and streams.

The threat to Harlequin Duck from siltation resulting from activities related to resource exploitation is likely low in severity.

*Modification of Coastlines*

Shipment of raw materials by sea from mining sites to processing sites may also be associated with habitat degradation or loss. Construction of piers could displace Harlequin Ducks from preferred wintering, moulting or staging sites if placed at or nearby these areas. Coastal development that permanently removes marine habitat could result in extirpation of local groups, due to the strong site fidelity Harlequin Ducks have to their moulting and wintering areas.

Harlequin Duck aggregations have been noted at anthropogenic coastal structures such as breakwaters and piers (S. Gilliland *pers. comm.*), indicating that coastal structures themselves may not discourage Harlequin Ducks. Modifications to coastal areas currently preferred by Harlequin Ducks, however, will likely result in a loss or degradation of the habitat.

The threat of coastline modification is low to high in severity as it is dependent on the proximity of such structures to known Harlequin Duck sites and the size of the local wintering, moulting or staging group.

**General Threat: Aquaculture**

Aquaculture is an establishing and growing industry in Atlantic Canada and along the northeast coast of the United States. Currently, marine aquaculture operations are primarily confined to protected bays, and generally not established in typical Harlequin Duck habitat. Some overlap between Harlequin Duck wintering sites and aquaculture already exists, but thus far has been limited to White Head Island (off Grand Manan) in the Bay of Fundy. It is also

anticipated that anthropogenic sources of pollution affecting nearshore areas will increase with current human population shifts toward coastal areas, further increasing the need for offshore aquaculture sites (Fisheries and Oceans Canada 2001). Commercial development of exposed coastal waters is expected to increase as the necessary technology becomes more economically accessible and may displace wintering and moulting Harlequin Ducks from preferred habitat.

At present, the threat of displacement of moulting or wintering Harlequin groups, due to development of traditional moulting and wintering areas for commercial aquaculture, is low in severity but anticipated to increase.

**General Threat: Inshore fishery**

Subtidal ledges may be degraded by fishing gear which remove submerged habitat, such as seaweed beds which in turn harbour local prey populations. Local food availability largely determines the distribution of Harlequin Ducks at their wintering sites (Robertson and Goudie 1999) and site fidelity of individuals to wintering areas may result in increased competition for reduced food resources and subsequent increased mortality if resources become limiting in these areas. Mobile gear associated with bottom dragging and bottom trawling is more likely to be destructive of subtidal ledges and other submerged habitat, but less likely to be used nearshore than fixed gear, such as traps and pots.

Commercial seaweed and sea urchin harvest have been identified as fisheries of particular concern (Thomas and Robert 2001) in terms of habitat degradation. Sea urchin harvesting is usually performed by divers and is thus selective and unlikely to damage habitat. Seaweed harvest regulations prohibit dragging for marine plants and require the cutting of marine plants above the holdfast [S.O.R./86-21] which effectively protects the underlying habitat structure, allowing for post-harvest restoration. Seaweed populations in the northwest Atlantic appear to recover quickly following harvest and are resistant to damage by some harvesting techniques (Sharp and Pringle 1990). The seaweed and sea urchin industries are relatively small in Atlantic Canada (D. Osborne *pers. comm.*) and unlikely to pose a large threat to Harlequin Duck habitat due to the difficulty of conducting any fishery activity in the types of marine areas preferred by Harlequin Ducks.

Scallop dragging, sea urchin dragging and mechanical periwinkle harvesting may be a concern in the Maritime Provinces. The threat of degradation of habitat by inshore fisheries or commercial seaweed and sea urchin harvest is low in severity.

## Threat Category: Disturbance

Harlequin Ducks are tolerant of moderate disturbance (Savard 1988, Clarkson 1994) but if females are disturbed from their nests, they may take several hours to return (Robertson and Goudie 1999). When windy, Harlequin Ducks tend to flush from coastal areas in response to boat activity (Robertson and Goudie 1999). Chronically disturbed areas may be abandoned (Robertson and Goudie 1999).

Disturbance on breeding streams may result in reduced reproductive success either due to increased predation or inconsistent incubation of unprotected nests, or nest abandonment. Mortality may increase due to disturbance at any time of year if the disturbance causes increased alert behaviour resulting in decreased foraging time or displacement from traditional wintering or moulting sites. When disturbance is localized and confined during the breeding season, the population effect of reduced reproductive success or increased mortality may be negligible, since Harlequin Ducks tend to breed at low densities over a large area. However, multiple sources of localized disturbance across the breeding range may have cumulative effects. Disturbance at

wintering or moulting sites may have severe population effects, both through increased mortality and decreased genetic diversity, if substantial additive mortality of a moulting or wintering aggregation results.

**General Threat: Resource Extraction**

*Activity*

The activity associated with resource extraction, including access to extraction areas, transport of raw materials from extraction sites, road building, and the extraction activity itself, all may cause disturbance to Harlequin Ducks. The severity of this disturbance will depend on the proximity of activity to breeding streams and the frequency of disturbance.

Construction of access roads for resource extraction activity such as forestry or mining also provides access for unrelated activity in previously remote locations. Recreational activity (fishing, canoeing/kayaking, rafting) may increase on breeding streams as access improves to remote areas.

The extent and intensity of disturbance from resource extraction activity or as a result of new access to previously remote areas is anticipated to be dependent on the geographic size of the project, the frequency of activity associated with the project and the ease of accessibility to unrelated users. The severity of the threat is difficult to evaluate but is likely moderate.

*Infrastructure*

Activity associated with the construction of access roads and other infrastructure associated with resource extraction and exploration may cause acute disturbance to Harlequin Ducks at their breeding sites. Cassirer *et al.* (1996) suggest that disturbance can be reduced, displacing this activity and the resulting infrastructure 2 sight-distances[2] from breeding rivers. They also recommend avoiding crossing streams at stream junctions because these appear to be preferred by Harlequin Ducks.

The severity of the threat from activity associated with the construction of infrastructure is thought to be low.

**General Threat: Wind Power Generation**

An increased demand for energy and an increased interest in clean energy resources is likely to result in a substantial increase in wind power development. In Atlantic Canada and Québec there are currently 232 wind turbines in operation, with a total capacity of 268 MW of power (Canadian Wind Energy Association 2006). Wind initiatives in this region are anticipated to result in an increase to a 5 330 MW capacity by 2016 (Canadian Wind Energy Association 2006).

Sound level pressure of wind turbines in California are approximately 10 dBA above ambient noise at a distance of 10 m from the base of the turbine (Dooling 2002). Dooling (2002) estimated that the distance at which birds can hear the noise of a wind turbine varies from 10 m to 50 m depending on the level of ambient noise (birds will be able to detect wind turbine noise further away on quieter, or less windy, days). Harlequin Ducks tend to occupy noisy habitats (40-70 dBA in breeding areas; Goudie 2004) due to their preference for turbulent water (fast running streams during nesting, rocky coastal shoreline during moulting and wintering). With the

[2] A sight-distance defined by Cassirer *et al*. (1996) is the distance at which the green line vegetation or riparian area is obscured from view prior to leaf-out. Two sight distances is twice this distance.

exception of brood-rearing areas, which tend to be in slower-moving stretches of stream (Robertson and Goudie 1999), noise disturbance from wind turbines appears unlikely to produce behavioural effects.

At present, Atlantic Canada's wind power generation is growing and all current structures are onshore. Should offshore wind power be explored, the threat of disturbance to Harlequin Ducks may increase. Sea ducks have a tendency to avoid the near vicinity of offshore wind turbines (Guillemette and Larson 2002) and tend to be more sensitive to the presence of wind turbines than other seabirds (Garthe and Hüppop 2004).

No studies have been designed specifically to quantify the disturbance effect of wind power generation on Harlequin Ducks. The current disturbance threat posed by wind power generation and associated activity is likely negligible but may require reassessment as the industry grows.

**General Threat: Recreational Activity**

Rivers used heavily for recreational activity may cause reduced reproductive success or displacement from suitable breeding and brood-rearing habitat. Large-scale river rafting operations have been reported to cause chronic disturbance to Harlequin Ducks in western Canada (Hunt 1998). Recreational fishing may cause substantial disturbance as fishers tend to remain on streams for extended periods of time (Wallen 1987). Disturbance may be of particular concern on scheduled salmon rivers as recreational salmonid fishing and Harlequin Duck breeding season temporally overlap.

Harlequin Ducks tend to remain close to shore while moulting and wintering and may be susceptible to disturbance from sea kayaking or recreational boating. Wintering aggregations likely face less recreational disturbance simply because of ocean conditions during the wintering season, however, since wintering Harlequin Ducks will form mixed-species flocks with other sea ducks (Robertson and Goudie 1999), they are susceptible to disturbance from recreational hunting directed toward these other species.

The threat to Harlequin Ducks of disturbance from recreational activity is low to moderate in severity.

**General Threat: Aquaculture**

The boat traffic associated with the operation and maintenance of aquaculture sites may be a source of chronic disturbance to aggregations of Harlequin Ducks nearby aquaculture areas. It is unknown whether moulting or wintering populations of Harlequin Ducks are passed closely by boats traveling to and from aquaculture sites on a regular basis.

Currently, marine aquaculture operations are primarily confined to protected bays, and generally not established in typical Harlequin Duck habitat. Some overlap between Harlequin Duck wintering sites and aquaculture already exists, but thus far has been limited to White Head Island (off Grand Manan) in the Bay of Fundy. Anthropogenic sources of pollution affecting nearshore areas are expected to increase with current human population shifts toward coastal areas, further increasing the need for offshore aquaculture sites (Fisheries and Oceans Canada 2001). Commercial development of exposed coastal waters is expected to increase as the necessary technology becomes more economically accessible and may displace wintering and moulting Harlequin Ducks from preferred habitat.

Disturbance from boat traffic associated with facility operations and maintenance is anticipated to pose a threat to Harlequin Ducks, but it is difficult to evaluate the severity of this threat at this time.

**General Threat: Aircraft Disturbance**

The reaction of Harlequin Ducks to aircraft disturbance has been the focus of much study in Labrador in recent years in order to assess the impact of low-level military flight training on breeding Harlequin. Harlequin Ducks react with increased alert behaviour immediately following low-level jet flight disturbance and can display residual behavioural effects up to 1.5 hours following disturbance (Goudie 2004). Further investigation by Goudie and Jones (2004) and Goudie (2006) determined that individual birds responded to sudden onset noise with alert behaviour that increased with amplitude, and these behavioural responses of Harlequin Ducks were 23 times stronger to military jets than to other aircraft types in the area. In addition to low-level flying military aircraft, other types of aircraft such as helicopters, cargo-planes, and smaller fixed-winged aircraft can elicit relatively large responses in the species (Goudie and Jones 1999, Goudie 2006).

The threat from aircraft disturbance will depend on the frequency of disturbance, the size of the local population subject to this, and the type of aircraft causing the disturbance. This threat is thought to be low in severity overall, but may be moderate to high in localized areas.

**General Threat: Nearshore Boat and Ship Traffic**

Nearshore boat traffic associated with hunting, commercial or recreational fishing, or recreation (see above) can be a source of disturbance to aggregations of moulting or wintering Harlequin Ducks. The distance at which boats can approach before eliciting a flushing response is unreported, as is the distance at which the Harlequin Ducks will react to boats or ships with increased alert behaviour. Alert and fright behaviour can reduce the time available for foraging and, especially during the winter when daylight hours are restrictive, create an additive energetic stress on the ducks. The tendency of Harlequin Ducks to aggregate near exposed headlands and in rocky areas close to shore may protect them from intense boat disturbance, as boats are unlikely to approach closely to these areas.

Nearshore boat traffic is likely to pose a greater threat than distant boat and ship activity to Harlequin Ducks. Chronic boat activity near traditional moulting and wintering sites does not appear to cause displacement from preferred habitat; in some areas where Harlequin Ducks are abundant, they coincide with frequent and chronic fishing boat activity (R. Milton *pers. comm.*). Potential effects of reduced foraging opportunities due to increased alert behaviour are unknown.

No studies have been done to quantify the disturbance effects of boat and ship traffic on Harlequin Duck. Mori *et al.* (2001) reported flushing in response to an approaching motor boat at distances from 65-100 m for 11 waterfowl species in wintering aggregations on lakes in Japan. Common Scoter (*Melanitta nigra*) wintering groups will flush in response to an approaching ship at distances sometimes in excess of 1 000 m (Kaiser 2004). Behavioural responses to approaching vessels likely occur at a distance greater than the threshold flushing distance. Harlequin Duck might be expected to be most sensitive to marine traffic during moult due to their limited ability to flee from harm.

**General Threat: Land-Based Coastal Development**

Early settlements in eastern Canada were commonly built around highly productive estuaries and sheltered bays and coves. Wintering and moulting Harlequin Ducks aggregate along rocky coastlines with turbulent waters. Although these sites are not generally conducive to human marine activities, they do afford striking views desirable for commercial and private vacation properties and private residences. Coastal property is highly sought after for development.

Building construction activities and subsequent use of these properties could displace Harlequin Ducks from their preferred wintering or moulting sites if placed at or nearby these areas. If activity is disruptive enough to displace Harlequin Duck wintering aggregations over the length of a few generations, wintering and moulting site occupation may never be restored, due to the high site fidelity Harlequin Ducks display.

The severity of the threat of coastal development is dependent on the proximity of such structures to Harlequin Duck aggregations and the size of the local wintering or moulting population.

## Threat Category: Consumptive Use

### General Threat: Hunting

*Historic*

Hunting has been cited as a significant contributor to the historic decline of Harlequin Duck populations in eastern Canada (Goudie 1990) but no causal evidence exists to confirm this. Numbers of harvested birds appear to have been low historically (Gilliland 2001) but it is unclear whether the population is sensitive to low harvest levels. Over-hunting is a plausible explanation of the historic decline of Harlequin Ducks, but may have been only a minor contributor.

A hunting ban has been in effect in Greenland since the 1960's, but population changes correlating with this ban are unknown. In 1989, hunting of Harlequin Ducks was restricted in the Atlantic Flyway. Subsequent to the end of the legal Harlequin Duck hunt, regular surveys of key areas indicate a positive trend in the numbers of Harlequin Ducks in Atlantic Canada (CWS *unpublished data*).

*Current*

Hunting is considered a continuing threat to Harlequin Ducks despite hunting bans in both eastern Canada and Greenland (Thomas and Robert 2001). Harlequin Duck can be legally hunted in Nunavut [C.R.C, c. 1035] and Aboriginal hunters harvest Harlequin Ducks in subsistence hunts at least occasionally (S. Gilliland *pers. comm.*, F. Phillips *pers. comm.*). In Newfoundland, Labrador, the Maritimes, Québec, Maine and Greenland, Harlequin Ducks continue to be reported shot by hunters, despite existing prohibitions.

Illegal hunting is thought to be largely accidental or incidental, rather than intentional in nature (Thomas and Robert 2001), but there is a high probability that trophy hunting of adult males occurs (M. Robert *pers. comm.*). In the eastern population, Harlequin Ducks tend to aggregate with Common Eiders and Black Scoters (Robertson and Goudie 1999) which may contribute to the frequency with which they are shot by hunters targeting these other species. Immature Harlequin Ducks, particularly in the fall, strongly resemble immatures of other diving ducks and are at increased risk of hunting mortality.

The extent of illegal, incidental and accidental hunting mortality is unknown and thought to vary across the range. The severity of this threat is presumed to be low overall, but may be moderate in some jurisdictions.

## Threat Category: Accidental Mortality

### General Threat: Collisions During Flight

There has been one report of an adult male Harlequin Duck colliding with a power line in Nain, Labrador and there is only one reported collision with vehicle (Robertson and Goudie 1999).

Collisions resulting in mortality appear to occur rarely and are negligible in severity as a threat.

### General Threat: Fishing Gear

Fishing gear may be a mortality threat to Harlequin Ducks in areas where the inshore fishery coexists with moulting or wintering groups and where inland river fisheries are conducted on breeding and brood rearing streams. Harlequin Ducks have been documented caught in gill nets and by hook and line (Robertson and Goudie 1999).

Inshore fishery activity in Atlantic Canada and Québec has declined with the reduction in available fish stocks, such as cod, in recent years. Additionally, the type of habitat preferred by Harlequin Ducks on the ocean reduces the potential overlap between intensive fishing and Harlequin Duck occupation in space. With the exception of the lobster fishery, inshore fishers tend to avoid rough, rocky water and exposed headlands, which are difficult places in which to set up nets (D. Osborne *pers. comm.*). Boat traffic associated with the lobster fishery could cause a disturbance threat, but the associated gear does not pose an entanglement threat. Due to the minimal geographic and temporal overlap between inshore fisheries and moulting and wintering Harlequin Duck aggregations, the threat of fishing gear entanglement is likely to be low. Lost or derelict gear washing into moulting or wintering grounds probably poses a greater risk, but the rate of incidence is unknown.

Weir fishing structures, used commonly in some parts of the Maritimes, are more likely to be used in rough water than gill or drift nets (R. Milton *pers. comm.*) and have a greater potential to conflict with Harlequin Ducks than other types of gear. Eiders carrying nasal tags are known to become entangled in weirs (K. Mawhinney *pers. comm.*, S. Gilliland *pers. comm.*) but there is no documentation of Harlequin Duck mortality associated with weirs.

Inland fisheries on breeding streams, such as recreational, aboriginal, or illegal salmonid fisheries, may pose a hook and line or net entanglement threat, particularly to adult females and their broods. Fisheries and Oceans Canada's Aboriginal Fisheries Strategy includes a provision to rely more heavily on traps and less heavily on nets for salmon catches to promote selective fishing (T. Howe *pers. comm.*); an indirect consequence of this is that the risk of net entanglement for Harlequin sharing streams with aboriginal fishers is reduced. The risk and incidence of Harlequin Duck entanglement in illegal nets is unknown and unlikely to be reported. Mortality of adult females on breeding streams would be expected to result in brood loss. Additive mortality of breeding age females caused by fishing gear entanglement on breeding rivers could have substantial population effects, given that reproductive success is highest for older females (>5 years old).

The actual risk of entanglement is unknown but likely low for the inshore fishery; the threat posed by inland river fisheries is also unknown but as it has the potential to remove breeding females from the population, it is expected to be moderate in severity.

## Threat Category: Changes in Ecological Dynamics

### General Threat: Aquaculture

Aquaculture operations can alter local biodiversity and ecological dynamics by the cultivation of a single species or species assemblage (e.g. blue mussel or blue mussel and seaweed), increasing their relative abundance in an area or by enrichment of the local environment from organic waste products (finfish feces, unconsumed food) and enrichment from pesticides and antibiotics administered to the cultivated species.

Documented ecological effects of near-field organic enrichment include the local extinction of soft-sediment macrofauna and subsequent re-establishment of opportunists, resulting in changes to indigenous species-assemblages (Wildish *et al.* 2004). Near-field ecological effects in other sediment types are unknown. The ecological effects of organic enrichment associated with aquaculture are thought to be less severe in Atlantic Canada than on the Pacific Coast due to energetic tidal mixing (Wildish *et al.* 2004).

Organic and chemical waste have been documented to commonly affect benthic community structure within a 50 m radius of finfish sites, and ecological effects have been documented at distances of 200 m in some cases (Hargrave 2003). Shellfish aquaculture has the potential to alter habitat structure and benthic community structure (Cranford *et al.* 2003). The ecological effects of acute and long term use of pesticide and antibiotic agents in marine aquaculture are poorly understood (Milewski 2001), but have the potential to affect indigenous species and communities through impacts on the bacterial communities, inhibition of chitin formation and disruption of moult patterns in aquatic crustaceans, and the introduction of toxins fatal to amphipods, echinoderms, crustaceans, and vertebrate fish (Burridge 2003).

Many knowledge gaps still exist regarding the ecological impacts of organic and chemical waste from aquaculture, but may have substantial effects in coastal waters, especially as the industry grows and fish farm density increases. As indicated previously, aquaculture sites are primarily located in sheltered bays and coves (with some local exceptions through Atlantic Canada and Québec), but are anticipated to expand into exposed coastal regions.

The threat to the abundance, relative abundance, and distribution of food resources for Harlequin Duck is difficult to evaluate but is potentially moderate to high in severity.

### General Threat: Inshore fishery

Thomas and Robert (2001) suggested that crustacean fishers could impact the food resources of Harlequin Ducks. Harlequin Duck winter diets consist mainly of amphipods, crabs and gastropods (Robertson and Goudie 1999), many of which, at large sizes, are commercially attractive. Although crustacean fisheries and Harlequin Ducks likely target different size prey, increased crustacean fishing may indirectly compete with Harlequin Ducks for food resources by reducing the overall prey population. Additionally, harvest of particular species can alter local biodiversity by altering resources or predation intensity within the community.

At present, the threat to food resources from competition with the inshore crustacean fisheries is unknown, but is likely low.

### General Threat: Invertebrate Control

Harlequin Ducks feed on aquatic invertebrates during their breeding season, particularly Plecoptera, Simuliid, and Tricoptera larvae (Robertson and Goudie 1999) found in rivers and streams. Insect control programs may have adverse effects on the food availability during breeding.

Spray programs used to control biting insects are likely to be employed only when a risk to human health is posed by associated insect-borne diseases. Harlequin Ducks tend to occupy remote areas during breeding and programs to control biting insects are unlikely to extend into regions sparsely populated by humans. For West Nile Virus control, specifically, the insect target of such programs (Culicidae) is not a typical food item for Harlequin Ducks. Additionally, Culicidae larvae are found in still, not running, waters. Spray programs in response to West Nile may contaminate running water if the spraying is indiscriminate over a watershed area or persists in the system and runs into rivers and streams from lakes and ponds.

Pesticides associated with forestry operations may have greater effects on invertebrate community structure in Harlequin Duck breeding habitat, as they are more likely to be used in remote areas than biting insect control programs. Insecticides used to control forest crop pests can kill aquatic invertebrates in forest wetlands and some are persistent in wetlands (Batzer and Wissinger 1996). The extent to which forest pesticides are used in breeding areas and the specific pesticides in use is necessary information to appropriately evaluate the associated threat.

The threat from invertebrate control programs is expected to be associated with forest management but not with biting insect control. This threat is difficult to evaluate presently but is thought to be low.

## Threat Category: Natural Processes and Activities

### General Threat: Disease

There are no known diseases described for wild populations, but several parasites have been identified (Robertson and Goudie, 1999). Risk of disease transmission is likely highest during moulting and wintering, simply due to the aggregative behaviour (relatively high density spacing).

Unless mortality due to disease becomes apparent as a significant source of mortality, the threat posed by disease is likely very low.

### General Threat: Predation

Confirmed and suspected predators of Harlequin Ducks across their range include Bald Eagles (*Haliaeetus leucocephalus*), hawks (*Buteo* spp.), Great-horned Owls (*Bubo virginianus*), mink (*Mustela vison*), marten (*Martes americana*), River Otter (*Lutra canadensis*) and seals (Robertson and Goudie 1999). In eastern Canada, Golden Eagle (*Aquila chrysaetos*), Peregrine Falcon (*Falco peregrinus*) and Gyrfalcon (*Falco rusticolus*) are also known predators of Harlequin Ducks during breeding season (Heath *et al.* 2006). Brodeur *et al.* (*in press*) documented depredation of breeding females by Red-tailed Hawk (*Buteo jamaicensis*) and Great-horned Owls in the Gaspé region. Confirmed and suspected egg predators include Common Raven (*Corvus corvax*), mink, and Arctic Fox (*Alopex lagopus*) and Red Squirrel (*Tamiasciurus hudsonicus*) (Robertson and Goudie 1999).

Given the life-history traits of Harlequin Ducks, adult female survival is likely to most strongly influence population growth. Predation during breeding season may be an important source of mortality for adult females and ducklings (Brodeur *et al. in press*). Raptors and mustelids are thought to be the most common predators of nesting females (Robertson and Goudie 1999); in Labrador, Harlequin Duck nest at higher densities in rivers with low raptor presence than in those with abundant raptor activity (Heath *et al.* 2006). It is unclear whether this is an effect of nest-site selection or nest-success.

Raptors pose a threat to Harlequin Ducks both at wintering and moulting sites and at breeding sites. Terrestrial predators are a threat specific to breeding areas. Raptor populations in

Atlantic Canada are generally stable (Kirk and Hyslop 1998) except for Peregrine Falcons which are increasing after a precipitous decline in from the 1950's through mid-1970's (White *et al.* 2002). Red-tailed hawk (*Buteo jamaicensis*) populations in Labrador may have increased substantially over the last 20 years and may be expanding their range northward (T. Chubbs *pers. comm.*) but the impression of this increase may be due to an increase in the effort and competency of birders in the region (F. Phillips *pers. comm.*).

The current threat of predation to Harlequin Ducks is difficult to evaluate due to insufficient documentation of predation rates.

## Threat Category: Exotic Species

Alien invasive species (exotic species) are an increasing problem for ecosystems globally. Invasive species may cause changes in invertebrate populations, replace indigenous species, or otherwise alter ecosystems. Currently, there are few known threats to Harlequin Duck associated with invasive species, but many of these species and their effects on ecosystems are still poorly understood. The potential exists for invasive species to have great effects on coastal and aquatic ecosystems occupied by Harlequin Ducks.

The European green crab (*Carcinus maenus*), a marine invasive species with a world-wide range, has been present along the New England coast since 1817 (Holmes 2001) but did not arrive in Nova Scotia until the 1980s (Audet *et al.* 2003) and has only recently expanded through the Canadian Maritimes, likely through multiple introductions (Roman 2006). The European green crab was first reported in Newfoundland waters in late August 2007 (Brautigam 2007). Due to its diverse diet, the European green crab is a possible resource competitor with Harlequin Ducks and has the potential to affect the species diversity in marine ecosystems (Holmes 2001). It is also a secondary host to a sea duck endoparasite, an acanthocephalan worm, which is known to be transmitted to Eider Ducks which consume the European green crab (Holmes 2001). The extent to which this invasive crab may threaten Harlequin Duck populations is currently unknown but monitoring of ecological impacts is recommended.

The overall severity of the threat to Harlequin Duck from invasive species cannot currently be evaluated, but should be monitored.

## Threat Category: Climate and Natural Disasters

### General Threat: Climate Change

Climate change is expected to increase the frequency and intensity of severe weather events (Trenberth *et al*. 2007). Harlequin Ducks prefer exposed and turbulent coastal waters and may sometimes receive serious, fatal or debilitating injury (M. Robert *pers. comm.*) particularly during severe storms. Injuries are more likely to be experienced by individuals than by entire moulting or wintering groups, and population effects of independent events would be low. Catastrophic storms or natural disasters (such as hurricanes) could have serious population consequences resulting from debilitating injury at a moulting or wintering site, depending on the extent of resulting mortalities. Severe storms or natural disasters, unless geographically extensive, would not be expected to have large population effects if they occur in breeding areas.

Climate change may result in a change in temperature, salinity, and alkalinity changes in both marine and freshwater systems. A very robust finding of climate changes scenarios is that climate change and subsequent global warming would lead to changes in the seasonality of river flows (Bates *et al*. 2008). These changes may affect invertebrate prey population abundance, distribution and phenology. Decreases in the quality or abundance of prey species may lead to increased mortality or decreased reproductive success of Harlequin Ducks.

The severity of threat(s) to Harlequin Ducks posed by anticipated correlates of climate change is currently difficult to evaluate.

## Summary of Threats to Harlequin Duck, Eastern Population

Due to the natural history, physiological, and behavioural traits of Harlequin Duck, threats which result in adverse effects to multiple individuals in moulting or wintering aggregations or to breeding females have the greatest potential to reduce population viability. As some General Threats contribute to more than one Threat Category, cumulative effects should be anticipated from these.

Acute and chronic oil and chemical pollution are the General Threats of greatest concern population-wide. Although catastrophic oil spills are infrequent, should one occur near a moulting or wintering area, large numbers of individuals may be adversely affected by both immediate and persistent effects of pollution (Esler *et al.* 2000). Similarly, due to continuous introduction of oil and chemical pollutants resulting from chronic oiling, this could have large population effects over time.

General Threats affecting coastal areas through Habitat Loss or Degradation, Disturbance, or Changes in Ecological Dynamics may also be severe due to their ability to adversely affect large aggregations of Harlequin Duck. General Threats of particular concern include aquaculture, coastal development (industrial, residential, and recreational) and coastline modification.

Habitat Loss or Degradation and Disturbance occurring in breeding areas disproportionately affects breeding females who spend more time on breeding and brooding streams than adult males or juvenile Harlequin Duck. The cumulative effects in breeding areas of resource exploitation, including forestry, mining, and, to a lesser extent, power generation are of high concern.

For some of the threats discussed in the above evaluation, sufficient information does not exist at present to adequately assess them. In particular, levels of predation in both inland and coastal areas, the effect of invasive species, and current hunting pressure are unknown. Continued monitoring of these threats is recommended so that reassessment can be preformed as better information becomes available.

## Threat Classification Table, Harlequin Duck, Eastern Population

The Threat Classification Table for the Harlequin Duck, eastern population, is provided on the following pages. Identified potential threats evaluated to be negligible or non-threatening to population viability are excluded from the table. The Severity and Level of Concern associated with threats in this table is an evaluation considering the whole eastern population; Severity and Level of Concern within each Atlantic Province may vary from that of the population. The Provincial Threat Analyses (Part II) provide specific details within the Provincial boundaries. Further explanation of the table headers is found in Appendix 1 - Threat Classification: A Guide to Terms and Structure.

| Threat Category | General Threat | Activity | Causal Certainty (*Cause and Effect* relationship) | Specific Threat | Stress | Timing (T)<br>Frequency (F)<br>Threat Extent (E) | Severity | Level of Concern |
|---|---|---|---|---|---|---|---|---|
| Pollution | Oil and Chemical Pollution<br><br>*Chronic Oiling* | illegal oil disposal | high | acute mortality due to lethal dose ingestion or smothering<br><br>plumage oiling; energetic costs of thermoregulation<br><br>plumage oiling; accumulation of toxins from ingestion by preening<br><br>ingestion of prey with accumulation of oil toxins | High Mortality<br><br>Low Reproductive Success | T current<br>F continuous<br>E widespread | moderate-high | high |
| | Oil and Chemical Pollution<br><br>*Oil and Chemical Spills* | accidental spill | high | acute mortality of due to lethal dose ingestion or smothering<br><br>acute mortality of entire wintering aggregation due to lethal dose ingestion or smothering<br><br>plumage oiling; energetic costs of thermoregulation | High Mortality<br><br>Low Reproductive Success<br><br>Loss of Genetic Diversity | T anticipated<br>F recurrent<br>E localized | low-high[1] | medium-high |
| | | | | plumage oiling; accumulation of toxins from ingestion by preening<br><br>ingestion of prey with accumulation of oil toxins | High Mortality<br><br>Low Reproductive Success | T current<br>F continuous<br>E widespread | low-high[1] | medium |

| Threat Category | General Threat | Activity | Causal Certainty (*Cause and Effect* relationship) | Specific Threat | Stress | Timing (T)<br>Frequency (F)<br>Threat Extent (E) | Severity | Level of Concern |
|---|---|---|---|---|---|---|---|---|
| Pollution | Acidification of streams | acid precipitation<br><br>resource extraction activity in watershed system | medium | reduction in invertebrate prey availability in breeding streams | Low Reproductive Success | T current<br>F seasonal<br>E localized | moderate | low |
| | Heavy Metals and other toxins | use of leads or other toxic material in hunting and fishing<br><br>heavy metal run-off from mining operations | medium | ingestion of prey with accumulation of heavy metals or other toxins<br><br>increased developmental abnormalities<br><br>reduced hatch success | Low Reproductive Success | T current<br>F seasonal<br>E localized | moderate-high | medium |
| Habitat Loss or Degradation | Resource exploitation<br><br>*Habitat removal* | resource extraction activity in watershed system<br><br>hydroelectric flooding[2] | medium- high | loss of suitable breeding habitat | Low Reproductive Success | T current<br>F recurrent<br>E localized | moderate | medium |
| | Resource exploitation<br><br>*Modification of watersheds* | hydroelectric power generation<br><br>construction of roads, dams and other infrastructure | high | changes in water levels and stream velocity<br><br>siltation of streams, reducing food availability | Low Reproductive Success | T historic, anticipated<br>F recurrent<br>E localized | moderate-high | medium |
| | Resource exploitation<br><br>*Modification of Coastlines* | construction of infrastructure for marine transport of raw materials | high | loss or degradation of preferred staging, wintering or moulting areas | High Mortality | T anticipated<br>F recurrent<br>E localized | low- high | medium |

| Threat Category | General Threat | Activity | Causal Certainty (*Cause and Effect* relationship) | Specific Threat | Stress | Timing (T)<br>Frequency (F)<br>Threat Extent (E) | Severity | Level of Concern |
|---|---|---|---|---|---|---|---|---|
| | Aquaculture | development of coastal aquaculture sites | medium | loss or degradation of preferred staging, wintering or moulting areas | High Mortality | T anticipated<br>F continuous<br>E localized | moderate-high | medium |
| Habitat Loss or Degradation | Land-based coastal development | development of coast for commercial, residential, or recreational use | medium | loss or degradation of preferred staging, wintering or moulting areas | High Mortality | T anticipated<br>F continuous<br>E localized | low-moderate | low |
| | Inshore fishery | bottom dragging or trawling<br><br>commercial harvest of algae, sea urchins | medium | loss or degradation of preferred staging, wintering or moulting areas | High Mortality | T current<br>F seasonal<br>E unknown | unknown | low |
| Disturbance | Resource extraction | exploration or extraction<br><br>construction and use of infrastructure (inland and coastal)<br><br>human access to previously remote areas | low - high | displacement from preferred habitat<br><br>costs of reduced foraging/ increased response to disturbance<br><br>abandonment of nests | High Mortality<br><br>Low Reproductive Success | T current, anticipated<br>F seasonal<br>E unknown | low-moderate | medium |
| | Wind power generation | tendency of waterfowl to avoid wind farms<br><br>construction of wind farms near aggregation areas | medium | displacement from staging, wintering, or moulting or breeding areas<br><br>costs of increased response to disturbance | High Mortality<br><br>Low Reproductive Success | T anticipated<br>F continuous<br>E localized | unknown | medium |

| Threat Category | General Threat | Activity | Causal Certainty (*Cause and Effect* relationship) | Specific Threat | Stress | Timing (T)<br>Frequency (F)<br>Threat Extent (E) | Severity | Level of Concern |
|---|---|---|---|---|---|---|---|---|
| | Recreational activity | recreational use of streams and rivers in breeding areas | medium | costs of increased response to disturbance<br><br>abandonment of nest sites | High Mortality<br><br>Low Reproductive Success | T current<br>F seasonal<br>E unknown | low-moderate | medium |
| Disturbance | Aquaculture | human activity associated with site maintenance | high | costs of increased response to disturbance | High Mortality | T anticipated<br>F continuous<br>E localized | unknown | medium |
| | Aircraft disturbance | low altitude flights by helicopter or fixed-wing aircraft | medium | costs of increased response to disturbance<br><br>abandonment of nest sites | High Mortality<br><br>Low Reproductive Success | T current<br>F unknown<br>E localized | low-moderate | low |
| | Nearshore boat/ship traffic | close approach of aggregations by marine vessels | medium | costs of increased response to disturbance | High Mortality | T current<br>F unknown<br>E widespread | unknown | medium |
| | Land-based coastal development | construction and use associated with coastal development | low | displacement from or abandonment of wintering, or moulting or breeding areas<br><br>costs of reduced foraging/ increased response to disturbance | High Mortality<br><br>Low Reproductive Success | T current, anticipated<br>F recurrent<br>E localized | low- high | high |
| Consumptive Use | Hunting | illegal harvest<br><br>subsistence hunting | high | accidental and incidental hunting<br><br>poaching | High Mortality | T current<br>F unknown<br>E unknown | moderate | medium |
| Accidental Mortality | Fishery gear | inshore fishery<br><br>inland/ river fishery | high | hook and line or net entanglement | High Mortality<br><br>Low Reproductive Success | T current<br>F unknown<br>E unknown | low-moderate | low |

| Threat Category | General Threat | Activity | Causal Certainty (*Cause and Effect* relationship) | Specific Threat | Stress | Timing (T)<br>Frequency (F)<br>Threat Extent (E) | Severity | Level of Concern |
|---|---|---|---|---|---|---|---|---|
| Changes in Ecological Dynamics | Aquaculture | organic and chemical waste from operations | medium | alteration of community structure in staging, moulting or wintering areas<br><br>increased intragroup competition for resources | High Mortality | T anticipated<br>F unknown<br>E localized | moderate-high | high |
| | Inshore fishery | commercial harvest of crustaceans | low | competition for food resources | High Mortality | T current<br>F seasonal<br>E unknown | unknown | low |
| Changes in Ecological Dynamics | Invertebrate Control | biting insect control<br><br>pesticides to control forest pests | high | reduction of prey availability in breeding areas | Low Reproductive Success | T unknown<br>F seasonal<br>E unknown | unknown | medium |
| Natural Processes and Activities | Disease | | N/A | direct or indirect mortality associated with disease | High Mortality | T unknown<br>F unknown<br>E unknown | unknown | low |
| | Predation | | N/A | | High Mortality | T current<br>F continuous<br>E widespread | unknown | low |
| Exotic Species | Invasive species | Range expansion or introduction of non-indigenous species | Unknown | competition for food resources<br><br>changes to local species assemblages and ecological dynamics<br><br>increased exposure to parasites | High Mortality<br><br>Low Reproductive Success | T current, anticipated<br><br>F continuous<br><br>E unknown | unknown | low, requires monitoring |

[1] the severity of threats posed by oil spills will depend on the characteristics of the spill (amount of oil, proximity to shore, proximity to Harlequin aggregations, speed of dispersal, efficacy of clean up; in the case of bioaccumulation of toxins in prey species and plumage oiling, the length of time contaminants persist will also affect severity).

[2] large-scale hydroelectric developments will have greater population impacts than small-scale hydroelectric development; threats are expected to be similar for hydroelectric development of any scale but the severity of the threats will increase with the size of the development.

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# Part II:

# Threat Analyses for Atlantic Provinces

**PART II: THREAT ANALYSES FOR ATLANTIC PROVINCES**

# Harlequin Duck Threat Analysis:

# Newfoundland and Labrador

## HARLEQUIN DUCK THREAT ANALYSIS: NEWFOUNDLAND AND LABRADOR

## *1.0 Introduction*

Harlequin Ducks are present in Newfoundland and Labrador year-round and are thus subject to risk of threats occurring at breeding, staging, moulting and wintering areas.

General Threats identified in section 3.0 of this chapter often influence more than one Threat Category (see Appendix I). In evaluating the priority of threats for minimization, mitigation, and elimination, the cumulative impacts of General Threats and associated activities need to be considered. In Newfoundland and Labrador, threats with the greatest potential to impact Harlequin Ducks at a population level include catastrophic oil or chemical spills, chronic oil pollution, and resource extraction and exploitation.

Oil and chemical pollution events may result in direct increases in mortality and possible decreases in genetic diversity, and may indirectly reduce reproductive success. The cumulative habitat loss and degradation as well as the level of disturbance associated with resource extraction (e.g. mining, forestry) and exploitation (e.g. hydroelectric development) combined with the construction of associated infrastructure have the potential to be substantially harmful to Harlequin Ducks. Disturbance from resource extraction and from other sources, such as recreational activity, might have important cumulative impacts on the population due to the abandonment of preferred habitat. Loss of or displacement from preferred habitat and chronic disturbance are likely to result in increases in mortality and decreases in reproductive success.

High mortality of adult females may limit population growth more than high mortality in any other age and sex class (see Part I, *Life History Traits*). Adult females spend more time on breeding rivers than adult males, juveniles or young of the year, and may be disproportionately affected by threats occurring in breeding areas. Predation may be an important source of female mortality and may explain differences in male and female survival rates (Robertson and Goudie 1999). Resource extraction and exploitation is an indirect threat to adult females (see Robertson and Goudie 1999). The frequency of mortality due to fishing gear entanglement and the intensity of chronic disturbance to Harlequin Duck associated with fishing activity on breeding streams is unknown, but is potentially a significant source of mortality and effective habitat loss for adult females in particular.

Any activities resulting in loss or long-term/permanent wintering habitat degradation is a potential threat to both current and future aggregations. As current numbers of Harlequin Ducks are expected to increase (Environment Canada 2007), management of habitat and mitigation of threats to habitat need to consider the likelihood of range expansion. Activities causing habitat loss or degradation in areas of suitable habitat may create barriers to range expansion. Effective habitat loss as a result of intense or chronic disturbance to habitat needs to be considered an additive threat to habitat.

## *2.0 Distribution and Abundance of Harlequin Ducks in Newfoundland and Labrador*

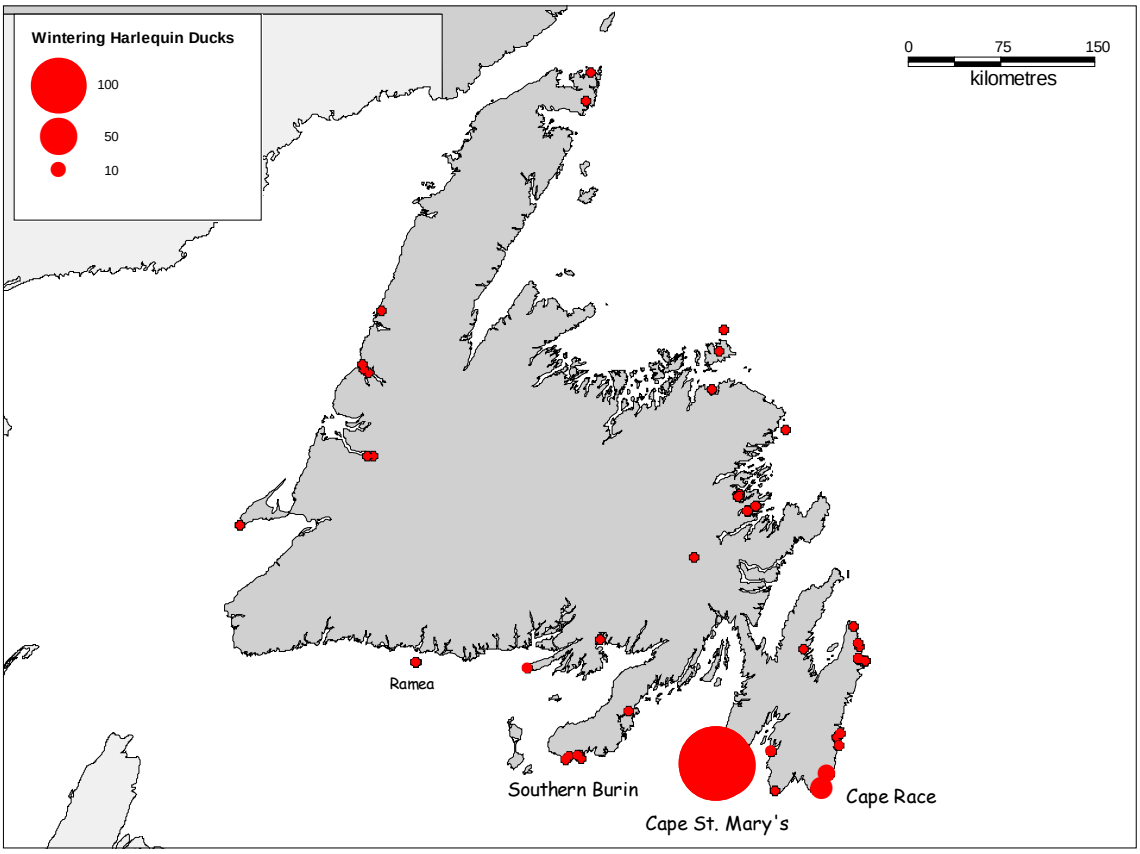


**Figure 2. Distribution of wintering Harlequin Ducks in Newfoundland and Labrador. Data used to produce this map include surveys and incidental sighting reports 1950-2006 (CWS, *unpublished data*).**

*Wintering*: (December - April)

Key areas for wintering aggregations in Newfoundland and Labrador are Cape St. Mary's, Cape Race, the southern shore of the Burin Peninsula, and Ramea. Historically, Jude Island in Placentia Bay was known to be a significant wintering area for Harlequin Duck, but recent winter surveys indicated that this area remains unoccupied by Harlequin Ducks (Goudie *et al*. 2007). The total number of wintering Harlequin Ducks along the south coast of Newfoundland is thought to be ~300 individuals, representing approximately 18% of the birds wintering in Atlantic Canada (~11% of the birds wintering in North America).

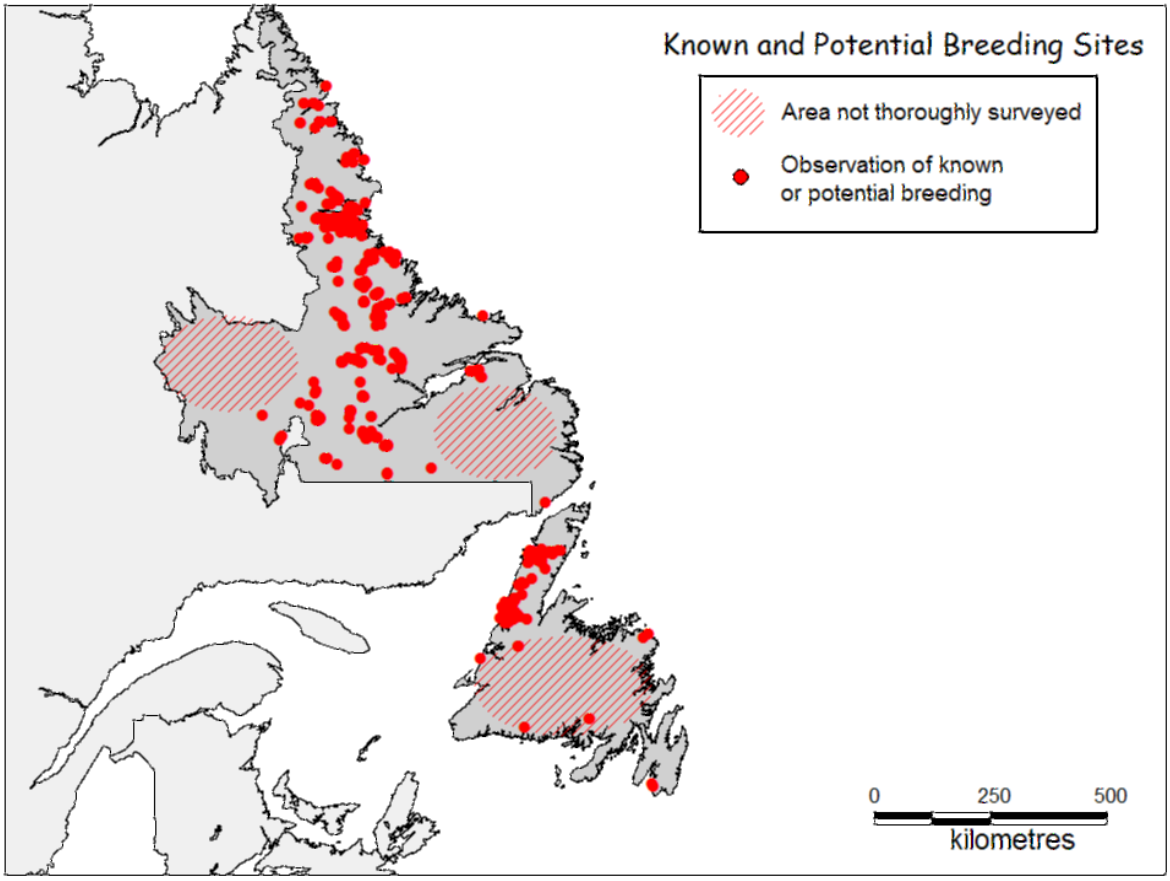


**Figure 3. Known and potential breeding sites of Harlequin Duck in Newfoundland and Labrador. Areas marked by shaded regions have not been surveyed and absence of known breeding may simply reflect a lack of search effort. Data used to produce this map include surveys and incidental sighting reports 1950-2006 (CWS, *unpublished data*).**

*Breeding*: (May - September)

The core breeding areas for Harlequin Duck in Atlantic Canada, and thereby the most significant breeding area for the eastern Harlequin Duck population, extends from south-central to northern Labrador. Due to their tendency to occupy remote rivers and streams, and their occurrence in low densities over a large area, specific key areas for breeding are difficult to determine. Southern Labrador (south of the Churchill River) likely supports fewer breeding pairs than northern Labrador (Thomas and Robert 2001). Most of the known information about Harlequin Duck breeding in Labrador is associated with surveys conducted for Environmental Assessments of ongoing or proposed developments.

For insular Newfoundland, the Northern Peninsula is a key breeding area. There is some evidence of breeding on the Bay du Nord watershed (Thomas and Robert 2001) and in other areas of southern Newfoundland (Thomas in *press*). Little investigation of potential breeding areas of insular Newfoundland, other than the Northern Peninsula, has been conducted. A population trend survey has been initiated for northern and central Labrador and the Northern Peninsula of Newfoundland but has not yet yielded enough data for trend analysis.

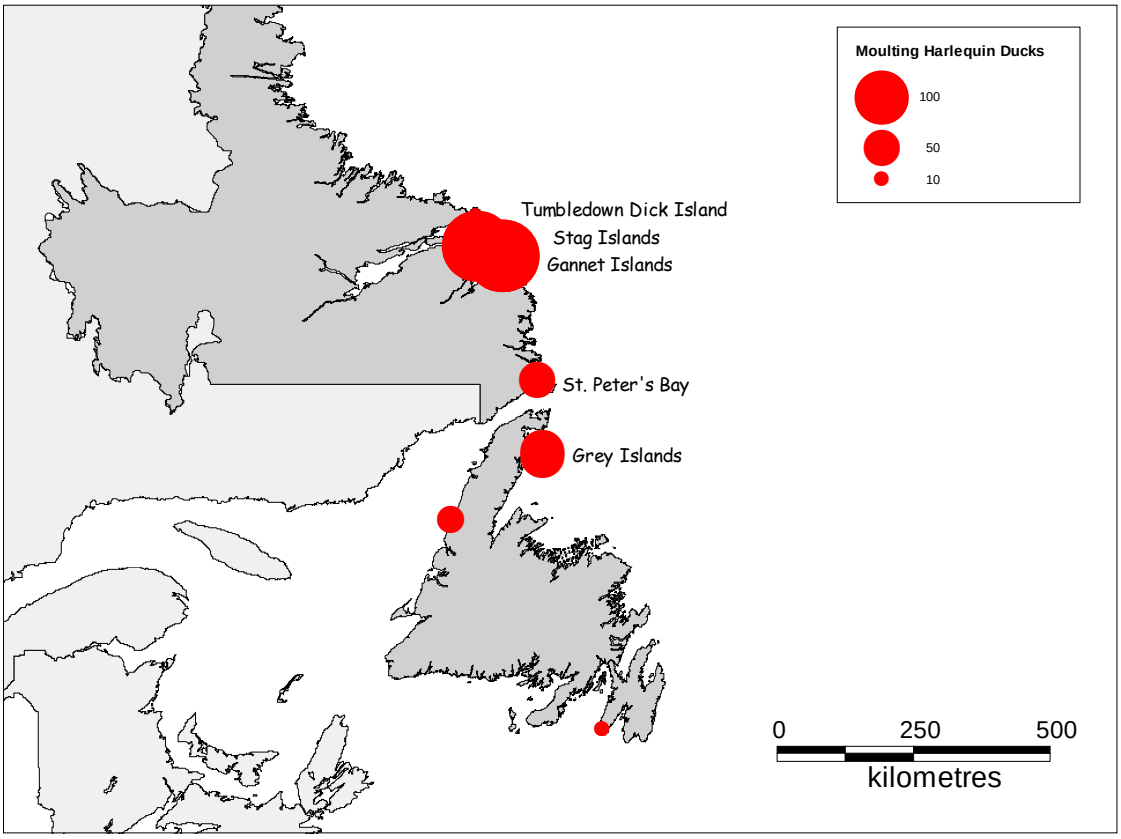


**Figure 4. Location of known moult sites for Harlequin Duck in Newfoundland and Labrador. Data used to produce this map include survey data and incidental sighting reports 1950-2006 (CWS, *unpublished data*).**

*Moulting*: (July – September)

The coastline of northern Labrador is thought to be a significant area for moulting and staging Harlequin Ducks (see Staging and Migration). Key moulting areas in southern Labrador include the Tumbledown Dick Island, Gannet Islands, Stag Islands, and St. Peter's Bay (Gilliland *et al.* 2002). Key moulting areas in Newfoundland include the Grey Islands, Stearin Island and Cape St. Mary's (Gilliland *et al.* 2002). A minimum of 500 individuals are thought to moult in Newfoundland and Labrador.

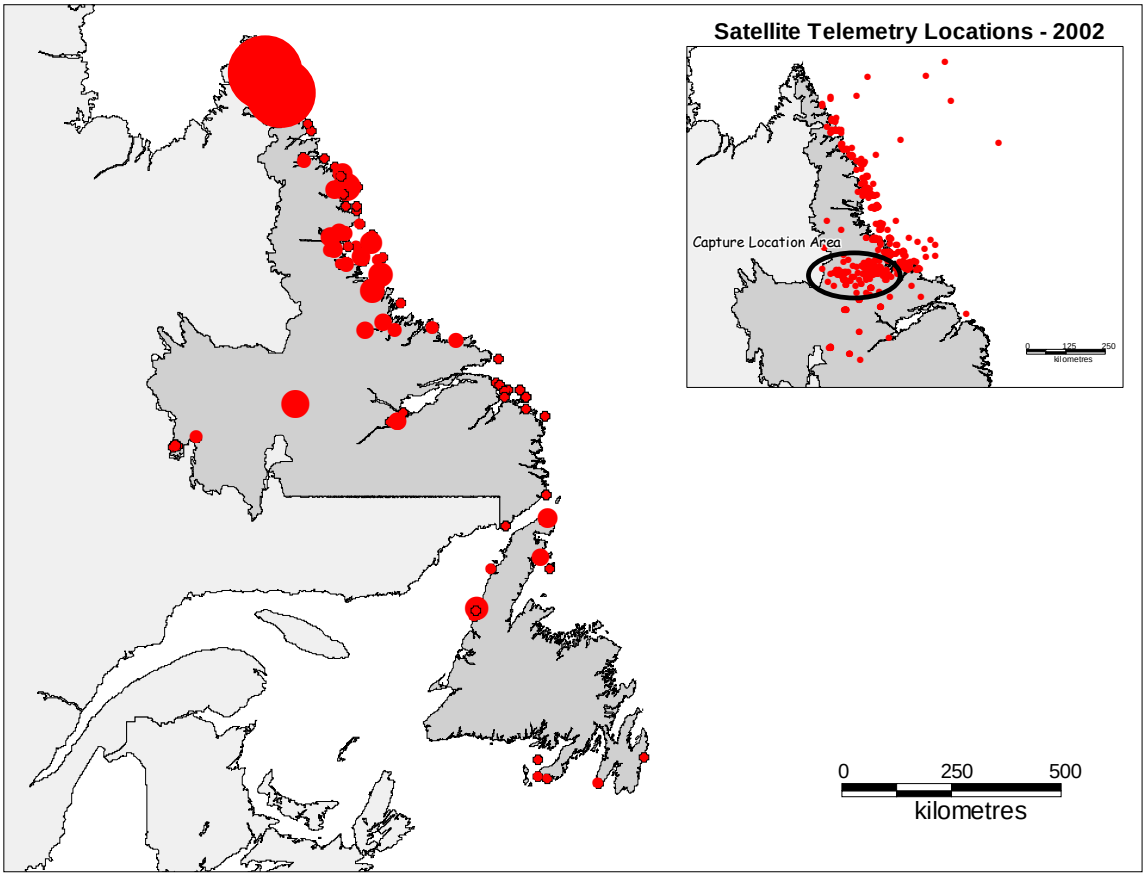


**Figure 5. Staging and migrating distribution of Harlequin Duck in Newfoundland and Labrador. Data used to produce the principal map are from surveys and incidental sighting reports 1950-2006 (CWS *unpublished data*), and selected representative locations from satellite telemetry locations (Robert *et al, in press*). The inset displays satellite telemetry locations of 11 individuals from a study conducted in Labrador in 2001-2002 (Chubbs *et al. in press*).**

*Staging and Migration*: (April – June, October – December)

Spring and autumn migrating Harlequin Ducks have been reported to use coastal areas of Newfoundland and southern Labrador as a migratory stop-over. Harlequin Ducks are thought to stage in Labrador both prior to breeding and prior to moulting. Pre-breeding staging occurs primarily in coastal areas of Labrador from the area around Natuashish north to the Saglek Fiord. Individuals breeding in Labrador and subsequently moulting in Greenland are thought to stage in northern coastal areas of Labrador before departing for Greenland (Trimper *et al. in press*). Key pre-moult staging areas include the Nain archipelago, and the coastal area from the Nachvak Fiord north to Cape Chidley.

## *3.0 Status of Threats to Newfoundland and Labrador's Harlequin Duck Population*

### 3.1 Resource extraction

*Threat Categories*: Habitat Loss or Degradation; Pollution; Disturbance

*Activities*: Siltation of streams; loss of breeding habitat; acid precipitation; heavy metal and acid run-off; direct contact with heavy metal enriched water; ingestion of prey with bioaccumulated heavy metals; construction of roads or other infrastructure associated with resource extraction activity; exploration activity; construction of coastal infrastructure for shipping of raw materials.

*Source*: Mining and forestry operations; associated infrastructure and activity.

*Relevance*: Forestry and mining operations are likely to overlap with Harlequin Duck breeding habitat in both Newfoundland and in Labrador. Since 2003, there has been a significant increase in claim staking and mineral exploration in Labrador (Canadian Intergovernmental Working Group on the Mineral Industry 2005). Mining activity is anticipated to increase from present levels.

Provincial regulations prohibit cutting of trees within 20 m of any water body visible on 1:50 000 map. For designated Salmon Rivers, which would include the high-density breeding rivers on Newfoundland's Northern Peninsula, the required buffer is 100 m. The required buffer for Sensitive Wildlife Areas is 50 m. Cassirer *et al.* (1996) recommend 100 m vegetative buffers around Harlequin Duck breeding rivers to adequately protect breeding habitat from siltation. Nest sites are poorly documented but are generally situated >20 m from river or stream banks, so 20 m buffers around breeding streams are inadequate to protect against habitat loss. The extent of nest loss with regard to forest removal and/or disturbance is unknown in Newfoundland and Labrador. Although many Harlequin Ducks nest in remote areas of the Province, some river systems are commonly used for recreational purposes, as well as for forest harvesting.

Particularly in Labrador, where relatively little infrastructure already exists, disturbance from the construction of related infrastructure may be a source of acute disturbance in many breeding areas. Infrastructure construction activity in breeding areas is are unlikely to have substantial effects as any one project is likely to disturb or displace only a few pairs of birds, but consideration of cumulative effects is necessary in infrastructure planning. Construction of coastal infrastructure associated with the transport of raw materials near traditional wintering or moulting sites may displace greater numbers of individuals from preferred habitat.

Ongoing activity may cause disturbance over several consecutive seasons, depending on project; wintering/moulting areas of particular importance (more birds potentially displaced, could lead to permanent abandonment of site if disturbance persists over generations).

Acid rain is not predicted to occur above critical load levels in any part of Newfoundland and Labrador by 2010 (Beattie and Ro 2004). Industrial pollution is relatively low in the province due to the small and low-density human population, and is not expected in increase substantially, although industrial pollutants from other jurisdictions may affect atmospheric acidity within the province. An increasing interest in mineral exploration in Labrador may cause sulphide-exposure to increase. The extent to which this may affect stream acidity in Labrador will depend on the amount of sulphide-exposure associated with each project and the ability for mine operators to minimize the likelihood of contaminating watersheds.

Heavy metal enrichment is anticipated to increase with increased mining activity, particularly if acid run-off also increases. The anticipated increase in heavy metal enrichment of

breeding streams similarly leads to an anticipation of increased ingestion of prey items with bioaccumulated heavy metals. It is unknown to what extent elevated levels of heavy metals could affect Harlequin Duck, but it may be severe. The risk associated with heavy metal enrichment of rivers and streams will be highest for those individuals occupying these streams for the longest periods of time and hence will disproportionately affect adult females and young of the year.

Harlequin Duck breed at low densities across a large portion of Labrador. Any one project may lead to increased stream acidity only affecting a small number of pairs; however, several projects over time may have large cumulative effects on the population.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Land Use Atlas (s.4.2); Legislation (s.4.6); Stewardship (s.4.4); Protected Areas (s.4.7).

*Recommendations*: Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time. Assessments should also consider project longevity as chronically disturbed areas may be abandoned; site fidelity to wintering, moulting and breeding areas may result in effective habitat loss if projects persist over generations of Harlequin Duck. When disturbance is likely to be severe or prolonged, seasonal restrictions on extraction and exploration activity should be applied to displace projects in time from Harlequin Duck occupation. Permitting coastal activity from May-October would displace coastal projects in time from the occupation of wintering sites; permitting coastal activity from October-June would displace projects in time from moulting sites. Permitting inland activity from October-April would displace projects in time from the occupation of breeding sites.

Roads should be built such that they are not visible from breeding streams and do not cross stream junctions. Buffers of at least 100 m vegetative cover from streams and rivers should be required when projects operate in known breeding areas. The buffer should be complete and not encroached upon by vehicles and/or other machinery during forestry operations. Thinning in the buffer should be restricted.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments. Important breeding habitat (specific rivers and streams or portions thereof) should be identified and registered as Sensitive Wildlife Areas, with a recommendation to use 100 m rather than 50 m buffers.

Corporate stewardship agreements should be pursued with forestry and mining companies to encourage voluntary protection of Harlequin Duck habitat.

## 3.2 Power Generation

*Threat Categories*: Habitat Loss or Degradation; Disturbance.

*Activities*: Water level manipulation by flooding or controlled fluctuation; siltation due to water control structures or construction of infrastructure; obstruction of brood travel; construction of wind turbines; traffic associated with maintenance.

*Source*: Hydroelectric and wind power generation.

*Relevance*: Historically, the Churchill Falls hydroelectric development may have resulted in substantial habitat loss due to permanent flooding, but is unknown how many suitable breeding

rivers may have been removed at that time. Further hydroelectric development, including the Lower Churchill project, currently in the environmental assessment process, is expected in Labrador. Since 1998, there has been a moratorium on small-scale hydroelectric projects; no small projects are anticipated in the near future but may occur following a review of the moratorium. The extent of habitat loss as a result of flooding and habitat degradation due to siltation and changes in stream flow will depend on the size of projects and the extent of overlap with suitable breeding habitat.

Manipulation of water levels on breeding rivers during the breeding season is likely to reduce reproductive rates. Increases in siltation resulting from hydroelectric development and operation may displace breeding pairs or females with broods from preferred habitat.

Newfoundland and Labrador plans to increase wind power from 390 kW capacity to 150 MW capacity by 2015 (Canadian Wind Energy Association 2006). Disturbance during construction will potentially be greatest at coastal areas in proximity to wintering or moulting sites. Offshore wind turbines are not expected in the near future, but may pose a disturbance threat should they become desirable. The remoteness of breeding areas in Labrador are likely to result in insignificant interest in turbine construction but breeding areas in insular Newfoundland may be more vulnerable.

Power line construction associated with hydroelectric and wind power development may pose a risk to Harlequin Duck breeding habitat, depending on the location of power development and planning of power lines. The extent of siltation resulting from the removal of vegetation will depend on power line planning.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Land Use Atlas (s.4.2); Protected Areas (s. 4.7)

*Recommendations*: Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.

The small-scale hydroelectric project moratorium should continue to be maintained on key breeding rivers if at some time in the future the moratorium is otherwise lifted.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments. Rivers known to be occupied by breeding Harlequin Ducks at relatively high densities should be registered in the Land Use Atlas.

Water level manipulation should maintain stream levels during breeding to avoid periodic fluctuation of stream water levels while the river is occupied by Harlequin Ducks.

Permitting coastal construction activity from May-September would displace coastal projects in time from the occupation of wintering sites, from October-May to displace in time from moulting sites. Permitting inland activity from October-April would displace construction in time from the occupation of breeding sites.

Power line corridors should avoid crossing rivers at stream junctions.

## 3.3 Chronic Oiling and Nearshore Oil Spills

*Threat Categories*: Pollution

*Activities*: Illegal oil disposal; bilge purging; lost or damaged vessels; spills of oil or chemical cargo during transport; oil and chemical contamination from land sources.

*Sources*: Marine oil and chemical pollution.

*Relevance*: An estimated 300 000 seabirds die annually from oil related events off the coast of Newfoundland (Wiese and Ryan 1999). Since 2002, there have been five known incidents of oiled Harlequin Ducks in southeastern Newfoundland: two recovered from Newfoundland beaches, one on water at Cape St. Mary's (Environment Canada Pollution Incident Reports); one additional bird found on a beach (S. Wilhelm *pers. comm.*) and one recovered in St. Pierre and Miquelon. The incidence of recovered oiled birds underestimates the frequency with which oiling occurs, as many injured or dead birds do not reach beaches or are not detected by surveys.

Harlequin Duck wintering areas along the Newfoundland coast are in close proximity to major shipping routes. No catastrophic oil spills have been recorded in the nearshore waters of Newfoundland but the potential for this may increase with the increased shipments of crude oil from offshore wells transported to various refineries in Atlantic Canada, Québec, Ontario and the United States. Transport Canada is phasing out single-hulled oil tankers by 2015 (Transport Canada 2005), which will reduce the likelihood of catastrophic oil spills occurring within Canadian waters.

Chronic oiling from ship and land sources is ongoing and anticipated to continue. Oil spills are likely to decrease but anticipated to occur occasionally, as oil tankers are not the only ship source of large spills (lost or damaged vessels, other types of ships containing chemical cargo). Harlequin Ducks occupy coastal areas of Newfoundland and Labrador during wintering and moulting. Due to their aggregative behaviour, they are at high risk should an oiling event occur nearby.

*Avenues for Mitigation*: Legislation (s.4.6); Enforcement (s.4.5).

*Recommendations*: Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.

Provide supplementary training to beached bird survey and beach clean-up volunteers through coordinating agencies regarding identification of Harlequin Duck and other Species At Risk. Improved identification will result in improved information about oiling rates of Harlequin Duck.

Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans.

## 3.4 Recreational Activity

*Threat Categories:* Disturbance; Accidental Mortality.

*Activities*: Recreational use of streams and rivers in breeding areas; close approach of Harlequin Duck aggregations by marine vessels.

*Sources*: Recreational boating and angling, hunting, adventure and eco-tourism.

*Relevance*: Although recreational fishing is commonplace in localized areas of Labrador, most of the primary Harlequin Duck breeding areas in Labrador are remote and unlikely to be subject to high intensity recreational use. The highest density breeding rivers for insular Newfoundland are on the Northern Peninsula. Many of these are scheduled salmon rivers subject to angling and boating activity during salmon season (coinciding with Harlequin Duck breeding). Most of this area has been surveyed for Harlequin Ducks but the extent of conflict between anglers and Harlequin Ducks on these rivers is unknown.

Coastal areas of Newfoundland and Labrador are occupied by Harlequin Ducks staging, moulting and wintering, so they are present on the water year round. Sea duck hunting seasons coincide with the wintering season of Harlequin Ducks and since they can mix with other sea duck species, the aggregations in which they occur may be disturbed by both boat traffic and gunshot noise. Recreational boating, sea kayaking, and boat tour operations are likely to be most frequent from late April through October. Sea kayakers are capable of approaching Harlequin Duck aggregations at close range relative to other sources of recreational boating activity. Distances at which Harlequin Ducks will react behaviourally to boat activity are unreported.

Newfoundland and Labrador's adventure and eco-tourism industries are increasing and may increase likelihood of disturbance from recreation, particularly from whale and seabird watching, river rafting, white water canoeing/kayaking and increased sea kayaking.

*Avenues for Mitigation*: Education and Awareness (s.4.3); Protected Areas (s.4.7); Enforcement (s.4.5).

*Recommendations*: Fisheries Guardians and outfitters on salmon rivers, and nearshore ocean boat tour operators should be encouraged to report Harlequin Duck sightings and record these observations relative to the sighting distance from nearest anglers in order to fill knowledge gaps about the potential conflict between fishing activity and Harlequin Duck breeding. Education and awareness initiatives directed toward recreational fishers, fishing guides, kayakers and tour operators could help minimize disturbance through voluntary avoidance.

## 3.5 Aquaculture

*Threat Categories*: Habitat Loss or Degradation, Pollution, Disturbance, Changes in Ecological Dynamics

*Activities*: Development of coastal aquaculture sites; human activity associated with site maintenance; organic and chemical waste from operations.

*Source*: Aquaculture operations and development of aquaculture industry.

*Relevance*: The threat to Harlequin Ducks from aquaculture is currently thought to be insignificant in Newfoundland and Labrador. Aquaculture sites are primarily located in sheltered bays and coves but the Newfoundland and Labrador Aquaculture Industry Strategic Review (Newfoundland Aquaculture Industry Association 2006) indicates a need to expand production areas into more exposed coastline.

The effects of organic and chemical enrichment on ecological dynamics are still poorly understood but may be substantial. Currently the disturbance threat from aquaculture activity is thought to be low but as the industry develops, occupation of exposed areas for aquaculture sites may result in increased traffic. Boat traffic associated with the maintenance of these sites may already include travel around headlands between sites.

The Newfoundland and Labrador Department of Fisheries and Aquaculture is responsible for the licensing of aquaculture operations, although applications are reviewed by several provincial departments and agencies, including Environment Canada.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Education and Awareness (s.4.3); Land Use Atlas (s.4.2); Legislation (s.4.6).

*Recommendations*: Key moulting and wintering areas not already falling under some protection should be registered in the provincial Land Use Atlas as Sensitive Wildlife Areas in order to ensure that Harlequin Duck presence will be considered when applications for submerged lands leases are evaluated.

Establish working relationship with aquaculture industry. Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.

Directed education at boat operators providing guidelines for the avoidance of Harlequin Duck moulting and wintering groups and/or known moulting and wintering areas would reduce the threat of disturbance. Flushing distances from boat disturbance would need to be established in order to provide effective guidelines

## 3.6 Hunting

*Threat Categories*: Accidental Mortality; Consumptive Use; Pollution.

*Activities*: Hunting mortality; discharge of toxic shot in breeding areas.

*Sources*: Accidental and incidental hunting, poaching; subsistence hunting; toxic shot.

*Relevance*: The incidence of accidental/incidental or purposeful harvest of Harlequin Ducks is difficult to assess but is known to happen occasionally in Newfoundland and Labrador. It is unknown to what extent hunters discriminate between diving duck species in general. Harlequin Ducks are thought to be killed in the spring, autumn and winter in Labrador, despite the hunting ban in the Atlantic Flyway. Open Migratory Bird season does not coincide with breeding (inland Newfoundland, late Sept – late Dec; Labrador regions early Sept – late Dec) but hunting by Aboriginal People is permitted year-round.

Harlequin Ducks are sometimes harvested in the spring of the year in Labrador (T. Chubbs *pers. comm.*) Hunting for diving ducks out of season has also been noted in Labrador (T. Chubbs *pers. comm.*). Throughout the province, immature Harlequin Ducks are known to sometimes be accidentally harvested in autumn (F. Phillips *pers. comm.*). Six Harlequin Ducks were reported shot on the Burin Peninsula of Newfoundland in 2000 and another reported near Lord's Cove in 2002. Additionally, at the Bull Cow and Calf Islands near Point Lance, Newfoundland, Harlequin Ducks are regularly hunted (R. Broccolo *pers. comm.*). The actual occurrence of hunting mortality is unknown, but very few Harlequin Duck wings have been turned in to Canadian Wildlife Service (under a requested submission program for migratory bird license holders) in the last few years (P. Ryan *pers. comm.*). Efforts to address these issues are ongoing with educational campaigns and stewardship initiatives.

Shot pellets settling into wintering or moulting areas are unlikely to be picked up and ingested as Harlequin Duck do not scrape substrate in order to acquire food in coastal environments. Lead shot ingestion is not considered a threat at wintering or moulting sites. Shot settling into breeding and brooding areas may be accidentally ingested while foraging for macroinvertebrates attached to substrate. It is unknown to what extent lead shot may still be in use in all areas, but is a low concern.

*Avenues for Mitigation*: Education and Awareness (s.4.3); Enforcement (s.4.5); Stewardship (s.4.4); Protected Areas (s.4.7).

*Recommendations*: Reduce accidental and incidental hunting mortality through hunter education programs to improve the ability to discriminate between Harlequin Ducks and other sea ducks

and to increase knowledge of Harlequin Duck ecology. Stewardship initiatives could be pursued with Labrador's Innu, Inuit and Métis People.

Address knowledge gaps regarding the extent of hunting mortality by encouraging hunters to report shot Harlequin Ducks.

Education initiatives delivered to enforcement officers should result in improved enforcement. In Labrador, increased enforcement may be necessary.

Continue enforcement of regulations regarding non-toxic shot.

## 3.7 Fisheries

*Threat Categories*: Disturbance, Accidental Mortality, Pollution, Changes in Ecological Dynamics.

*Activities*: Boat traffic; gear entanglement; gear ingestion; indirect competition with crustacean fishery; changes in marine communities as a result of seaweed harvest.

*Sources*: Inshore and river fisheries; associated gear in use and lost or derelict gear.

*Relevance*: There are 186 scheduled salmon rivers in Newfoundland and Labrador, many of which are known or likely breeding rivers for Harlequin Ducks. The highest density breeding rivers in northern Newfoundland (Torrent, Portland Creek, Cloud River) are listed Salmon Rivers and the salmon fishery coincides temporally with breeding. In addition to the legal recreational salmon, trout and arctic char fisheries, there is a substantial amount of illegal fish harvesting on the province's rivers. In 2004-2005, 180 charges were laid for inland fisheries related offences (Byrne 2005), including charges for the illegal use of nets to catch salmon and arctic char.

The decline of inshore fishery in recent years and the low overlap between Harlequin Duck marine habitat and suitable waters for fishing minimizes the risk of a disturbance or entanglement threats from the inshore fishery. The current overlap is unknown but thought to be low (D. Osborne *pers. comm.*). Fishing boats have been noted by survey crews near Grey Islands during moult (S. Gilliland *pers. comm.*). Herring, mackerel and lumpfish fisheries and the winter cod fishery in fishing zone 3Ps may be marine sources of net entanglement, but there are no known entanglement reports of Harlequin Ducks associated with these.

There is little documentation of Harlequin Ducks becoming entangled in nets (see Robertson and Goudie 1999), but is likely to go unreported when associated with illegal fisheries. Given the potential for net entanglement, particularly of adult females and broods, this may be a substantial source of mortality.

No data is found on extent of gear ingestion, such as lead sinkers, by Harlequin Duck. The Newfoundland and Labrador Fisheries Act prohibits discard or abandonment of equipment.

Very little information was found with details of commercial shellfish harvest in coastal areas. The extent of overlap between key wintering areas and summer seaweed harvest is unknown, but has occurred historically in Ramea (D. Osborne *pers. comm.*). The commercial seaweed industry is currently very small in Newfoundland and Labrador.

*Avenues for Mitigation*: Education and Awareness (s.4.3); Legislation (s.4.6); Enforcement (s.4.5); Protected Areas (s.4.7)

*Recommendations*: Request Fisheries Guardians and Observers to record and report incidents of net entanglement of Harlequin Duck in order to help fill knowledge gaps about the frequency of entanglement.

Deliver education and awareness initiatives directed towards fisheries enforcement officers. Directed education at boat operators providing guidelines for the avoidance of Harlequin Duck moulting and wintering groups and/or known moulting and wintering areas would reduce the threat of disturbance. Flushing distances from boat disturbance would need to be established in order to provide effective guidelines.

Knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery need to be filled in order to better evaluate the need for mitigation. Protected area status where fishery activity overlaps with high concentrations of Harlequin Ducks is advisable.

## 3.8 Air Traffic

*Threat Categories*: Disturbance

*Activities*: Noise and visual disturbance from helicopter; fixed-wing craft; low-level military training; super-sonic training; wildlife surveys (including Harlequin Duck).

*Sources*: Low-level flights near sites occupied by Harlequin Ducks.

*Relevance*: The frequency of helicopter and fixed-wing disturbance is unknown but may be substantial, particularly helicopter traffic associated with mining activity. As industrial activity and mineral exploration continue to increase in Labrador, aircraft activity will increase to support these endeavours, and therefore the potential threat may increase with time in both severity and impact.

Low-level military flight training in Goose Bay has ceased but super-sonic training is expected in the near future. It is unknown how super-sonic flights might affect Harlequin Ducks. Military aircraft may be a substantial source of disturbance, particularly in Labrador.

Harlequin Duck surveys are conducted annually during wintering and may be conducted during other seasons for research purposes or for environmental assessment component studies. Low-level aerial surveys are conducted annually for other wildlife species throughout Newfoundland and Labrador.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Education and Awareness (s.4.3)

*Recommendations*: Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time. Restrictions on the number of flights, particularly helicopter, occurring from May through September should reduce disturbance in breeding areas. Harlequin Duck surveys should follow Environment Canada protocols, available through the Canadian Wildlife Service, to minimize disturbance. Frequency and duration of flights, especially helicopter flights, occurring at key wintering areas needs to be established. Education initiatives aimed at helicopter operators and users may help alleviate disturbance to wintering Harlequin Duck through voluntary avoidance.

## 3.9 Invasive Species

*Threat Categories*: Exotic Species, Changes in Ecological Dynamics

*Activities*: Accidental, incidental or planned introduction; range expansion and encroachment.

*Source*: Unknown but should be anticipated.

*Relevance*: Extent and impact of invasive alien species on ecological dynamics affecting Harlequin Ducks are currently unknown, but should be anticipated. European green crab was confirmed in Newfoundland waters in late August 2007, but its current range and the extent of probable effect on Harlequin Duck is still unknown.

*Avenues for Mitigation*: Not identified at present.

*Recommendations*: Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species. Monitor ecological impacts of the European green crab and other invasive species which become identified as a potential threat to Harlequin Ducks to determine the need for mitigation.

## 3.10 Predation

*Threat Categories*: Predation.

*Activities*: Predation.

*Sources*: Raptors; mustelids.

*Relevance*: Red-tailed Hawk populations in Labrador may have increased substantially over the last 20 years and may be expanding their range northward (T. Chubbs *pers. comm.*) but the impression of this increase may be due to an increase in the effort and competency of birders in the region (F. Phillips *pers. comm.*). Eagles, falcons and Gyrfalcons may be substantial predators in Labrador (Heath *et al.* 2006).

Rates of nest predation by raptors and mustelids are unknown; rates of predation at wintering and moulting sites are also unknown. The greatest risk to the population from the threat of predation is loss of adult females because older females likely contribute disproportionately to population recruitment.

*Avenues for Mitigation*: Not identified at present.

*Recommendations*: Identify rates and sources of predation for breeding females in order to inform mitigation action, if appropriate. If it is determined that predator control is required to promote population recovery, mitigative options should be developed.

# *4.0 Threat Mitigation*

## 4.1 Environmental Assessment

Environmental assessment (EA) provides a means to integrate environmental considerations into planning and decision-making regarding proposed projects. The role of EA is to eliminate, mitigate or minimize environmental harm which may result from project undertakings. Most threats to Harlequin Duck in Newfoundland and Labrador are resultant, directly and indirectly, of industrial or commercial activity and development. For that reason, the most powerful tool for mitigation of threats is through Environmental Assessment.

Federally, EAs are led by Environment Canada's Canadian Environmental Assessment Agency; provincially, they are led by the Environmental Assessment Division of the Department of Environment and Conservation. Canada, and Newfoundland and Labrador, endorsed the Canada-Wide Accord on Environmental Harmonization and the Sub-Agreement on Environmental Assessment in 1998 in order to promote improved cooperation on environmental matters. The sub-agreement contemplates a bilateral agreement between Canada and Newfoundland and Labrador to cooperatively manage EAs and reduce redundancy when EAs are required by both jurisdictions. At present, the EA bilateral agreement is in draft form, but will provide clear guidelines regarding responsibility, timelines and decision-points.

The presence of Harlequin Ducks does not, in itself, trigger an EA, but up-to-date information about local Harlequin Duck distribution and abundance, ecology of the species and the potential threats to their populations needs to be available to the officers, both provincial and federal, responsible for EAs. Proponents preparing EA reports and EA agencies reviewing these are able to access up-to-date Harlequin Duck survey data and incidental sightings through the Atlantic Canada Conservation Data Center (see 4.1.3). These data are required to develop effective mitigation against project impacts on Harlequin Ducks.

To supplement the general EA best practices guidelines for Wildlife at Risk in Canada (Lynch-Stewart 2004), specific information about Harlequin Ducks should be provided to EA responsible agencies. Education programs will be the best method of ensuring Harlequin Duck ecology and threats to their populations are well understood by EA officers (s.4.3).

### 4.1.1 Triggers of Environmental Assessments

Under the Environmental Assessment Regulations, 2003 (N.L.R. 54/03), projects requiring a provincially-led EA include those related to:

- Aquaculture;
- Forestry and logging;
- Oil and gas extraction;
- Mining;
- Utilities;
- Prime contracting;
- Construction servicing;
- Food and beverage manufacturing;
- Textiles and leather;
- Wood products and paper;
- Petroleum and coal products;
- Chemical manufacturing;
- Plastic and rubber products;

- Non-metallic mineral products;
- Primary metals and metal manufacturing;
- Petroleum product and other wholesaler-distributors;
- Air transportation;
- Waste management;
- Spectator sports and recreation industries;
- Accommodation services; or
- Provincial government programs involving species introductions and recreational development.

Under the Canadian Environmental Assessment Act (S.C. 1992, c. 37), projects requiring a federally-led EA include those in which a:

- Federal authority is the project proponent;
- Federal authority provides money or other forms of financial assistance or guarantee in relation to a project;
- Federal authority grants an interest in land to enable a project to be carried out (i.e., sell, lease or otherwise transfer control of land); or
- Federal authority exercises a power or performs a duty or function specified in the Law List Regulations (S.O.R. 94/636) (e.g., issues a permit or license, etc.).

### 4.1.2 Harlequin Duck Survey Protocol (Component Studies)

When component studies require surveys for Harlequin Duck occurrence and abundance, it is recommended that standardized protocols be followed. Environment Canada's Canadian Wildlife Service (EC-CWS) Harlequin Duck Survey Protocols should be followed to minimize disturbance and to maintain consistent methods for data collection.

Survey protocols are available from EC-CWS for aerial, ground-based, and boat surveys of Harlequin Duck.

### 4.1.3 Access to Updated Harlequin Duck Distribution Data

EC-CWS Atlantic Region collects and maintains data regarding Harlequin Duck distribution. Data is obtained through standardized monitoring surveys, surveys conducted by external organizations (e.g. for EA component studies), and incidental sighting reports. Incidental sighting reports are obtained from historic records, birding listservs, and local birding chat rooms.

EC-CWS Atlantic has a data-sharing agreement with the Atlantic Canada Conservation Data Centre (ACCDC). As part of this agreement, ACCDC receives annual updates of the Harlequin Duck survey and sighting data. Organizations, agencies and individuals can obtain this data for a fee by contacting the ACCDC. Contact information and available data services are listed on their website, http://www.accdc.com.

## 4.2 Land Use Atlas

The Land Use Atlas (LUA) is a land use planning tool based on Geographic Information Systems (GIS) that allows for complex analysis of natural resources, land use demands, and socio-economic development needs. The Land Management Division of the Department of

Environment and Conservation is responsible for the planning and management of land use activity on crown lands, relying on the LUA to evaluate conflicts of land management between provincial priorities and proposed activities. Approximately 95% of Newfoundland and Labrador's land surface is Crown Land, making the LUA an important tool and an effective avenue for mitigating threats to Harlequin Ducks and their habitat.

Proposals for land use are analysed from the perspective of sustainable development and maintaining the integrity of wildlife populations and habitat, biodiversity and rare species. The Land Management Division solicits input from other divisions and departments with an interest in lands identified by proponent for development.

Important areas for Harlequin Duck can be registered in the LUA as Sensitive Wildlife Areas. The designation does not provide direct protection to the identified areas, but will ensure that the proximity to these sites is considered when evaluating proposals for activities such as mineral exploration, fishing, commercial recreational development, outfitting, and adventure tourism, among others.

The distribution and abundance of Harlequin Duck within Newfoundland and Labrador is expected to change over time. To mitigate threats that are resultant from land-use activity on Crown Lands, Harlequin Duck data need to be kept up to date. Wildlife Division of the Department of Environment and Conservation is responsible for identifying and contributing Sensitive Wildlife Areas to the LUA, but Harlequin Duck surveys within the province and the maintenance of incidental sighting records are managed by the Canadian Wildlife Service. Newfoundland and Labrador can obtain current Harlequin Duck information from ACCDC (as indicated in 4.1.3) for regular updates.

## 4.3 Education and Awareness

Current education and awareness campaigns highlighting Harlequin Ducks are limited to distribution of materials for the general public. To improve the efficacy of minimizing, mitigating and eliminating threats to Harlequin Duck, there is a need to develop and deliver education campaigns targeting relevant stakeholders.

Within the province of Newfoundland and Labrador, education and awareness campaigns should be delivered to:

*Environmental Assessment Agencies/Officers*. Education will be best achieved by in-person presentations and distribution of fact sheets to agencies and individuals responsible for Environmental Assessments. Information of importance would include basic Harlequin Duck ecology, threats to the population, and their distribution and abundance within the jurisdiction. Advice should be provided on evaluating the extent of threat posed by a project and accessing updated distribution and abundance data. To make effective use of resources, ecology and population threats workshops could be designed to transfer knowledge regarding multiple species at risk for which threat mitigation through EA is key.

*Enforcement Officers*. Improved enforcement is likely best achieved through education of enforcement officers. Education will be most effectively accomplished by in-person delivery of presentations and the distribution of summary hand-outs. Key topics would need to include field identification of Harlequin Ducks (see Hunters, below), and laws and regulations applicable to Harlequin Ducks. In-person events would create an excellent opportunity for the collection of knowledge regarding the probable incidence of hunting mortality, fishery gear entanglement, and knowledge of habitat or areas frequented by Harlequin Duck that may be currently unreported.

This would provide an opportunity for discussing the challenges and successes of enforcing regulations relevant to species at risk in general.

*Hunters*. Concern over the inability of some hunters to distinguish Harlequin Ducks from other diving ducks drives the need for education of hunters. An identification guide should be produced which depicts Harlequin Duck at different age classes and with seasonal plumage of both sexes; it should also depict the other species with which Harlequin Duck are likely to be confused. The guide should contain brief wording regarding the at-risk status and the hunting ban. As the frequency of hunting mortality is unknown, provision of a mechanism for reporting shot Harlequin Ducks should be included. Options for distribution of the information include, but are not limited to, distribution of posters and guides to retailers who sell hunting equipment, direct distribution to Migratory Bird License holders, or distribution through and agreement with organizations, such as Ducks Unlimited Canada, to reach their membership. Delivery of hunter education to Labrador's aboriginal groups will likely be most effective through community meetings and best conducted in association with the Nunatsiavut Government, the Innu Nation and the Métis Nation.

*Municipalities*. Municipalities near key breeding, moulting and wintering areas have the opportunity to protect municipal spaces from development and/or to restrict or encourage particular activities through municipal planning. This might be best delivered through the provincial Municipal Stewardship and Wetland Stewardship initiative. Regarding Harlequin Ducks, information on basic ecology, local abundance and occurrence, at-risk status, and the potential threats to their population posed by coastal development should be conveyed. Avenues for Municipal involvement, such as incorporation of habitat protection into municipal planning or the development of stewardship agreements, should be outlined for land planners.

*Aircraft and Boat Operators, Adventure and Eco-Tour Operators*. Particularly in the case of helicopter operators, small boat operators, and kayakers, establishing or increasing awareness of Harlequin Duck sensitivity to disturbance may encourage voluntary avoidance or reduced disturbance of Harlequin Duck aggregations. Guidelines regarding safe distance from aggregations, minimization of time spent nearby aggregations, and general information about Harlequin Ducks should be provided.

*Aquaculture Industry*. It will be vital to establish and maintain a good relationship with aquaculture operators in order to effectively open communication channels between operators and resource managers. A request to speak at a Newfoundland Aquaculture Industry Association (NAIA) meeting or conference could provide an opportunity to discuss potential conflict between aquaculture operations and Harlequin Duck. NAIA should be approached with the concept of anticipating a shared problem and presentations to the organization will need to convey an opportunity and responsibility to work together to mitigate potential impacts.

Individuals responsible for issuing aquaculture licenses and leases should be made aware of the potential threats posed by aquaculture in order to make sound decisions regarding the geographic planning of future development. Delivery of education to outline threats, identify regions and habitat preferred by Harlequin Duck, and offer means by which to periodically acquire up to date distribution and abundance data should be provided.

*Volunteers*. Organizations which coordinate volunteer activity such as beached bird surveys and beach clean-ups may be able to provide important information on oil-related deaths of Harlequin Duck. Delivery of education aimed at improving identification of Harlequin Duck and other Species at Risk which may be found on beaches should be achieved in cooperation with these organizations. Hand-outs or brochures that can be carried during beach work should be created

and delivered through regular volunteer training or instruction. In-person presentations to volunteer coordinators may be a good strategy for transferring information. Hand-outs or brochures should include identification guidance, instructions on where carcasses are likely to be found and where live birds might be spotted, and contact information for reporting. To maximize ease of reporting, data collection cards could accompany the distributed guidance.

## 4.4 Stewardship

Stewardship agreements with private landowners, industry stakeholders or non-governmental organizations can be powerful tools for species conservation and habitat management. Given that approximately 95% of Newfoundland and Labrador is crown-owned, the efficacy of stewardship agreements is likely limited but may be a viable avenue in key Harlequin Duck areas in or in close proximity to private land and municipalities. In some cases, private land protection may be best pursued through conservation covenants (section 4.7.2).

Threats to the sustainability of many species however are not just limited to loss or degradation of habitat. Hunting and other forms of disturbance to the species throughout its life cycle may also impact on their sustainability. Legislation is in place to restrict hunting of Harlequin Duck. However, due to the remoteness of much of its range, enforcement tends to be very difficult. Encouraging resource users to recognize their responsibility towards the conservation of wildlife should be an essential component of any conservation strategy. Effective stewardship programs are long term, target resource users and the local community, and provide nurturing and reinforcement of the concept of stewardship and individual responsibility towards the resource. Appropriately delivered stewardship programs greatly compliment the enforcement activities associated with species at risk legislation.

## 4.5 Enforcement

Continued support for enforcement of laws and regulations that can aid in threat mitigation is important.

Enforcement of regulations under the Migratory Bird Convention Act, Canada Shipping Act, and the Canadian Environmental Protection Act with regard to marine oil and chemical pollution has been the focus of legislative changes to these acts recently under Bill C-15. These amendments are intended to increase the efficacy of enforcement and create a greater deterrent to potential offenders, which is expected to improve the prevention of chronic oil and chemical pollution in Canadian waters.

In Newfoundland and Labrador, particularly with respect to hunting mortality of Harlequin Duck, a combination of increased enforcement in Labrador and improved enforcement throughout the province is recommended. The best way to achieve improved enforcement is through an education and awareness initiatives targeting enforcement officials, including municipal police, Royal Canadian Mounted Police, Conservation Officers, Park Wardens, Fishery Officers, Fishery Guardians, River Guardians and Environmental Guardians.

## 4.6 Legislation

Legislation identified below is not to be considered comprehensive; an attempt has been made to summarize the most relevant legislation, provincially and federally, which addresses issues related to mitigation of probable threats to Harlequin Ducks. Acts and regulations pertaining to protected areas are discussed in section 4.7.

### 4.6.1 Provincial Statutes and Regulations Relevant to Mitigation of Threats

Endangered Species Act (S.N.L. 2001, c. E-10.1) provides for protection, designation, recovery and other aspects relevant to the conservation of species at risk in Newfoundland and Labrador. The Act prohibits actual or attempted actions that result in harm to individuals of species designated as threatened, endangered or extirpated. It enables land to be designated as recovery habitat or critical habitat to protect the important habitat of vulnerable, threatened, endangered or extirpated species. Harlequin Duck are currently designated vulnerable under the Endangered Species List Regulations (N.L.R. 57/02).

Wild Life Act (R.S.N.L. 1990, c.W-8) enables the regulation of inland fishing and hunting and trapping of wildlife through licensing, permitting, and the prescription of quotas and management areas. The Act prohibits disturbance and harassment of wildlife. It also allows for the establishment of parks and reserves (see 4.7).

Environmental Protection Act (S.N.L. 2002, c.E-14.2) in part, governs the management of wastes, air quality, soil contamination, dangerous goods and pesticides. The Act establishes Environmental Assessments for the purpose of protecting the environment and quality of life for the people of the province and to facilitate the wise management of natural resources. The Environmental Assessment Regulations, 2003 (N.L.R. 54/03) are enabled by the Act.

Labrador Inuit Land Claims Agreement Act (S.N.L. 2004, c.L-3.1) establishes the legal commencement of the Labrador Inuit Land Claims Agreement. The Agreement takes precedence over provincial legislation including the Endangered Species Act, the Environmental Protection Act, the Lands Act, and others. With respect to wildlife and plants, the Agreement transfers management of wild populations, including harvest regulations, to the Nunatsiavut Government. The Agreement stipulates that management of wildlife and plants is subject to a precautionary approach.

Lands Act (S.N.L. 1991, c.36) addresses the management and control of provincial crown lands. The Act allows for the establishment of special management areas, reservations of land, and reservations of shoreline and the establishment of authorities and prohibitions to manage these areas for their purpose. The Act also specifies the requirement to apply for a grant, lease or easement of crown land for private or commercial rights to that land.

Urban and Rural Planning Act, 2000 (S.N.L. 200, c.U-8) governs the requirements for municipal plans and mechanisms of establishing and adopting land plans, including the designation of local protected areas and local protected roads.

Forestry Act (R.S.N.L 1990, c. F-23) governs the management of provincial forests in accordance with the principles of sustained management. The Act allows the establishment of forest

management areas, the granting of cutting rights, and the approval of pesticide use, among others. Cutting of Timber Regulations (C.N.L.R. 1108/96) are enabled by the Act.

Mining Act (S.N.L. 1999, c. M-15.1) governs the operation of mines and mills in the province and requires the progressive rehabilitation of sites and complete rehabilitation at closure of the site. The Act enables the Mining Regulations (N.L.R. 42/00).

Water Resources Act (S.N.L. 2002, c. W-4.01) among others, governs the use of water resources for power generation. The act allows the enforced regulation of water level control at dams, the designation of reservoir development areas and the licensing of the flooding of lands (subject to the Lands Act).

Aquaculture Act (R.S.N.L. 1990, c.A-13) is intended to encourage and regulate the aquaculture industry in the province. The purpose of the Act is to promote the industry, secure property rights of operators and minimize conflicts with competing interests and uses of properties. The Act governs the issuance of licenses, the rights and responsibilities of site operators, and enables regulations to be made regarding sustainable development, protection of the environment, and the use (or prohibition of use) of organic and chemical substances used in operations.

### 4.6.2 Federal Statutes and Regulations Relevant to Mitigation of Threats

Species at Risk Act, (S.C. 2002, c. 29). The purposes of the Act are to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and encourage the management of other species to prevent them from becoming at risk. The eastern population of Harlequin Duck is listed as Special Concern in Schedule 1. The Act requires the development and implementation of a management plan for species designated Special Concern and allows for regulations to be made, as necessary, to put the management plan into effect with respect to migratory birds.

Migratory Birds Convention Act, 1994 (S.C. 1994, c. 22) protects migratory birds, as populations and as individual birds, and their nests. This includes prohibitions against depositing any substance that is harmful to migratory birds in waters or in areas frequented by migratory birds. The Act allows for regulations governing migratory bird hunting, treatment of migratory bird nests and nest sites, and the designation of protected areas, among others.

Canada Wildlife Act, (R.S.C. 1985, c. W-9) enables the acquisition and designation of lands and designation of marine areas for the purposes of research, conservation and interpretation in respect of migratory. The Act also allows for the prescription of measures for the conservation of wildlife within these lands or waters.

Canadian Environmental Assessment Act, (S.C. 1992, c. 37) establishes a federal environmental assessment process to achieve sustainable development by conserving and enhancing environmental quality. The Act governs the federal environmental assessment process and enables regulations governing identification of projects requiring and those excluded from federal environmental assessment (see Section 4.1).

Canadian Environmental Protection Act, 1999, (S.C. 1999, c. 33) in part, protects the marine environment from land based pollutants and those disposed of at sea. At sea disposal prohibitions are, in part, intended to protect against chronic oil pollution. The Act also governs environmental

emergency plans and response and the enforcement of statutes and regulations within and enabled by the Act.

Canada Shipping Act, (R.S.C. 1985, c.S-9) among others, regulates the location of shipping lanes and recreational boat activity. The Act enables Ballast Water Control and Management Regulations, (S.O.R./2006-129), Hull Construction Regulations, (C.R.C., c. 1431), Oil Pollution Prevention Regulations, (S.O.R./93-3), Pollutant Substances Pollution Prevention Regulations, (C.R.C., c. 1458), and Response Organizations and Oil Handling Facilities Regulations, (S.O.R./95-405).

Canada Shipping Act, (R.S.C. 2001, c. 26) among others, identifies the responsibilities of the Fisheries and Oceans Canada and Transport Canada with respect to marine pollution prevention, response, and enforcement.

Canada-Newfoundland Atlantic Accord Implementation Act, (S.C. 1987, c. 3) governs the issuance of offshore petroleum interests, and licensing for exploration and operational activity. The Act also prohibits causing a spill of petroleum in offshore areas and requires reporting of spills and reasonable measures to be taken to reduce or mitigate dangers to the environment resulting from a spill.

Fisheries Act, (R.S.C. 1985, c. F-14) governs the management and control of sea coast and inland fisheries. The Act enables regulation relating to, among others, seasons and quotas, the operation of fishing vessels, and the use of fishing gear and equipment. The Act enables the Newfoundland and Labrador Fisheries Regulations (S.O.R./2003-338, s.1) which, among others, designates scheduled salmon rivers, identifies allowed and prohibited fishing areas and fishing gear, and regulates fisheries seasons.

## 4.7 Protected Areas

Protected areas currently constitute only a small portion of habitat occupied by Harlequin Ducks in Newfoundland and Labrador. Large aggregations of moulting Harlequin Ducks have been recorded consistently at the Gannet Islands Ecological Reserve. The Cape St. Mary's Ecological Reserve contains the largest wintering aggregations and a small moulting aggregation of Harlequin Ducks. A small number of breeding pairs have been reported within the boundaries of Gros Morne National Park, and large groups of pre-moult individuals, thought to be staging, have been recorded within the boundaries of Torngat Mountains National Park Reserve. The Torngat Mountains National Park Reserve and the proposed Mealy Mountain National Park together contain Harlequin Duck breeders and/or breeding habitat.

Most of the land in Newfoundland and Labrador is controlled by the crown (except in Labrador, where Innu and Métis land claims negotiations may result in control being transferred to Aboriginal control, as has been seen with the Labrador Inuit Land Claim Agreement), and Harlequin Ducks and their habitat may be effectively protected through other avenues, such as designation in the Land Use Atlas (s.4.2). Establishment of protected areas should be considered where other types of mitigation are ineffective, inappropriate, or impossible.

*Provincial Parks*. Provincial Parks and Waterway Provincial Parks may be established under the Provincial Parks Act (R.S.N.L. 1990, c.P-32). The Act allows for the prescription of activities which may or may not take place within Provincial Parks. The Provincial Park Regulations

(N.L.R. 91/97) prohibit removal, harm, destruction or harassment of any object that is contained within the boundaries of a park and prohibit the introduction of plant or animal species. Some exceptions for angling and hunting are contained within these regulations.

*Wilderness and Ecological Reserves*. Under the Wilderness and Ecological Reserves Act (R.S.N.L. 1990, c. W-9), land, including water, may be designated as a Wilderness Reserve or Ecological Reserve. Wilderness Reserves may be established in areas of the province subject to little or no human activity to conserve important hunting and fishing areas, to preserve pristine wilderness, to preserve large areas necessary for the continued survival of a particular species or to protect areas with primitive or extraordinary characteristics. Wilderness Reserves may be beneficial in breeding areas where stewardship or other initiatives are not feasible. Ecological Reserves may be established in areas of the province containing a representative or unique ecosystem or species to, among other things, protect the habitat of an animal or plant species that is rare or endangered, to provide the ability to study the recovery of ecosystems, or to preserve organisms in their natural habitat to ensure the preservation of their gene pools. Due to their ability to protect both land and water, Wilderness and Ecological Reserves may be a useful tool for protecting key breeding, moulting and wintering sites.

The Wilderness and Ecological Reserves Advisory Council (WERAC) is responsible for advising the government regarding the creation and management of wilderness and ecological reserves.

*Wildlife Reserves*. Wildlife Reserves may be established under the Provincial Wild Life Act (R.S.N.L. 1990, c.W-8). The Act prohibits disturbance and harassment of wildlife, and allows for the designation of Reserves in which wildlife or a specified class of wildlife may not be hunted, taken or killed, or can be done so under specific conditions and regulations.

*National Parks.* National Parks including park reserves, adjuncts, historic parks and historic sites, can be established under the Canada National Parks Act (S.C. 2000, c.32). The Act prohibits actions which unreasonably interfere with the fauna or natural beauty of a park.

*National Migratory Bird Sanctuaries*. Migratory Bird Sanctuary Regulations (C.R.C., c. 1036) enabled by the Migratory Birds Convention Act (S.C. 1994, c. 22) establish National Migratory Bird Sanctuaries for the protection of migratory birds within Sanctuary boundaries. The regulations prohibit hunting of any migratory bird within sanctuary boundaries. A hunting ban is in place in the Atlantic Flyway for Harlequin Duck, but a reason for their vulnerability to incidental shooting is their tendency to mix with other sea ducks in wintering groups. Establishment of a Migratory Bird Sanctuary could be used if a particular area is subject to a disproportionately high rate of incidental hunting mortality.

*Wildlife Areas*. Wildlife Area Regulations, (C.R.C., c. 1609), enabled by the Canada Wildlife Act, (R.S.C. 1985, c. W-9), allow for the designation of National Wildlife Areas. Within these Wildlife Areas, prohibitions include, among others, hunting and fishing, possession of lead shot or lead sinkers, industrial or agricultural activity, recreational activity, and harm of any wild animal or plant.

*Marine Protected Areas.* Under the Oceans Act, (S.C. 1996, c.31), Marine Protected Areas can be designated for the protection or conservation of marine resources and habitat. Regulations can be made restricting activity in the protected area and any other measures consistent with the designation. The wording in the Act largely refers to marine resources, commercial and non-commercial fishery resources, and marine habitat. Designation of a marine protected area for the purpose of conserving or protecting Harlequin Duck may not be possible. Under the Canada

Wildlife Act, (R.S.C. 1985, c. W-9), protected marine areas can be established but are not restricted to the protection of marine resources.

## *5.0 Summary of Threats to Harlequin Ducks in Newfoundland and Labrador*

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Resource Extraction | - Acidification and heavy metal enrichment of streams<br>- Infrastructure development<br>- Habitat removal, siltation<br>- Air traffic<br>- Disturbance associated with construction and maintenance | medium-high | Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.<br><br>Assessments should consider project longevity as chronically disturbed areas may be abandoned.<br><br>Seasonal restrictions on extraction and exploration activity should be considered, when practical.<br><br>Roads should be built such that they are not visible from breeding streams and do not cross stream junctions.<br><br>Buffers of at least 100 m should be required when projects operate in known breeding areas.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.<br><br>Important breeding habitat registered in the Land Use Atlas.<br><br>Corporate stewardship agreements should be pursued with forestry and mining companies to encourage voluntary protection of Harlequin Duck habitat. |
| Power Generation | - Infrastructure development<br>- Flooding, water level manipulation, siltation<br>- Disruptive activity | medium-high | Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.<br><br>Rivers known to be occupied by breeding Harlequin at relatively high densities should be registered in the Land Use Atlas.<br><br>Water level manipulation should be conducted as to maintain stream levels during breeding.<br><br>Restrict construction activity to period from May-September to displace coastal projects in time from the occupation of wintering sites.<br><br>Restrict construction activity to periods from October-April to displace construction in time from the occupation of breeding sites.<br><br>Power line corridors should avoid crossing rivers at stream junctions. |

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Chronic Oiling and Oil or Chemical Spills | - Illegal and incidental oil disposal<br>- Accidental spills | medium-high | Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.<br><br>Provide supplementary training to beached bird survey and beach clean-up volunteers.<br><br>Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans. |
| Recreational Activity | - Fishing gear entanglement<br>- Chronic or prolonged disturbance<br>- Adventure and eco-tourism | medium | Encourage Fisheries Guardians on salmon rivers to report Harlequin Duck sightings to fill knowledge gaps about the conflict between fishing activity and Harlequin Duck breeding.<br><br>Education and awareness initiatives directed toward recreational fishers, fishing guides, kayakers and tour operators could help minimize disturbance through voluntary avoidance. |
| Aquaculture | - Development of coastal aquaculture sites<br>- Boat activity associated with maintenance and operation of sites<br>- Organic and chemical waste produced during operation | low | Key moulting and wintering areas should be registered in the provincial Land-Use.<br><br>Establish working relationship with aquaculture industry.<br><br>Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.<br><br>Directed education at boat operators providing guidelines to reduce the threat of disturbance through voluntary avoidance.<br><br>Determine flushing distances from boat disturbance to provide effective guidelines |
| Hunting | - Incidental/accidental harvest<br>- Illegal harvest<br>- Lead shot | low- medium | Reduce accidental and incidental hunting mortality through hunter education programs.<br><br>Pursue stewardship initiatives with Labrador's Innu, Inuit and Métis People.<br><br>Address knowledge gaps regarding the extent of hunting mortality by encouraging hunters to report shot Harlequin Ducks.<br><br>Deliver education initiatives to enforcement officers for improved enforcement.<br><br>Continue enforcement of regulations regarding non-toxic shot. |

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Fisheries | - Close approach of Harlequin aggregations by marine vessels<br>- Loss of lead and plastic fishing gear<br>- Gear entanglement<br>- Crustacean fishery<br>- Harvest of algae, sea urchins | low | Encourage Fisheries Guardians and Observers to report incidents of net entanglement.<br><br>Deliver education and awareness initiatives to fisheries enforcement officers.<br><br>Directed education at boat operators providing guidelines to reduce the threat of disturbance through voluntary avoidance.<br><br>Determine flushing distances from boat disturbance to provide effective guidelines<br><br>Fill knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery. |
| Air Traffic | - Low altitude flights by helicopter or fixed-wing aircraft | medium | Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects of several projects over time.<br><br>Restrict flights occurring from May through September to reduce disturbance in breeding areas.<br><br>Harlequin Duck surveys should follow Environment Canada protocols.<br><br>Education initiatives aimed at helicopter operators and users to alleviate disturbance to wintering Harlequin through voluntary avoidance. |
| Invasive Species | - accidental, incidental or planned introduction<br>- range expansion and encroachment | unknown | Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species.<br><br>Monitor ecological impacts of invasive species which are identified as potentially threatening to Harlequin Ducks to determine the need for mitigation. |
| Predation | - predation | unknown | Identify rates and sources of predation for breeding females.<br><br>If it is determined that predator control is required, mitigative options should be developed. |

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# Harlequin Duck Threat Analysis:

# Nova Scotia

## HARLEQUIN DUCK THREAT ANALYSIS: NOVA SCOTIA

## *1.0 Introduction*

Harlequin Ducks in Nova Scotia have an exclusively coastal distribution and their occurrence in the province is primarily during the winter season, but they are commonly sighted during autumn and spring migration. Moulting aggregations may occur in coastal Nova Scotia, but confirmation of this requires dedicated surveys to be conducted. Harlequin Ducks tend to be gregarious in coastal areas, a characteristic that puts them at high risk of threats which have the potential to significantly increase adult mortality, particularly where they occur in abundance.

General Threats identified in section 2.0 often influence more than one Threat Category (see Appendix I). In evaluating the priority of threats for minimization, mitigation, and elimination, the cumulative impacts of General Threats and associated activities need to be considered. In Nova Scotia, threats with the greatest potential to impact Harlequin Ducks at a population level include catastrophic oil or chemical spills, chronic oil pollution, aquaculture development and coastal development.

Oil and chemical pollution events may result in direct increases in mortality and possible decreases in genetic diversity, and may indirectly reduce reproductive success. Aquaculture development, though currently of only medium concern, should be anticipated to conflict with Harlequin Duck wintering habitat in the future. The potential for loss of preferred habitat, changes to local marine ecology and disturbance associated with the maintenance and operation of aquaculture sites could result in cumulative effects that put Harlequin Ducks at substantial risk. The development of the aquaculture industry in Nova Scotia should be closely monitored.

Coastal development for residential, recreational, commercial or industrial use is also of particular concern. Nova Scotia's coastal areas have seen and increase in human population density over the last several decades and no comprehensive provincial strategy currently exists to guide coastal development. Threats to Harlequin Duck from coastal development include habitat loss and degradation and increased disturbance from both acute sources (e.g. construction) and chronic sources (e.g. activity or traffic associated with use and access of developed areas).

Any activities resulting in habitat loss, or long-term or permanent habitat degradation is a potential threat to both current and future wintering aggregations. As current numbers are expected to increase (Environment Canada 2007), management of habitat and mitigation of threats to habitat need to consider the likelihood of range expansion. Activities causing habitat loss or degradation in areas of suitable habitat may create barriers to range expansion.

## *2.0 Distribution and Abundance of Harlequin Ducks in Nova Scotia*

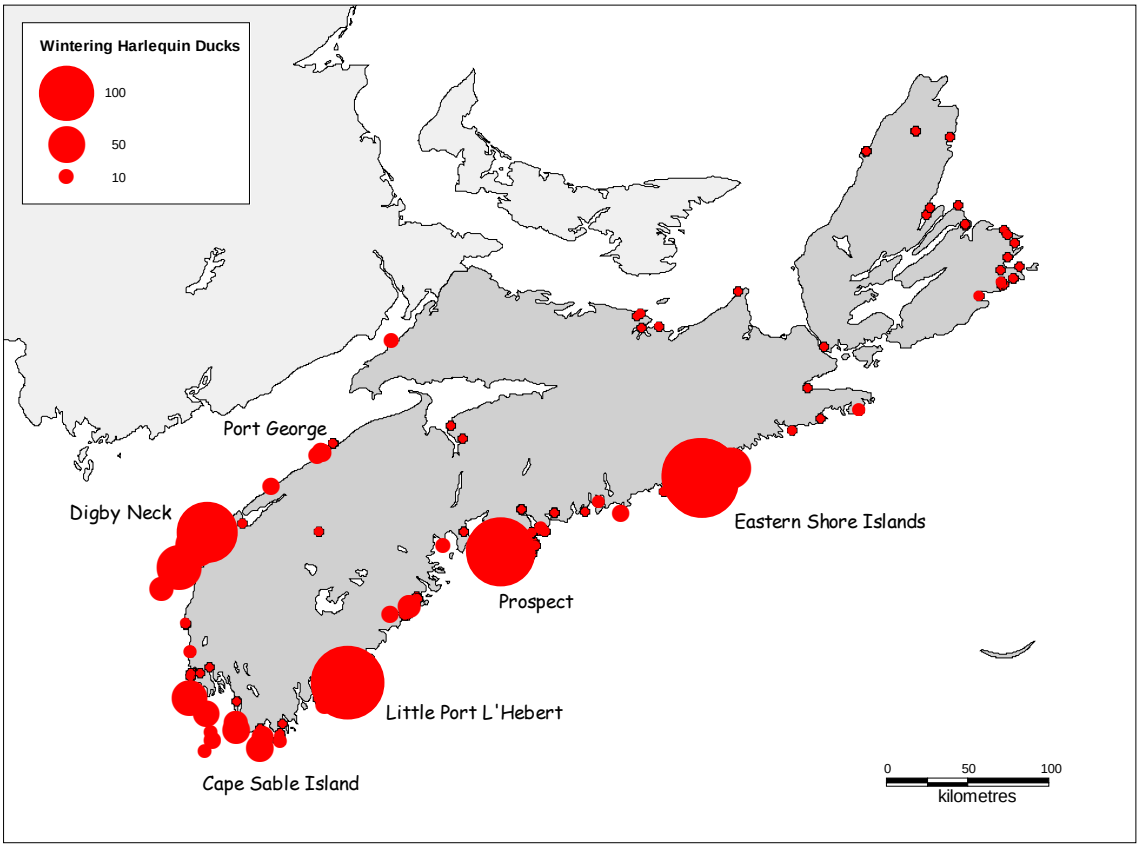


**Figure 6. Distribution of wintering Harlequin Ducks in Nova Scotia. Data used to produce this map include survey data and incidental sighting reports 1950-2006 (CWS *unpublished data*).**

*Wintering*: (December - April)

The Eastern Shore Islands Wildlife Management Area (ESIWMA) is the major wintering site for Harlequin Ducks in Nova Scotia, supporting more than half of the known wintering Harlequin Ducks in the province. Other key wintering areas in Nova Scotia are Prospect, Little Port l'Hebert, the southwestern shore (including Cape Sable Island), Digby Neck and Port George. Smaller aggregations of Harlequin Duck are common along the southern and southwestern shores during winter. Currently, 1 100 – 1 200 birds are estimated to over-winter in Nova Scotia.

*Breeding*: (May - September)

There are no current or historic records for breeding Harlequin Ducks in Nova Scotia.

*Moulting*: (July – September)

There are no current or historic records for moulting Harlequin Ducks in Nova Scotia, but dedicated moult surveys have not been conducted. The lack of evidence of moulting aggregations might be due to a lack of search effort rather than an absence of birds. Non-breeding individuals may over-summer and moult in Nova Scotia, rather than migrating to breeding areas or other moulting sites.

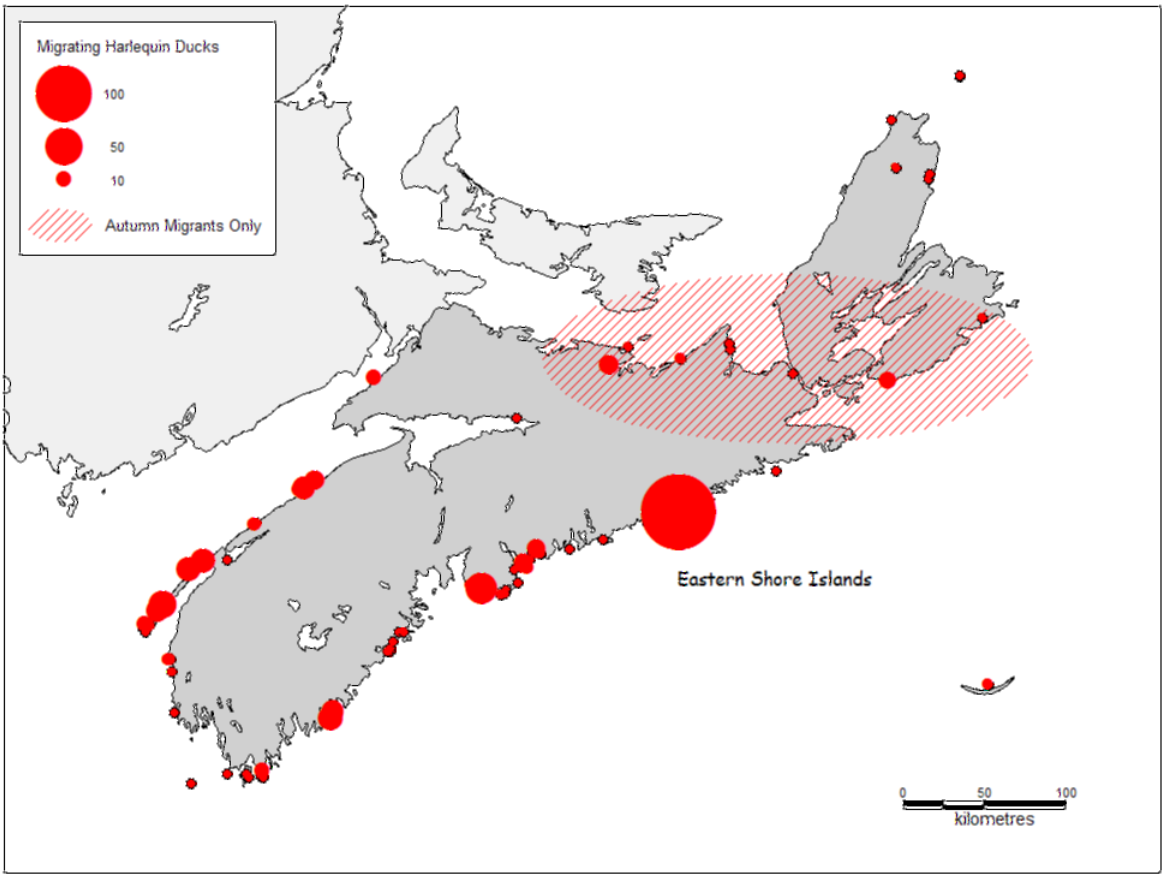


**Figure 7. Distribution of migrating Harlequin Ducks (autumn and spring) in Nova Scotia. Data used to produce this map include survey data and incidental sighting reports since 1950 (CWS *unpublished data*). Observations of Harlequin Ducks on the north shore of mainland Nova Scotia and the south shore of Cape Breton have only been recorded in autumn, as indicated by the shaded area.**

*Migration*: (April – May, October – December)

Incidental reports of Harlequin Duck sightings indicate that many coastal areas are used during migration, particularly the south and southwestern shores. Observations of migrating birds along the north coast of mainland Nova Scotia and the south coast of Cape Breton have only been recorded during autumn migration. Observations of Harlequin Duck during migration should be interpreted cautiously, as some of these sightings may be of individuals arriving early to or leaving late from wintering grounds.

# *3.0 Status of Threats to Nova Scotia's Harlequin Ducks*

## 3.1 Land-based Coastal Development

*Threat Categories*: Habitat Loss and Degradation; Disturbance.

*Activities*: Loss of habitat; disturbance from construction activity associated with development in coastal regions; use of developed properties.

*Sources*: Industrial, commercial and residential/vacation property development.

*Relevance*: In Nova Scotia, 95% of the coastline is privately owned. Municipal Planning Strategies are in place in 56% of municipalities, but these strategies do not necessarily address coastal development. Coastal property is in high demand, particularly for residential and vacation property. Little Port l'Hebert, for example, has experienced heavy summer home development, and although these homes are generally unoccupied during the winter, they are in some cases within 25 m of rocks where Harlequin Ducks typically haul-out [3] (Boyne *in press*).

Most industrial and some commercial development will trigger and Environmental Assessment but residential development on private property will rarely do so (Section 3.1). Development and building permits are issued by the responsible municipality.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Integrated Resource Management (s.4.2); Education and Awareness (s.4.3); Stewardship (s.4.4); Legislation (s.4.6); Protected Areas (s.4.7).

*Recommendations*: Targeted education for municipal planners to increase awareness of effects of coastline development. Stewardship programs and agreements should be pursued with municipalities and private land-owners in areas known to be occupied by wintering Harlequin Ducks.

Although any one particular project may disturb or displace only a small number of birds, environmental assessments need to consider both project impacts and cumulative effects of several projects over time. Disruptive construction (that is likely to cause substantial disturbance to wintering groups) should be limited to the period from May – October to reduce adverse effects on Harlequin Ducks. Developments expected to encourage human activity through the winter months should have a coastal set-back such that human activity is not typically visible to Harlequin Ducks; this set-back distance will need to be determined on a case by case basis.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.

## 3.2 Aquaculture

*Threat Categories*: Habitat Loss or Degradation; Disturbance; Changes in Ecological Dynamics.

*Activities*: Development of coastal aquaculture sites; human activity associated with site maintenance; organic and chemical waste from operations.

[3] "haul-out" refers to an area on-shore where Harlequin Ducks come out of the surrounding waters

*Source*: Aquaculture operations and development of aquaculture industry.

*Relevance*: In Nova Scotia, current aquaculture operations are in sheltered bays and coves, not exposed and turbulent areas preferred by Harlequin Duck. Changes in cost-effectiveness of new technology or in environment requirements for waste removal may encourage new aquaculture operations in exposed areas and could create conflict with Harlequin Duck wintering groups. Developing aquaculture in harsher marine environments has been identified as a future need for the Nova Scotia aquaculture industry to continue to meet demand for aquaculture products (Nova Scotia Agriculture and Fisheries 2005). At present, habitat threats from aquaculture are low in Nova Scotia, but should be anticipated.

Leases or grants of submerged lands are administered by the Department of Natural Resources. Permitting for new aquaculture operations is the responsibility of the Department of Fisheries and Aquaculture.

The far-field effects of organic and chemical enrichment on ecological dynamics are still poorly understood; near-field effects may alter food quality and availability.

Boat traffic associated with the maintenance of these sites may currently include travel around headlands between sites. Areas occupied by wintering Harlequin Ducks tend to be, but are not limited to, rough waters. Most of these locations are likely to be avoided by boaters. The lobster fishery in southern areas is open throughout the winter and associated boat traffic may affect distribution of Harlequin Ducks on wintering grounds.

*Avenues for Mitigation*: Education and Awareness (s.4.3); Environmental Assessment (s.4.1); Legislation (s.4.6)

*Recommendations*: Establish working relationship with aquaculture industry. Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.

Avoid aquaculture development in key Harlequin Duck wintering areas. Although any one particular project may disturb or displace only a small number of birds, environmental assessments need to consider both project impacts and cumulative effects of several projects over time. Up to date Harlequin Duck distribution and abundance data needs to be available to agencies responsible for environmental assessment, permits and leases.

Directed education at boat operators providing guidelines for the avoidance of Harlequin Duck wintering groups and/or known wintering areas would reduce the threat of disturbance. Flushing distances from boat disturbance would need to be established in order to provide effective guidelines; indications from available data for other duck species indicates that 100 m may be a minimum recommended avoidance distance.

## 3.3 Chronic Oiling and Oil and Chemical Spills

*Threat Categories*: Pollution

*Activities*: Illegal oil disposal; bilge purging; lost or damaged vessels; spills of oil or chemical cargo during transport; oil and chemical contamination from land sources.

*Sources*: Illegal oil disposal; bilge purging; lost or damaged vessels; spills of oil or chemical cargo during transport; oil and chemical contamination from land sources.

*Relevance*: Annual mortality of Harlequin Ducks due to oil related events is unknown for the Nova Scotia coast. Bird Studies Canada coordinates beached bird surveys on Cape Breton

Island and in the Bay of Fundy. Between 2001 and 2005, no Harlequin Duck were reported oiled (Campbell 2005a) and in 2005 no oiled birds of any species were found during Bay of Fundy suveys (Campbell 2005b).

Harlequin Duck wintering areas along the Nova Scotia coast are in close proximity to major shipping routes. Halifax Harbour is a principal port in the region and regularly receives oil tankers (Brander-Smith *et al.* 1990). Two large oil spills have already occurred in Nova Scotia waters (Arrow – Feb 1970, Kurdistan – March 1979). Transport Canada is phasing out single-hulled oil tankers by 2015 (Transport Canada 2005) which will reduce the likelihood of catastrophic oil spills occurring within Canadian waters.

Chronic oiling is ongoing and anticipated to continue. Oil spills are likely to decrease but anticipated to occur occasionally, as oil tankers are only one ship source of large spills. Harlequin Ducks occupy coastal areas of Nova Scotia primarily for wintering and due to their aggregative behaviour are at high risk should an oiling event occur nearby.

Increasing interest in coastal development (see above) may result in increase oil and chemical pollution from land sources.

*Avenues for Mitigation*: Education and Awareness (s.4.3); Legislation (s.4.6); Enforcement (s.4.5).

*Recommendations*: Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.

Provide supplementary training to beached bird survey and beach clean-up volunteers through coordinating agencies regarding identification of Harlequin Duck and other Species At Risk. Improved identification will result in improved information about oiling rates of Harlequin Duck.

Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans.

## 3.4 Coastline Modification

*Threat Categories*: Habitat Loss or Degradation; Disturbance.

*Activities*: Loss or degradation of wintering habitat due to new infrastructure; offshore wind power development; activity associated with the construction and use of coastal infrastructure.

*Source*: Construction of coastal infrastructure such as piers or breakwaters.

*Relevance*: The Provincial Crown owns all lands and submerged land from the normal high tide watermark seaward. Permitting for construction and repair of wharves and for Water Lot Grants for large construction projects requiring submerged land is issued by the Nova Scotia Department of Natural Resources.

Nova Scotia has made a commitment to double current wind power capacity to 400 MW by 2016 (Canadian Wind Energy Association 2006). Disturbance is only likely to occur during construction and maintenance of sites located in coastal areas in close proximity to Harlequin Duck wintering sites. Offshore wind turbines are not expected in the near future.

No information was found regarding the likely demand, in the near future, for increased coastal infrastructure associated with transport to or from Nova Scotia.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Integrated Resource Management (s.4.2); Education and Awareness (s.4.3); Stewardship (s.4.4); Legislation (s.4.6); Protected Areas (s.4.7).

*Recommendations*: Although any one particular project may disturb or displace only a small number of birds, environmental assessments need to consider both project impacts and cumulative effects of several projects over time.

Disruptive construction (that which is likely to cause substantial disturbance to wintering groups) should be limited to the period from May - October to reduce adverse effects on Harlequin Ducks. Projects expected to result in activity through the winter months should have a buffer such that activity is not typically visible to Harlequin Ducks; this distance will need to be determined on a case by case basis.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.

## 3.5 Resource Extraction

*Threat Categories*: Habitat Loss or Degradation; Pollution; Disturbance.

*Activities*: Exploration activity; construction of coastal infrastructure for shipping of raw materials.

*Sources*: Activity associated with resource extraction in coastal or nearshore areas in proximity to Harlequin Duck wintering groups.

*Relevance*: Exploration and extraction activity, including shipping, associated with oil holdings in coastal regions of Cape Breton (on and offshore) may be or may become a source of disturbance to the local wintering groups. No information was found on the extent of commercial interest in other resource deposits in coastal areas of the province adjacent to known wintering sites. Chronic disturbance associated with long-term projects could cause abandonment of preferred wintering sites, should the activity extend through a few generations of Harlequin Duck.

*Avenues for Mitigation*: Environmental Assessment (s.4.1)

*Recommendations*: Although any one particular project may disturb or displace only a small number of birds, environmental assessments need to consider both project impacts and cumulative effects of several projects over time.

Restriction of exploration or construction activity to the period from May - October would displace it in time from the occupation of wintering sites.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.

## 3.6 Inshore Fisheries

*Threat Categories*: Habitat Loss or Degradation; Disturbance: Accidental Mortality.

*Activities*: Indirect competition with crustacean fishery; changes in marine communities as a result of seaweed harvest; gear entanglement; ingestion of toxic materials from fishing gear; boat traffic.

*Sources*: Inshore fishery activity; gear in use; lost or derelict gear.

*Relevance*: There is a low incidence of overlap in time and space between the fishing industry and Harlequin Duck wintering areas (D. Osborne *pers. comm.*), other than the lobster fishery along the south shore, which is open through the winter. Very little information was found with details of commercial shellfish harvest in coastal areas of Nova Scotia. The extent of overlap between key wintering areas and summer seaweed harvest is unknown. The decline of the inshore fishery in recent decades further reduces the likelihood of ingestion of either gear in use or lost and derelict gear.

No records were found documenting the extent, intensity or probability of ingestion by Harlequin Duck, but may be important in areas with active inshore fisheries.

*Avenues for Mitigation*: Education and Awareness (s.4.3); Protected Areas (s.4.7); Legislation (s.4.6).

*Recommendations*: Knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery need to be filled in order to evaluate the need for mitigative measures.

Education and awareness initiatives should be delivered to fishers. Encourage cooperation from fishers in monitoring and reporting of apparent gear ingestion incidents and net or gear entanglement. Promote reduced disturbance from boat traffic through voluntary avoidance; indications from available data for other duck species indicates that 100 m may be a minimum recommended avoidance distance.

## 3.7 Air Traffic

*Threat Categories*: Disturbance.

*Activities*: Low-level flights near Harlequin Duck wintering groups; Harlequin Duck surveys.

*Sources*: Helicopter or small fixed-wing aircraft traffic.

*Relevance*: Annual Harlequin Duck surveys of wintering areas. The frequency and duration of other flights which may cause similar disturbance is unknown.

*Mitigation*: Education and Awareness (s.4.3); Environmental Assessment (s.4.1).

*Recommendations*: Restrictions on the number of flights, particularly helicopter, occurring from November through April near wintering sites.

Harlequin Duck surveys should follow Environment Canada protocols, available through the Canadian Wildlife Service, to minimize disturbance. Frequency and duration of flights, especially helicopter flights, occurring at key wintering areas needs to be established. Education initiatives aimed at helicopter operators and users (like tour operators, search and rescue training) may help alleviate disturbance to wintering Harlequin through voluntary avoidance.

## 3.8 Hunting

*Threat Categories*: Consumptive Use; Accidental Mortality.

*Activities*: Incidental or accidental harvest; illegal harvest; subsistence hunting.

*Sources*: Hunting mortality.

*Relevance*: The frequency of Harlequin Duck hunting mortality in Nova Scotia is unknown. Due to Harlequin Duck wintering habitat preferences, sea conditions would dissuade most hunters from using these areas; hunting pressure (accidental, incidental and illegal) is thought to low for this reason. As recently as 2002, six Harlequin Ducks were reported shot and killed near Gabarus, Cape Breton Island (CWS *unpublished data*).

*Avenues for Mitigation*: Legislation (s.4.6); Enforcement (s.4.5); Education and Awareness (s.4.3); Protected Areas (s.4.7).

*Recommendations*: Reduce accidental and incidental hunting mortality through hunter education programs to improve the ability to discriminate between Harlequin Ducks and other sea ducks and to increase knowledge of Harlequin Duck ecology. Address knowledge gaps regarding the extent of hunting mortality by encouraging hunters to report shot Harlequin Ducks. Education initiatives delivered to enforcement officers should result in improved enforcement.

## 3.9 Invasive Species

*Threat Categories*: Exotic Species; Changes in Ecological Dynamics.

*Activities*: Accidental, incidental or planned introduction; range expansion and encroachment.

*Source*: Unknown but should be anticipated.

*Relevance*: Extent and impact of invasive alien species on ecological dynamics affecting Harlequin Ducks are currently unknown, but should be anticipated. European green crab has been present in the Canadian Maritimes since the 1980's and is likely to be or become a threat to local Harlequin Duck populations through resource competition, as a vector for parasites, or by influencing local ecological dynamics by affecting species assemblages.

*Avenues for Mitigation*: Not identified at present.

*Recommendations:* Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species. Monitor ecological impacts of the European green crab and other invasive species which become identified as a potential threat to Harlequin Ducks to determine the need for mitigation.

# *4.0 Avenues for Threat Mitigation*

## 4.1 Environmental Assessment

Environmental assessment (EA) provides a means to integrate environmental considerations into planning and decision-making regarding proposed projects. The role of EA is to eliminate, mitigate or minimize environmental harm which may result from project undertakings. Most threats to Harlequin Duck in Nova Scotia are result from, directly and indirectly, industrial activity and coastal development. For that reason, the most powerful tool for mitigation of threats is through Environmental Assessment.

Federally, EAs are led by Environment Canada's Canadian Environmental Assessment Agency. Provincially, they are led by the Environmental Assessment Branch of the Department of Environment and Labour. Canada and Nova Scotia endorsed the Canada-Wide Accord on Environmental Harmonization and the Sub-Agreement on Environmental Assessment in 1998 in order to promote improved cooperation on environmental matters. The sub-agreement contemplates a bilateral agreement between Canada and Nova Scotia to cooperatively manage EAs and reduce redundancy when EAs are required by both jurisdictions. At the time of writing, the EA bilateral agreement was still being negotiated, but is expected to provide clear guidelines regarding responsibility, timelines and decision-points.

The presence of Harlequin Ducks does not, in itself, trigger an EA, but up-to-date information about local Harlequin Duck distribution and abundance, ecology of the species and the potential threats to their populations needs to be available to the officers, both provincial and federal, responsible for EAs. Proponents preparing EA reports and EA agencies reviewing these are able to access up-to-date Harlequin Duck survey data and incidental sightings through the Atlantic Canada Conservation Data Center (section 4.1.3).

To supplement the general EA best practices guidelines for Wildlife at Risk in Canada (Lynch-Stewart 2004), specific information about Harlequin Ducks should be provided to EA responsible agencies. Education programs will be the best method of ensuring Harlequin Duck ecology and threats to their populations are well understood by EA officers. Delivery through in-person workshops, accompanied by the distribution of fact sheets, would allow both a transfer of knowledge and an opportunity for individuals involved in EAs to seek clarification of information presented. To make effective use of resources, workshops on ecology and population threats could be designed to transfer knowledge regarding multiple species at risk for which threat mitigation through EA is key.

### 4.1.1 Triggers of Environmental Assessments

Under the Environmental Assessment Regulations (N.S. Reg. 26/95), projects requiring a provincially-led EA include those related to:

- Industrial Facilities;
- Mining;
- Transportation;
- Energy;
- Waste Management; or
- Others, such as the transfer of water where drainage area to be diverted >1 $km^2$; disruption of >2 ha of wetland and undertakings as Minister may from time to time determine.

Additionally, the Environmental Assessment Regulations (N.S. Reg. 26/95) specify that EAs are not required provincially for:

- Nova Scotia Department of Transportation and Public Works (TPW) pits and quarries used solely to provide fill or aggregate for road building and maintenance contracts with TPW;
- Routine maintenance or repair of existing facilities;
- Policies, plans or programs developed after March 17, 1995, which will not directly or indirectly cause an adverse effect or significant environmental effect; or
- An undertaking that was registered before the *Environmental Assessment Act* (1989) and regulations became law.

Under the Canadian Environmental Assessment Act (S.C. 1992, c. 37) projects requiring a federally-led EA include those in which a:

- Federal authority is the project proponent;
- Federal authority provides money or other forms of financial assistance or guarantee in relation to a project;
- Federal authority grants an interest in land to enable a project to be carried out (i.e., sell, lease or otherwise transfer control of land); or
- Federal authority exercises a power or performs a duty or function specified in the Law List Regulations (S.O.R. 94/636) (e.g., issues a permit or license, etc.).

### 4.1.2 Harlequin Duck Survey Protocol (Component Studies)

When component studies require surveys for Harlequin Duck occurrence and abundance, it is recommended that standardized protocols be followed. Environment Canada's Canadian Wildlife Service (EC-CWS) Harlequin Duck Survey Protocols should be followed to minimize disturbance and to maintain consistent methods for data collection.

Survey protocols are available from EC-CWS for aerial, ground-based, and boat surveys of Harlequin Duck.

### 4.1.3 Access to Updated Harlequin Duck Distribution Data

EC-CWS Atlantic Region collects and maintains data regarding Harlequin Duck distribution. Data is obtained through standardized monitoring surveys, surveys conducted by external organizations (e.g. for EA component studies), and incidental sighting reports. Incidental sighting reports are obtained from historic records and birding listservs and chat rooms.

EC-CWS Atlantic has a data-sharing agreement with the Atlantic Canada Conservation Data Centre (ACCDC). As part of this agreement, ACCDC receives annual updates of the Harlequin Duck survey and sighting data. Organizations, agencies and individuals can obtain this data for a fee by contacting the ACCDC. Contact information and available data services are listed on their website, http://www.accdc.com.

## 4.2 Integrated Resource Management

Integrated Resource Management (IRM) is a land use planning tool based on Geographic Information Systems (GIS) that allows for complex analysis of natural resources, land use demands, and socio-economic development needs. The Nova Scotia Department of Natural resources uses IRM for planning the management of Crown Lands. The Nova Scotia Database of Significant Wildlife Habitats and Species (NSDSWHS), is included in IRM analysis, ensuring that important spaces for wildlife are considered as one priority of sustainable land management.

Most of the land in Nova Scotia comprising or adjacent to Harlequin Duck habitat is privately owned, except for the submerged land between the high and low watermarks. The Department of Natural Resources sponsors initiatives such as the Private Land Stewardship Program, the Eastern Habitat Joint Venture Habitat Program and the Public Extension Information Program in order to encourage IRM-type planning on privately owned land.

The distribution and abundance of Harlequin Ducks within Nova Scotia is expected to change over time. In order to mitigate threats to Harlequin Ducks that are resultant from land-use activity on Crown Lands (such as aquaculture operations), Harlequin Duck data needs to be kept up to date. Wildlife Division of the Department of Natural resources is responsible for maintaining the NSDSWHS, but Harlequin Duck surveys within the province and the maintenance of incidental sighting records are managed by the Canadian Wildlife Service. Nova Scotia can obtain current Harlequin Duck information from ACCDC (as indicated in section 4.1.3) to update the NSDSWHS on a regular basis.

## 4.3 Education and Awareness

Current education and awareness campaigns highlighting Harlequin Ducks are limited to distribution of materials for the general public. To improve the efficacy of minimizing, mitigating and eliminating threats to Harlequin Duck, there is a need to develop and deliver education campaigns targeting relevant stakeholders.

Within the province of Nova Scotia, education and awareness campaigns should be delivered to:

*Environmental Assessment Agencies/Officers*. Education will be best achieved by in-person presentations and distribution of fact sheets to agencies and individuals responsible for Environmental Assessments. Information of importance would include basic Harlequin Duck ecology, threats to the population, and their distribution and abundance within the jurisdiction. Advice should be provided on evaluating the extent of threat posed by a project and accessing updated distribution and abundance data.

*Enforcement Officers*. Improved enforcement is likely best achieved through education of enforcement officers. Education will be most effectively accomplished by in-person delivery of presentations and the distribution of summary hand-outs. Key topics would need to include field identification of Harlequin Ducks (see Hunters, below), and laws and regulations applicable to Harlequin Ducks. In-person events would create an excellent opportunity for the collection of knowledge regarding the probable incidence of hunting mortality and other offences, knowledge of habitat or areas frequented by Harlequin Duck that may be currently unreported, and provide an opportunity for discussing the challenges and successes of enforcing regulations relevant to species at risk in general.

*Hunters*. Concern over the inability of some hunters to distinguish Harlequin Ducks from other diving ducks drives the need for education of hunters. An identification guide should be produced which depicts Harlequin Ducks at different age classes and with seasonal plumage of

both sexes; it should also depict the other species with which Harlequin Ducks are likely to be confused. The guide should contain brief wording regarding the at-risk status and the hunting ban. As the frequency of hunting mortality is unknown, provision of a mechanism for reporting shot Harlequin Ducks should be included. Options for distribution of the information include, but are not limited to, distribution of posters and guides to retailers who sell hunting equipment, direct distribution to Migratory Bird License holders, or distribution through and agreement with organizations, such as Ducks Unlimited Canada, to reach their membership.

*Municipalities*. Coastal municipalities near key wintering areas have the opportunity to protect their shores from development and/or to restrict or encourage particular activities through municipal planning. Municipalities without Municipal Planning Strategies, and those with insufficiently protective ones, should be targeted for direct education through meetings with planners. This might be best delivered in cooperation with other organizations with interest in strategic and sustainable coastal development, such as the Ecology Action Centre or the Coastal Communities Network, to offer a broader perspective on the importance of strategic coastal development and to emphasize support from non-governmental sectors. Regarding Harlequin Ducks, information on basic ecology, local abundance and occurrence, at-risk status, and the potential threats to their population posed by coastal development should be conveyed. Avenues for Municipal involvement, such as incorporation of coastal protection into Municipal Planning Strategies or the development of stewardship agreements, should be outlined for land planners.

*Aircraft and Boat Operators*. Particularly in the case of helicopter operators and small boat operators (fishers, recreational boaters), establishing or increasing awareness of Harlequin Duck sensitivity to disturbance may encourage voluntary avoidance or reduced disturbance of Harlequin Duck aggregations. Guidelines regarding safe distance from aggregations, minimization of time spent nearby aggregations, and general information about Harlequin Ducks should be provided.

*Aquaculture Industry*. It will be vital to establish and maintain a good relationship with aquaculture operators in order to effectively open communication channels between operators and resource managers. A request to speak at the Aquaculture Association of Nova Scotia (AANS) annual conference, Scotian Pride, could provide an opportunity to discuss potential conflict between aquaculture operations and Harlequin Duck. AANS should be approached with the concept of anticipating a shared problem and presentations to the organization will need to convey an opportunity and responsibility to work together to mitigate potential impacts.

Individuals responsible for issuing aquaculture licenses and leases should be made aware of the potential threats posed by aquaculture in order to make sound decisions regarding the geographic planning of future development. Delivery of education to outline threats, identify regions and habitat preferred by Harlequin Duck, and offer means by which to periodically acquire up to date distribution and abundance data, should be provided.

*Volunteers*. Organizations which coordinate volunteer activity such as beached bird surveys and beach clean-ups may be able to provide important information on oil-related deaths of Harlequin Duck. Delivery of education aimed at improving identification of Harlequin Duck and other Species at Risk which may be found on beaches should be achieved in cooperation with these organizations. Hand-outs or brochures that can be carried during beach work should be created and delivered through regular volunteer training or instruction. In-person presentations to volunteer coordinators may be a good strategy for transferring information. Hand-outs or brochures should include identification guidance, instructions on where carcasses are likely to be found and where live birds might be spotted, and contact information for reporting. To maximize ease of reporting, data collection cards could accompany the distributed guidance.

## 4.4 Stewardship

Stewardship agreements with private landowners, industry stakeholders or non-governmental organizations can be powerful tools for species conservation and habitat management. Given that approximately 95% of Nova Scotia's coastline is privately owned, and that Harlequin Duck are found exclusively in coastal areas within the province, voluntary stewardship activities may be the most effective tool for management of habitat.

Stewardship agreements with municipalities and private landowners in key wintering areas should be actively pursued. Private land can also be protected through conservation easements (see section 4.7.2).

## 4.5 Enforcement

Continued support for enforcement of laws and regulations that can aid in threat mitigation is important.

Enforcement of regulations under the Migratory Bird Convention Act, Canada Shipping Act, and the Canadian Environmental Protection Act with regard to marine oil and chemical pollution has been the focus of legislative changes to these acts recently under Bill C-15. These amendments are intended to increase the efficacy of enforcement and create a greater deterrence to potential offenders, which is expected to improve the prevention of chronic oil and chemical pollution in Canadian waters.

In Nova Scotia, particularly with respect to hunting mortality of Harlequin Duck, there is no evidence that increased enforcement is a necessary measure, but improved enforcement is recommended. The best way to achieve improved enforcement is through education and awareness initiatives targeting enforcement officials, including municipal police, Royal Canadian Mounted Police, Conservation Officers, Park Wardens, Fishery Officers, and Fishery Guardians.

## 4.6 Legislation

Legislation identified below is not to be considered comprehensive; an attempt has been made to summarize the most relevant legislation, provincially and federally, which addresses issues related to mitigation of probable threats to Harlequin Ducks. Acts and regulations pertaining to protected areas are discussed in section 4.7.

### 4.6.1 Provincial Statutes and Regulations Relevant to Mitigation of Threats

Endangered Species Act (S.N.S. 1998, c. 11) provides for protection, designation, recovery and other aspects relevant to the conservation of species at risk in Nova Scotia. The Act prohibits actual or attempted actions that result in harm to individuals or areas habitually occupied by individuals of species designated as endangered or threatened. Harlequin Duck are currently designated endangered under the Species at Risk List Regulations (N.S. Reg. 109/2000), but that status is expected to change (R. Milton *per*s. comm.).

Wildlife Act (R.S.N.S. 1989, c. 504) enables the development and implementation of policies and programs designed to manage wildlife populations to maintain diversity, maintain adequate

abundance and ensure adequate habitat exists to support these populations. The Act also allows for the establishment of Wildlife Sanctuaries, Wildlife Management Areas and Wildlife Parks, within which regulations can be made as necessary for the control or management of wildlife and wildlife habitat. Importantly, wildlife habitat is defined in the Act to include water where wildlife may be found.

Environment Act (S.N.S. 1994-95, c. 1) in part, provides for the maintenance of principles of sustainable development, including the preservation and prevention of loss of biological diversity and specifies that the precautionary principle be used in decision-making. Environmental Assessment Regulations (N.S. Reg. 26/95) (see 4.1.1) and Pesticide Regulations (N.S. Reg. 61/95) are enabled by the Act.

Crown Lands Act (R.S.N.S. 1989, c.114) primarily addresses forest management, but also provides for the effective administration and management of all Crown lands. The Act specifies control of the Minister of Lands and Forests over the management of Crown lands including habitats for the maintenance and protection of wildlife on Crown lands. Given the exclusively coastal distribution of Harlequin Duck within the province, it is notable that all land submerged between the normal high tide and normal low tide marks is Crown land.

Fisheries and Coastal Resources Act (S.N.S. 1996, c. 25) addresses items of Provincial interest in fisheries, including aquaculture, and other coastal resources. Among other items, the purposes of the Act include fostering community involvement in the management of coastal resources and providing training and education to fishery and aquaculture participants. Of particular interest, the Act governs training, technology and development of fisheries and aquaculture; licensing of aquaculture operations and leasing of Crown land for aquaculture, and; leases and permits regarding sea plant harvesting. The Act enables Aquaculture License and Lease Regulations (N.S. Reg. 15/2000), which require aquaculture licensees to maintain operation records regarding, among other items, the type and amount of food used and the types and dosages of medications administered. The Act also enables Rock Weed Harvesting Regulations (N.S. Reg. 55/2001) which regulate harvest methods, leasing of submerged land for harvest, and permitting.

Municipal Government Act (S.N.S. 1998, c. 18) enables municipalities to develop Municipal Planning Strategies which, among others, allow for the development of policies regarding the protection, use and development of lands within the municipality. This includes the identification, protection, use and development of environmentally sensitive areas. Municipal Planning Strategies may also include policies governing by-laws regarding land-use activities within the municipalities, including prohibitions of particular types of development in municipally designated zones.

### 4.6.2 Federal Statutes and Regulations Relevant to Mitigation of Threats

Species at Risk Act, (S.C. 2002, c. 29). The purposes of the Act are to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and to encourage the management of other species to prevent them from becoming at risk. The eastern population of Harlequin Duck is listed as Special Concern in Schedule 1. The Act requires the development and implementation of a management plan for species designated Special Concern and allows for regulations to be made, as necessary, to put the management plan into effect with respect to migratory birds.

Migratory Birds Convention Act, 1994 (S.C. 1994, c. 22) protects migratory birds, as populations and as individual birds, and their nests. This includes prohibitions against depositing any substance that is harmful to migratory birds in waters or in areas frequented by migratory birds. The Act allows for regulations governing migratory bird hunting, treatment of migratory bird nests and nest sites, and the designation of protected areas, among others.

Canada Wildlife Act, (R.S.C. 1985, c. W-9) enables the acquisition and designation of lands and designation of marine areas for the purposes of research, conservation and interpretation in respect of migratory. The Act also allows for the prescription of measures for the conservation of wildlife within these lands or waters.

Canadian Environmental Assessment Act, (S.C. 1992, c. 37) establishes a federal environmental assessment process to achieve sustainable development by conserving and enhancing environmental quality. The Act governs the federal environmental assessment process and enables regulations governing identification of projects requiring and those excluded from federal environmental assessment (see Section 4.1).

Canadian Environmental Protection Act, 1999, (S.C. 1999, c. 33) in part, protects the marine environment from land based pollutants and those disposed of at sea. At sea disposal prohibitions are, in part, intended to protect against chronic oil pollution. The Act also governs environmental emergency plans and response and the enforcement of statutes and regulations within and enabled by the Act.

Canada Shipping Act, (R.S.C. 1985, c.S-9) among others, regulates the location of shipping lanes and recreational boat activity. The Act enables Ballast Water Control and Management Regulations, (S.O.R./2006-129), Hull Construction Regulations, (C.R.C., c. 1431), Oil Pollution Prevention Regulations, (S.O.R./93-3), Pollutant Substances Pollution Prevention Regulations, (C.R.C., c. 1458), and Response Organizations and Oil Handling Facilities Regulations, (S.O.R./95-405).

Canada Shipping Act, (R.S.C. 2001, c. 26) among others, identifies the responsibilities of the Fisheries and Oceans Canada and Transport Canada with respect to marine pollution prevention, response, and enforcement.

Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act, (S.C. 1988, c. 28) governs the issuance of offshore petroleum interests, and licensing for exploration and operational activity. The Act also prohibits causing a spill of petroleum in offshore areas and requires reporting of spills and reasonable measures to be taken to reduce or mitigate dangers to the environment resulting from a spill.

Fisheries Act, (R.S.C. 1985, c. F-14) governs the management and control of sea coast and inland fisheries. The Act enables regulation relating to, among others, the operation of fishing vessels, the use of fishing gear and equipment, seasons and quotas.

## 4.7 Protected Areas

Following is a description of the types of protected area which can be established in Nova Scotia. Provincial Wildlife Management Areas and Marine Protected Areas are likely the most effective ways to protect the habitat used by Harlequin Duck, as these are the only designations which allow for prohibitions of entry and activity within marine waters. Other protected area

designations can be useful for protecting coastal land from development. Given the large amount of privately owned coastal land, conservation easements may be of substantial value.

### 4.7.1 Public Lands

Within Nova Scotia, lands with restricted or limited use exist to protect the land and habitat, species, or other natural features contained within. In most instances, the protection afforded by these designated lands does not extend to the surrounding marine environment, but protection of the associated coastline will have benefits for Harlequin Ducks wintering nearby. A small amount of coastline from Prospect northeast to Cape Breton Island receives some amount of protection, although very few of the offshore islands are designated protected. The southwestern shore of Nova Scotia, which includes Little Port l'Hebert, Cape Sable Island and area, Digby Neck and Port George, is almost completely unprotected.

The establishment of protected areas is an option for mitigation, particularly of threats from coastal development, but is likely to be of limited value in Nova Scotia due to the large amount of coastal land which is privately owned. It should be considered in key wintering areas only if education and awareness campaigns and stewardship programs are ineffective.

*Provincial Wildlife Management* Areas. Wildlife Management Areas can be declared under the Wildlife Act (R.S.N.S. 1989, c.504) for the purpose of the control and management of wildlife and habitat within the wildlife management area. Regulations can be made to enable wildlife management within these areas, including items such as prohibitions of entry and restrictions of specific activities within the boundaries. For mitigation of threats to Harlequin Duck, an advantage of Wildlife Management Areas is that since the boundaries are not restricted to land, restrictions to access and activities can be applied to marine areas.

The Eastern Shore Islands Wildlife Management Area was designated in 1976. ESIWMA is closed to human activity from April 1 to August 15. There are year-round prohibitions against destroying, disturbing or molesting the habitat or nesting sites of any mammal or bird found within the boundaries. Little protection is available to the Harlequin Duck as a result of their presence in ESIWMA as they are only known to be present during wintering and migration which coincide with permissible human activity. Disturbance by human activity is thought to be insubstantial here during the winter due to the inhospitable marine conditions.

*Provincial Parks and Reserves.* Under the Provincial Parks Act (R.S.N.S. 1989, c.367), lands and water-covered lands can be designated as Provincial Parks. The Act prohibits wilful destruction of park property, trees, or other natural resources. Although no specific protection is conferred to Harlequin Ducks occupying coastal waters adjacent to Parks, the presence of coastally located Provincial Parks effectively protects coastlines within Park boundaries from development.

*Protected Beaches.* The Beaches Act (R.S.N.S. 1989, c32) enables the protection of dedicated beach areas, the regulation and enforcement of land-use activities on beaches and the control of recreational and other use of beaches that may result in undesirable impacts. As with Provincial Parks, protection and regulations apply only to the designated land, but restrictions of activity and development in these areas can mitigate threats that may otherwise be present. The emphasis on dedication of beaches is for the protection of sand dunes, so few Protected Beaches are associated with typical wintering habitat for Harlequin Duck.

*Nature Reserves*. Under the Special Places Protection Act (R.S.N.S. 1989, c.438), among others, sites which contain rare or endangered native plants or animals in their natural habitat can be

designated as a Nature Reserves. The Act prohibits activity which may alter or disturb fauna or flora within the site.

*Wilderness Areas*. Wilderness Areas are intended to protect or restore biodiversity and to protect representative, unique, rare, or vulnerable natural features. The Wilderness Areas Protection Act (S.N.S. 1998, c. 27) enables the establishment of Wilderness Areas within which management plans are required for protection, management or use the Wilderness Area. Resource extraction and exploitation, agriculture, construction of infrastructure, and other related activities are prohibited. In addition, recreational use of Wilderness Areas is restricted.

*National Parks.* National Parks including park reserves, adjuncts, historic parks and historic sites, can be established under the Canada National Parks Act (S.C. 2000, c.32). The Act prohibits actions which unreasonably interfere with the fauna or natural beauty of a park. This can afford protection from coastal development.

*National Migratory Bird Sanctuaries.* Migratory Bird Sanctuary Regulations (C.R.C., c. 1036) enabled by the Migratory Birds Convention Act (S.C. 1994, c. 22) establish National Migratory Bird Sanctuaries for the protection of migratory birds within Sanctuary boundaries. The regulations prohibit hunting of any migratory bird within sanctuary boundaries. A hunting ban is in place in the Atlantic Flyway for Harlequin Duck, but a reason for their vulnerability to incidental shooting is their tendency to mix with other sea ducks in wintering groups. Establishment of a Migratory Bird Sanctuary could be used if a particular area is subject to a disproportionately high rate of incidental hunting mortality.

*Wildlife Areas*. Wildlife Area Regulations, (C.R.C., c. 1609), enabled by the Canada Wildlife Act, (R.S.C. 1985, c. W-9), allow for the designation of National Wildlife Areas. Within these Wildlife Areas, prohibitions include, among others, hunting and fishing, possession of lead shot or lead sinkers, industrial or agricultural activity, recreational activity, and harm of any wild animal or plant.

*Marine Protected Areas.* Under the Oceans Act, (S.C. 1996, c.31), Marine Protected Areas can be designated for the protection or conservation of marine resources and habitat. Regulations can be made restricting activity in the protected area and any other measures consistent with the designation. The wording in the Act largely refers to marine resources, commercial and non-commercial fishery resources and marine habitat. Designation of a marine protected area for the purpose of conserving or protecting Harlequin Duck may not be possible. Under the Canada Wildlife Act, (R.S.C. 1985, c. W-9), protected marine areas can be established but are not restricted to the protection of marine resources.

### 4.7.2 Private Lands

Private land can be protected through legally binding agreements which prescribe land management for a period of time agreed upon by the land owner and the organization with which the agreement is formed. In Nova Scotia, this can be done through conservation easements with eligible conservation organizations, or provincial or federal government. The level of protection offered through conservation easements will depend on the precise agreement between the land owner and the conservation organization. For Harlequin Duck protection, securing easements which restrict or prohibit coastal development in key wintering areas could be of benefit.

The Conservation Easements Act (S.N.S. 2001, c. 28) governs the creation, maintenance, and termination of conservation easements within the province and enables the Designation of Eligible Bodies Regulations (N.S. Reg. 12/2002). This regulation allows for organizations to be

designated eligible to hold conservation easements. At present, the following organizations are eligible easement holders in Nova Scotia:

Ecology Action Centre
Nova Scotia Nature Trust
Nature Conservancy of Canada
Bras d'Or Preservation Foundation
Ducks Unlimited Canada
Federation of Nova Scotia Naturalists
Kingsburg Coastal Conservancy Association
Blomidon Naturalists Society
Shubenacadie Canal Commission

## *5.0 Summary of Threats to Harlequin Ducks in Nova Scotia*

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Coastal Development | - industrial, commercial, residential & vacation property development<br>- construction activity associated with coastal development<br>- subsequent activity associated with use | high | Targeted education for municipal planners to increase awareness of effects of coastline development.<br><br>Actively pursue stewardship agreements with municipalities, non-profit organizations, industry and individuals.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments |
| Aquaculture | - development of coastal aquaculture sites, particularly in or nearby traditional wintering areas<br>- boat activity associated with maintenance and operation of sites<br>- organic and chemical waste produced during operation | medium-high | Establish working relationship with aquaculture industry through outreach and education.<br>Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.<br><br>Avoidance of aquaculture development in key Harlequin wintering areas.<br><br>Environmental assessments need to consider both project impacts and cumulative effects of several projects over time.<br><br>Up to date Harlequin Duck distribution and abundance data needs to be available to agencies responsible for environmental assessment, permits and leases. |

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Chronic Oiling and Oil or Chemical Spills | - illegal and incidental oil disposal<br>- accidental spills | medium-high | Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.<br><br>Provide supplementary training to beached bird survey and beach clean-up volunteers.<br><br>Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans. |
| Coastline Modification | - development of coastal infrastructure such as piers or breakwaters<br>- construction activity associated with coastline modification<br>- subsequent activity associated with use | medium | Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments. |
| Resource Extraction | - exploration or extraction in coastal areas | medium | Environmental assessments need to consider both project impacts and cumulative effects of several projects over time.<br><br>Restriction of exploration or construction activity to the period from May-October to displace it from the occupation of wintering sites.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments |
| Inshore Fishery | - loss of lead and plastic fishing gear<br>- crustacean fishery<br>- harvest of algae, sea urchins | low | Education and awareness initiatives should be delivered to fishers.<br><br>Encourage cooperation from fishers in monitoring and reporting of apparent gear ingestion or entanglement incidents.<br><br>Address knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery. |
| Boat Traffic | - close approach of harlequin aggregations by marine vessels | low | Directed education at providing guidelines for the avoidance of Harlequin Duck wintering groups and/or known wintering areas to reduce the threat of disturbance.<br><br>Address knowledge gaps in flushing distances from boat disturbance to provide effective guidelines for avoidance. |

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Air Traffic | - low altitude flights by helicopter or fixed-wing aircraft | low | Harlequin Duck surveys should follow Environment Canada protocols to minimize disturbance.<br><br>Address knowledge gaps regarding the frequency and duration of flights, especially helicopter flights, occurring at key wintering areas.<br><br>Targeted education initiatives for helicopter operators and users to encourage voluntary avoidance. |
| Hunting | - incidental/accidental harvest<br>- illegal harvest<br>- subsistence hunting | low | Reduce accidental and incidental hunting mortality through hunter education programs to improve the ability to discriminate between Harlequin Ducks and other sea ducks and to increase knowledge of Harlequin Duck ecology.<br><br>Encourage hunters to report shot Harlequin Ducks.<br><br>Improve enforcement through targeted education for enforcement officers. |
| Invasive Species | - accidental, incidental or planned introduction<br>- range expansion and encroachment | unknown | Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species.<br><br>Monitor ecological impacts of invasive species which are identified as potentially threatening to Harlequin Ducks to determine the need for mitigation. |

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# Harlequin Duck Threat Analysis:

# New Brunswick

## HARLEQUIN DUCK THREAT ANALYSIS: NEW BRUNSWICK

## *1.0 Introduction*

Harlequin Duck occupy coastal waters of New Brunswick primarily for wintering. Breeding activity is known to occur in northern parts of the province but the extent and abundance of breeding Harlequin Ducks is unknown and in need of dedicated surveys.

Threats that put wintering populations at risk are of particular concern for New Brunswick, as the aggregative behaviour of the ducks during winter makes them particularly vulnerable to localized threats. Although breeding numbers are thought to be low, any threats which lead to increased mortality of adult females are of concern as the loss of even a few breeding females may have substantial effects on the number of Harlequin Ducks in New Brunswick during that season.

General Threats identified in section 2.0 often influence more than one Threat Category (see Appendix I). In evaluating the priority of threats for minimization, mitigation, and elimination, the cumulative impacts of General Threats and associated activities needs to be considered.

In New Brunswick, threats with the greatest potential to impact Harlequin Ducks at a population level include aquaculture development and catastrophic oil or chemical spills. Aquaculture development currently infringes on Harlequin Duck wintering habitat and should be anticipated to continue to conflict with wintering habitat in the future. The potential for loss of preferred habitat, changes to local marine ecology and disturbance associated with the maintenance and operation of sites could result in cumulative effects that put Harlequin Ducks at substantial risk. Oil and chemical pollution events may result in direct increases in mortality and possible decreases in genetic diversity, and may indirectly reduce reproductive success.

## *2.0 Distribution and Abundance of Harlequin Ducks in New Brunswick*

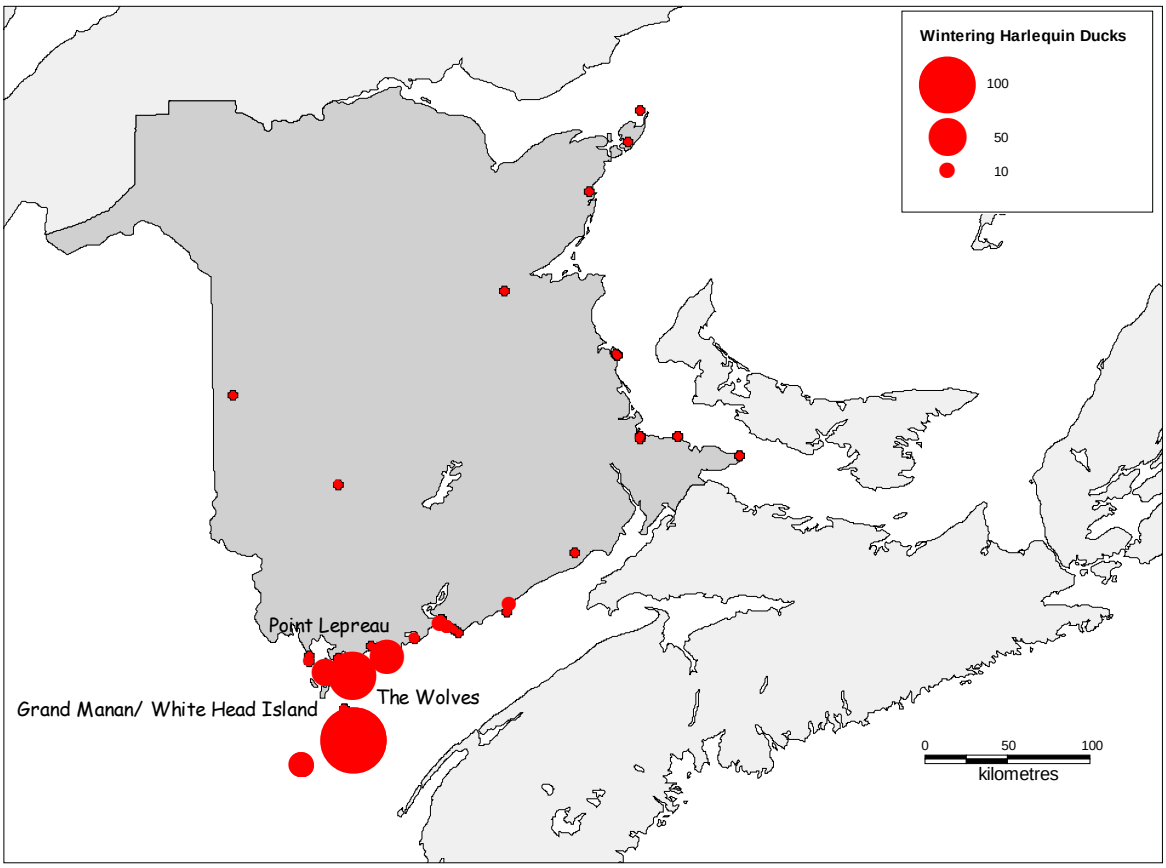


**Figure 8. Distribution of wintering Harlequin Ducks in New Brunswick. Data used to produce this map include surveys and incidental sighting reports 1950-2006 (CWS *unpublished data*).**

*Wintering:* (December-April)

The key traditional wintering areas in New Brunswick are at the Wolves archipelago and White Head Island (Grand Manan), Point Lepreau and Machias Seal Island (Boyne *in press*). Birds have been documented along southern coastal areas of New Brunswick and include locations like Kent Island, Saint John and Maces Bay (CWS *unpublished data*). New Brunswick supports 200-300 wintering Harlequin Ducks.

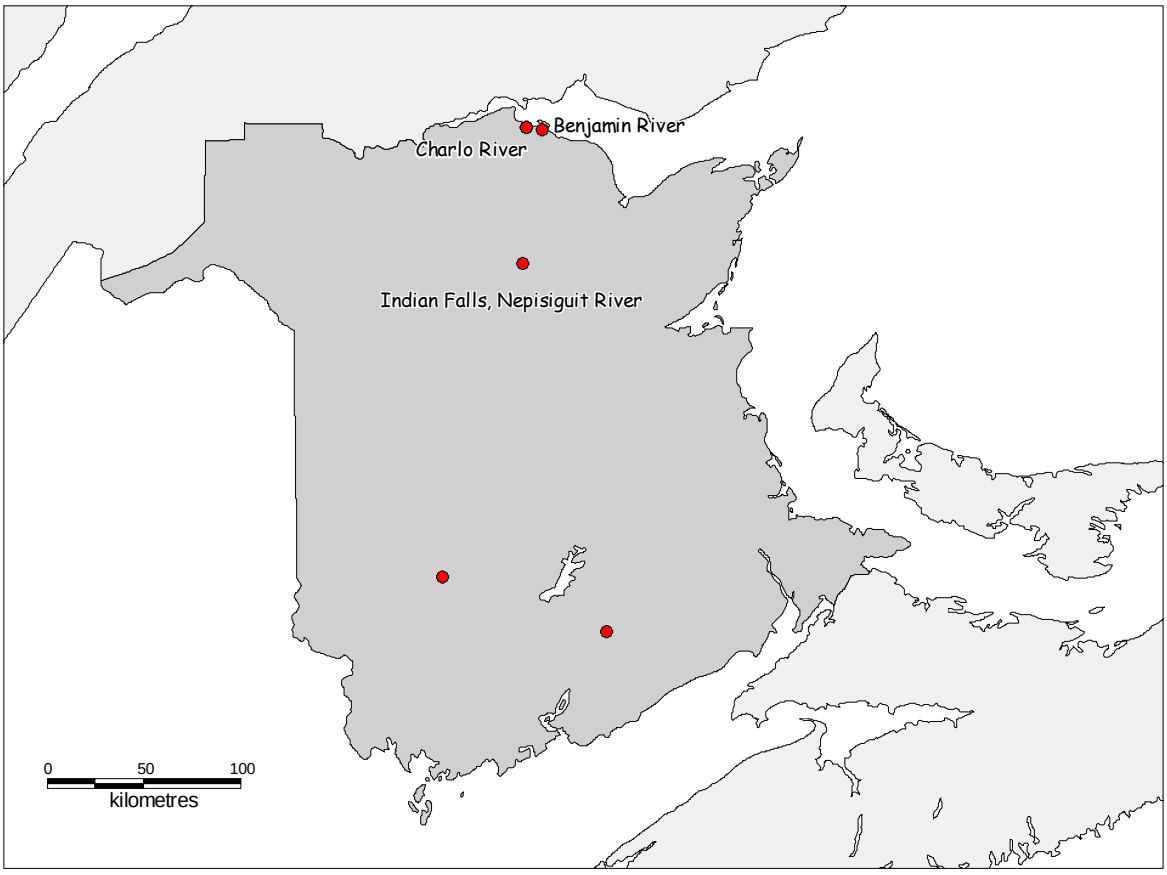


**Figure 9. Potential breeding sites of Harlequin Duck in New Brunswick. Data used to produce this map include surveys and incidental sightings 1950-2006 (CWS *unpublished data*).**

*Breeding*: (May-September)

There is little evidence that Harlequin Duck historically bred in New Brunswick (Boyne *in press*), but in recent years sightings of females and broods indicate that the Charlo River and Benjamin River likely support at least some breeding pairs (Thomas and Robert 2001). Incidental reports of Harlequin Ducks observed near rivers during the breeding season (CWS *unpublished data*) suggest that breeding may not be confined to northern New Brunswick. Breeding surveys have not been extensively conducted in New Brunswick and the extent of Harlequin Duck breeding within the province is thought to be low but is poorly understood at present.

*Moulting*: (July-September)

There are no current or historic records for moulting Harlequin Ducks in New Brunswick.

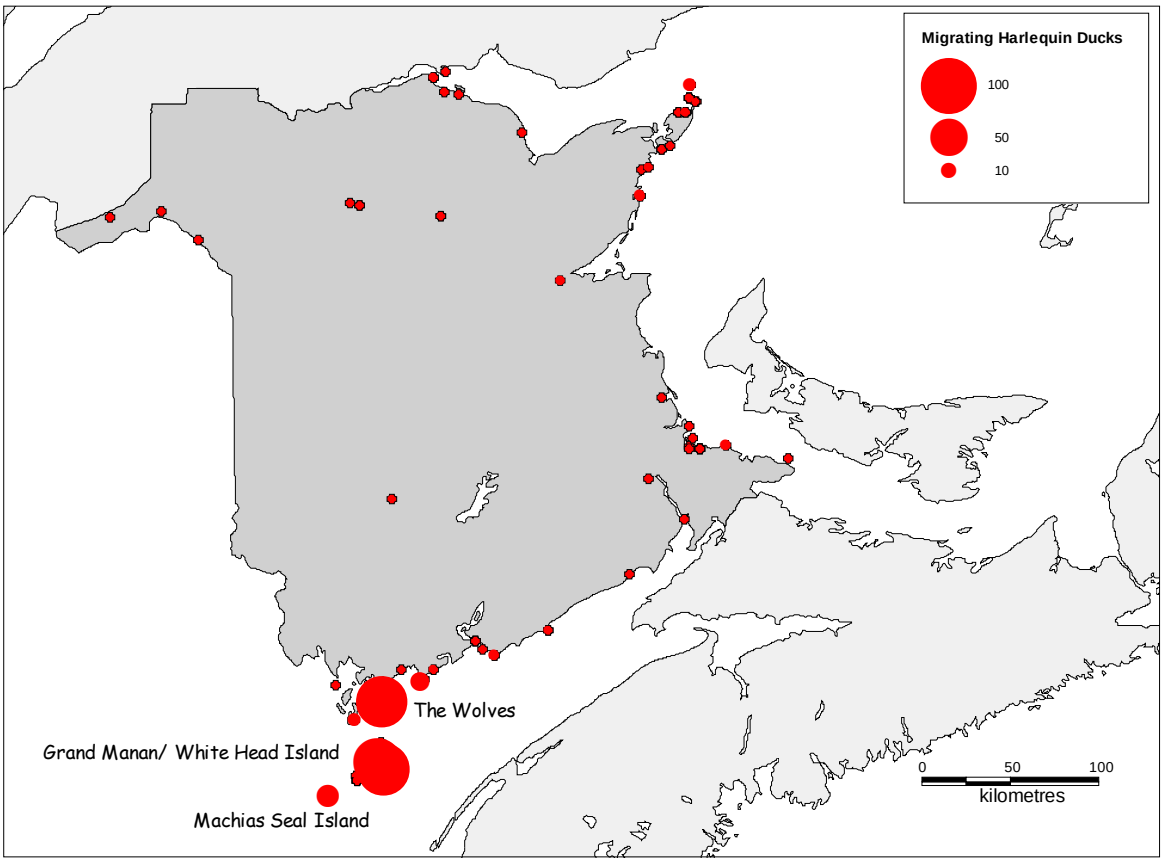


**Figure 10. Distribution of Harlequin Duck during migration in New Brunswick. Data used to produce this map are from surveys and incidental sighting reports 1950-2006 (CWS *unpublished data*).**

*Migration*: (April-June, October-December)

Incidental reports of Harlequin Duck sightings indicate that many coastal areas are used during spring and fall migration, particularly Grand Manan Island and the Wolves archipelago. Observations of Harlequin Duck at traditional wintering sites during migration should be interpreted cautiously, as some of these sightings may be of individuals arriving early to, or leaving late from, wintering grounds.

## *3.0 Status of Threats to New Brunswick's Harlequin Duck Population*

### 3.1 Aquaculture

*Threat Categories*: Habitat Loss or Degradation; Pollution; Disturbance; Changes in Ecological Dynamics.

*Activities*: Development of coastal aquaculture sites; human activity associated with site maintenance; organic and chemical waste from operations.

*Source*: Aquaculture operations and development of aquaculture industry.

*Relevance*: The threat to Harlequin Ducks from aquaculture is currently thought to be moderate in New Brunswick. Aquaculture sites are generally located in sheltered bays and coves but some spatial overlap between aquaculture operations and traditional Harlequin Duck wintering sites already occurs at White Head Island. Competition between aquaculture operators for space in a growing industry is expected to lead to increased rough water and offshore facilities. As the aquaculture industry grows, this conflict with Harlequin Ducks for space is anticipated to increase.

The far-field effects of organic and chemical enrichment on ecological dynamics are still poorly understood; near-field effects may alter food quality and availability. Currently the disturbance threat from aquaculture activity is undocumented but thought to be low-moderate, however, as the industry develops, increased traffic is expected in these areas. Boat traffic associated with the maintenance of aquaculture sites may be currently disruptive to wintering Harlequin Ducks, particularly traffic associated with maintenance of sites at White Head Island.

The New Brunswick Department of Natural Resources grants permits and leases pertaining to the occupation of submerged crown lands. The Department of Agriculture and Aquaculture issues permits for aquaculture activity and, after leases have been active for a year, assumes the administration of submerged crown land leases.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Crown Land Management (s.4.2); Coastal Areas Protection Policy (s.4.3); Education and Awareness (s.4.4); Legislation (s.4.7), Protected Areas (s.4.8).

*Recommendations*: Key wintering areas not already falling under some protection should be identified for crown lands management to ensure their consideration in the review of submerged crown land occupation requests and in the environmental assessment process.

Environmental Assessments are conducted on project by project basis; assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time. Assessments should also consider project longevity as chronic disturbance may cause abandonment; site fidelity to wintering and breeding areas may result in effective habitat loss if disturbance persists over generations of Harlequin Duck. When disturbance is likely to be severe or prolonged, seasonal restrictions on activity could be used, when practical.

Establish working relationship with aquaculture industry to build and maintain an effective communication network. Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.

Directed education at boat operators providing guidelines for the avoidance of Harlequin Duck moulting and wintering groups and/or known moulting and wintering areas would reduce

the threat of disturbance. Flushing distances from boat disturbance would need to be established in order to provide effective guidelines.

## 3.2 Fisheries

*Threat Categories*: Disturbance, Accidental Mortality, Pollution, Changes in Ecological Dynamics.

*Activities*: Boat traffic; gear entanglement; gear ingestion; indirect competition with crustacean fishery; changes in marine communities as a result of seaweed harvest.

*Sources*: Inshore and river fisheries; associated gear in use and lost or derelict gear.

*Relevance*: Recreational angling is discussed in section 3.4. Fisheries occurring on rivers are unlikely to pose a threat to Harlequin Ducks due to low breeding densities; however, any mortality associated with breeding adults in New Brunswick may have a substantial effect on the number of breeding pairs in the province.

The decline of inshore fishery in recent years and the low overlap between Harlequin Duck marine habitat and suitable waters for fishing minimizes the risk of a disturbance or entanglement threats from the inshore fishery. The current overlap is unknown but may be higher in New Brunswick than other provinces due to the diversity of fisheries in the Bay of Fundy. Weirs are commonly used in the Bay of Fundy but are not anticipated to pose an entanglement threat for Harlequin Duck. Herring, mackerel, and lobster fisheries may be a source of disturbance to wintering groups. Algae (rockweed), periwinkle, sea urchin and scallop fisheries may be a source of habitat degradation and alteration of invertebrate community structure.

*Avenues for Mitigation*: Education and Awareness (s.4.4); Legislation (s.4.7); Enforcement (s.4.6).

*Recommendations*: Request Fisheries Observers and fishers to record and report incidents of net entanglement of Harlequin Duck in order to help fill knowledge gaps about the frequency of entanglement.

Deliver education and awareness initiatives directed towards fisheries enforcement officers. Directed education at boat operators providing guidelines for the avoidance of Harlequin Duck wintering groups and/or known wintering areas would reduce the threat of disturbance. Flushing distances from boat disturbance would need to be established in order to provide effective guidelines.

Knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery need to be filled in order to better evaluate the need for mitigation.

## 3.3 Chronic Oiling and Nearshore Oil Spills

*Threat Categories*: Pollution

*Activities*: Illegal oil disposal, bilge purging; lost or damaged vessels; spills of oil or chemical cargo during transport.

*Sources*: Marine oil and chemical pollution.

*Relevance*: Annual mortality of Harlequin Ducks due to oil related events is unknown for the New Brunswick coast. Bird Studies Canada coordinates beached bird surveys in the Bay of Fundy; in 2005, no oiled birds of any species were found during surveys (Campbell 2005).

Harlequin Duck wintering areas are not immediately adjacent to major shipping lanes, but oil tankers regularly visit the Saint John Port and must pass Grand Manan en route. Between 1985 and 1989, 23-37 large oil tankers delivered crude oil to the Irving refinery in Saint John (Brander-Smith *et al.* 1990).

One major oil spill has occurred near Dalhousie (Golden Robin in 1974) and 37 smaller spills have been recorded between 1975 and 1987 (Brander-Smith *et al.* 1990). Transport Canada is phasing out single-hulled oil tankers by 2015 (Transport Canada 2005), which will reduce the likelihood of catastrophic oil spills occurring within Canadian waters.

Chronic oiling is ongoing and anticipated to continue. Oil spills are likely to decrease but anticipated to occur occasionally, as oil tankers are not the only ship source of large spills (lost or damaged vessels, other types of ships containing chemical cargo). Harlequin Ducks occupy coastal areas of New Brunswick for wintering and to some extent during migration. Due to their aggregative behaviour, they are at high risk should an oiling event occur nearby.

*Avenues for Mitigation*: Legislation (s.4.7); Enforcement (s.4.6); Stewardship (s.4.5).

*Recommendations*: Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.

Provide supplementary training to beached bird survey and beach clean-up volunteers through coordinating agencies regarding identification of Harlequin Duck and other Species At Risk. Improved identification will result in improved information about oiling rates of Harlequin Duck.

Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans.

## 3.4 Recreational Activity

*Threat Categories:* Disturbance; Accidental Mortality.

*Activities*: Recreational use of streams and rivers in breeding areas; close approach of Harlequin Duck aggregations by marine vessels.

*Sources*: Recreational boating, angling, hunting, and adventure and eco- tourism.

*Relevance*: Anglers are known to use the Charlo and Benjamin Rivers, and similar rivers where Harlequin Duck breeding is presently unknown.

Sea duck hunting seasons coincide with wintering and as Harlequin Duck tend to mix with other sea ducks, aggregations in which they occur may be disturbed by both boat traffic and gun shot noise. The Wolves archipelago is an area known to be used by hunters, but hunting there is restricted to a short season. Recreational boating, sea kayaking, and boat tour operations are likely to be most frequent from late April through October, and not overlap to a great extent with Harlequin Ducks. Sea kayakers are capable of approaching Harlequin Duck aggregations close range relative to other sources of recreational boating activity. Distances at which Harlequin Ducks will react behaviourally to boat activity are unreported.

New Brunswick's adventure and eco-tourism industries are growing and are anticipated to increase likelihood of disturbance from recreation.

*Avenues for Mitigation*: Education and Awareness (s.4.4); Enforcement (s.4.6).

*Recommendations*: Enforcement officers and anglers should be encouraged to report Harlequin Duck sightings in order to fill knowledge gaps about the potential conflict between fishing activity and Harlequin Duck breeding. Education and awareness initiatives directed toward recreational fishers, fishing guides, kayakers and tour operators could help minimize disturbance through voluntary avoidance.

## 3.5 Land-based Coastal Development

*Threat Categories*: Habitat Loss or Degradation; Disturbance.

*Activities*: Disturbance from activity associated with construction or use of developed areas; siltation of wintering areas.

*Source*: Industrial, commercial and residential/vacation property development in coastal areas.

*Relevance*: Approximately 60% of the human population of New Brunswick lives within 50 kilometres of the coastline. From 1990-1999, an average of 627 new coastal properties were created annually (New Brunswick Department of the Environment and Local Government 2002). In response to the increasing pressure for coastal development, the government of New Brunswick adopted a strategic policy for coastal development. The policy is intended, in part, to promote sustainable development while preserving coastal habitat. Coastal development is provincially regulated and the threat to wintering Harlequin Duck is anticipated to be low.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Coastal Areas Protection Policy (s.4.3); Stewardship (s.4.5); Legislation (s.4.7); Protected Areas (s.4.8).

*Recommendations*: Targeted education for municipal planners to increase awareness of effects of coastline development. Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.

## 3.6 Resource extraction

*Threat Categories*: Habitat Loss or Degradation; Pollution; Disturbance.

*Activities*: Siltation of streams; loss of breeding habitat; acid precipitation; heavy metal and acid run-off; direct contact with heavy metal enriched water; ingestion of prey with bioaccumulated heavy metals; construction of roads or other infrastructure associated with resource extraction activity; exploration activity; construction of coastal infrastructure for shipping of raw materials.

*Source*: Mining and forestry operations; associated infrastructure and activity.

*Relevance*: Forestry and mining operations may overlap with Harlequin Duck breeding habitat in New Brunswick. Forests are intensively managed for productivity in New Brunswick and there are active operations in the Charlo and Benjamin watersheds. The mining industry is relatively

small, but in recent years mining exploration activity has been greatest southwest of Bathurst (Canadian Intergovernmental Working Group on the Mineral Industry 2005), including portions of the Nepisiguit watershed. Although Harlequin Duck breeding is expected to be uncommon in New Brunswick the extent is unknown.

Provincial regulations prohibit cutting of trees within 30 m water bodies. Cassirer *et al.* (1996) recommend 100 m buffers around Harlequin Duck breeding rivers to adequately protect breeding habitat from siltation. Nest sites are poorly documented but may be situated >20 m from river or stream banks, so 30 m buffers around breeding streams are insufficient to protect against habitat loss and disturbance.

Infrastructure construction activity in breeding areas are unlikely to have substantial population effects as any one project is likely to disturb or displace only a few pairs of birds, but one or two breeding pairs may comprise a substantial portion of breeders within New Brunswick.

Construction of coastal infrastructure associated with the transport of raw materials near traditional wintering sites may displace greater numbers of individuals from preferred habitat. Ongoing activity may cause disturbance over several consecutive seasons, depending on project. Wintering areas are of particular importance as more birds are potentially displaced, and prolonged disturbance could lead to permanent abandonment of site.

The bedrock in New Brunswick is not typically capable of neutralizing acid deposition; rivers and streams are therefore sensitive to acidification. Acid rain is predicted to occur only marginally above critical load levels in New Brunswick by 2010 (Beattie and Ro 2004). The extent to which acid run-off from mines may affect stream acidity will depend on the amount of sulphide-exposure associated with each project and the ability for mine operators to minimize the likelihood of contaminating watersheds. Similarly, heavy metal enrichment is anticipated to depend on the extent of mining activity and associated acid run-off, as heavy metal leaching can accelerated by acidic water contact.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Crown Land Management (s.4.2); Coastal Areas Protection Policy (s.4.3); Legislation (s.4.7).

*Recommendations*: Dedicated breeding surveys need to be conducted to understand the distribution and abundance of Harlequin Ducks breeding in New Brunswick.

Environmental Assessments are conducted on project by project basis; assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time. Assessments should also consider project longevity as chronic disturbance may lead to site abandonment; site fidelity to wintering and breeding areas may result in effective habitat loss if projects persist over generations of Harlequin Duck. When disturbance is likely to be severe or prolonged, seasonal restrictions on extraction and exploration activity could be used, when practical.

Roads should be built such that they are not visible from breeding streams and do not cross stream junctions. Buffers of at least 100 m should be required when projects operate in known breeding areas.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.

## 3.7 Power Generation

*Threat Categories*: Habitat Loss or Degradation; Disturbance.

*Activities*: Water level manipulation by flooding or controlled fluctuation; downstream siltation from water control structures or construction of infrastructure; obstruction of brood travel; construction of wind turbines; traffic associated with maintenance.

*Source*: Hydroelectric and wind power generation.

*Relevance*: Habitat loss due to flooding from hydroelectric development is not anticipated to be considerable in New Brunswick. Where hydroelectric facilities already exist, manipulation of water levels on breeding rivers during the breeding season could reduce reproductive rates and increase siltation; hydroelectric development and operation may displace breeding pairs or females with broods from preferred habitat. Dedicated breeding surveys will be needed in order to evaluate whether a real threat exists.

New Brunswick plans to increase wind power to a 4 000 MW capacity by 2015 (Canadian Wind Energy Association 2006). Disturbance during construction will potentially be greatest at coastal area in proximity to wintering sites. New Brunswick's crown land management policy with respect to wind power stipulates set-back distances of at least 150 m from water bodies and coastal features and 1 000 m from endangered species habitat, migratory bird nesting sites, wildlife refuges, and wildlife management areas. Offshore wind turbines are not expected in the near future, but may pose a disturbance threat should they become desirable.

The impact of power line construction associated with hydroelectric and wind power development (disturbance and habitat degradation) will depend on the location of power development and planning of power lines.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Crown Land Management (s.4.2); Coastal Areas Protection Policy (s.4.3).

*Recommendations*: Dedicated breeding surveys need to be conducted to understand the distribution and abundance of Harlequin Ducks breeding in New Brunswick.

Water level manipulation should be conducted as to maintain stream levels during breeding, to avoid periodic fluctuation of stream water levels while the river is occupied by Harlequin Ducks. Power line corridors should avoid crossing rivers at stream junctions.

Environmental Assessments are conducted on project by project basis; assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.

Restricting coastal construction activity from the period from November-April would displace coastal projects in time from the occupation of wintering sites; restricting inland construction activity near breeding rivers from May-September would displace construction in time from the occupation of breeding sites.

## 3.8 Hunting

*Threat Categories*: Accidental Mortality; Consumptive Use; Pollution.

*Activities*: Hunting mortality; discharge of toxic shot in breeding areas.

*Sources*: Accidental and incidental hunting; poaching; subsistence hunting; toxic shot.

*Relevance*: The incidence of accidental/incidental or purposeful harvest of Harlequin Ducks is unknown but thought to be low in New Brunswick. There have been no recent reports of shot Harlequin Ducks. The Wolves archipelago is an area known to be used by hunters, but hunting there is restricted to a short season. Other key wintering areas are largely inaccessible to hunters.

Shot settling into wintering areas is unlikely to be picked up (Harlequin Duck do not scrape substrate in order to acquire food in coastal environments) and is not considered a threat at wintering or moulting sites. Shot settling into breeding and brooding areas may be accidentally ingested, but as breeding is thought to be rare in New Brunswick and thus the threat from lead shot is expected to be low.

*Avenues for Mitigation*: Education and Awareness (s.4.4); Enforcement (s.4.6).

*Recommendations*: Reduce the probability of accidental or incidental hunting mortality through hunter education programs to improve the ability to discriminate between Harlequin Ducks and other sea ducks and to increase knowledge of Harlequin Duck ecology.

Address knowledge gaps regarding the extent of hunting mortality by encouraging hunters to report shot Harlequin Ducks.

Education initiatives delivered to enforcement officers should result in improved enforcement.

## 3.9 Air Traffic

*Threat Categories*: Disturbance.

*Activities*: Noise and visual disturbance from helicopter; fixed-wing craft; Harlequin Duck surveys.

*Sources*: Low level flights nearby sites occupied by Harlequin Ducks.

*Relevance*: Harlequin Duck surveys are conducted annually during wintering and may be conducted during other seasons for research purposes or for environmental assessment component studies. The frequency and duration of other flights which may cause similar disturbance is unknown.

*Avenues for Mitigation*: Education and Awareness (s.4.4); Environmental Assessment (s.4.1).

*Recommendations*: Restrictions on the number of flights, particularly helicopter, occurring from November through April near wintering sites.

To minimize disturbance, Harlequin Duck surveys should follow Environment Canada protocols, available through the Canadian Wildlife Service.

Education initiatives aimed at helicopter operators and users may help alleviate disturbance to wintering Harlequin through voluntary avoidance.

## 3.10 Invasive Species

*Threat Categories*: Exotic Species; Changes in Ecological Dynamics.

*Activities*: Accidental, incidental or planned introduction; range expansion and encroachment.

*Source*: Unknown but should be anticipated.

*Relevance*: Extent and impact of invasive alien species on ecological dynamics affecting Harlequin Ducks are currently unknown, but should be anticipated. European green crab has been present in the Canadian Maritimes since the 1980's and is likely to be or become a threat to local Harlequin Duck populations through resource competition, as a vector for parasites, or by influencing local ecological dynamics by affecting species assemblages.

*Avenues for Mitigation*: Not identified at present.

*Recommendations:* Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species. Monitor ecological impacts of the European green crab and other invasive species which become identified as a potential threat to Harlequin Ducks to determine the need for mitigation.

## 3.11 Predation

*Threat Categories*: Predation.

*Activities*: Predation.

*Sources*: Raptors; mustelids.

*Relevance*: Rates of nest predation by raptors and mustelids are unknown. As with other threats to breeding Harlequin Ducks, predation mortality at nests sites unlikely to have population effects but may substantially decrease the number of breeding pairs resident in New Brunswick annually. Rates of predation at wintering sites are also unknown.

*Avenues for Mitigation*: Not identified at present.

*Recommendations*: Identify rates and sources of predation in order to inform mitigation action, if appropriate.

# *4.0 Avenues for Threat Mitigation*

## 4.1 Environmental Assessment

Environmental assessment (EA) provides a means to integrate environmental considerations into planning and decision-making regarding proposed projects. The role of EA is to eliminate, mitigate or minimize environmental harm which may result from project undertakings. Most threats to Harlequin Duck in New Brunswick are resultant, directly and indirectly, of industrial or commercial activity and development. For that reason, the most powerful tool for mitigation of threats is through Environmental Assessment.

Federally, EAs are led by Environment Canada's Canadian Environmental Assessment Agency. Provincially, they are led by the Project Assessment Branch of the Department of the Environment and Local Government. Canada and New Brunswick endorsed the Canada-Wide Accord on Environmental Harmonization and the Sub-Agreement on Environmental Assessment in 1998 in order to promote improved cooperation on environmental matters. The sub-agreement contemplates a bilateral agreement between Canada and New Brunswick to cooperatively manage EAs and reduce redundancy when EAs are required by both jurisdictions. At present, the EA bilateral agreement is being developed, but will provide clear guidelines regarding responsibility, timelines and decision-points.

In New Brunswick rare or endangered features of the environment will trigger EAs, but environment is defined as air, water and soil. The presence of Harlequin Ducks does not, in itself, trigger an EA, but up to date information about local Harlequin Duck distribution and abundance, ecology of the species, and the potential threats to their populations need to be available to the officers, both provincial and federal, responsible for EAs. Proponents preparing EA reports and EA agencies reviewing these are able to access up to date Harlequin Duck survey data and incidental sightings through the Atlantic Canada Conservation Data Center (section 4.1.3).

To supplement the general EA best practices guidelines for Wildlife at Risk in Canada (Lynch-Stewart 2004), specific information about Harlequin Ducks should be provided to EA responsible agencies. Education programs will be the best method of ensuring Harlequin Duck ecology and threats to their populations are well understood by EA officers. Delivery through in-person workshops, accompanied by the distribution of fact sheets, would allow both a transfer of knowledge and an opportunity for individuals involved in EAs to seek clarification of information presented. To make effective use of resources, ecology and population threats workshops could be designed to transfer knowledge regarding multiple species at risk for which threat mitigation through EA practices is key.

### 4.1.1 Triggers of Environmental Assessments

Under the Environmental Impact Assessment Regulation (N.B. Reg. 87-83), projects requiring a provincially-led EA include those related to:

- commercial extraction or processing of a mineral;
- electric power generating facilities;
- water reservoirs;
- electric power transmission lines;
- linear communications transmission;
- commercial extraction or processing of combustible energy-yielding materials, except fuelwood;
- offshore drilling for, or extraction of, oil, natural gas or minerals;
- pipelines, except water, steam or domestic wastewater pipelines;
- causeways and multiple-span bridges;
- major highway projects;
- facilities for the commercial processing or treatment of timber resources;
- programs or commercial ventures involving the introduction into New Brunswick of plant or animal species which are not indigenous to New Brunswick;
- waste disposal facilities or systems;
- disposal, destruction, recycling, reprocessing or storage of waste that originates outside New Brunswick and associated facilities or systems;
- sewage disposal or sewage treatment facilities;
- provincial or national parks;

- major recreational or tourism developments;
- ports, harbours, railroads or airports;
- projects involving the transfer of water between drainage basins;
- waterworks;
- major residential developments outside incorporated areas;
- undertakings affecting any unique, rare or endangered feature of the environment;
- undertakings affecting two hectares or more of bog, marsh, swamp or other wetland;
- facilities for the processing of radioactive materials.

Under the Canadian Environmental Assessment Act (S.C. 1992, c. 37) projects requiring a federally-led EA include those in which a:

- Federal authority is the project proponent;
- Federal authority provides money or other forms of financial assistance or guarantee in relation to a project;
- Federal authority grants an interest in land to enable a project to be carried out (i.e., sell, lease or otherwise transfer control of land); or
- Federal authority exercises a power or performs a duty or function specified in the Law List Regulations (S.O.R. 94/636) (e.g., issues a permit or license, etc.).

### 4.1.2 Harlequin Duck Survey Protocol (Component Studies)

When component studies require surveys for Harlequin Duck occurrence and abundance, it is recommended that standardized protocols be followed. Environment Canada's Canadian Wildlife Service (EC-CWS) Harlequin Duck Survey Protocols should be followed to minimize disturbance and to maintain consistent methods for data collection.

Survey protocols are available from EC-CWS for aerial, ground-based, and boat surveys of Harlequin Duck.

### 4.1.3 Access to Updated Harlequin Duck Distribution Data

EC-CWS Atlantic Region collects and maintains data regarding Harlequin Duck distribution. Data is obtained through standardized monitoring surveys, surveys conducted by external organizations (e.g. for EA component studies), and incidental sighting reports. Incidental sighting reports are obtained from historic records and birding listservs and chat rooms.

EC-CWS Atlantic has a data-sharing agreement with the Atlantic Canada Conservation Data Centre (ACCDC). As part of this agreement, ACCDC receives annual updates of the Harlequin Duck survey and sighting data. Organizations, agencies and individuals can obtain this data for a fee by contacting the ACCDC. Contact information and available data services are listed on their website, http://www.accdc.com.

## 4.2 Crown Land Management

Crown Land in New Brunswick is managed by the Department of Natural Resources in alignment with the priorities of the Crown Land Management Strategy. Approximately 45% of New Brunswick's land surface and all coastal submerged land from the ordinary high water mark to the ordinary low water mark is crown owned.

Crown lands are available for sustainable economic development, recreation, environmental protection, education and other social benefits. The Department of Natural Resources solicits input from stakeholders regarding the direction of land management. Applications and proposals for the use of crown land are reviewed by the Department to ensure land use is consistent with strategic management.

Important areas for Harlequin Duck should be identified to land managers and information should be kept up to date. The distribution and abundance of Harlequin Ducks within New Brunswick is expected to change over time; traditional wintering sites will likely remain important, but as the population continues to grow new areas may be exploited by Harlequin Ducks. Harlequin Duck surveys within the province and the maintenance of incidental sighting records are managed by the Canadian Wildlife Service. New Brunswick can obtain current Harlequin Duck information from ACCDC (section 4.1.3) for regular updates.

## 4.3 Coastal Areas Protection Policy

New Brunswick introduced a Coastal Areas Protection Policy in 2002 to provide guidelines for sustainable coastal development and coastal protection. The intent of the policy is largely to protect the public purse from liabilities associated with damage from storm surges and expected rising sea levels due to climate change, and to protect the natural features and ecosystems of coastal areas. Currently, two coastal zones and development restrictions within these zones are defined.

Zone A includes beaches, dunes, rock platforms, coastal marches and dyked lands found between the Higher High Water Large Tide and the Lower Low Water Large Tide and dunes extending inland. This zone is identified as being highly sensitive and development activities are limited to maintenance or restoration of coastal features, erosion control, development for educational purposes, and development providing access to the shoreline while protecting coastal features. Socio-economic developments can be exempted but are subject to “appropriate analysis” of the undertaking.

Zone B consists of a 30 m buffer of Zone A and restricts activity within the zone to that of Zone A plus the construction of single family residences and associated infrastructure not interfering with Zone A and the maintenance, repair, and expansion of existing structures in a way not interfering with Zone A. In general, all developments in Zone B must be a minimum of 2 m above the Higher High Water Large Tide in elevation.

Animate coastal features, such as wildlife, are not explicitly protected by the policy, but the protection of the coastline from development will indirectly protect habitat. In connection with other development reviews, such as Crown Land Management and Environmental Assessment, the Coastal Areas Protection Policy may be substantially useful for protecting Harlequin Ducks from disturbance and Harlequin Duck habitat from loss or degradation.

## 4.4 Education and Awareness

Current education and awareness campaigns highlighting Harlequin Ducks are limited to distribution of materials for the general public. To improve the efficacy of minimizing, mitigating and eliminating threats to Harlequin Duck, there is a need to develop and deliver education campaigns targeting relevant stakeholders.

Within the province of New Brunswick, education and awareness campaigns should be delivered to:

*Environmental Assessment Agencies/Officers*. Education will be best achieved by in-person presentations and distribution of fact sheets to agencies and individuals responsible for Environmental Assessments. Information of importance would include basic Harlequin Duck ecology, threats to the population, and their distribution and abundance within the jurisdiction. Advice should be provided on evaluating the extent of threat posed by a project and accessing updated distribution and abundance data.

*Aquaculture Industry*. It will be vital to establish and maintain a good relationship with aquaculture operators in order to effectively open communication channels between operators and resource managers. Aquaculture industry participants should be approached with the concept of anticipating a shared problem and presentations to operators will need to convey an opportunity and responsibility to work together to mitigate potential impacts.

Individuals responsible for issuing aquaculture licenses and leases should be made aware of the potential threats posed by aquaculture in order to make sound decisions regarding the geographic planning of future development. Delivery of education to outline threats, identify regions and habitat preferred by Harlequin Duck, and offer means by which to periodically acquire up to date distribution and abundance data should be provided.

*Enforcement Officers*. As indicated above, improved enforcement is likely best achieved through education of enforcement officers. Education will be most effectively accomplished by in-person delivery of presentations and the distribution of summary hand-outs. Key topics would need to include field identification of Harlequin Ducks (see Hunters, below), and laws and regulations applicable to Harlequin Ducks. In-person events would create an excellent opportunity for the collection of knowledge regarding the probable incidence of hunting mortality, fishery gear entanglement, and knowledge of habitat or areas frequented by Harlequin Duck that may be currently unreported. This would provide an opportunity for discussing the challenges and successes of enforcing regulations relevant to species at risk in general.

*Hunters*. Concern over the inability of some hunters to distinguish Harlequin Ducks from other diving ducks drives the need for education of hunters. An identification guide should be produced which depicts the Harlequin Duck at different age classes and with seasonal plumage of both sexes; it should also depict the other species with which Harlequin Ducks are likely to be confused. The guide should contain brief wording regarding the at-risk status and the hunting ban. As the frequency of hunting mortality is unknown, provision of a mechanism for reporting shot Harlequin Ducks should be included. Options for distribution of the information include, but are not limited to, distribution of posters and guides to retailers who sell hunting equipment, direct distribution to Migratory Bird License holders, or distribution through and agreement with organizations, such as Ducks Unlimited Canada, to reach their membership.

*Municipalities*. Municipalities near key wintering areas and known breeding areas have the opportunity to protect municipal spaces from development and/or to restrict or encourage particular activities through municipal planning. Regarding Harlequin Ducks, information on basic ecology, local abundance and occurrence, at-risk status, and the potential threats to their population posed by coastal development should be conveyed. Options for Municipal involvement, such as incorporation of habitat protection into municipal planning or the development of stewardship agreements, should be outlined for land planners.

*Aircraft and Boat Operators, Adventure and Eco-Tour Operators*. Particularly in the case of helicopter operators, small boat operators, and kayakers, establishing or increasing awareness of Harlequin Duck sensitivity to disturbance may encourage voluntary avoidance or reduced disturbance of Harlequin Duck aggregations. Guidelines regarding safe distance from

aggregations, minimization of time spent nearby aggregations, and general information about Harlequin Ducks should be provided.

*Volunteers*. Organizations which coordinate volunteer activity such as beached bird surveys and beach clean-ups may be able to provide important information on oil-related deaths of Harlequin Duck. Delivery of education aimed at improving identification of Harlequin Duck and other Species at Risk which may be found on beaches should be achieved in cooperation with these organizations. Hand-outs or brochures that can be carried during beach work should be created and delivered through regular volunteer training or instruction. In-person presentations to volunteer coordinators may be a good strategy for transferring information. Hand-outs or brochures should include identification guidance, instructions on where carcasses are likely to be found and where live birds might be spotted, and contact information for reporting. To maximize ease of reporting, data collection cards could accompany the distributed guidance.

## 4.5 Stewardship

Stewardship agreements with private landowners, industry stakeholders or non-governmental organizations can be powerful tools for species conservation and habitat management. Approximately 45% of New Brunswick land surface is crown-owned, and New Brunswick has a strong coastal development policy, the need for stewardship agreements is limited but may be a viable avenue in key Harlequin Duck areas in or in close proximity to private land and municipalities.

Corporate stewardship agreements with aquaculture operators, fishers, and other commercial or industrial sectors with an interest in coastal activity should be pursued to encourage voluntary conservation. Private land can also be protected through conservation easements (see section 4.8.2).

## 4.6 Enforcement

Continued support for enforcement of laws and regulations that can aid in threat mitigation is important.

Enforcement of regulations under the Migratory Bird Convention Act, Canada Shipping Act, and the Canadian Environmental Protection Act with regard to marine oil and chemical pollution has been the focus of legislative changes to these acts recently under Bill C-15. These amendments are intended to increase the efficacy of enforcement and create a greater deterrence to potential offenders, which is expected to improve the prevention of chronic oil and chemical pollution in Canadian waters.

In New Brunswick, particularly with respect to hunting mortality of Harlequin Duck, there is no evidence that increased enforcement is a necessary measure, but improved enforcement is recommended. The best way to achieve improved enforcement is through education and awareness initiatives targeting enforcement officials including municipal police, Royal Canadian Mounted Police, Conservation Officers, Park Wardens, Fishery Officers, and Fishery Observers.

## 4.7 Legislation

Legislation identified below is not to be considered comprehensive; an attempt has been made to summarize the most relevant legislation, provincially and federally, which addresses

issues related to mitigation of probable threats to Harlequin Ducks. Acts and regulations pertaining to protected areas are discussed in section 4.8.

### 4.7.1 Provincial Statutes and Regulations Relevant to Mitigation of Threats

Endangered Species Act (S.N.B. 1996, c. E-9.101) provides for designation and protection of species at risk in New Brunswick. The Act prohibits actual or attempted actions that result in harm to individuals of species designated as threatened, endangered or extirpated. The Act also prohibits actual or attempted destruction or degradation of nests, nest shelter, dens, and critical habitat of listed species. Harlequin Duck are currently designated endangered under the Endangered Species Regulation – Endangered Species Act (N.B. Reg. 96-26).

Fish and Wildlife Act (S.N.B. 1980, c. F-14.1) governs the regulation of inland fishing and the hunting and trapping of wildlife. The Act confers powers of enforcement to Conservation Officers. Among others, the Act prohibits the import of exotic wildlife. It also allows for the establishment of refuges and wildlife management areas (see 4.7).

Clean Environment Act (R.S.N.B. 1973, c. C-6) in part, governs the management wastes, air quality, soil contamination, dangerous goods and pesticides. It allows for the designation of protected coastal areas, including land or water adjacent to coastal areas, to limit activities and use of the designated area for the purpose of protecting the environment within. The Environmental Impact Assessment Regulations (N.B. Reg. 87-83) is enabled by the Act.

Clean Water Act (S.N.B. 1989, c. C-6.1), among others, governs the designation of contaminants and empowers the Minister of the Environment to establish allowable amounts and concentrations of waste or contaminants permissible in or upon water that is not potable. Water is defined in the Act to include coastal waters.

Community Planning Act (R.S.N.B. 1973, c.C-12) guides the development of and governs the requirements for regional plans, municipal plans, and rural plans.

Conservation Easements Act (S.N.B. 1998, c. C-16.3) defines the obligations and responsibilities of parties entering a conservation easement agreement. The Act identifies, among others, that conservation easements may be granted for the purpose of the protection or restoration of wildlife habitat or wildlife, and the conservation of habitat of rare or endangered plant or animal species.

Crown Lands and Forests Act (S.N.L. 1991, c.36) addresses the management and control of provincial crown lands. Most notably, this Act contains legislation governing timber harvest and management including the construction of access roads. The Act enables the Timber Regulation – Crown Lands and Forests Act (N.B. Reg. 86-160), which establishes the Crown Lands and Forests Advisory Board to, among others, advise on matters related to policies and practices, including forest management.

Mining Act (S.N.B. 1985, c. M-14.1) governs mineral claims, mining leases, and the operation of mines in the province. Under the Act, reclamation programs are required as dictated by the type and amount of work, the nature and severity of environmental damage, and the nature and current use of affected property. The Act enables the General Regulation – Mining Act (N.B. Reg. 86-98) which regulates construction and decommissioning of access roads, and the operation and reclamation of mines.

Aquaculture Act (S.N.B. 1988, c. A-9.2) controls the licensing and permitting of aquaculture operations and the leasing of land for such purpose. The Act requires reporting of disease, disease agents, parasites, toxins and contaminants, and action to be taken to minimize the environmental impact of these. The Act enables the General Regulation – Aquaculture Act (N.B. Reg. 91-158) which prohibits aquaculture operations where they would result in undue conflict with ecologically and environmentally sensitive areas.

### 4.7.2 Federal Statutes and Regulations Relevant to Mitigation of Threats

Species at Risk Act, (S.C. 2002, c. 29). The purposes of the Act are to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and encourage the management of other species to prevent them from becoming at risk. The eastern population of Harlequin Duck is listed as Special Concern in Schedule 1. The Act requires the development and implementation of a management plan for species designated Special Concern and allows for regulations to be made, as necessary, to put the management plan into effect with respect to migratory birds.

Migratory Birds Convention Act, 1994 (S.C. 1994, c. 22) protects migratory birds, as populations and as individual birds, and their nests. This includes prohibitions against depositing any substance that is harmful to migratory birds in waters or in areas frequented by migratory birds. The Act allows for regulations governing migratory bird hunting, treatment of migratory bird nests and nest sites, and the designation of protected areas, among others.

Canada Wildlife Act, (R.S.C. 1985, c. W-9) enables the acquisition and designation of lands and designation of marine areas for the purposes of research, conservation and interpretation. The Act also allows for the prescription of measures for the conservation of wildlife within these lands or waters.

Canadian Environmental Assessment Act, (S.C. 1992, c. 37) establishes a federal environmental assessment process to achieve sustainable development by conserving and enhancing environmental quality. The Act governs the federal environmental assessment process and enables regulations governing identification of projects requiring and those excluded from federal environmental assessment (see Section 4.1).

Canadian Environmental Protection Act, 1999, (S.C. 1999, c. 33) in part, protects the marine environment from land based pollutants and those disposed of at sea. At sea disposal prohibitions are, in part, intended to protect against chronic oil pollution. The Act also governs environmental emergency plans and response and the enforcement of statutes and regulations within and enabled by the Act.

Canada Shipping Act, (R.S.C. 1985, c.S-9) among others, regulates the location of shipping lanes and recreational boat activity. The Act enables Ballast Water Control and Management Regulations, (S.O.R./2006-129), Hull Construction Regulations, (C.R.C., c. 1431), Oil Pollution Prevention Regulations, (S.O.R./93-3), Pollutant Substances Pollution Prevention Regulations, (C.R.C., c. 1458), and Response Organizations and Oil Handling Facilities Regulations, (S.O.R./95-405).

Canada Shipping Act, (R.S.C. 2001, c. 26) among others, identifies the responsibilities of the Fisheries and Oceans Canada and Transport Canada with respect to marine pollution prevention, response, and enforcement.

Fisheries Act, (R.S.C. 1985, c. F-14) governs the management and control of sea coast and inland fisheries. The Act enables regulation relating to, among others, seasons and quotas, the operation of fishing vessels, and the use of fishing gear and equipment. The Act enables the Atlantic Fisheries Regulations, 1985 (S.O.R/86-21) which, among others, identifies allowed and prohibited fishing areas and fishing gear, including marine plant fisheries, and regulates fisheries seasons.

## 4.8 Protected Areas

Following is a description of the types of protected area which can be established in New Brunswick. Marine Protected Areas are likely the most effective ways to protect the habitat used by Harlequin Duck, as this is the only designation which allows for prohibitions of entry and activity within marine waters. Other protected area designations can be useful for protecting coastal land from development. Given the large amount of privately owned coastal land, conservation easements may be of substantial value.

### 4.8.1 Public Lands

At present, no key Harlequin Duck habitat is within or adjacent to New Brunswick's parks or protected areas. Coastal areas are currently protected to some extent through crown land management and coastal development policies. Particularly with the pressure of a growing aquaculture industry, Harlequin Ducks and their habitat may not be effectively protected. Establishment of protected areas should be considered where other types of mitigation are ineffective, inappropriate, or impossible.

The establishment of protected areas is an option for mitigation, particularly of threats from coastal development, but is likely to be of limited value in Nova Scotia due to the large amount of coastal land which is privately owned. It should be considered in key wintering areas only if education and awareness campaigns and stewardship programs are ineffective.

*Provincial Parks*. Provincial Parks, including recreational parks, campground parks, beach parks, wildlife parks, picnic ground parks, resource parks, and park reserves may be established under the Parks Act (S.N.B. 1982, c.P-2.1). The General Regulation – Parks Act (N.B.Reg. 85-104) prohibits removal or damage of any vegetation, removal of artifacts or natural objects, and damage or alteration to water bodies. Hunting is also prohibited by regulation.

*Protected Natural Areas*. Protected Natural Areas may be established under the Protected Natural Areas Act (S.N.B. 2003, c.P-19.01) for the purposes of protecting, conserving or managing lands that, among others, contain native fauna that is rare or endangered or contain ecologically sensitive habitats. The Act enables the General Regulation – Protected Natural Areas Act (N.B. Reg. 2004-57) which further defines permissible and prohibited activity within the Protected Natural Areas. In Class I Areas, all activities, including entry, are prohibited except educational and scientific activities, which require a permit issued by the Department of Natural Resources. In Class II Areas, all industrial, commercial, agricultural and development activities are prohibited. Recreational use with minimal environmental impact is allowed in Class II Areas.

Lands are defined under the act to include water upon or under land and Protected Natural Area designation may be useful for protecting submerged crown land in key wintering areas.

*Wildlife Refuges and Wildlife Management Areas.* Wildlife Refuges and Management Areas may be established under the Fish and Wildlife Act (S.N.B. 1980, c.F-14.1) and are governed by Wildlife Refuges and Wildlife Management Areas Regulation – Fish and Wildlife Act (N.B. Reg. 94-43). Hunting is prohibited within Wildlife Refuges and Wildlife Management Areas, including all waters contained within the boundaries.

*National Parks.* National Parks including park reserves, adjuncts, historic parks and historic sites, can be established under the Canada National Parks Act (S.C. 2000, c.32). The Act prohibits actions which unreasonably interfere with the fauna or natural beauty of a park.

*National Migratory Bird Sanctuaries.* Migratory Bird Sanctuary Regulations (C.R.C., c. 1036) enabled by the Migratory Birds Convention Act (S.C. 1994, c. 22) establish National Migratory Bird Sanctuaries for the protection of migratory birds within Sanctuary boundaries. The regulations prohibit hunting of any migratory bird within sanctuary boundaries. A hunting ban is in place in the Atlantic Flyway for Harlequin Duck, but a reason for their vulnerability to incidental shooting is their tendency to mix with other sea ducks in wintering groups. Establishment of a Migratory Bird Sanctuary could be used if a particular area is subject to a disproportionately high rate of incidental hunting mortality.

*Wildlife Areas.* Wildlife Area Regulations, (C.R.C., c. 1609), enabled by the Canada Wildlife Act, (R.S.C. 1985, c. W-9), allow for the designation of National Wildlife Areas. Within these Wildlife Areas, prohibitions include, among others, hunting and fishing, possession of lead shot or lead sinkers, industrial or agricultural activity, recreational activity, and harm of any wild animal or plant.

*Marine Protected Areas.* Under the Oceans Act, (S.C. 1996, c.31), Marine Protected Areas can be designated for the protection or conservation of marine resources and habitat. Regulations can be made restricting activity in the protected area and any other measures consistent with the designation. The wording in the Act largely refers to marine resources, commercial and non-commercial fishery resources and marine habitat. Designation of a marine protected area for the purpose of conserving or protecting Harlequin Duck may not be possible. Under the Canada Wildlife Act, (R.S.C. 1985, c. W-9), protected marine areas can be established but are not restricted to the protection of marine resources.

### 4.8.2 Private Lands

Private land can be protected through legally binding agreements which prescribe land management for a period of time agreed upon by the land owner and the organization with which the agreement is formed. In New Brunswick, this can be done through conservation easements with eligible conservation organizations, or provincial or federal government. The level of protection offered through conservation easements will depend on the precise agreement between the land owner and the conservation organization. For Harlequin Duck protection, securing easements which restrict or prohibit coastal development in key wintering areas could be of benefit.

The Conservation Easements Act, S.N.B. 1998 (c. C-16.3) governs the creation, maintenance, and termination of conservation easements within the province. The Act also identifies eligible easement holders, which include provincial and federal governments, municipalities, rural communities, non-profit organizations, and private individuals or groups able to hold an interest in the easement for conservation purposes.

## *5.0 Summary of Threats to Harlequin Ducks in New Brunswick*

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Chronic Oiling and Oil or Chemical Spills | - Illegal and incidental oil disposal<br>- Accidental spills | medium-high | Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.<br><br>Provide supplementary training to beached bird survey and beach clean-up volunteers.<br><br>Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans. |
| Aquaculture | - development of coastal aquaculture sites<br>- human activity associated with site maintenance<br>- organic and chemical waste from operations | medium-high | Key wintering areas not already falling under some protection should be identified for crown lands management.<br><br>Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.<br><br>Assessments should consider project longevity as chronically disturbed areas may be abandoned.<br><br>When disturbance likely to be severe or prolonged, seasonal restrictions on activity are recommended.<br><br>Establish working relationship with aquaculture industry.<br><br>Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.<br><br>Direct education to boat operators providing guidelines for avoidance. Establish flushing distances from boat disturbance order to provide effective guidelines |
| Fisheries | - boat traffic<br>- gear entanglement<br>- gear ingestion<br>- indirect competition with crustacean fishery<br>- changes in marine communities as a result of seaweed harvest | medium | Deliver education and awareness initiatives to fisheries enforcement officers.<br><br>Direct education to boat operators providing guidelines for avoidance. Establish flushing distances from boat disturbance order to provide effective guidelines<br><br>Request Fisheries Observers and fishers to record and report incidents of net entanglement.<br><br>Address knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery. |

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Recreational Activity | - recreational use of streams and rivers in breeding areas<br>- close approach of Harlequin by marine vessels. | medium | Encourage enforcement officers and anglers to report Harlequin Duck sightings.<br><br>Education and awareness initiatives for recreational fishers, fishing guides, kayakers and tour operators to minimize disturbance through voluntary avoidance. |
| Land-based Coastal Development | - Disturbance from activity associated with construction or use of developed areas<br>- siltation of wintering areas | medium | Targeted education for municipal planners to increase awareness of effects of coastline development.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments. |
| Resource extraction | - siltation of streams<br>- loss of breeding habitat<br>- acid rain<br>- acid run-off from exposed sulphide-containing rocks during mining operation<br>- heavy metal leaching from exposed rock<br>- direct contact with heavy metal enriched water<br>- ingestion of prey with bioaccumulated heavy metals<br>- construction of roads or other infrastructure associated with resource extraction activity<br>- exploration activity<br>- construction of coastal infrastructure for shipping of raw materials | medium | Dedicated breeding surveys need to be conducted to understand the distribution and abundance of Harlequin Ducks breeding in New Brunswick.<br><br>Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.<br><br>Assessments should consider project longevity as chronically disturbed areas may be abandoned.<br><br>Seasonal restrictions on extraction and exploration activity should be used, when practical.<br><br>Roads should be built such that they are not visible from breeding streams and do not cross stream junctions. Buffers of at least 100 m should be required when projects operate in known breeding areas.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments. |

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Power Generation | - water level manipulation by flooding or controlled fluctuation<br>- downstream siltation from water control structures<br>- obstruction of brood travel<br>- construction of wind turbines<br>- traffic associated with maintenance<br>- siltation of streams due to construction of cut-throughs and placement of power lines | medium | Dedicated breeding surveys need to be conducted to understand the distribution and abundance of Harlequin Ducks breeding in New Brunswick.<br><br>Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.<br><br>Assessments should consider project longevity as chronically disturbed areas may be abandoned.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.<br><br>Water level manipulation should be conducted as to avoid periodic fluctuation of stream water levels while the river is occupied by Harlequin Ducks.<br><br>Seasonal restrictions on construction and maintenance activity should be considered.<br><br>Power line corridors should avoid crossing rivers at stream junctions. |
| Hunting | - hunting mortality<br>- discharge of toxic shot in breeding areas | low | Reduce the probability of accidental or incidental hunting mortality through hunter education.<br><br>Encourage hunters to report shot Harlequin Ducks.<br><br>Education initiatives delivered to enforcement officers to improve enforcement. |
| Air Traffic | - Noise and visual disturbance from helicopter, fixed-wing craft<br>- Harlequin Duck surveys | low | Restrictions on the number of flights, particularly helicopter, occurring from November through April near wintering sites.<br><br>Harlequin Duck surveys should follow Environment Canada protocols.<br><br>Education initiatives aimed at helicopter operators and users to alleviate disturbance to wintering Harlequin through voluntary avoidance. |
| Invasive Species | - accidental, incidental or planned introduction<br>- range expansion and encroachment | unknown | Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species.<br><br>Monitor ecological impacts of invasive species which are identified as potentially threatening to Harlequin Ducks to determine the need for mitigation. |
| Predation | - predation | unknown | Identify rates and sources of predation for breeding females.<br><br>If it is determined that predator control is mitigative options should be developed. |

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# Harlequin Duck Threat Analysis:

# Prince Edward Island

## HARLEQUIN DUCK THREAT ANALYSIS: PRINCE EDWARD ISLAND

## *1.0 Introduction*

Harlequin Ducks are considered to be rare or transient in Prince Edward Island and have an exclusively coastal distribution. Threats to these ducks are unlikely to affect the viability of the eastern population, but even small impacts may have substantial effects on the numbers within the province. Harlequin Ducks tend to be gregarious in coastal areas, a characteristic that puts them at high risk of threats which have the potential to significantly increase adult mortality.

General Threats identified in section 2.0 often influence more than one Threat Category (see Appendix I). In evaluating the priority of threats for minimization, mitigation, and elimination, the cumulative impacts of General Threats and associated activities needs to be considered. Individual Harlequin Ducks are at particular risk from threats associated with catastrophic oil or chemical spills, chronic oil pollution, and coastal development.

Oil and chemical pollution events may result in direct increases in mortality and possible decreases in genetic diversity, and may indirectly reduce reproductive success.

Coastal development for residential, recreational, commercial or industrial use is also of concern. Threats to Harlequin Duck from coastal development include habitat loss and degradation and increased disturbance from both acute sources (like construction) and chronic sources (like activity or traffic associated with use and access of developed areas).

Any activities resulting in habitat loss, or long-term or permanent habitat degradation is a potential threat to both current and future wintering and migrating individuals. As current numbers are expected to increase (Environment Canada 2007), management of habitat and mitigation of threats to habitat need to consider the likelihood of range expansion and increased presence of Harlequin Ducks in Prince Edward Island. Activities causing habitat loss or degradation in areas of suitable habitat may create barriers to range expansion.

## *2.0 Distribution and Abundance of Harlequin Ducks in Prince Edward Island*

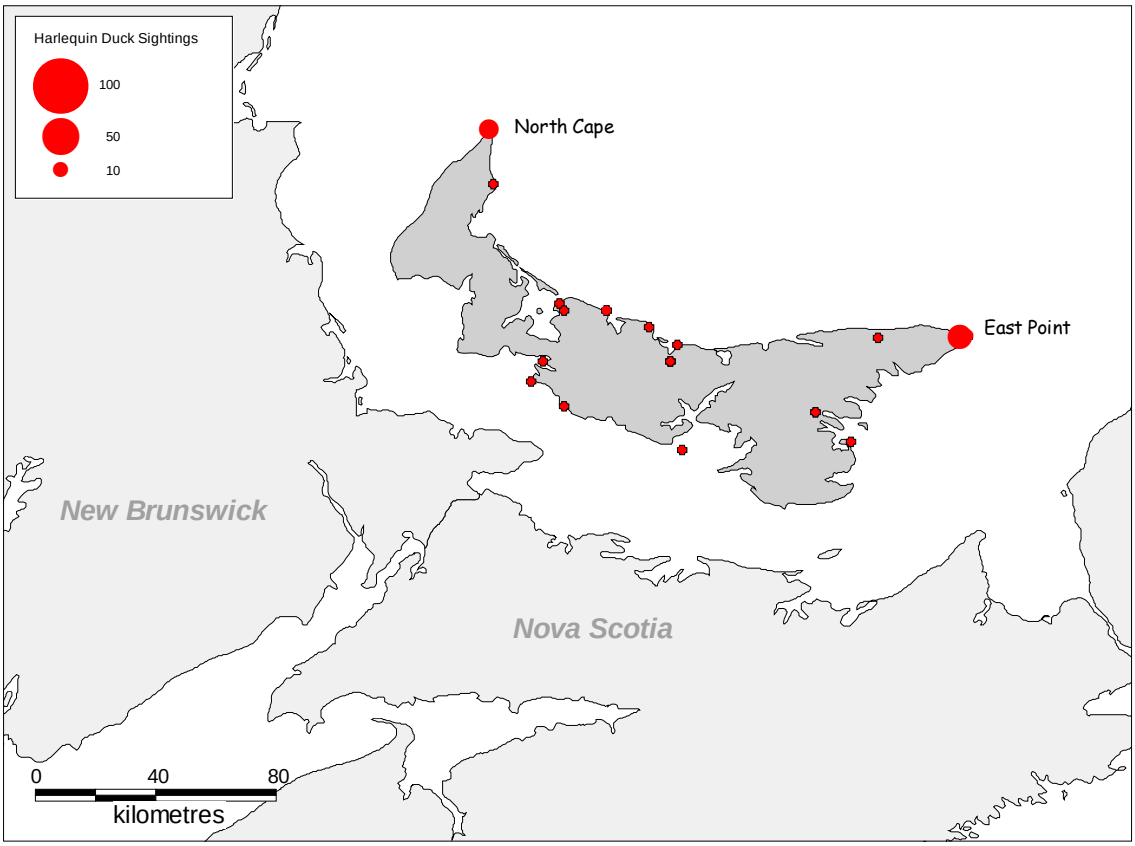


**Figure 11. Distribution of Harlequin Ducks in Prince Edward Island. Data used to produce this map include surveys and incidental sighting reports 1950-2006 (CWS *unpublished data*).**

*Wintering* (December - April)

Harlequin Duck are known to winter off the coast of Prince Edward Island in small numbers. They are considered rare or transient here, and are thought to have been so historically (Goudie 1990). The key wintering area in the province is East Point, which likely supports about 10 Harlequin Ducks annually. North Cape may also support a few wintering individuals.

*Breeding and Moulting* (May - September)

There are no current or historic records for breeding or moulting Harlequin Ducks in Prince Edward Island.

*Migration*: (April - May, October - December)

North Cape is a key site for Harlequin Duck during spring migration; there have been as many as 17 individuals observed there in one day (CWS *unpublished data*).

# *3.0 Status of Threats to Prince Edward Island's Harlequin Ducks*

## 3.1 Coastal Development

*Threat Categories*: Habitat Loss and Degradation; Disturbance.

*Activities*: Loss of habitat; disturbance from construction activity associated with development in coastal regions; use of developed properties.

*Sources*: Industrial, commercial and residential/vacation property development.

*Relevance*: Over 90% of the land on Prince Edward Island is privately owned, which creates a challenge for the planning and management of land. Coastal property is in high demand and coastal development has increased substantially in recent years. Coastal property is in high demand, particularly for residential and vacation property.

Most industrial and some commercial development will trigger an Environmental Assessment but residential development on private property will rarely do so (section 4.1). Development and building permits are issued by the responsible municipality.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Land Use Planning (s.4.2); Education and Awareness (s.4.3); Stewardship (s.4.4); Legislation (s.4.6); Protected Areas (s.4.7).

*Recommendations*: Targeted education for municipal planners to increase awareness of effects of coastline development.

Although any one particular project may disturb or displace only a small portion of birds, environmental assessments need to consider both project impacts and cumulative effects of several projects over time. Disruptive construction (that which is likely to cause substantial disturbance, especially to wintering groups) should be limited to the period from June - September, to reduce adverse effects on Harlequin Ducks. Developments expected to encourage human activity through the winter months should have a coastal set-back such that human activity is not typically visible to Harlequin Ducks; this set-back distance will need to be determined on a case by case basis.

Up to date Harlequin Duck distribution data should be readily available to relevant municipalities and agencies responsible for environmental assessments.

## 3.2 Aquaculture

*Threat Categories*: Habitat Loss or Degradation; Disturbance; Changes in Ecological Dynamics.

*Activities*: Development of coastal aquaculture sites; human activity associated with site maintenance; organic and chemical waste from operations.

*Source*: Aquaculture operations and development of aquaculture industry.

*Relevance*: In Prince Edward Island, current aquaculture activity is primarily shellfish operations. The majority of Prince Edward Island's aquaculture production is mussel, but oyster farming is increasing in presence, most notably in western Prince Edward Island. Shellfish farms can become attractive feeding grounds for sea ducks. Aquaculture operators in Prince Edward Island

have already experienced conflict with other duck species depredating these resources. Finfish farming is present to a much lesser extent, but changes in cost-effectiveness of new technology may encourage new aquaculture operations in exposed areas and could create conflict with Harlequin Duck wintering groups.

Areas occupied by wintering Harlequin Ducks tend to be, but are not limited to, rough waters and exposed headlands. The current habitat and disturbance threats to Harlequin Ducks from aquaculture are thought to be minimal. Boat traffic associated with the maintenance of these sites, however, may include travel around headlands between sites.

The Prince Edward Island Department of Natural Resource, Fisheries and Oceans Canada, Canadian Wildlife Service and representatives of the aquaculture industry have an existing relationship through Sea Duck/Mussel Aquaculture Working Group that is mandated to direct the planning for aquaculture development in the province. Presently there is a moratorium on new mussel leases in the Province.

Aquaculture licenses and leases of submerged land are administered by Fisheries and Oceans Canada.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Land Use Planning (s.4.2); Education and Awareness (s.4.3); Protected Areas (s.4.7); Legislation (s.4.6)

*Recommendations*: Maintain current working relationship with aquaculture industry. Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.

Avoid aquaculture development in key Harlequin Duck wintering areas.

Directed education at boat operators providing guidelines for the avoidance of Harlequin Duck wintering groups and/or known wintering areas would reduce the threat of disturbance. Flushing distances from boat disturbance would need to be established in order to provide effective guidelines; indications from available data for other duck species indicates that 100 m may be a minimum recommended avoidance distance.

## 3.3 Chronic Oiling and Oil and Chemical Spills

*Threat Categories*: Pollution.

*Activities*: Illegal oil disposal; bilge purging; lost or damaged vessels; spills of oil or chemical cargo during transport; oil and chemical contamination from land sources.

*Source*: Marine oil and chemical pollution.

*Relevance*: Annual mortality of Harlequin Ducks due to oil related events is unknown for the Prince Edward Island coast. Bird Studies Canada has initiated a beached bird survey program for the province, but results are not yet available from the first year. Increasing interest in coastal development (see above) may result in increased oil and chemical pollution from land sources.

Harlequin Ducks wintering in the East Point area are in close proximity to a major shipping route. Prince Edward Island is at a lower risk of catastrophic oil spill than the other Atlantic Provinces, but the potential for such an event does exist. Between 1975 and 1987, four tanker spills were reported in Prince Edward Island, but no major oil spills have occurred (Brander-Smith *et al.* 1990). Transport Canada is phasing out single-hulled oil tankers by 2015 (Transport Canada 2005), which will reduce the likelihood of catastrophic oil spills occurring within Canadian waters.

Chronic oiling is ongoing and anticipated to continue. Oil spills are likely to decrease but anticipated to occur occasionally, as oil tankers are only one ship source of large spills. Land sources of oil and chemical contamination are likely to increase with increased coastal development. Due to their aggregative behaviour, the relatively low abundance in the province, and the cumulative effects oil and chemical pollution can have, Harlequin Ducks are at high risk should an oiling event occur.

*Avenues for Mitigation*: Legislation (s.4.6); Enforcement (s.4.5).

*Recommendations*: Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.

Provide supplementary training to beached bird survey and beach clean-up volunteers through coordinating agencies regarding identification of Harlequin Duck and other Species At Risk. Improved identification will result in improved information about oiling rates of Harlequin Duck.

Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans.

## 3.4 Coastline Modification

*Threat Categories*: Habitat Loss or Degradation; Disturbance.

*Activities*: Loss or degradation of wintering habitat due new infrastructure; offshore wind power development; activity associated with the construction and use of coastal infrastructure.

*Source*: Construction of coastal infrastructure such as piers or breakwaters.

*Relevance*: No information was found regarding the likely demand, in the near future, for increased coastal infrastructure associated with transport to or from Prince Edward Island.

Prince Edward Island has made a notional goal of producing 100% of electricity with wind by 2015 (Canadian Wind Energy Association 2006). Disturbance to Harlequin Ducks is only likely to occur during construction and maintenance of sites located in coastal areas in close proximity to Harlequin Duck wintering sites. Offshore wind turbines are not expected in the near future.

Currently there is a 16-turbine wind farm at North Cape which attracts tens of thousands of tourists annually. Depending on the timing of tourist activity, this may be a source of disturbance to the Harlequin Ducks in the area.

*Avenues for Mitigation*: Environmental Assessment (s.4.1); Land Use Planning (s.4.2); Education and Awareness (s.4.3); Stewardship (s.4.4); Legislation (s.4.6); Protected Areas (s.4.7).

*Recommendations*: Disruptive construction (that which is likely to cause substantial disturbance to wintering groups) should be limited to the period from June - September to reduce adverse effects on Harlequin Ducks. Projects expected to result in activity through the winter months should have a coastal set-back such that activity is not typically visible to Harlequin Ducks; this distance will need to be determined on a case by case basis.

Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments.

## 3.5 Inshore Fisheries

*Threat Categories*: Habitat Loss or Degradation; Disturbance; Accidental Mortality.

*Activities*: Indirect competition with crustacean fishery; changes in marine communities as a result of seaweed harvest; gear entanglement; ingestion of toxic materials from fishing gear; boat traffic.

*Sources*: Inshore fishery activity; gear in use; lost or derelict gear.

*Relevance*: Very little inshore fishing activity takes place during the winter due to the propensity for the nearshore to become ice-covered around Prince Edward Island. Very little information was found with details of commercial shellfish harvest in coastal areas of Prince Edward Island. The extent of overlap between key wintering areas and summer seaweed harvest is unknown. The decline of the inshore fishery in recent decades further reduces the likelihood of ingestion of either gear in use or lost and derelict gear.

No records were found documenting the extent, intensity or probability of entanglement by Harlequin Duck, but may be important in areas with active inshore fisheries.

*Avenues for Mitigation*: Education and Awareness (s.4.3); Legislation (s.4.6).

*Recommendations*: Knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery need to be filled in order to evaluate the need for mitigative measures.

Education and awareness initiatives should be delivered to fishers. Encourage cooperation from fishers in monitoring and reporting of apparent gear ingestion or entanglement. Promote reduced disturbance from boat traffic through voluntary avoidance; indications from available data for other duck species indicates that 100 m may be a minimum recommended avoidance distance.

## 3.7 Air Traffic

*Threat Categories*: Disturbance.

*Activities*: Low-level flights near Harlequin Duck wintering groups; Harlequin Duck surveys.

*Sources*: Helicopter or small fixed-wing aircraft traffic.

*Relevance*: The frequency and duration of other flights which may cause similar disturbance is unknown.

*Mitigation*: Education and Awareness (s.4.3); Environmental Assessment (s.4.1)

*Recommendations*: Restrictions on the number of flights, particularly helicopter, occurring from November through April near wintering sites. Education initiatives aimed at helicopter operators and users (like tour operators, search and rescue training) to encourage voluntary avoidance.

Harlequin Duck surveys should follow Environment Canada protocols, available through the Canadian Wildlife Service, to minimize disturbance. Frequency and duration of flights, especially helicopter flights (e.g. Coast Guard flights in the area for maintaining lighthouses and other infrastructure) occurring at key wintering areas, need to be established.

## 3.8 Hunting

*Threat Categories*: Consumptive Use; Accidental Mortality.

*Activities*: Incidental or accidental harvest; illegal harvest; subsistence hunting.

*Sources*: Hunting mortality.

*Relevance*: Few Harlequin Duck occupy coastal waters of Prince Edward Island at any time during the year and due to their habitat preferences, hunting pressure - accidental, incidental and illegal - is thought to be low for this reason. The frequency of Harlequin Duck hunting mortality in Prince Edward Island is unknown, but there are no recent reports of Harlequin Duck hunting mortality from Prince Edward Island (CWS, *unpublished*).

*Avenues for Mitigation*: Legislation (s.4.6); Enforcement (s.4.5); Education and Awareness (s.4.3); Protected Areas (s.4.7).

*Recommendations*: Reinforce the continued low frequencies of accidental and incidental hunting mortality through hunter education programs to improve the ability to discriminate between Harlequin Ducks and other sea ducks and to increase knowledge of Harlequin Duck ecology. Address knowledge gaps regarding the extent of hunting mortality by encouraging hunters to report shot Harlequin Ducks.

There is no evidence that increased enforcement of the hunting ban is needed, but education initiatives delivered to enforcement officers should result in improved enforcement.

## 3.9 Invasive Species

*Threat Categories*: Exotic Species Changes in Ecological Dynamics.

*Activities*: Accidental, incidental or planned introduction; range expansion and encroachment.

*Source*: Unknown but should be anticipated.

*Relevance*: Extent and impact of invasive alien species on ecological dynamics affecting Harlequin Ducks are currently unknown, but should be anticipated. European green crab has been present in the Canadian Maritimes since the 1980's and could possibly be, or become, a threat to local Harlequin Duck populations through resource competition, as a vector for parasites, or by influencing local ecological dynamics by affecting species assemblages.

*Avenues for Mitigation*: Not identified at present.

*Recommendations:* Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species. Monitor ecological impacts of the European green crab and other invasive species which become identified as a potential threat to Harlequin Ducks to determine the need for mitigation.

## *4.0 Avenues for Threat Mitigation*

## 4.1 Environmental Assessment

Environmental assessment (EA) provides a means to integrate environmental considerations into planning and decision-making regarding proposed projects. The role of EA is to eliminate, mitigate or minimize environmental harm which may result from project undertakings. Most threats to Harlequin Duck in Prince Edward Island are resultant, directly and indirectly, of industrial activity and coastal development. For that reason, the most powerful tool for mitigation of threats is through Environmental Assessment.

Federally, EAs are led by Environment Canada's Canadian Environmental Assessment Agency; provincially, they are led by the Department of Environment and Energy. Canada and Prince Edward Island endorsed the Canada-Wide Accord on Environmental Harmonization and the Sub-Agreement on Environmental Assessment in 1998 in order to promote improved cooperation on environmental matters. The sub-agreement contemplates a bilateral agreement between Canada and Prince Edward Island to cooperatively manage EAs and reduce redundancy when EAs are required by both jurisdictions. At the time of writing, the EA bilateral agreement was not yet negotiated, but is expected to provide clear guidelines regarding responsibility, timelines and decision-points.

The presence of species at risk does not, in itself, trigger a federal EA, but does trigger a provincial EA. As yet, Prince Edward Island has not listed any species at risk, but Harlequin Ducks are listed federally; it is unclear as to whether federally-listed species trigger EA under provincial legislation. Regardless, up-to-date information about local Harlequin Duck distribution and abundance, ecology of the species and the potential threats to their populations needs to be available to the officers, both provincial and federal, responsible for EAs. Proponents preparing EA reports and EA agencies reviewing these are able to access up-to-date Harlequin Duck survey data and incidental sightings through the Atlantic Canada Conservation Data Center (see 4.1.3).

To supplement the general EA best practices guidelines for Wildlife at Risk in Canada (Lynch-Stewart 2004), specific information about Harlequin Ducks should be provided to EA responsible agencies. Education programs will be the best method of ensuring Harlequin Duck ecology and threats to their populations are well understood by EA officers. Delivery through in-person workshops, accompanied by the distribution of fact sheets, would allow both a transfer of knowledge and an opportunity for individuals involved in EAs to seek clarification of information presented. To make effective use of resources, ecology and population threat workshops could be designed to transfer knowledge regarding multiple species at risk for which threat mitigation through EA is key.

### 4.1.1 Triggers of Environmental Assessments

Under the Canadian Environmental Assessment Act (S.C. 1992, c. 37), projects requiring a federally-led EA include those in which a:

- Federal authority is the project proponent;
- Federal authority provides money or other forms of financial assistance or guarantee in relation to a project;
- Federal authority grants an interest in land to enable a project to be carried out (i.e., sell, lease or otherwise transfer control of land); or
- Federal authority exercises a power or performs a duty or function specified in the Law List Regulations (S.O.R. 94/636) (e.g., issues a permit or license, etc.).

Under the Environment Protection Act (R.S.P.E.I. 1988, c. E-9), projects requiring a provincially-led EA include undertakings which will or may:

- Cause the emission or discharge of any contaminant into the environment;
- Effect any unique, rare or endangered feature of the environment (the definition of environment under the Act includes plant and animal life);
- Significantly effect the environment or necessitate further development significantly effecting the environment; or
- Cause public concern regarding real or perceived effects on the environment;

but excludes:

- Permitted or licensed alteration of watercourses, approved wells, and approved waste treatment and water supply systems.

### 4.1.2 Harlequin Duck Survey Protocol (Component Studies)

When component studies require surveys for Harlequin Duck occurrence and abundance, it is recommended that standardized protocols be followed. Environment Canada's Canadian Wildlife Service (EC-CWS) Harlequin Duck Survey Protocols should be followed to minimize disturbance and to maintain consistent methods for data collection.

Survey protocols are available from EC-CWS for aerial, ground-based, and boat surveys of Harlequin Duck.

### 4.1.3 Access to Updated Harlequin Duck Distribution Data

EC-CWS Atlantic Region collects and maintains data regarding Harlequin Duck distribution. Data is obtained through standardized monitoring surveys, surveys conducted by external organizations (e.g. for EA component studies), and incidental sighting reports. Incidental sighting reports are obtained from historic records and birding listservs and chat rooms.

EC-CWS Atlantic has a data-sharing agreement with the Atlantic Canada Conservation Data Centre (ACCDC). As part of this agreement, ACCDC receives annual updates of the Harlequin Duck survey and sighting data. Organizations, agencies and individuals can obtain this data for a fee by contacting the ACCDC. Contact information and available data services are listed on their website, http://www.accdc.com.

## 4.2 Land Use Planning

No Provincial land-use policy is formally in place in Prince Edward Island, but regulations under the Planning Act allow the Provincial government to restrict development or define acceptable development adjacent to cities and in coastal areas. Coastal areas are considered to be the 500 m strip of land bordering all coastal and tidal waters. Additionally,

Prince Edward Island has established a Land Use Coordinating Committee (LUCC) to coordinate all significant land use and development policy of the Province ensuring sustainable economic development. The LUCC maintains a GIS-based Provincial Lands Inventory (PLI) to be used for land-planning.

Important areas for Harlequin Duck should be identified to land managers and included in the PLI. The distribution and abundance of Harlequin within Prince Edward Island is expected to change over time; traditional wintering sites will likely remain important, but as the population continues to grow new areas may be exploited by Harlequin Ducks. Harlequin Duck surveys within the province and the maintenance of incidental sighting records are managed by the Canadian Wildlife Service. Prince Edward Island can obtain current Harlequin Duck information from ACCDC (section 4.1.3) for regular updates.

## 4.3 Education and Awareness

Current education and awareness campaigns highlighting Harlequin Ducks are limited to distribution of materials for the general public. To improve the efficacy of minimizing, mitigating and eliminating threats to Harlequin Duck, there is a need to develop and deliver education campaigns targeting relevant stakeholders.

Within the province of Prince Edward Island, education and awareness campaigns should be delivered to:

*Environmental Assessment Agencies/Officers*. Education will be best achieved by in-person presentations and distribution of fact sheets to agencies and individuals responsible for Environmental Assessments. Information of importance would include basic Harlequin Duck ecology, threats to the population, and their distribution and abundance within the jurisdiction. Advice should be provided on evaluating the extent of threat posed by a project and accessing updated distribution and abundance data.

*Enforcement Officers*. As indicated above, improved enforcement is likely best achieved through education of enforcement officers. Education will be most effectively accomplished by in-person delivery of presentations and the distribution of summary hand-outs. Key topics would need to include field identification of Harlequin Ducks (see Hunters, below), and laws and regulations applicable to Harlequin Ducks. In-person events would create an excellent opportunity for the collection of knowledge regarding the probable incidence of hunting mortality and other offences, knowledge of habitat or areas frequented by Harlequin Duck that may be currently unreported, and provide an opportunity for discussing the challenges and successes of enforcing regulations relevant to species at risk in general.

*Hunters*. Concern over the inability of some hunters to distinguish Harlequin Ducks from other diving ducks drives the need for education of hunters. An identification guide should be produced which depicts the Harlequin Duck at different age classes and with seasonal plumage of both sexes; it should also depict the other species with which Harlequin Ducks are likely to be confused. The guide should contain brief wording regarding the at-risk status and the hunting ban. As the frequency of hunting mortality is unknown, provision of a mechanism for reporting shot Harlequin Ducks should be included. Options for distribution of the information include, but are not limited to, distribution of posters and guides to retailers who sell hunting equipment, direct distribution to Migratory Bird License holders, or distribution through and agreement with organizations, such as Ducks Unlimited Canada, to reach their membership.

*Municipalities*. Coastal municipalities near key wintering areas have the opportunity to protect their shores from development and/or to restrict or encourage particular activities through municipal planning. This might be best delivered in cooperation with other organizations with interest in strategic and sustainable coastal development, such as Island Nature Trust, to offer a broader perspective on the importance of strategic coastal development. Regarding Harlequin Ducks, information on basic ecology, local abundance and occurrence, at-risk status, and the potential threats to their population posed by coastal development should be conveyed. Avenues for municipal involvement, such as incorporation of coastal protection into municipal planning or the development of stewardship agreements, should be outlined for land planners.

*Aircraft and Boat Operators*. Particularly in the case of helicopter operators and small boat operators (fishers, recreational boaters), establishing or increasing awareness of Harlequin Duck sensitivity to disturbance may encourage voluntary avoidance or reduced disturbance of Harlequin Duck aggregations. Guidelines regarding safe distance from aggregations, minimization of time spent nearby aggregations, and general information about Harlequin Ducks should be provided.

*Volunteers.* Organizations which coordinate volunteer activity such as beached bird surveys and beach clean-ups may be able to provide important information on oil-related deaths of Harlequin Duck. Delivery of education aimed at improving identification of Harlequin Duck and other Species at Risk which may be found on beaches should be achieved in cooperation with these organizations. Hand-outs or brochures that can be carried during beach work should be created and delivered through regular volunteer training or instruction. In-person presentations to volunteer coordinators may be a good strategy for transferring information. Hand-outs or brochures should include identification guidance, instructions on where carcasses are likely to be found and where live birds might be spotted, and contact information for reporting. To maximize ease of reporting, data collection cards could accompany the distributed guidance.

## 4.4 Stewardship

Stewardship agreements with private landowners, industry stakeholders or non-governmental organizations can be powerful tools for species conservation and habitat management. Given that approximately 90% of Prince Edward Island is privately owned, voluntary stewardship activities may be the most effective tool for management of habitat.

Stewardship agreements with municipalities and private landowners in key wintering areas should be actively pursued. Private land can also be protected through conservation agreements (see section 4.7.2).

## 4.5 Enforcement

Continued support for enforcement of laws and regulations that can aid in threat mitigation is important.

Enforcement of regulations under the Migratory Bird Convention Act, Canada Shipping Act, and the Canadian Environmental Protection Act with regard to marine oil and chemical pollution has been the focus of legislative changes to these acts recently under Bill C-15. These amendments are intended to increase the efficacy of enforcement and create a greater deterrence to potential offenders, which is expected to improve the prevention of chronic oil and chemical pollution in Canadian waters.

In Prince Edward Island, particularly with respect to hunting mortality of Harlequin Duck, there is no evidence that increased enforcement is a necessary measure, but improved enforcement is recommended. The best way to achieve improved enforcement is through an education and awareness initiatives targeting enforcement officials, including municipal police, Royal Canadian Mounted Police, Conservation Officers, Park Wardens, and Fishery Officers.

## 4.6 Legislation

Legislation identified below is not to be considered comprehensive; an attempt has been made to summarize the most relevant legislation, provincially and federally, which addresses issues related to mitigation of probable threats to Harlequin Ducks. Acts and regulations pertaining to protected areas are discussed in section 4.7.

### 4.6.1 Provincial Statutes and Regulations Relevant to Mitigation of Threats

Wildlife Conservation Act (R.S.P.E.I. 1988, c. W-4.1) provides for the protection, management and conservation of wildlife and wildlife habitat in the province. The Act requires periodic inventory of wildlife habitat and assessment of wildlife resources. The act also allows for the designation and protection of endangered and threatened species and species of special concern. The Act prohibits actual or attempted actions that result in harm to individuals or areas habitually occupied by individuals of species designated as endangered or threatened. No species are yet designated in Prince Edward Island under this Act.

Also of note, the Act governs Conservation Agreements for the purposes, among others, of the protection, enhancement or restoration of habitat of rare, threatened or endangered species. Covenants and easements are binding for the term of the agreement (including in perpetuity) on the landowner signing the agreement and successive land owners.

The act allows regulations to be made with respect to hunting and trapping, including the designation of prohibited areas, seasons, limits, and the methods and devices allowable for taking wildlife.

Environmental Protection Act (R.S.P.E.I. 1988, c. E-9) governs the management, protection and enhancement of air, land, water, and plant and animal life. The Act establishes provincial requirements for Environmental Impact Assessments for proposed undertakings (s.4.1).

Natural Areas Protection Act (R.S.PE.I.. 1988, c. N-2) enables the designation of natural areas to conserve the aesthetic, scenic and natural character and condition of ecosystems. General Regulations (P.E.I. Reg. EC554/89) prohibit the destruction of vegetation and the introduction of non-native wildlife. The Regulations also prohibit development in natural areas.

Lands Protection Act, P.E.I. (R.S.P.E.I. 1988, c.L-5) provides for the regulation of property rights in the province. The Act recognizes that due to the fragile nature of the province's ecology, there is a need for responsible stewardship to protect the province's lands. The Act enables the Land Identification Regulations (P.E.I. Reg. EC606/95) which allows for lands to be identified for non-development. Protection of land does not confer direct benefit to Harlequin Duck habitat but can protect coastal areas adjacent to key areas for the species from development and associated activity.

Planning Act (R.S.P.E.I. 1998, c. P-8) empowers municipalities to develop Municipal Plans and for the province to develop land use plans for lands not falling within any municipal boundaries. Objectives of the act include, among others, to protect the unique environment of the province and to provide the opportunity for public participation in the planning process. The Lands Protection Act, P.E.I. (R.S.P.E.I. 1988, c.L-5) land identification program takes precedent over land use planning in the Planning Act.

Acts and regulations pertaining to protected areas are discussed in section 4.7.

### 4.6.2 Federal Statutes and Regulations Relevant to Mitigation of Threats

Species at Risk Act, (S.C. 2002, c. 29). The purposes of the Act are to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and encourage the management of other species to prevent them from becoming at risk. The eastern population of Harlequin Duck is listed as Special Concern in Schedule 1. The Act requires the development and implementation of a management plan for species designated Special Concern and allows for regulations to be made, as necessary, to put the management plan into effect with respect to migratory birds.

Migratory Birds Convention Act, 1994 (S.C. 1994, c. 22) protects migratory birds, as populations and as individual birds, and their nests. This includes prohibitions against depositing any substance that is harmful to migratory birds in waters or in areas frequented by migratory birds. The Act allows for regulations governing migratory bird hunting, treatment of migratory bird nests and nest sites, and the designation of protected areas, among others.

Canada Wildlife Act, (R.S.C. 1985, c. W-9) enables the acquisition and designation of lands and designation of marine areas for the purposes of research, conservation and interpretation in respect of migratory. The Act also allows for the prescription of measures for the conservation of wildlife within these lands or waters.

Canadian Environmental Assessment Act, (S.C. 1992, c. 37) establishes a federal environmental assessment process to achieve sustainable development by conserving and enhancing environmental quality. The Act governs the federal environmental assessment process and enables regulations governing identification of projects requiring, and those excluded from, federal environmental assessment (see Section 4.1).

Canadian Environmental Protection Act, 1999, (S.C. 1999, c. 33) in part, protects the marine environment from land based pollutants and those disposed of at sea. At sea disposal prohibitions are, in part, intended to protect against chronic oil pollution. The Act also governs environmental emergency plans and response and the enforcement of statutes and regulations within and enabled by the Act.

Canada Shipping Act, (R.S.C. 1985, c.S-9) among others, regulates the location of shipping lanes and recreational boat activity. The Act enables Ballast Water Control and Management Regulations, (S.O.R./2006-129), Hull Construction Regulations, (C.R.C., c. 1431), Oil Pollution Prevention Regulations, (S.O.R./93-3), Pollutant Substances Pollution Prevention Regulations, (C.R.C., c. 1458), and Response Organizations and Oil Handling Facilities Regulations, (S.O.R./95-405).

Canada Shipping Act, (R.S.C. 2001, c. 26) among others, identifies the responsibilities of the Fisheries and Oceans Canada and Transport Canada with respect to marine pollution prevention, response, and enforcement.

Fisheries Act, (R.S.C. 1985, c. F-14) governs the management and control of sea coast and inland fisheries. The Act enables regulation relating to, among others, the operation of fishing vessels, the use of fishing gear and equipment, seasons and quotas.

Acts and regulations pertaining to protected areas are discussed in section 4.7.

## 4.7 Protected Areas

Following is a description of the types of protected area which can be established in Prince Edward Island. Marine Protected Areas are likely the most effective ways to protect the habitat used by Harlequin Duck, as this is the only designation which allows for prohibitions of entry and activity within marine waters. Other protected area designations can be useful for protecting coastal land from development. Given the large amount of privately owned coastal land, conservation agreements may be of substantial value.

### 4.7.1 Public Lands

Within Prince Edward Island, lands with restricted or limited use exist to protect the land and habitat, species, or other natural features contained within. The protection afforded by these designated lands does not extend to the surrounding marine environment, but protection of the associated coastline will have benefits for Harlequin Ducks during migration and wintering.

The establishment of protected areas is an option for mitigation, particularly of threats from coastal development, but is likely to be of limited value in Prince Edward Island due to the large amount of land which is privately owned. It should be considered only where education and awareness campaigns and stewardship programs are ineffective. Following is a description of the types of protected area which can be established in Prince Edward Island.

*Provincial Protected Areas*. The Natural Areas Protection Act (R.S.P.E.I. 1988, Cap. N-2) was created to preserve natural areas of the Province, and also provides the right for the Provincial Minister, by order, to designate land as a natural area. Regulations can be made to protect the site from development and potentially damaging activities. Provincial Parks, Protected Beaches and Protected Areas may be designated under the Recreation Development Act (R.S.P.E.I. 1988, c. R-9) for the purpose of preserving, among others, animate or inanimate objects of aesthetic, educational, historical or scientific interest. Regulations can be made for the protection, care, management, and improvement of protected areas and to restrict the use of a protected area. Regulations may also be made within protected areas with respect to objectives of the Wildlife Conservation Act (R.S.P.E.I. 1988, c. W-4.1). The Recreation Development Act enables Provincial Parks Regulations (P.E.I. Reg. EC1134/66) which, among others, prohibit removal, destruction or defacement of natural objects within parks.

*National Parks.* National Parks including park reserves, adjuncts, historic parks and historic sites, can be established under the Canada National Parks Act (S.C. 2000, c.32). The Act prohibits actions which unreasonably interfere with the fauna or natural beauty of a park. This can afford protection from coastal development.

*National Migratory Bird Sanctuaries*. Migratory Bird Sanctuary Regulations (C.R.C., c. 1036) enabled by the Migratory Birds Convention Act (S.C. 1994, c. 22) establish National Migratory Bird Sanctuaries for the protection of migratory birds within Sanctuary boundaries. The regulations prohibit hunting of any migratory bird within sanctuary boundaries. A hunting ban is in place in the Atlantic Flyway for Harlequin Duck, but a reason for their vulnerability to incidental shooting is their tendency to mix with other sea ducks in wintering groups. Establishment of a Migratory Bird Sanctuary could be used if a particular area is subject to a disproportionately high rate of incidental hunting mortality.

*Wildlife Areas*. Wildlife Area Regulations, (C.R.C., c. 1609), enabled by the Canada Wildlife Act, (R.S.C. 1985, c. W-9), allow for the designation of National Wildlife Areas. Within these Wildlife Areas, prohibitions include, among others, hunting and fishing, possession of lead shot or lead sinkers, industrial or agricultural activity, recreational activity, and harm of any wild animal or plant.

*Marine Protected Areas.* Under the Oceans Act, (S.C. 1996, c.31), Marine Protected Areas can be designated for the protection or conservation of marine resources and habitat (e.g. Basin Head Lagoon Marine Protected Area southwest of East Point). Regulations can be made restricting activity in the protected area and any other measures consistent with the designation. The wording in the Act largely refers to marine resources, commercial and non-commercial fishery resources and marine habitat. Designation of a marine protected area for the purpose of conserving or protecting Harlequin Duck may not be possible. Under the Canada Wildlife Act, (R.S.C. 1985, c. W-9), protected marine areas can be established but are not restricted to the protection of marine resources.

### 4.7.2 Private Lands

Private land can be protected through legally binding agreements which prescribe land management for a period of time agreed upon by the land owner and the organization with which the agreement is formed. In Prince Edward Island, this can be done through conservation agreements (easements or covenants) with eligible conservation organizations, or provincial or federal government. The level of protection offered through conservation easements will depend on the precise agreement between the land owner and the easement holder. For Harlequin Duck protection, securing easements which restrict or prohibit coastal development in key wintering and migration areas could be of benefit.

Section 18 of the Wildlife Conservation Act (R.S.P.E.I. 1988, c. W-4.1) governs the creation, maintenance, and termination of conservation agreements within the province. Additionally, the Natural Areas Protection Act (R.S.P.E.I. 1988, Cap. N-2) has been used extensively on private lands in Prince Edward Island. Through this legislation a private landowner who wishes to have their land designated as a natural area may enter into an agreement with the Minister for the purchase, lease or acquisition of the land by the government.

## *5.0 Summary of Threats to Harlequin Ducks in Prince Edward Island*

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Coastal Development | - industrial, commercial, residential & vacation property development<br>- construction activity associated with coastal development<br>- subsequent activity associated with use | medium | Targeted education for municipal planners to increase awareness of effects of coastline development.<br><br>Actively pursue stewardship agreements with municipalities, non-profit organizations, industry and individuals.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments |
| Aquaculture | - development of coastal aquaculture sites, particularly in or nearby traditional wintering areas<br>- boat activity associated with maintenance and operation of sites<br>- organic and chemical waste produced during operation | medium | Maintain current working relationship with aquaculture industry.<br><br>Monitor research and development of aquaculture techniques and waste management to fill in knowledge gaps.<br><br>Avoid aquaculture development in key Harlequin wintering areas.<br><br>Directed education at providing guidelines for the avoidance of Harlequin Duck on the water to reduce the threat of disturbance. Recommend a 100 m minimum avoidance distance. |
| Chronic Oiling and Oil or Chemical Spills | - illegal and incidental oil disposal<br>- accidental spills | medium | Continue to work in a preventative capacity to reduce chronic oil pollution and acute oil and chemical spills.<br><br>Provide supplementary training to beached bird survey and beach clean-up volunteers.<br><br>Locations of key wintering areas should be communicated to emergency response teams and incorporated into oil-spill contingency plans. |
| Coastline Modification | - development of coastal infrastructure such as piers or breakwaters<br>- construction activity associated with coastline modification<br>- subsequent activity associated with use | low | Environmental Assessments need to consider both the extent and impact of individual projects and the cumulative effects on habitat of several projects over time.<br><br>Up to date Harlequin Duck distribution data should be readily available to agencies responsible for environmental assessments. |

| General Threat | Activity | Level of Concern | Recommendations |
|---|---|---|---|
| Inshore Fishery | - loss of lead and plastic fishing gear<br>- crustacean fishery<br>- harvest of algae, sea urchins | low | Education and awareness initiatives should be delivered to fishers.<br><br>Encourage cooperation from fishers in monitoring and reporting of apparent gear ingestion or entanglement incidents.<br><br>Address knowledge gaps regarding the extent and consequence of conflict between Harlequin Duck and ecological impacts of the inshore fishery.<br><br>Directed education at providing guidelines for the avoidance of Harlequin Duck on the water to reduce the threat of disturbance. Recommend a 100 m minimum avoidance distance. |
| Air Traffic | - low altitude flights by helicopter or fixed-wing aircraft | low | Harlequin Duck surveys should follow Environment Canada protocols to minimize disturbance.<br><br>Address knowledge gaps regarding the frequency and duration of flights, especially helicopter flights, occurring at key wintering.<br><br>Targeted education initiatives for helicopter operators and users to encourage voluntary avoidance. |
| Hunting | - incidental/accidental harvest<br>- illegal harvest<br>- subsistence hunting | low | Reduce accidental and incidental hunting mortality through hunter education programs to improve the ability to discriminate between Harlequin Ducks and other sea ducks and to increase knowledge of Harlequin Duck ecology.<br><br>Encourage hunters to report shot Harlequin Ducks.<br><br>Improve enforcement through targeted education for enforcement officers. |
| Invasive Species | - accidental, incidental or planned introduction<br>- range expansion and encroachment | unknown | Continue to work in a preventative and mitigative capacity to reduce and control the effects of invasive species.<br><br>Monitor ecological impacts of invasive species which are identified as potentially threatening to Harlequin Ducks to determine the need for mitigation. |

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# APPENDIX I:

# Threat Classification: A guide to terms and structure

***Adapted from:***

**Environment Canada. 2005. Species at Risk Act Implementation Guidance: Best Practices for Identifying Threats to Species at Risk. Draft Document, Government of Canada. 19 pp.**

Threat Classification Tables, like that found in Part I, were developed to allow Environment Canada (EC) to better address species recovery/management requirements as mandated in the *Species At Risk Act* (SARA). The purpose of the guidelines used to build the threat table is to create standardized terminology to be used in Species at Risk documents and reports. This should improve both clarity and consistency in the literature.

Threat Classification Tables are a relatively new recommendation from EC, but have already been used in the Atlantic Region (e.g. within the Piping Plover and Red Crossbill Recovery Strategies). As they are new, the structure of the table and the terms used for identifying and describing threats may be unfamiliar. To better explain this process of threat assessment, a brief overview of terminology used is provided below.

## System for Classification

Threats are named by categorizing and identifying components from a general to specific level. Threats are then contextualized within the ecology of the species of interest to allow for priorities to be identified. Context and priority help inform planning for mitigation, alleviation, and elimination of threats.

## Naming Threats (Classification)

**STRESS**: Factor which reduces viability of a population (reduction of population size or of effective population size), e.g. high mortality, low reproductive success, loss of genetic diversity.

**THREAT**: Any activity or process that imposes a Stress on a species. Threats may be intrinsic or extrinsic and:

- Contribute to a population decline,
- Perpetuate a population decline, or
- Impede recovery or growth.

**THREAT CATEGORY**: Organization of Threats by establishing a thematic relationship to the natural history and ecology of the species and to anthropogenic influence on its ecology or biology. Ten categories are identified as fixed selections:

- Habitat Loss or Degradation
- Consumptive Use
- Pollution
- Natural Processes and Activities
- Modification of Natural Processes
- Changes in Ecological Dynamics
- Exotic Species
- Accidental Mortality

- Disturbance and Persecution
- Climate and Natural Disasters

**GENERAL THREAT**: Organization within Threat Categories of the type of event associated with the Threat. These will normally be identified in a Status Report or identified by a Recovery Team.

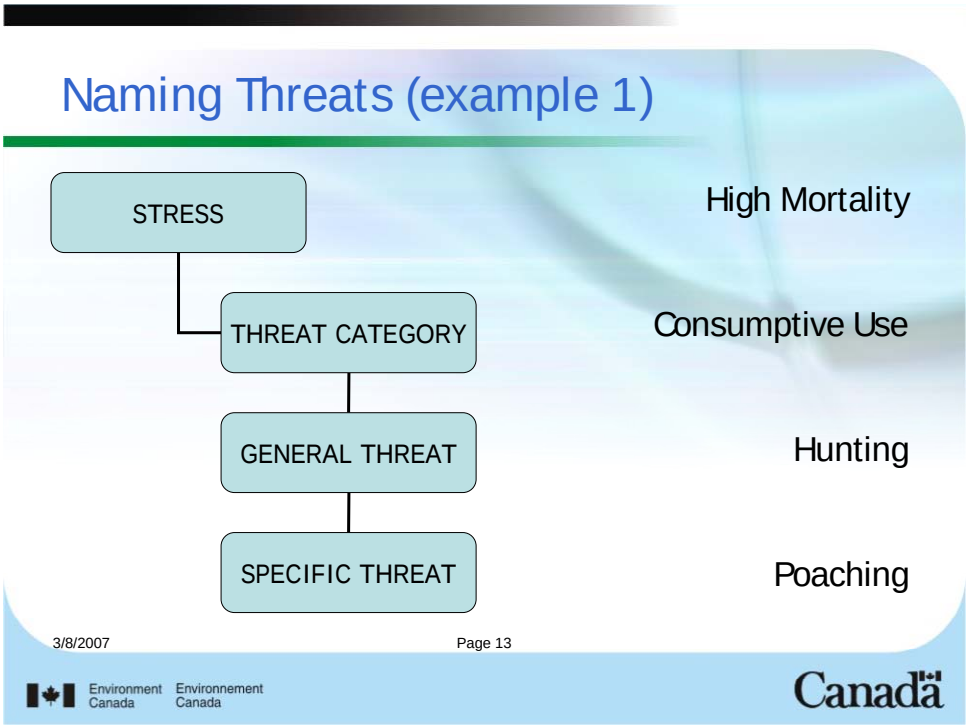
*Examples*: disease; chronic oiling; hunting; small body size

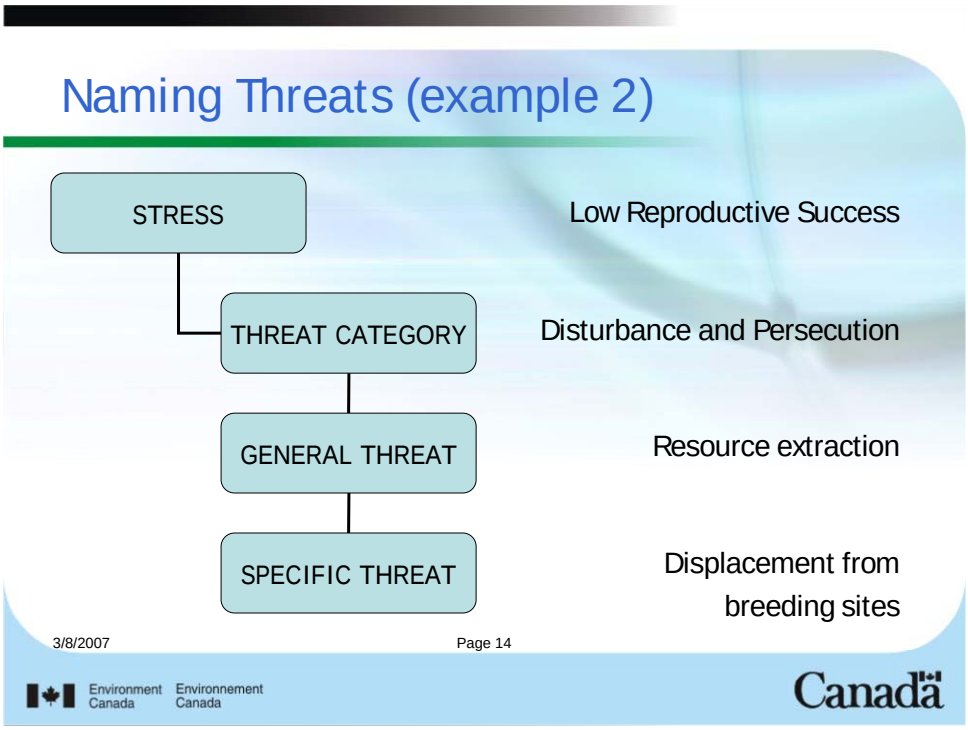
**SPECIFIC THREAT**: The component of the General Threat causing the Stress to the population, when known or plausibly identified.

*Examples*: rabies; plumage oiling; poaching; high energetic costs at northern extent of range

**ACTIVITY**: Specific event(s) or action(s) which cause the General and/or Specific Threat

*Examples*: increase in population of disease vector; disposal of oil at sea; illegal hunting; morphological characteristic






## Identifying the Context of Threats

**CAUSAL CERTAINTY**: Describes the strength of our certainty in a cause and effect relationship between the Activity and the Threat. This requires an evaluation of the type of available evidence that would illustrate a cause and effect relationship between the Activity and the Threat. Three categories are available as descriptors:

- High – there is strong evidence to link the activity to the threat being described
- Medium – there is a correlation between the activity and the threat; expert opinion; several sources of evidence suggest link
- Low – putative or plausible link only; no evidence

**TIMING**: Describes when the Threat did/ does/ will occur. Five descriptors are identified as fixed selections:

- Historic – contributed to the 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 some time in the future
- Unknown

**FREQUENCY**: Describes how often the Threat occurs. Four descriptors are available as fixed selections:

- One-time – has occurred once or will occur only once
- Seasonal – due to migration of the species of interest or association with particular seasonal behaviour (e.g. nesting) or seasonal nature of threat itself (e.g. lobster fishery)
- Recurrent – events expected to occur occasionally or to occur as isolated events in several places throughout the range
- Continuous – the threat is always present

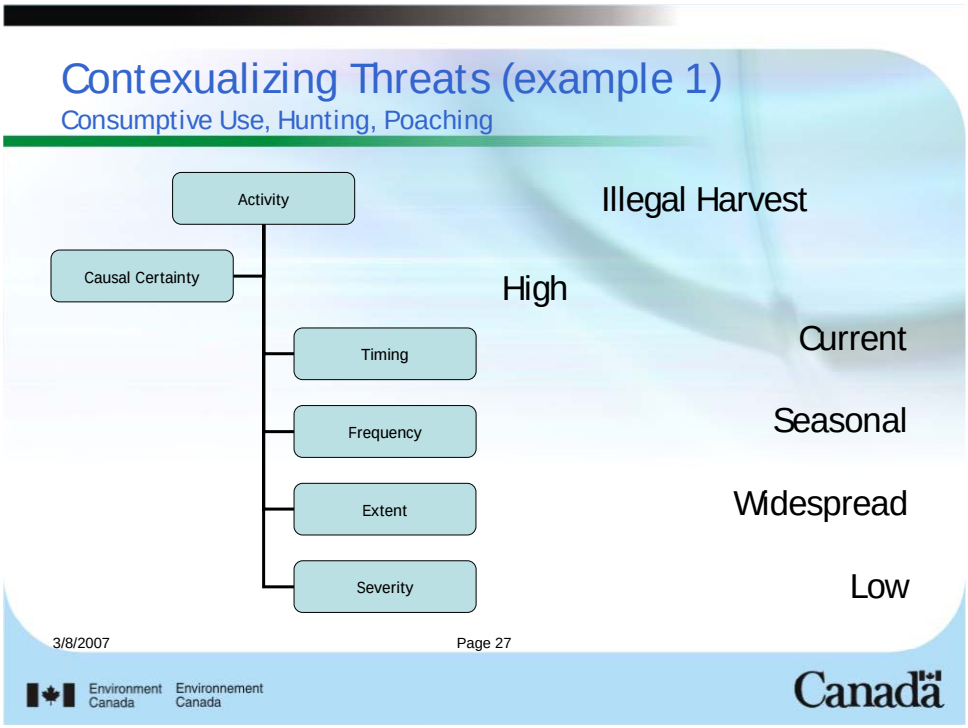
- Unknown

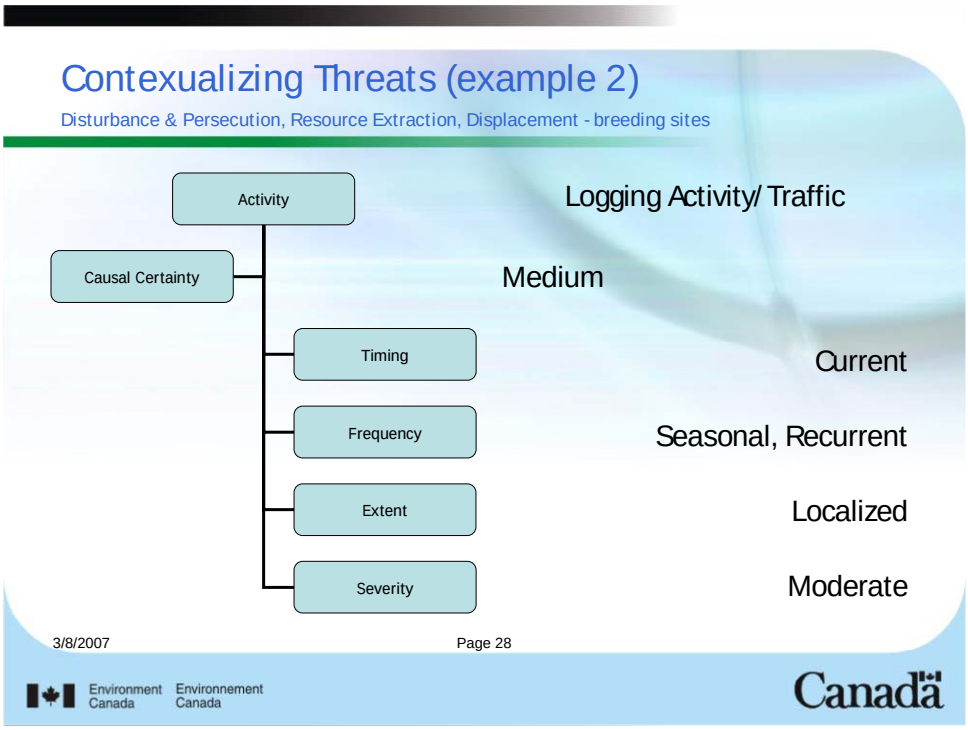
**THREAT EXTENT**: Describes the relationship of the threat to the range of the population. Three descriptors are available:

- Widespread
- Localized
- Unknown

**SEVERITY**: Describes the relationship between the Threat and the Stress, should the Threat occur (or when the Threat does/did occur).

- High – very large population-level effect
- Moderate – substantial population effect
- Low – small population effect
- Unknown





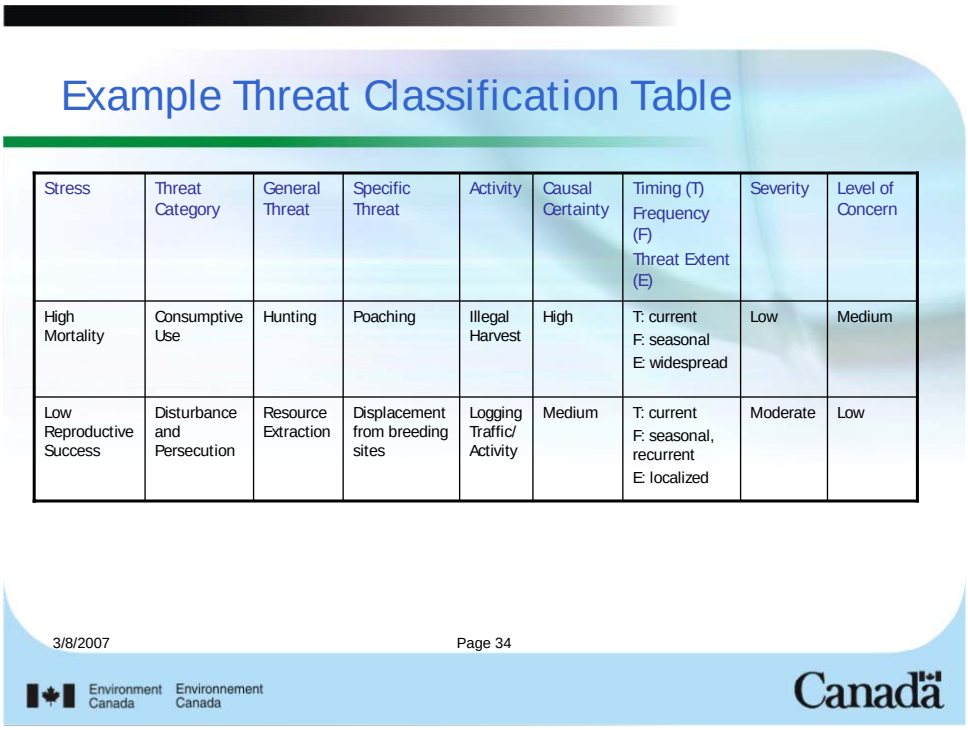

## Prioritization

Consider the Timing, Frequency, Extent and Severity of the Threat. A Threat occurring seasonally as a localized event may be a lower priority than a less severe but widespread seasonal Threat.

**LEVEL OF CONCERN**: Indicate, from a management or recovery standpoint, how important the threat is. Consider the context of the threat and the potential for mitigation or control.

## The Threat Classification Table

The Threat Classification Table is intended as a brief summary of Threats. The table includes naming (identification) of threat, the context and the priority. The table is purposefully brief. It accompanies lengthier written text in a report.



## Example Threat Classification Table

| Stress | Threat Category | General Threat | Specific Threat | Activity | Causal Certainty | Timing (T) Frequency (F) Threat Extent (E) | Severity | Level of Concern |
|---|---|---|---|---|---|---|---|---|
| High Mortality | Consumptive Use | Hunting | Poaching | Illegal Harvest | High | T: current<br>F: seasonal<br>E: widespread | Low | Medium |
| Low Reproductive Success | Disturbance and Persecution | Resource Extraction | Displacement from breeding sites | Logging Traffic/ Activity | Medium | T: current<br>F: seasonal, recurrent<br>E: localized | Moderate | Low |

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### *A Few Additional Notes*:

- A General or Specific Threat may apply to more than one Threat Category or more than one Stress.
- There may be several Specific Threats associated with a General Threat.
- There may be several Activities which cause, or are thought to cause, a Threat.