MONTEGO
RESOURCES

WILDLIFE/VEGETATION and ARCHAEOLOGICAL MANAGEMENT PLAN

KIYUK LAKE PROJECT, NU

Effective Date: 26 February 2019

TABLE OF CONTENTS

1.0 INTRODUCTION

This Wildlife/Vegetation Management Plan (WVMP) applies to mineral exploration activities conducted by Montego Resources Inc (Montego) on the Kiyuk Lake Project (Kiyuk Lake), Nunavut, Canada.

Copies and updates to this plan may be obtained from Montego. The WVMP will be replaced, upon approval, if there are any significant changes to the activities outlined in the existing permits which warrant changes to the WVMP. Minor changes will be submitted as an addendum to the WVMP and submitted to the distribution list as required.

1.1 Corporate Details

Montego Resources Inc.
800 – 1199 West Hastings
Vancouver, BC
V6C 2C2
Phone: (604) 283-1722
Fax: (888) 241-5996

Montego Resources Inc (Montego) endeavours to take every reasonable precaution towards ensuring the protection and conservation of the natural environment and the safety and health of all employees and contractors from any potential harmful effects of stored materials and operations.

1.2 Purpose

The primary objective of the Kiyuk Lake WVMP is to provide employees and contractors with guidelines to eliminate or minimize any interaction or effects on wildlife and natural vegetation in the Kiyuk Lake Project area during active exploration programs.

1.3 Environmental Policy

The present WVMP has been prepared in accordance with the commitments made in Montego's environmental policy which are to:

- Assess the potential environmental impacts of any new undertaking with an objective to minimize adverse impacts;
- Design and operate facilities to ensure that effective controls are in place to minimize risks to health, safety and the environment;
- Implement an emergency response plan to minimize the impacts of unforeseen events;
- Provide a professional environmental for staff to plan and direct environmental compliance programs and to assist in training and education activities;
- Provide training and resources to develop environmentally responsible employees;
- Ensure that environmental factors are included in the purchase of equipment and materials;
- Ensure that contractors operate according to the company's environmental policy and procedures;
- Comply with all applicable environmental laws and regulations;
- Communicate with employees, the public, government agencies and other stakeholders on activities involving health, safety and the environment;
- Regularly verify environmental performance and implement any required corrective action;

- Minimize the generation of hazardous, as well as non-hazardous, waste and ensure proper disposal of all waste materials;
- Implement measures to conserve natural resources such as energy and water, and;
- Rehabilitate sites in accordance with regulatory criteria and within established timeframes.

1.4 Other Plans

The WVMP should be considered as a part of the Property-wide management system. Other management plans in place at the Kiyuk Lake Property include:

- Abandonment and Restoration Plan (ARP)
- Spill Prevention and Response Plan (SPRP)
- Waste Management Plan (WMP)

2.0 VEGETATION

All reasonable care will be taken to avoid unnecessary impacts to vegetation and to mitigate required impacts.

2.1 Clearing Vegetation for Vehicle Access

Since all operations requiring vehicle access will be conducted during the winter-spring period, the only vegetation clearing that may be necessary involves the removal of trees. This will only be done if access cannot be obtained via frozen waterways, natural and/or existing clearings and existing tracks.

- Keep the track width to a minimum.
- Weave around large trees and avoid creating long straight stretches.
- Use naturally cleared areas and consider the thickness of vegetation.
- Tracks should be positioned along ridges.
- Whenever possible, avoid clearing on steep slopes, side hills and drainage banks.

2.2 Clearing Vegetation in General

- Determine the exact requirements to avoid unnecessary and excessive clearing.
- Lop branches in preference to felling trees.
- Leave felled timber in a manner acceptable to the authorities. Otherwise, stockpile the cleared vegetation for subsequent re-spreading over the track. This is to protect exposed soil from erosion and to enable seed stocks to regenerate.

2.3 Geochemical Sampling

When taking soil/till samples, areas naturally free of vegetation (frost boils) will be selected whenever possible. When this is not possible the organic layer and any topsoil should be put to one side and replaced after the sample is collected.

2.4 Grid Lines

- Foot accessible grid lines for geophysics, geochemistry and geology will be at minimal width.
- No large trees are to be felled. Branches will be cut to allow foot access and line of sight.
- The blazing of trees will be avoided unless required by government regulations.
- Do not leave pointed stakes that will endanger humans or animals.
- Wooden survey stakes will be used in preference to steel.

- Steel markers will only be used as permanent survey points and where possible will be positioned where they will not cause injury to animals or people, or interfere with vehicle movement.
- Care will be taken to ensure all stakes/tape are removed at the completion of exploration.
- Flagging tape and spray paint will be used sparingly. If possible, biodegradable items will be used.
- Hip-chain line will be broken after crossing a track or trail and care taken to ensure that the line has fallen clear of the right of way.

3.0 WILDLIFE

The predicted impacts to wildlife due to the presence of the Kiyuk Lake Project include:

- attracting wildlife,
- habitat disturbance
- unintentional disturbances

3.1 General

Wildlife can be naturally curious and some species are attracted to areas that are occupied by humans. Montego will discourage this by minimizing the attractants. All waste will be stored such that it is not accessible until such time as it can be appropriately disposed of. Combustible waste, including food wastes from the kitchen will be incinerated frequently so that there are no scents and smells attracting hungry wildlife. At no time will it be permitted by any personnel, contractors, consultants or anyone else visiting the camp and property to feed wildlife or try to entice wildlife closer to any activities. The drills will be kept clean and tidy and lunches will be stored such that they are not accessible to wildlife. No beverages will be poured out on the tundra and no food or food wastes/wrappers will be left lying around. While the incinerator is in use, it will not be left unattended at any time. Incineration guidelines can be found in the WMP.

Habitat disturbance at exploration programs is temporary. Montego has a policy of progressive reclamation, meaning as when preparations are made to leave a site, it is ensured that the site is clean, tidy and reclaimed as needed before moving to the next site. Habitat disturbance at the Kiyuk Lake Project results from drilling, infrastructure and ground traverses (geophysics, sampling). The habitat disturbance effects from drilling are very temporary and in most cases it is nearly impossible to locate the drill hole and sump the next year.

Despite best efforts and practices, unintentional disturbances can occur. For example, every effort will be made to avoid nest and den sites. However, should a field crew happen upon nests or dens, the coordinates will be recorded (of where the field crew was when the discovery is made) and the crew will immediately vacate the area. These areas will be avoided until they are no longer being inhabited. These encounters will be reported immediately to the GN and to the Kivalliq Inuit Association. All unintentional disturbances, no matter what the nature, will be reported immediately and will be documented in the annual report.

Monitoring is an important part of any activity. Exploration is dynamic and continually changing. Every field season is different and work is conducted in different areas each year. The only constant location known for an exploration program is the camp location. Drill sites, sampling locations and prospecting changes from year to year. All drill sites, the camp, field

crews and the helicopter pilot will have wildlife sighting sheets that they are required to fill in. These locations will be reported each year as part of the Annual Report. See Appendix V for the wildlife sightings sheets.

Additional procedures and practices are to be followed to minimize impact on wildlife:

- **Approaching and feeding wildlife is prohibited.** Montego has made commitments to communities and regulatory agencies that wildlife will not be harassed or disturbed. These commitments are also part of the Terms and Conditions provided by regulatory authorities in our LUPs and Water License.
- **Harassment of all wildlife is strictly forbidden by all individuals conducting business on behalf of Montego.** Appropriate measures will be taken to penalize any individual(s) who have been involved in such activities.
- **Sightings of wildlife are to be recorded on the wildlife sheets provided**. This is a requirement for our conducting exploration in the Kitikmeot Region. This information is reported by Montego to all regulatory agencies in annual reports. Wildlife sighting sheets will be posted at the drill site(s), camp kitchen, and helicopter, and in the camp office. Field crews will also carry wildlife sighting sheets with them in their field books. This information will be entered in to a master spreadsheet which will comprise part of the annual report. Refer to Appendix V for a wildlife sighting sheet.
- **Firearms may be carried for safety reasons**, but only if such firearms are properly registered (to be verified by the Technical Advisor) and stored in accordance with applicable legislation. A secure lock & key gun case is kept by the Site Manager for storage of all firearms at camp. Carrying a firearm must first be acknowledged by the Technical Advisor and the Site Manager. All such firearm discharges must be reported to the Technical Advisor and the Site Manager.
- **Hunting of wildlife, while conducting business on behalf of Montego, is strictly forbidden by ALL Montego employees.** The regulatory agencies have made this a Term and Condition as part of our LUPs. There are NO exceptions to this rule.
- **Low-level aircraft and helicopter flights must make efforts to avoid areas which are crucial nesting and denning habitats.** Prior to conducting any low-level airborne geophysical surveys the Technical Advisor must be contacted. Helicopters will not land in any area where wildlife are present unless under an emergency situation. Should an emergency situation arise this will be documented and reported to the appropriate regulatory agencies and will be noted in the annual report.
- **Nuisance wildlife is to be reported immediately**. Proper food storage and handling of cooking wastes will prevent problems with attracting wildlife. All wastes will be stored such that they are not accessible to any wildlife until such time that they can be appropriately disposed of. Should any wildlife become a nuisance, the GN Wildlife Biologist and the Kivalliq Inuit Association will be notified immediately. Table 1 provides emergency contact numbers.
- **All human-bear interactions are to be reported immediately** to the Project Manager, who will then contact the Kivalliq Inuit Association, the Government of Nunavut-Department of Wildlife, Environment Canada, the Nunavut Impact Review Board, and HTO's. A copy of the Bear Safety material is located in the office at the camp and in the office in Vancouver (see Appendix I). Employees and contractors are given an orientation when they arrive at site which includes information on working safely in bear country.

- **The Kiyuk Lake Project is within the range of the barren-ground caribou and special considerations are required** so as to avoid disturbance of migrating and calving herds. In keeping with the Caribou Protection Measures (Appendix III), Montego will cease all activities when caribou are present and will not resume activities until the caribou have moved safely out of the area. This includes drilling, operation of snowmobiles and/or ATV's, low-level airborne surveys, mapping, prospecting, sampling, etc. When caribou are present in the area around the camp, the camp will go on "quiet mode" with no flights and no activity UNLESS IN AN EMERGENCY SITUATION. Personnel will be encouraged to remain quiet and out of sight. Absolutely no activities will be conducted that will obstruct or divert caribou. No drilling will be conducted within 5 kilometres of a designated caribou crossing and no camp will be constructed or blasting occur within 10 kilometres of a designated caribou crossing, DURING ACTIVE MIGRATION TIMES.
- **No eggs or nests are to be disturbed by any activities.** If an employee or contractor comes across any active nests, they are to cease all activities immediately to ensure that the nest is not disturbed. Coordinates are to be recorded on the wildlife sighting sheets. These coordinates are to be reported to the Project Manager who will contact Environment Canada. Work will not resume until the nest is no longer occupied, mid to late July. Moving or disturbing the nest of a migratory bird is in contravention of the *Migratory Birds Convention Act.*
- **Den sites will be avoided.** All den sites are to be avoided. If a den site is discovered, the GPS coordinates will be recorded so that the site can be avoided. These coordinates will be provided to the appropriate regulatory authorities. No dens are to be disturbed. Any exploration activities will cease immediately.
- **The following buffers** are provided (by the Government of the Northwest Territories) for active dens between the den and all exploration activities between May 1st and July 15th:
    - Wolves 800m buffer
    - Grizzly Bear 300m buffer
    - Wolverine 2km buffer
    - Fox 150m buffer

Table 1: Wildlife Emergency Contact Information

NAME	POSITION	CONTACT INFORMATION
Mitch Campbell	GN Wildlife Manager, Arviat	867-857-2828
Sarah Medill	GN Wildlife Deterrent Specialist, Igloolik	867-934-2075
	GN Conservation Officer, Arviat	867-857-2976
Luis Manzo	KIA Director of Lands, Rankin Inlet	867-645-5731
Veronica Tattuniee	KIA Lands Administrator, Kugluktuk	867-645-5734
Stephen Hartmann	KIA, Senior Environmental Officer, Rankin Inlet	867-983-2458
Christopher Pennimpede	Montego Diamonds, Technical Advisor	778-241-0170
Andy McMullan	BEARWISE	867-766-4847

3.2 Species at Risk:

The Nunavut Impact Review Board (NIRB) and Environment and Climate Change Canada (ECCC) have indicated that there may be Species at Risk within the Kiyuk Lake Project. Table 2 lists the species identified by NIRB and ECCC within the area of the Kiyuk Lake Project.

Table 2: Species At Risk - Area of Kiyuk Lake Project

Terrestrial Species At Risk	COSEWIC Designation	Schedule of SARA
Caribou (*Rangifer Tarandus*), Barren-ground population	Threatened	No schedule
Grizzly Bear (*Ursus arctos*)	Special Concern	Schedule 1
Horned Grebe (*Podiceps auritus*)	Special Concern	Schedule 1
Red Knot (*rufa* subspecies)	Endangered	Schedule 1
Red-necked Phalarope (*Phalaropus lobatus*)	Special Concern	No schedule
Rusty Blackbird (*Euphagus carolinus*)	Special Concern	Schedule I
Short-eared Owl (*Asio flammeus*)	Special Concern	Schedule 1
Transverse Lady Beetle (*Coccinella transversoguttata*)	Special Concern	No schedule
Wolverine (Gulo gulo)	Special Concern	Schedule 1

If any of these species are sighted the information will be recorded using the wildlife sighting sheets and will be reported. Fact sheets, where available, on these species are included in Appendix IV. Recovery Plan documents, where they exist, will be reviewed and will be available in the field.

4.0 AQUATIC LIFE

Working in and around water bodies must be done in such a way that prevents disturbance to aquatic life and habitat.

- **Fishing while conducting business on behalf of Montego is strictly forbidden**. There are no exceptions to this rule.
- **The drill contractor is responsible for proper testing of ice-thickness prior to moving heavy equipment across water bodies and prior to drilling on ice.** Until testing is done so, any activities on the ice will be suspended.
- **Waterlines must be properly placed and screened** in accordance with the *Freshwater Intake End-of-Pipe Screen Guideline* (DFO) (Appendix II).
- **No wastes are to enter any water bodies.** This includes any discharge from the camp facilities.
- **All sumps, fuel caches and camps must be located at least 31 metres from the high water mark** of any water body unless otherwise approved by the appropriate regulatory authority.

Montego provides environmentally friendly laundry detergent, shampoo, conditioner, shower gel and soap for all employees and contractors. The use of these products is strongly encouraged.

5.0 ARCHAEOLOGICAL SITES

During field programs, care will be taken to be observant of possible archaeological sites. Cultural objects, remains and sites of spiritual, archaeological, anthropological or historical significance may be encountered and will require additional study and protection. Should any sites be encountered, the sites must be left undisturbed and reported to the appropriate authority. Follow-up Heritage Resources Impact Assessment studies are recommended.

APPENDIX I

WORKING IN BEAR COUNTRY
(A script for the *Working In Bear Country* DVD)

Safety in Bear Country Society

Script of the Video Module

WORKING IN BEAR COUNTRY

Working in Bear Country, provides advice and illustrates techniques for industry managers and supervisors. This video is not a stand-alone educational tool. It is essential to be familiar with the content of Staying Safe in Bear Country before viewing Working in Bear Country.

We cannot ensure the advice in these videos will prevent you from being harmed by a bear but the content may help you reduce your risks. If people understand and apply a few safety principles a much greater degree of co-existence with bears is possible.

While this video provides knowledge and planning tools for working in bear country, it should not replace site visits by qualified wildlife personnel who can provide specific and detailed advice regarding site planning, attractant management, and deterrent and firearm training. When working in bear country, your actions can either prevent or possibly create problems with bears.

This program is divided into the following sections:

1. Field Safety, including
   a) Employee Responsibilities
   b) Helicopter Support
2. Camp Safety, including
   a) Location & Design
   b) Attractant Management
3. Detection Systems,
4. Bear Deterrents,
5. Firearms, and
6. Bear Response Planning.

Field Safety

Employee Responsibilities

First, let's take a look at field safety and employee responsibilities. All camp and field personnel should be familiar with the content of Staying Safe in Bear Country. You may choose to have some personnel watch relevant sections of this video as well. Get everyone thinking about bear safety so they can take responsibility for their own actions.

Keeping everyone aware and alert is your best defence against bear problems. Consider the

following when planning for employee safety in the field: Communication is important. Establish a system where employees must report where they will be working and when they are coming back. Check out and check in. Use portable communication devices such as a radio or satellite phone. Get people in the habit of recording and reporting bear sign and sightings. Share this information with others working in the area.

It's advisable to have field crew's work in pairs and watch out for each other. Lunches should be carried into the field in airtight containers and garbage packed back to camp for proper disposal.
Make sure no one shares their lunch with the local wildlife.

Equipment noise won't always keep bears away, and in some cases may even attract a curious bear. Workers should be extra cautious in logging slash and recent burns. The thick new growth of fruit-bearing shrubs, during the early stages of regeneration, can produce excellent food and cover for bears. Consider having field crews carry bear deterrents and make sure they know how to use them.

Helicopter Support

Helicopters have become an important part of fieldwork in remote areas and can be used to increase personnel safety in bear country. During the pre-flight briefing, employees must tell the pilot if they are carrying bear spray or deterrent devices. Ideally, bear spray should be stored in an airtight container and transported in the baggage compartment. Accidental discharge of bear spray inside the cabin could disable the pilot. When dropping off field workers, have the pilot fly their planned ground route, from pickup point to drop off point, so they can look for bears and potential problem areas. Above the drop off point, the pilot should circle the area to look for bears. Crews should work in an alternate area if a bear hazard is identified. If field crews can not avoid working near a potential bear hazard, the helicopter must stay with them. Have the pilot exit drop-off sites along the field crews planned route, keeping an eye out for bears. If a bear is spotted, the pilot must alert the field crew. It is illegal to harass wildlife with aircraft, but, occasionally, and only for reasons of human safety, it may be necessary to "push" a bear using a helicopter. To stress the bear as little as possible, the pilot should stay well back from the bear, not fly over it, and only push it until it moves off.

Camp Safety

Location and Design

Now let's talk about preventing bear problems around camp starting with camp location and design. Camps can range in size from a small two-person camp to a substantial industrial installation. Although different in scale, potential problems and their solutions are similar. After consulting with local wildlife personnel, scout a camp location with bears in mind. Identify and avoid natural wildlife travel routes and bear feeding areas. Choose as open a site as possible that does not have excessive natural sound, which can make it difficult for bears and people to detect each other. Once the site is selected, camps should be laid out so tents or buildings are well spaced, in a straight line or a semi-circle. This gives a bear an avenue of escape and allows you to use deterrents or firearms more safely. Cooking and food storage sites should be separate, yet visible from sleeping areas and preferably downwind. Try to prevent surprise encounters with bears. Eliminate places that may conceal bears, such as blind corners or clumps of vegetation.

Skirting attached to buildings and elevated walkways will prevent bears from taking refuge under them. Provide lighting at building exits, along pathways and at outside work areas so people can move about camp more safely after dark. A window in a door, or next to it, allows people to check for bears before exiting. Larger buildings should have more than one exit.

Attractant Management

All camps, regardless of size, have to deal with the management of substances that might attract bears, especially food and garbage, grey water, sewage, and petroleum products. Most bear problems and encounters occur around camps that fail to manage these attractants carefully ... the consequence is usually a dead bear. Bears can smell odours at long distances. Minimizing odours makes camps safer.

Food Odours

In small camps left empty during the day, store food in bear-proof containers. If possible, hang food containers or store them in a cache at least 4 meters above the ground. In larger camps food should be stored indoors. Bears and other wildlife will easily find food stored outdoors. Defrost meats inside the fridge, not on the counter top. Cooking grease is a powerful bear attractant and requires special attention. Do not store excess cooking grease; incinerate it immediately after a meal.

Garbage Odours

Discarded food waste and packaging is a strong bear attractant. Badly managed garbage has resulted in human injuries as well as unnecessary bear deaths and extensive property damage. Proper garbage management is crucial to camp safety. High temperature incineration is the most effective way to destroy garbage and its odours. An ordinary 45-gallon drum with the top removed is not an incinerator! Without excessive amounts of fuel and constant labour, garbage burned in these drums is simply scorched and odours are sent far and fast to bears in the area. 45-gallon drums can be converted into small-scale incinerators using a simple conversion-kit, which produces an effective burning chamber with a proper fuel and oxygen supply. Semi-permanent camps should use oil-fired, forced-air incinerators located close to the kitchen. In permanent camps, such an incinerator should be located in the same building as the kitchen. Regardless of camp size or type of incinerator, incinerate garbage after every meal. If you can't incinerate garbage on site, store it in a bear resistant container and transport it to the nearest facility for proper disposal. Do not bury it, bears will only dig it up.

Grey Water Odours

Many people give little or no thought to grey water as a bear attractant. This waste water from kitchen sinks, showers, basins, and washing machines combines the odours of cooking grease, food particles and soaps. To a bear, the smell of untreated grey water... advertises your camp as a potential food source. Grease traps are simple devices added to your grey water discharge lines that allow the recovery and incineration of food particles and cooking grease. A regular sprinkling of chlorinated lime in the sump can help mask odours. Long-term camps should treat grey water along with sewage in approved waste treatment systems.

Sewage Odours

Consult with local health, land and water authorities for advice on which sewage treatment system will be most effective for your situation. Whether outhouses or commercial sewage treatment systems are used, proper maintenance is required to prevent these from becoming bear

attractants.

Other Camp Odours

Bears are attracted by many odours such as lubricating oils, anti-freeze and other chemicals. Store them to minimize odours and where bears and other wildlife cannot get into them. Any fuel can also be a bear attractant. Check for leaking drums and clean up any spills immediately. Before closing a camp for a portion of the season, clean the kitchen thoroughly, treat grey water pits and latrines with lime and inspect the entire camp for attractants. Don't leave food in the camp unless it's properly stored in bear-proof containers.

Detection Systems

An effective detection system sounds an alarm and warns of a bear's approach giving you time to assess the situation, and take action. The bear alarm must sound distinctly different from a fire alarm or any other warning signals. Three common detection systems are trip-wire fencing, motion alarms, and dogs.

1. A trip-wire fence is portable, and easy to set up around a small camp. A distance of 10 metres from all sides of the camp is recommended for adequate response time.
2. Infrared beams or motion detectors can create an invisible fence linked to lights and alarms. These sensors can detect bears up to 10 metres and the alarm may be enough to scare a curious bear away from a small camp left vacant for the day. Trip wires and motion detectors can be set off by smaller animals, a warning of potential attractant problems.
3. A trained dog working with an experienced handler can be useful for detecting and deterring bears. These dogs must be on a leash or chained. A dog roaming miles away is of little use if a bear shows up and the dog may harass local wildlife or aggravate a bear. Be realistic about the dog's training and behaviour. Dog food can be an attractant. Do not leave uneaten dog food out overnight. Don't over feed the dog... it will cache extra food around your camp.

Even with a reliable detection system, stay aware of your surroundings. Every system is prone to human error and technical failure. Maintain your efforts to minimize the attractants in your camp.

Bear Deterrents

Deterrents have two basic purposes: 1) The short-term protection of people and property, and 2) The long-term goal of teaching bears to avoid humans and areas of human activity.

Air horns and explosive devices fired from specialized launchers and 12 gauge shot guns produce loud noises that can deter a bear. One example of a noise-making device is the 12 gauge Shell Cracker that travels up to 65 meters before exploding. Make sure that the bear is not closer than 65 meters. If the explosive lands behind the bear the blast may drive the bear toward you.

Noise-makers may become less effective with repetitive use. Sometimes it takes more than a noise to deter a bear. It may be necessary to use a non-lethal projectile designed to inflict pain but not penetrate the hide or injure the bear. Two types of non-lethal projectiles fired from a 12-guage shot gun are rubber slugs, effective to 40 meters, and bean bags, which are limited to 20 meters or less. Load deterrent cartridges directly into the chamber of an open-choked shotgun. Do not place them in the magazine or use them in a semi-automatic shotgun. Before using these deterrents, let the bear know your location. Be careful not to startle a grizzly bear at close range.

Be sure the bear has a clear path of escape and have an experienced person with a loaded firearm as backup. Aim projectile deterrents at a large muscle mass such as the shoulder or rump.

Training and practice is necessary to use deterrents safely and with confidence. Read and follow the manufacturer warnings and instructions. Be prepared to deter any bear that approaches camp and deter the bear every time it returns. A bear that has obtained human food or garbage may be difficult to deter. Eliminating the food reward that attracted the bear is critical to the success of deterrent efforts.

A well-maintained electric fence is an effective method for excluding bears. Both light gauge temporary and more permanent high tensile fencing can be used in a variety of applications. Multiple strands of alternating positive and negative charged wires deliver a shock to a bear even in very dry soil conditions.

Even with the best prevention measures in place, remote camps should have at least one firearm on site capable of killing a bear that presents a serious and immediate threat to human safety. One person should be responsible for firearms and their maintenance. A short-barrelled, 12-gauge pump or hinge action shotgun can provide reliable bear protection at close range when used with slugs. A high powered rifle – 30 calibre or larger, with 200 grain soft point ammunition is also an option for those who are competent with it. A firearm is not a substitute for other preventative measures or proper camp management.

Bear deterrents and firearms have regulations governing their use, storage, and transportation. Plan in advance of your field season; find out from local authorities what is allowed in the area you plan to work and what permits you'll need.

Bear Response Planning

All work sites should have a response plan for dealing with bears. Everyone on site should understand the plan and know their role. At large sites an assigned response team may be necessary for handling bear problems. Good communication is critical. It's everyone's responsibility to immediately report a bear's presence to the response team. The response team would then be responsible for letting others know and, if necessary, restricting activities in the area. Other team duties can include:

- the maintenance of detection and deterrent equipment,
- monitoring bear activity in the vicinity of camp,
- compiling and reporting bear problems to the nearest wildlife office, and
- deterring, and if necessary, destroying a bear. If a bear must be killed in defence of life or property, follow the legal requirements. These vary so check with local authorities.

Conclusion

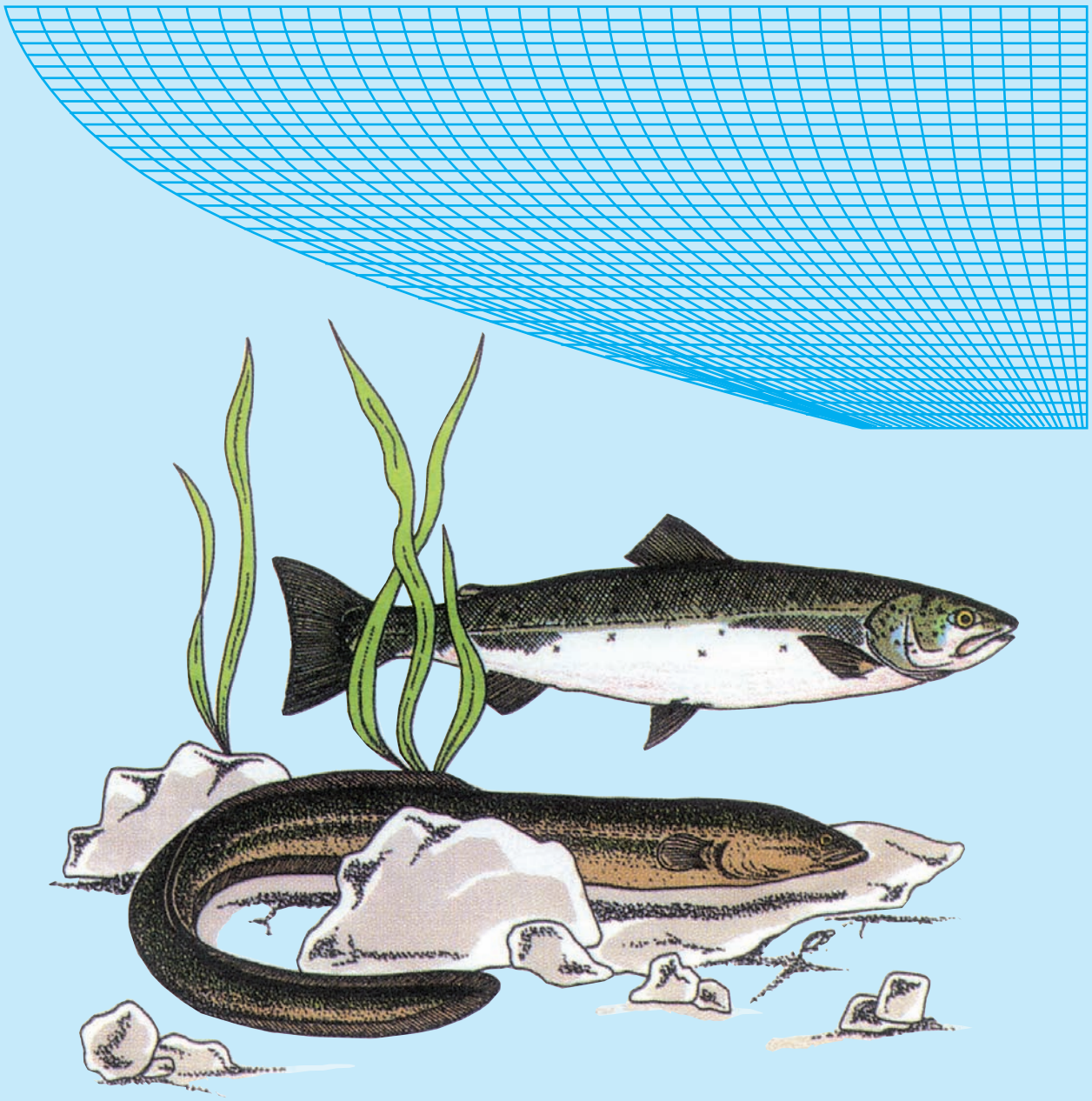
Plan to work safely in bear country. The wisest and most economical approach is to actively practice prevention. Remember when working in bear country everyone has the responsibility to prevent conflicts; for reasons of human safety as well as for the conservation of bears.

APPENDIX II

FRESHWATER INTAKE END-OF-PIPE SCREEN GUIDELINE (DFO)

Department of Fisheries and Oceans

Freshwater Intake End-of-Pipe Fish Screen Guideline



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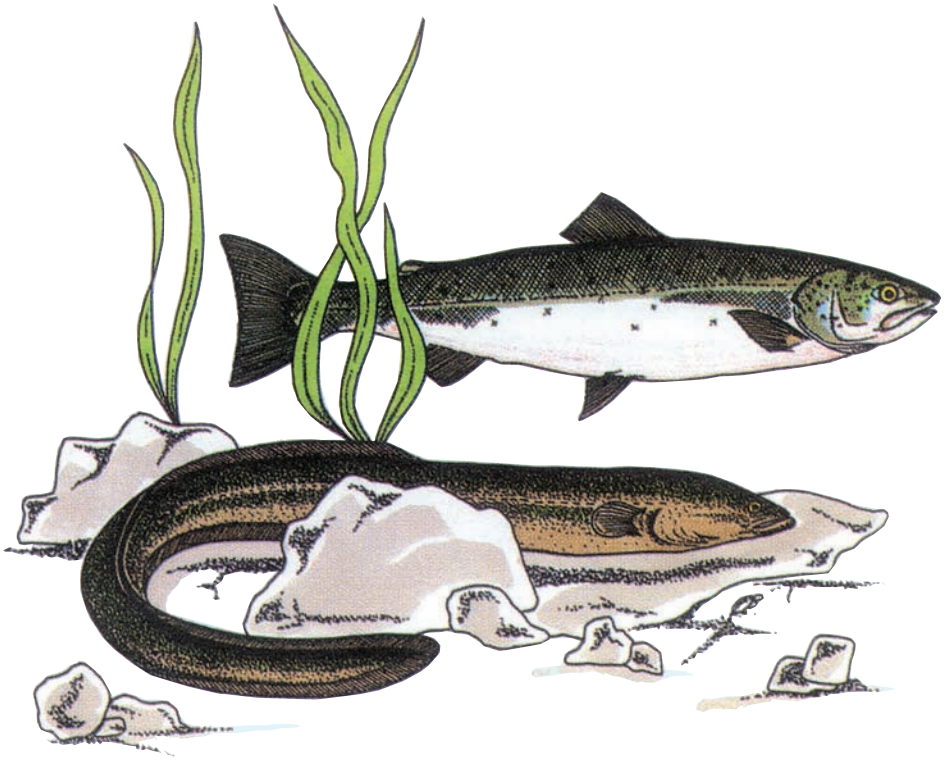
Canada

Department of Fisheries and Oceans

Freshwater Intake End-of-Pipe Fish Screen Guideline



Fisheries and Oceans Pêches et Océans

Canada

Published by:

Communications Directorate
Department of Fisheries and Oceans
Ottawa, Ontario
K1A OE6

DFO / 5080

ISBN 0-662-23168-6

Catalogue No. Fs 23-270 / 1995E

Printed on recycled paper

Table of Contents

List of Figures

List of Tables

1.0 Introduction

The Department of Fisheries and Oceans (DFO) has prepared the **Freshwater Intake End-of-Pipe Fish Screen Guideline** to assist proponents in the design and installation of fish screens for the protection of anadromous and resident fish where freshwater is extracted from fish-bearing waters. This guideline will also assist regulatory agencies in the review of fish screen proposals.

A requirement for fish screening is stated under Section 30 of the *Fisheries Act*, where every water intake, ditch, channel, or canal in Canada constructed or adapted for conducting water from any Canadian fisheries waters must provide for a fish guard or a screen, covering, or netting over the entrance or intake so as to prevent the passage of fish into such water intake, ditch, channel or canal. Other sections of the *Fisheries Act*, or other Federal, Provincial, or Municipal Legislation and Policy may also apply to associated water extraction activities. Proponents are advised to contact the appropriate regulatory agencies regarding approvals or permits.

2.0 Guideline Objective

The objective of the guideline is to provide a National standard-of-practice and guidance for end-of-pipe fish screens at freshwater intakes to prevent potential losses of fish due to entrainment or impingement. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. The severity of the impact on the fisheries resource and habitat depends on the abundance, distribution, size, swimming ability, and behaviour of the organisms in the vicinity of the intake, as well as, water velocity, flow and depth, intake design, screen mesh size, installation and construction procedures and other physical factors.

The **Freshwater Intake End-of-Pipe Fish Screen Guideline** deals exclusively with the sizing and design of fixed screens that are often placed at the end of a pipe used to extract water up to 0.125 m^3/s, or 125 litres per second (L/s) (i.e., 2000 US gallons per minute (US gpm)). The guideline is intended for use in addressing fish screens for small permanent and temporary withdrawals for irrigation, construction, small municipal and

private water supplies, etc. It is *not* intended for application to hydroelectric or canal screen designs; however, such proposals can be considered by regulatory agencies on a site-specific basis. The guideline focuses on the technical aspects of intake screens and the protection of fish rather than on policy, legislation, or environmental assessment processes and their application. This guideline has been developed to provide protection of freshwater fish with a minimum fork length of 25 mm (approximately 1 inch) since most eggs and fish larvae remain in bottom substrates until they reach the fry stage (i.e., 25 mm fork length). Other designs, in addition to intake screens, may be appropiate to address fish and fish habitat protection associated with water withdrawals. Such proposed designs should be addressed with the appropriate regulatory agencies on a site-specific basis.

3.0 Information Requirements for Evaluation of Intake Screens

Information that should be provided to facilitate evaluation of an end-of-pipe intake screen design intended for fish protection during a freshwater withdrawal is highlighted below. Types of information requirements that may also be applicable to the water intake project as a whole are identified in Appendix A.

- fish presence, species, and possible fish size or fish habitat conditions at the project site
- rate or ranges of rates of withdrawal from the watercourse
- screen open and effective areas
- physical screen open parameters with respect to the intake and the watercourse
- screen material, method of installation and supporting structures
- screen maintenance, cleaning, or other special requirements

4.0 Design, Installation, & Maintenance of Freshwater Intake End-of-Pipe Fish Sereens

The appropriate design of a fish screen is largely dependent upon the species and the size of fish requiring protection. Appropriate installation and maintenance/cleaning of the screen are also important in keeping approach velocities low and ensuring satisfactory operation of the screen. For the purposes of this guideline, emphasis is placed on the protection of freshwater fish with a minimum fork length of 25 mm from entrainment and impingement due to water extraction activities. Depending upon site-specific circumstances, a case may be made whereby the minimum fork length size of fish to be protected is greater than 25 mm. In this instance, the fish screen criteria for open screen area (Table 2 and Figure 1) and screen mesh size (2.54 mm) presented here do not apply. Fish screen criteria and guidance for the protection of fish larger than 25 mm is provided by Katopodis (1992).

The following sections address the appropriate design of fixed freshwater intake end-of-pipe fish screens for the protection of fish with a minimum fork length of 25 mm. Guidance on

installation, cleaning, and maintenance is provided. Common types of intake screens and associated intakes are also presented. Appendix B presents a sample calculation utilizing the guideline to determine the appropriate end-of-pipe intake screen size for the protection of freshwater fish.

4. 1 Fish Screen Criteria

To protect fish from impingement or entrainment, the approach velocity (i.e., the water velocity into, or perpendicular to, the face of an intake screen) should not exceed certain values based on the swimming mode (i.e., subcarangiform or anguilliform) of the fish present in the watercourse. The subcarangiform group includes fish that swim like a trout or salmon, and move through the water by undulating the posterior third to half of their bodies. The anguilliform group includes fish that swim like an eel, and move through the water by undulating most or all of their body. Table 1 presents the swimming modes of most common fish species in Canada. Contact DFO or provincial fisheries agencies regarding fish species that are not included in Table 1.

Envelope curves for approach velocities were developed for each swimming mode corresponding to a minimum fork length of 25 mm and a maximum endurance time of 10 minutes (the time the fish is in front of the face of the screen before it can elude it). To satisfy approach velocities of approximately 0.11 m/s and 0.038 m/s for the subcarangiform and anguilliform groups respectively, curves indicating the required open screen areas, based on fish swimming performance data, including fish species and size (Katopodis, 1990) and related to flows/extractions, were developed. Table 2 presents the required open screen area, in both metric and non-metric units, for end-of-pipe intake screens with a capacity up to 125 L/s (2000 US gpm). The open screen area is the area of all open spaces on the screen available for the free flow of water. The same information is presented graphically in Figure 1.

Table 1
Summary of Common Fish Species and Swimming Modes

SUBCARANGIFORM SWIMMING MODE

Common Name	Scientific Name
Alewife (Gaspereau)	*Alosa pseudoharengus*
Arctic Char	*Salvelinus alpinus*
Arctic Grayling	*Thymallus arcticus*
Atlantic Salmon	*Salmo salar*
Broad Whitefish	*Coregonus nasus*
Brook Trout	*Salvelinus fontinalis*
Brown Trout	*Salmo trutta*
Carp	*Cyprinus carpio*
Channel Catfish	*Ictalurus punctatus*
Chinook Salmon	*Oncorhynchus tshawytscha*
Chum Salmon	*Oncorhynchus keta*
Cisco	*Coregonus artedii*
Coho Salmon	*Oncorhynchus kisutch*
Cutthroat Trout	*Oncorhynchus clarki clarki*
Dolly Varden	*Salvelinus malma*
Goldeye	*Hiodon alosoides*
Green Sturgeon	*Acipenser medirostris*
Inconnu	*Stenodus leucichthys*
Kokanee	*Oncorhynchus nerka*
Lake Sturgeon	*Acipenser fulvescens*
Lake Trout	*Salvelinus namaycush*
Lake Whitefish	*Coregonus clupeaformis*
Largemouth Bass	*Micropterus salmoides*
Longnose Sucker	*Catostomus catostomus*
Mooneye	*Hiodon tergisus*
Mountain Whitefish	*Prosopium williamsoni*
Ouananiche	*Salmo salar ouananiche*
Pink Salmon	*Oncorhynchus gorbuscha*
Rainbow Smelt	*Osmerus mordax*
Rainbow Trout	*Oncorhynchus mykiss*
Sauger	*Stizostedion canadense*
Smallmouth Bass	*Micropterus dolomieui*
Sockeye Salmon	*Oncorhynchus nerka*
Walleye	*Stizostedio vitreum*
White Bass	*Morone chrysops*
White Perch	*Morone americana*
White Sturgeon	*Acipenser transmontanus*
White Sucker	*Catostomus commersoni*
Yellow Perch	*Perca flavescens*

ANGUILLIFORM SWIMMING MODE

Common Name	Scientific Name
American Eel	*Anguilla rostrata*
Burbot	*Lota lota*
Sea Lamprey	*Petromyzon marinus*

Note: The few data points available for Northern Pike *(Esox lucius)* are close to the anguilliform group.

4.2 Design of Fixed End-of-Pipe Fish Screens

Once the required open area has been found from Table 2 or Figure 1, the effective screen area must be calculated. It is the area occupied by the open spaces (i.e., open screen area) and the screen material available for the free flow of water. The effective screen area should be provided at the intake location and is determined as follows:

$$\text{Effective Screen Area } (m^2 \text{ or } ft^2) = \frac{\text{Open Screen Area (Table 2)}}{\left(\frac{\text{\% Open Area (Table 3)}}{100}\right)}$$

It should be noted that if the percent (%) open screen area is maximized, then the effective screen area required for a given flow is minimized. The narrowest dimension of any opening on the screen is referred to as the design opening, regardless of opening shape. The maximum design opening for a fish of 25 mm fork length is estimated at 2.54 mm (0.10 inches). Guidance on screen openings and materials is presented below.

- The screen openings may be round, square, rectangular, or any combination thereof, but should not have any protrusions that could injure fish.
- Screen materials may include brass, bronze, aluminum, monel metal, galvanized or stainless steel, and plastics. The screen material should be resistant to corrosion and UV light.
- Note: clogging due to corrosion is minimized with the use of stainless steel.
- Welded wedge wire screens offer reduced debris clogging and increased open area and screen stiffness, in comparison to round wire mesh and punch plate.

Table 3 presents several common types of screening material that meet the requirements of wire diameter, clear opening width and percent open area,

The dimensions of the fish screen can be calculated after the correct shape, configuration, location, and method of installation have been determined. This will usually be determined after a site investigation and a review of these guidelines. Included in Figure 2 are common screen shapes and the associated

Table 2
Open Screen Area Required for End-of-Pipe Water Intakes

Metric Units			Non-Metric Units		
Flow (L/s)	Subcarangiform (m^2)	Anguilliform (m^2)	Flow (US gpm)	Subcarangiform (ft^2)	Anguilliform (ft^2)
1	0.01	0.03	10	0.1	0.2
5	0.05	0.13	50	0.3	0.9
6	0.06	0.16	100	0.6	1.8
8	0.07	0.21	150	0.9	2.7
10	0.09	0.26	200	1.3	3.6
12	0.11	0.31	250	1.6	4.5
14	0.13	0.37	300	1.9	5.4
15	0.14	0.39	350	2.2	6.2
16	0.15	0.42	400	2.5	7.1
18	0.17	0.47	450	2.8	8.0
20	0.18	0.52	500	3.2	8.9
22	0.20	0.58	550	3.5	9.8
24	0.22	0.63	600	3.8	10.7
25	0.23	0.65	650	4.1	11.6
26	0.24	0.68	700	4.4	12.5
28	0.26	0.73	750	4.7	13.4
30	0.28	0.79	800	5.0	14.3
32	0.30	0.84	850	5.4	15.2
34	0.31	0.89	900	5.7	16.0
35	0.32	0.92	950	6.0	16.9
36	0.33	0.94	1000	6.3	17.8
38	0.35	0.99	1050	6.6	18.7
40	0.37	1.05	1100	6.9	19.6
45	0.42	1.18	1150	7.2	20.5
50	0.46	1.31	1200	7.6	21.4
55	0.51	1.44	1250	7.9	22.3
60	0.55	1.57	1300	8.2	23.2
65	0.60	1.70	1350	8.5	24.1
70	0.65	1.83	1400	8.8	25.0
75	0.69	1.96	1450	9.1	25.8
80	0.74	2.09	1500	9.4	26.7
85	0.78	2.23	1550	9.8	27.6
90	0.83	2.36	1600	10.1	28.5
95	0.88	2.49	1650	10.4	29.4
100	0.92	2.62	1700	10.7	30.3
110	1.02	2.88	1750	11.0	31.2
120	1.11	3.14	1800	11.3	32.1
125	1.16	3.30	1850	11.6	33.0
			1900	12.0	33.9
			1950	12.3	34.8
			2000	12.6	35.7

Table 3
Examples of Sereen Material

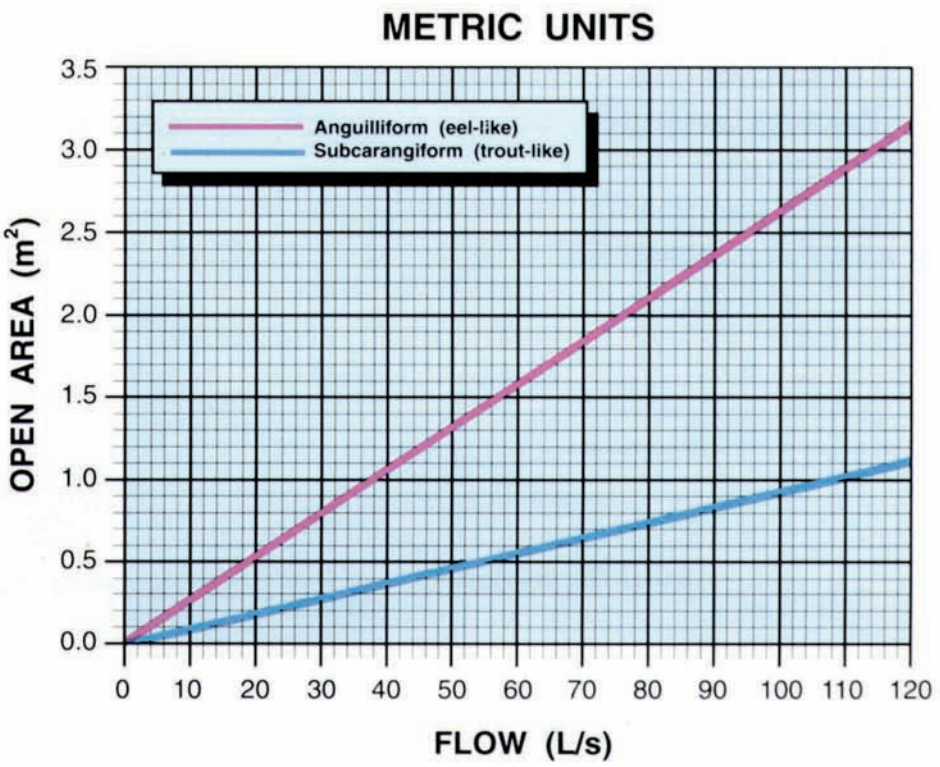
Material	Wire Thickness	Opening Width	% Open Area
8x 8 Stainless Steel Alloy Mesh	0.711 mm (0.028”)	2.44 mm (0.096”)	60
#7 Mesh Wire Cloth	1.025mm (0.041”)	2.54 mm (0.100”)	51
#8 Mesh Wire Cloth	0.875 mm (0.035”)	2.25 mm (0.089”)	52
#8 Mesh Wire Cloth	0.700mm (0.028”)	2.54 mm (0.100”)	62
#60 Wedge Wire Screen	1.50mm (0.059”)	2.54 mm (0.100”)	63
#45Wedge Wire Screen	1.10mm (0.080”)	2.54 mm (0.100”)	69

dimensions and area formulae. These are just examples of the many shapes and sizes in which fish screens can be fabricated. Screens are instream structures and, as such, should have sufficient strength and durability, and be capable of withstanding any potential large forces and impacts. Figure 3, 4, and 5 illustrate some of the various configurations, applications, and screen material types of end-of-pipe fish screens.

4.3 Installation

- Screens should be located in areas and depths of water with low concentrations of fish throughout the year.
- Screens should be located away from natural or man-made structures that may attract fish that are migrating, spawning, or in rearing habitat.
- The screen face should be oriented in the same direction as the flow.
- Ensure openings in the guides and seals are less than the opening criteria to make “fish tight”.
- Screens should be located a minimum of 300 mm (12 in.) above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
- Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.
- Large cylindrical and box-type screens should have a manifold installed in them to ensure even water velocity distribution across the screen surface. The ends of the structure should be made out of solid materials and the end of the manifold capped.
- Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially where there is debris loading (woody material, leaves, algae mats, etc.). A 150 mm (6 in.) spacing between bars is typical.

Figure 1
Open Screen Area for End-of-Pipe Water Intake Flow



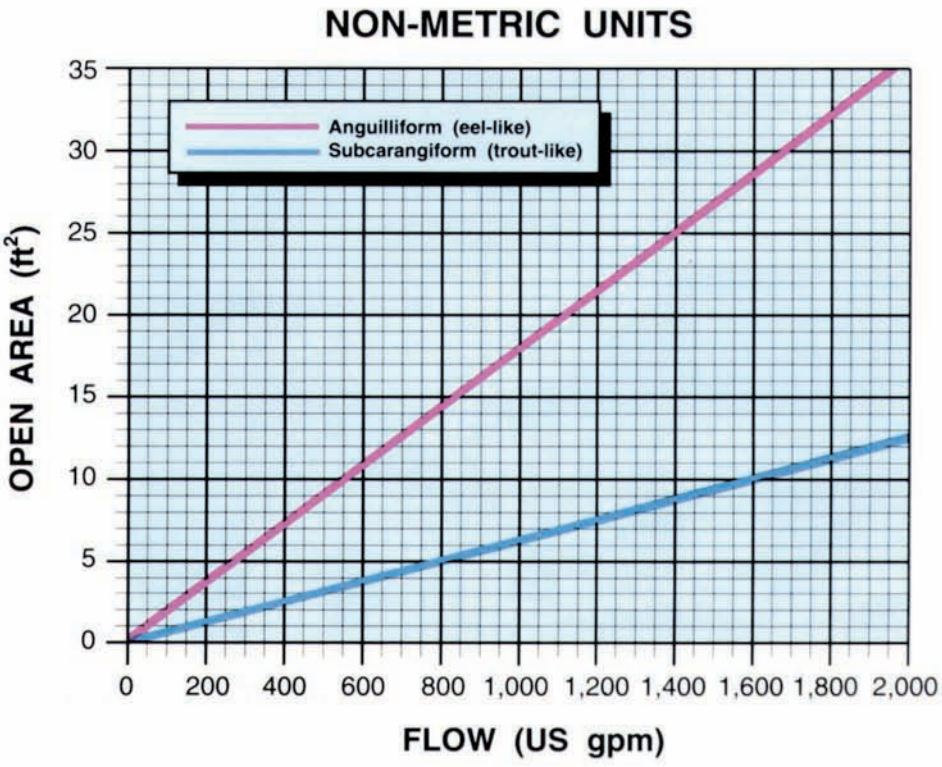
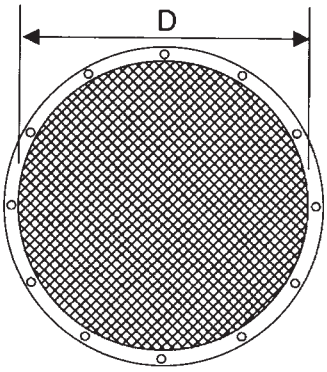


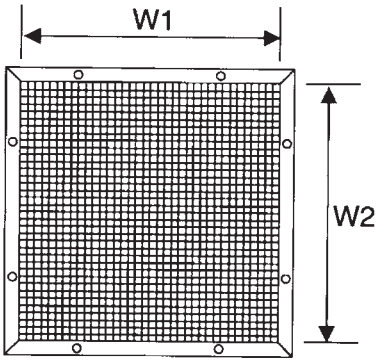
Figure 2
Common Screen Shapes and Area Formulae

CIRCULAR SCREEN



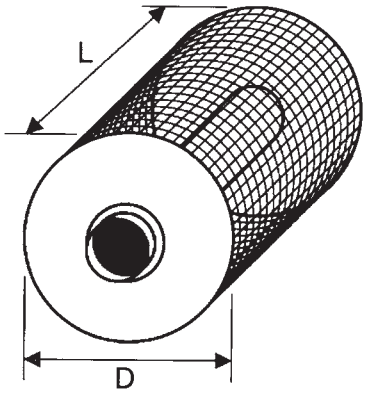
Area = $\frac{\pi}{4} D^2$

SQUARE SCREEN



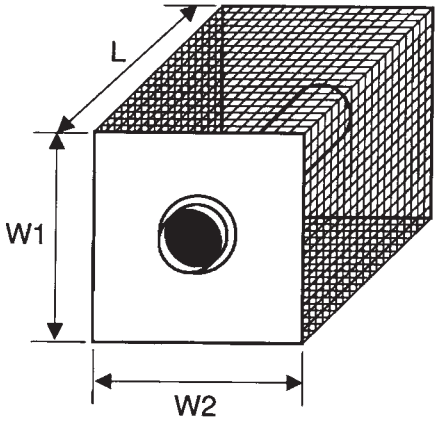
Area = W1 x W2

CYLINDRICAL SCREEN



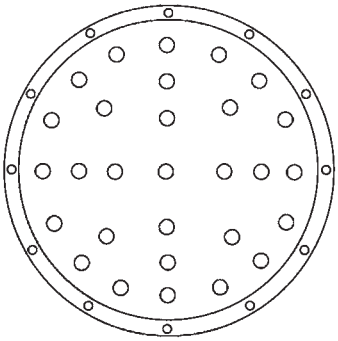
Area = πDL

BOX SCREEN

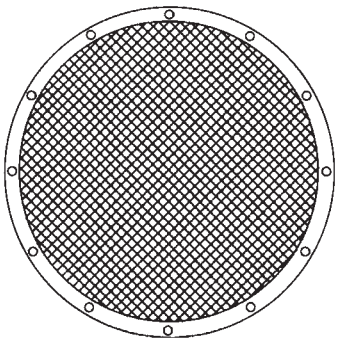


Area = 2L(W1 + W2)

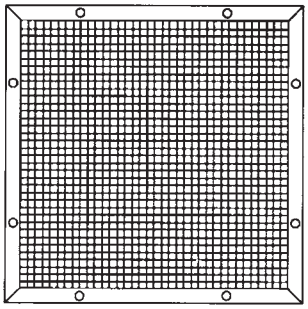
Figure 3
Typical Applications and Features of End-of-Pipe Screens



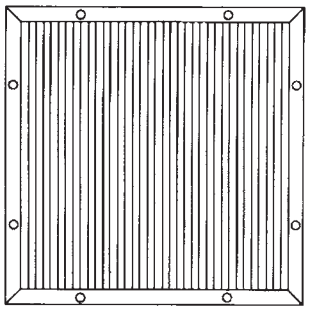
PERFORATED PLATE (PUNCHED)



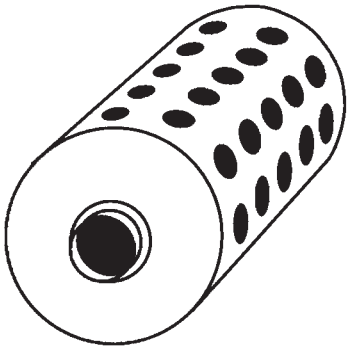
CIRCULAR MESH SCREEN



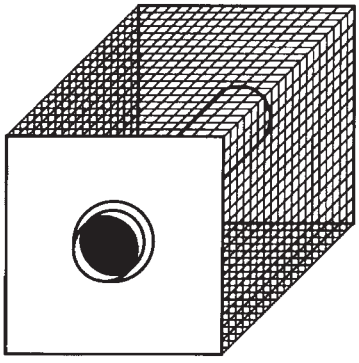
SQUARE MESH SCREEN



SQUARE WEDGE WIRE SCREEN

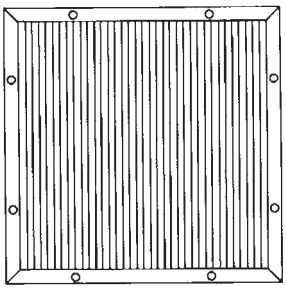


DRUM OR CYLINDER WITH PERFORATED PIPE

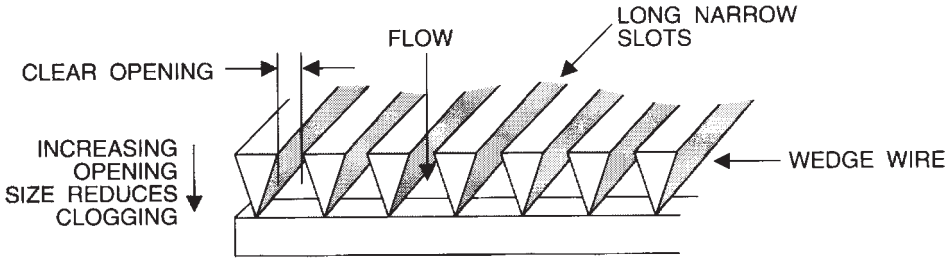


BOX-TYPE WITH MESH SCREEN

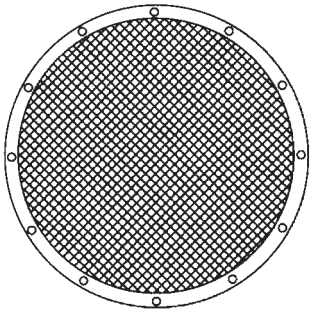
Figure 4
Examples of Typical Screen and Material Types



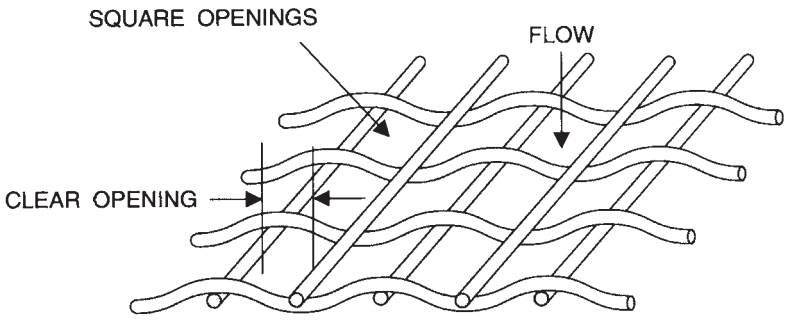
SQUARE WEDGE WIRE SCREEN



WEDGE WIRE PROFILE



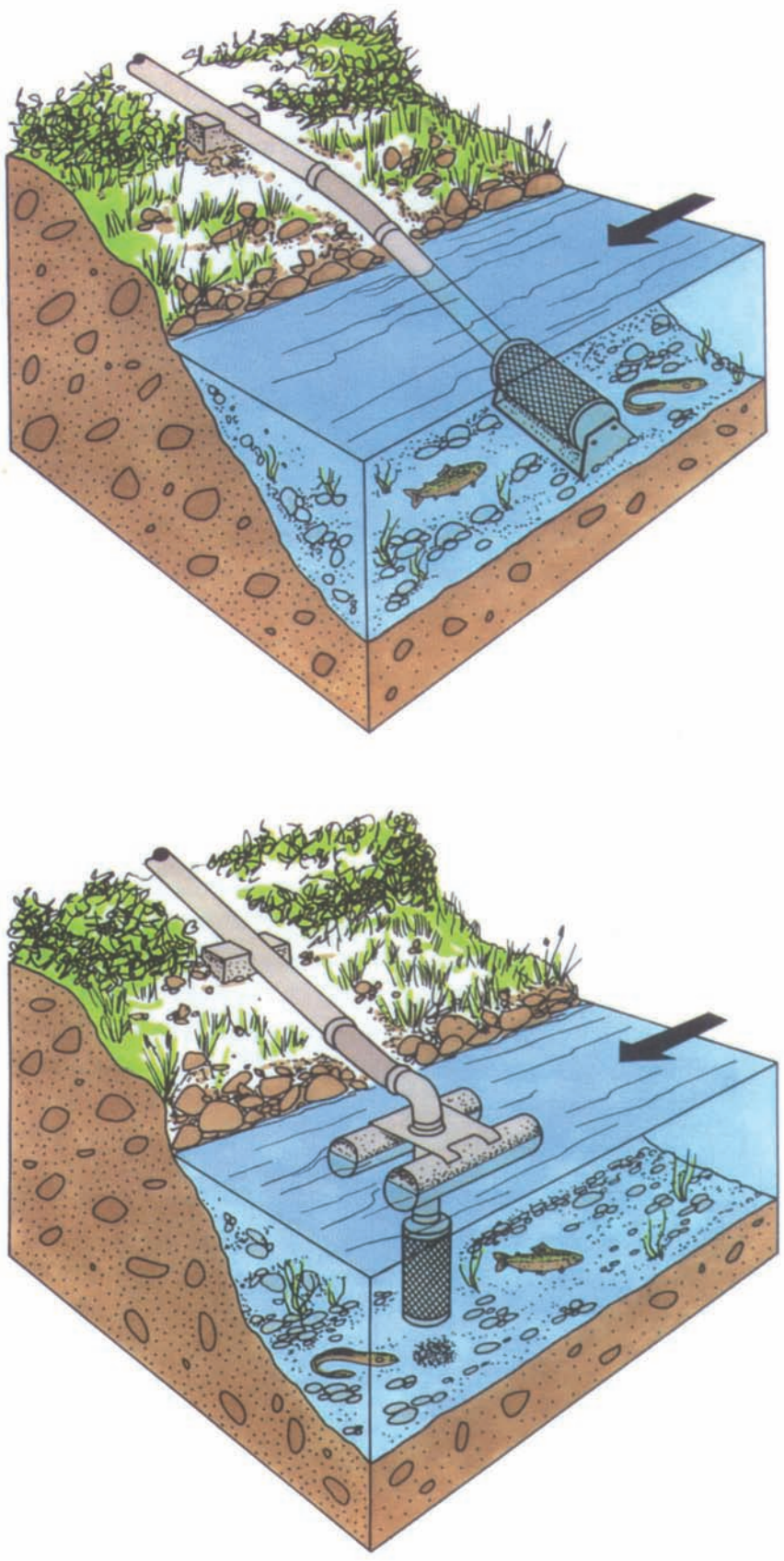
CIRCULAR MESH SCREEN

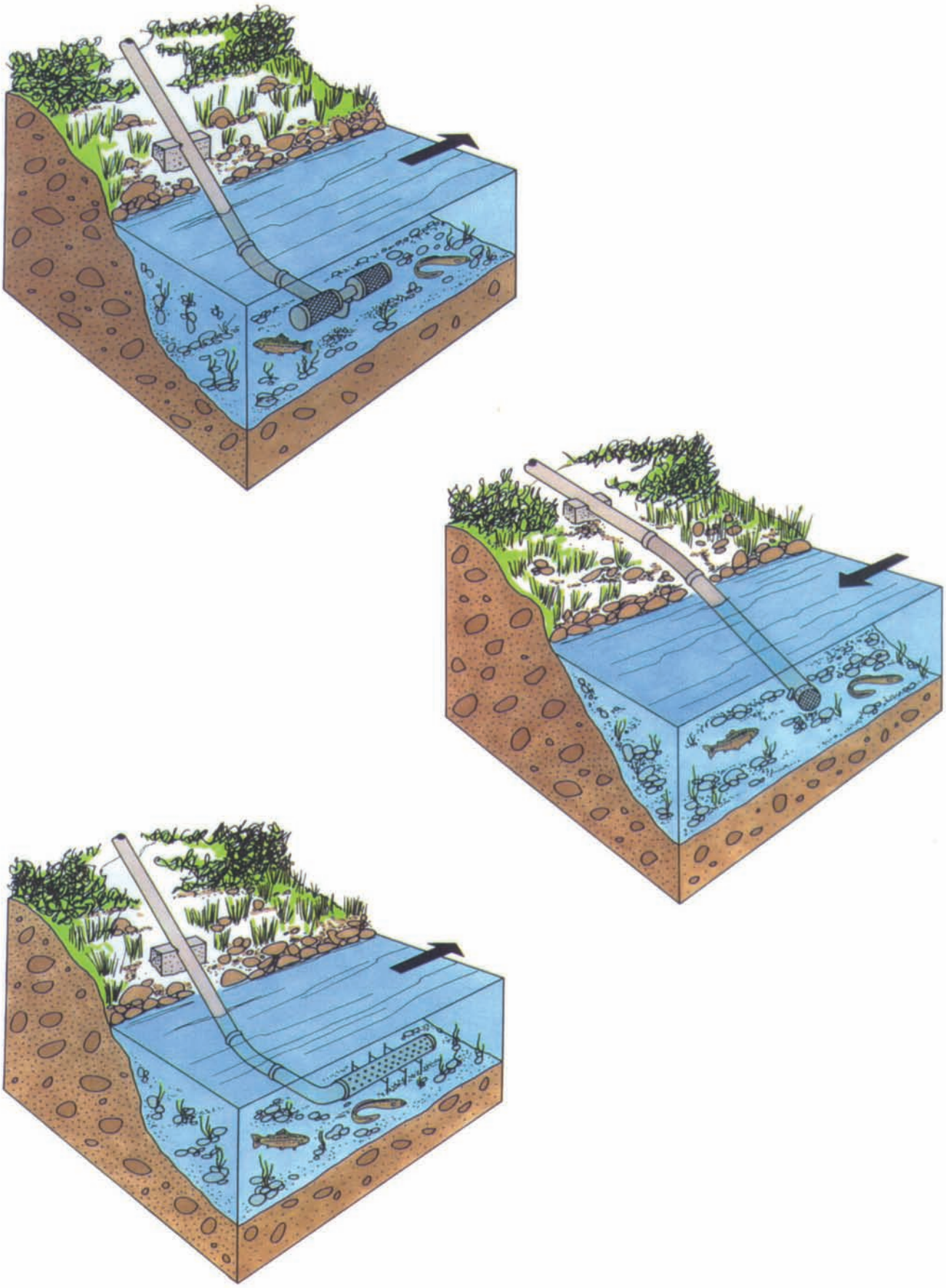


WOVEN WIRE MESH PROFILE

Figure 5

Examples of Typical Installations of End-of-Pipe Screen





4.4 Cleaning and Maintenance

- Provision should be made for the removal, inspection, and cleaning of screens.
- Ensure regular maintenance and repair of cleaning apparatus, seals, and screens is carried out to prevent debris-fouling and impingement of fish.
- Pumps should be shut down when fish screens are removed for inspection and cleaning.
- Screens may be cleaned by methods such as air or water, backwashing, removal and pressure washing or scrubbing.
- Under certain site-specific winter conditions, it may be appropriate to remove screens to prevent screen damage.
- Flexible suction pipe may be used instead of solid, fixed piping for ease of screen removal and cleaning.
- Pump suction pressure can be measured to assess the need for screen cleaning.

To facilitate intake screen cleaning/maintenance, design and installation features such as orientation of the screen (e.g., in a cove) or variation in mesh shape (i.e., square wire/bars versus round wire/bars), etc. may be considered for regularly cleaned screens. For screens that will not be cleaned regularly, provision of considerably more open screen area (e.g., four times more) than determined from Table 2/Figure 1 may be considered. Such design/installation features should be addressed with the appropriate regulatory agencies on a site-specific basis.

Appendix C presents a list of units of conversion.

For more information on the appropriate design of freshwater intake end-of-pipe fish screens, contact the nearest DFO office. In addition, a list of DFO Regional contacts is presented in Appendix D. Other appropriate regulatory agencies should also be contacted.

References

Fish Screening Directive. 1990. Department of Fisheries and Oceans, Ottawa, Ontario,

Katopodis, C. 1990. *Advancing the art of engineering fishways for upstream migrants.* Proceedings of International Symposium on Fishways '90, Oct. 8-10, 1990, Gifu, Japan, p. 19-28.

Katopodis, C. 1992. *Fish screening guide for water intakes*. Working Document, Freshwater Institute, Winnipeg, Manitoba.

Katopodis, C, 1994. *Analysis of ichthyomechanical data for fish passage or exclusion system design*. Proc. International Fish Physiology Symposium, July 16-21, 1994, Vancouver, B.C. American Fisheries Society and Fish Physiology Association.

Katopodis, C. and R. Gervais, 1991. *Icthyomechanics*, Working Document, Department of Fisheries and Oceans, Freshwater Institute, Winnipeg, Manitoba.

Glossary

Anadromous: Fish species that migrate from the sea to freshwater systems in order to spawn.

Anguilliform: The type of swimming mode for fish that swim like an eel, and move through the water by undulating most or all of their body.

Effective Screen Area: The area occupied by the open spaces (i.e., open screen area) and screen material available for the free flow of water.

Entrainment: Occurs when a fish is drawn into a water intake and cannot escape.

Fork Length: The straight line distance measured from the tip of the nose to the fork of the tail of a fish.

Impingement: Occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself.

Open Screen Area: The area of all open spaces on the screen available for the free flow of water.

Subcarangiform: The type of swimming mode for fish that swim like trout or salmon, and move through the water by undulating the posterior third to half of their body.

Appendix A Information Requirements

Appendix A Information Requirements

Types of information requirements that may be applicable to a freshwater intake proposal are highlighted below. While this listing is not intended to be all inclusive, it indicates information that may be necessary to enable regulatory agencies to review a water intake and fish screen proposal. The information highlighted below considers Section 30 and other sections of the *Fisheries Act* .These information requirements may also address other Federal, Provincial, and Municipal legislation and policies.

General and Site Information

- gazette or common name of the watercourse
- location of the watercourse
- type of watercourse (e.g., pond or stream)
- type of water intake
- other activities associated with the development or construction of the intake/screen structure

Biophysical Information

- fish presence, species, and possible fish size or fish habitat conditions at the protect site
- physical description of the watercourse at the intake site, including channel width and depth, direction and velocity of water currents, variations in wafer levels, sediment transport processes, lateral or channel grade movement, debris loading, etc.
- location and position of the intake within the watercourse, including dimensions, alignment, depth in the water column, wetted area, etc.
- description of the site features and characteristics, including site access

Water Use Information

- purpose of water withdrawal

- average rate, or ranges of rates, of withdrawal from the watercourse
- duration and lime of withdrawal
- estimates of ranges of flow (i.e., daily, weekly, monthly) in the watercourse during times of withdrawal with dates and times of year (with particular consideration to periods of low flow)
- expected effects of withdrawal on existing watercourse (e.g., drawdown, downstream dewatering, etc)
- description of structures or activities associated with the development of the intake
- whether the application is for a new intake, or re-development or upgrading of an existing structure

Other Information

- site plans/sketches indicating intake site and location (detailed on 1:50,000 topographic map)
- photographs/video of the site are often useful

Fish Screen Information

- screen open and effective areas
- physical screen parameters with respect to the intake and the watercourse
- screen material, method of installation and supporting structures
- screen maintenance, cleaning or other special requirements

Appendix B
Sample Calculation

A proponent wishes to withdraw water at a rate of 0.075 m^3/s from a nearby pond. The pond supports populations of brown trout, brook trout, and American eel. The intake is proposed to be cylindrical with the ends solid and #60 wedge wire screen around the cylinder.

What size must the intake screen be to satisfy the guideline requirements?

There are 4 steps to finding the answer:

1. Determine the fish swimming mode.
2. Determine the open screen area.
3. Determine the effective screen area.
4. Determine the dimensions necessary to produce the effective screen area.

1. Fish Swimming Mode

The fish swimming mode is found from Table 1. Brook trout and brown trout are listed as subcarangiform swimmers, while the American eel is an anguilliform swimmer.

2. Open Screen Area

Table 2 lists the required open screen area for both subcarangiform and anguilliform swimmers under flows up to 125 L/s (2000 US gpm). To use the table, if is necessary first to convert the flow from cubic metres per second to litres per second.

$$0.075 \frac{m^3}{s} \times \frac{1000\ L}{1\ m^3} = 75 \frac{L}{s}$$

For a flow of 75 L/s, Table 2 indicates that the open screen area must be:

- 0.69 m^2 for subcarangiform swimmers, and
- 1.96 m^2 for anguilliform swimmers.

The higher number (1.96 m^2) is the more stringent requirement, therefore, it is used in the calculation of effective screen area,

3. Effective Screen Area

The screen material in this case is # 60 Wedge Wire. A review of Table 3 indicates that the % Open Area for this material is 63%, With this value and the previously determined area from Step 2, the following formula is used to determine the Effective Screen Area.

$$\text{Effective Screen Area} = \frac{\text{Open Screen Area}}{\left(\frac{\text{\% Open Area}}{100}\right)}$$

$$= \frac{1.96\ \text{m}^2}{\left(\frac{63}{100}\right)}$$

$$= 3.111\ \text{m}^2$$

4. Dimensions of Intake Screen

Figure 2 lists several common screen shapes and their respective area formulae. For a cylindrical screen where the ends are solid and screening is around the cylinder, the following formula applies:

$$\text{Area} = \pi DL$$

The unknown dimensions are diameter (D) and length (L). These dimensions are determined by choosing a value for one and solving the equation for the other.

If the diameter is 0.600 m, then the length follows as:

$$\text{Area} = \pi DL$$

$$3.111\ \text{m}^2 = (0.600\ \text{m})L$$

$$3.111\ \text{m}^2 = (1.885\ \text{m})L$$

$$L = \frac{3.111\ \text{m}^2}{1.885\ \text{m}}$$

$$L = 1.65\ \text{m}$$

A 0.600 m diameter, 1.65 m long cylindrical screen would meet the design requirements. It should be noted that the dimensions given are representative of the screening area only; they do not include any screen that may be blocked by framing, etc. By comparison, if the pond only supported trout (subcarangiform), a 0.600 m diameter, 0.58 m long cylindrical screen would meet the design requirements.

Appendix C
Units of Conversion

To Convert	Into	Multiply By
cubic feet per second	cubic metres per second	0.0283
cubic feet per second	litres per second	28.3
cubic feet per second	US gallons per minute	448.9
cubic metres per second	cubic feet per second	35.3
cubic metres per second	US gallons per minute	15850
litres per second	cubic feet per second	0.0353
litres per second	cubic feet per minute	2.12
litres per second	cubic metres per second	0.001
litres per second	US gallons per minute	15.85
square metre	square foot	10.76
square metre	square inch	1550
square foot	square metre	0.0929
US gallons per minute	litres per second	0.0631
US gallons per minute	cubic feet per second	0.00223
US gallons per minute	Imperial gallons per minute	0.833
Imperial gallons per minute	litres per second	0.0758

Appendix D
DFO Regional Contacts

NEWFOUNDLAND REGION	Habitat Management Division P.O. Box 5667 St. John's NF A1C 5X1 Tel: 709-772-6157 Fax: 709-772-5562
GULF REGION	Habitat Management Division P.O. Box 5030 Moncton NB E1C 9B6 Tel: 506-851-6252 Fax: 506-851-6579
SCOTIA-FUNDY REGION	Habitat Management Division P.O. Box 550 Halifax NS B3J 2S7 Tel: 902-426-6027 Fax: 902-426-1489
QUEBEC REGION	Fish Habitat Management P.O. Box 15550 Quebec QC G1K 7Y7 Tel: 418-648-4092 Fax: 418-648-7777
CENTRAL & ARCTIC REGION	Habitat Management 501 University Crescent Winnipeg MB R3T 2N6 Tel: 204-983-5181 Fax: 204-984-2404
PACIFIC REGION	Habitat Management 555 W. Hastings St. Vancouver BC V6B 5G3 Tel: 604-666-6566 Fax: 604-666-7907

Local DFO offices should be contacted. Other appropriate regulatory agencies should also be contacted.

APPENDIX III

CARIBOU PROTECTION MEASURES

(from *Keewatin Regional Land Use Plan*, Appendix H)

Keewatin Regional Land Use Plan
Appendix H
DIAND Caribou Protection Measures

1. (a) The Permittee shall not, without approval, conduct any activity between May 15 and July 15 within the Caribou Protection Areas depicted on the map certified by the Engineer as the “Caribou Protection Map” and annexed to this Land Use Permit.
   (b) A Permittee may, upon approval by the Land Use Inspector, operate within the said Caribou Protection Areas beyond the May 15 deadline set out in 1 (a), provided that, when monitoring information indicates that caribou cows are approaching the area of operation, the Permittee will implement 1 (c).
   (c) On cessation of activities pursuant to 1 (a) or 1 (b), the Permittee will remove from the zone all personnel who are not required for the maintenance and protection of the camp facilities and equipment, unless otherwise directed by the Land Use Inspector.
   (d) The Permittee may commence or resume activities prior to July 15 within those parts of the Caribou Protection Areas released by the Land Use Inspector for the reason that caribou cows are not expected to use those parts for calving or post-calving (note 1).

2. (a) In the event that caribou cows calve outside of the Caribou Protection Areas, the Permittee shall suspend operations within the area(s) occupied by cows and/or calves between May 15 and July 15.
   (b) In the event that caribou cows and calves are present, the permittee shall suspend:
      (i) blasting;
      (ii) overflights by aircraft at any altitude of less that 300 meters above ground level; and
      (iii) the use of snowmobiles and ATVs (all-terrain vehicles) outside the immediate vicinity of the camp.
3. (a) During migration of caribou, the Permittee shall not locate any operation so as to block or cause substantial diversion to migration.
   (b) The Permittee shall cease activities that may interfere with migration, such as airborne geophysics surveys or movement of equipment, until the migrating caribou have passed.

4. (a) The Permittee shall not, between May 15 and September 1, construct any camp, cache any fuel, or conduct any blasting within 10 kilometres of any “Designated Crossing” as outlined on the map certified by the Engineer as the “Caribou Protection Map” and annexed to this Land Use Permit.
   (b) The Permittee shall not, between May 15 and September 1, conduct any diamond drilling operation within 5 kilometres of any “Designated Crossing” as outlined on the map certified by the Engineer as the “Caribou Protection Map” and annexed to this Land Use Permit.

KIA Sample Land Use Plan Caribou and Muskox Protection Conditions

35. The Permittee is given permission to conduct the approved land use operations between May 15 and July 15, provided that when caribou and muskox cows are approaching the area of operation, the Permittee shall cease blasting, overflights by aircraft at any altitude less than 300 meters above ground level, and the use of snowmobiles and ATVs (all-terrain vehicles) outside the immediate vicinity of the camp. Other activities shall also be suspended if the caribou approach the immediate vicinity of the specific operation and the monitoring work (described in another clause) indicates that there is stress on the animals.

36. During the presence of caribou and muskox within sight and sound of camp, all personnel will remain quietly in camp.

37. The Permittee may resume activities prior to July 15 if the caribou and muskox cows have ceased to use the area for calving and post-calving.

39. The Permittee shall not locate any operation so as to block or cause substantial diversion to migration of caribou.

40. The Permittee shall cease activities that may interfere with migration or calving, such as airborne geophysics surveys or movement of equipment, until the migrating caribou have passed.

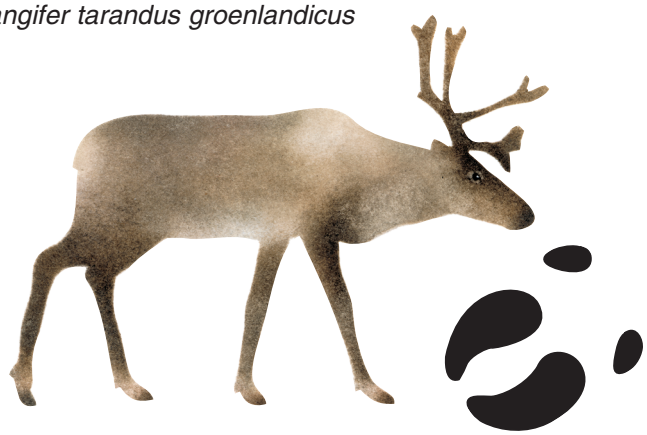
41. The Permittee shall not conduct any operation within 5 km of any “Designated Crossing” as outlined on the map annexed to this Land Use Permit.

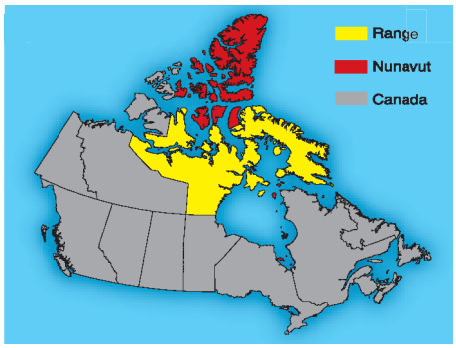
APPENDIX IV

SPECIES AT RISK FACT SHEETS

Barrenground Caribou

Rangifer tarandus groenlandicus





Range

Barrenground caribou are found throughout the mainland in the Kivalliq and Kitikmeot regions and most of Baffin. Several herds on the mainland winter in the forests south of Nunavut; while populations on the northern mainland and arctic islands occupy Nunavut's tundra year-round.

Appearance

Barrenground caribou are medium sized cervids that have adapted to a life spent in the cold. They have large, well-furred muzzles; and short, broad, furred ears. The have a very warm coat of fur and can vary in colour from brown to cream to white depending on the region and the time of year. Both males and females have antlers. On the mainland of Nunavut, adult males weigh an average of about 150kgs in the autumn, while females average about 90kgs. Barrenground caribou on the southern arctic islands of Nunavut usually weigh somewhat less.

Food And Feeding

Caribou that winter in the forests south of Nunavut eat a high percentage of lichens. The barrenground caribou also eats grasses, sedges, mosses, forbs, willow leaves, twigs and mushrooms. They may sometimes chew on old discarded antlers, eat seaweed and lick salt deposits in the ground and fresh sea ice, likely for the mineral content. There are rare reports of lemmings, arctic char and bird eggs being consumed by caribou.

Behaviour

Barrenground caribou travel in herds of 10 to 50 animals or loose bands of a thousand on the mainland. They are almost always on the move from one seasonal pasture to the next and some seasonal migrations can be as far as 1200km. No matter the distance, their migrations take them across many rivers, and fortunately, caribou are excellent swimmers. Caribou are generally quiet animals but when they are surprised, or perhaps annoyed by insects, they snort loudly. Caribou have a great sense of smell but their hearing and eyesight are average. The average caribou can outrun a wolf.

Habitat

Barrenground caribou live on the barren land or tundra of northern Canada.

Reproduction

Barrenground caribou breed in the autumn. Calving times are generally during the month of June following a gestation period of 7.5 to 8 months. At birth, fawns weigh about 5kg. They can usually stand up shortly after birth and within 2 days they are able to keep up with their mothers.

Status Survival and Managemen

According to the Nunavut Wild Species 2000 report, the status of barrenground caribou is secure. Their main predators in Nunavut include humans and wolves. Lichens can store high levels of radioactive fallout although the levels of contaminants found in caribou have decreased in recent years.

Other Species in Nunavut

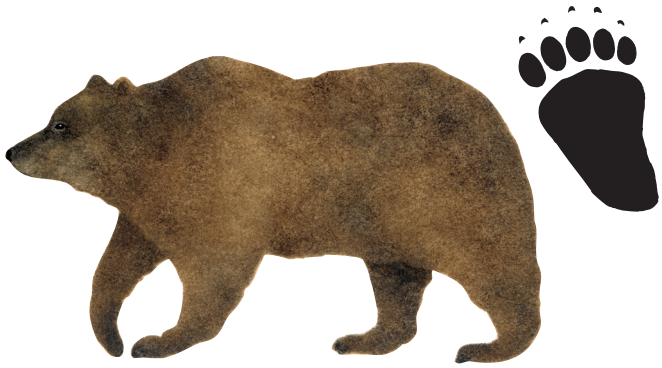
It is generally accepted that barrenground and Peary caribou are different subspecies to the main species of caribou and reindeer. The caribou found on the Belcher islands and Sanikiluaq are reindeer that were introduced in 1978 from a semi-domesticated herd in the NWT.

Did You Know?

Upper canine teeth are generally found in males and females, however they remain unused and below their gums. This indicates that at one time the caribou may have had a use for canines.

Barren Ground Grizzly

Ursus arctos

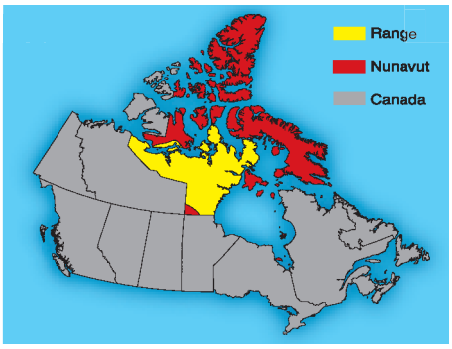


Appearance

Grizzly bears are the second largest carnivores after the polar bear. They have large heads with long snouts and two small, round, heavily furred ears. One of the ways to distinguish grizzly bears from black bears is that grizzlies have a noticeable hump on their shoulders. The claws of the front feet are long, sharp and pale yellow or brown in colour. Before shedding every year, grizzlies have long shaggy coats. Their fur is made up of coarse guard hairs and a thick coat of under-fur. Colours range from light gold to almost black with the lightest bears most commonly found on the barren lands or tundra. Grizzly bears in Nunavut are generally smaller than those found further south. They are at their largest in the fall before entering their dens and leanest in the spring when they emerge from their dens. Generally, females are smaller than males and reach their maximum weight before males do. Adult males and females can be anywhere between 146 and 382kg and measure an average of 2.6m in length.

Food And Feeding

Grizzlies are omnivorous. Some studies show that caribou are a very important food source for barren ground grizzlies. They appear to hunt them often during the spring, and from mid-summer to autumn. The young caribou provide a great source of food for the hungry bears and newborns. In addition, they feed on many small mammals such as lemmings, red-backed voles, ground squirrels and also some birds, ringed seals, beached whales and various kinds of spawning fish. During the summer, horsetail, sedge, arctic cotton grass and various berries make up a large portion of the bears' diet.



Behaviour

Grizzly bears are generally solitary animals although small groups may be seen feeding in the same area at certain times of the year. Grizzlies have good eyesight but their hearing and sense of smell are excellent. They growl and roar when fighting and can run with great bursts of speed. Males tend to roam farther than females. Denning occurs in late October and November. Like black bears, their body temperatures drop slightly and they fall into a deep slumber. However, they can be awakened by noise or disturbances in the area. The timing when grizzlies enter and emerge from their dens varies, depending on their geographic location.

Range

In Nunavut, the grizzly can be found throughout the Kivalliq region and in large portions of the Kitikmeot and Baffin regions.

Reproduction

The breeding season for grizzlies is generally late spring to early summer. After a gestation period of 6 to 8 months the female gives birth to usually 2 cubs, although 1, 3 and even 4 are also possible. They are born in mid-winter and are the size of a small squirrel, weighing between 350-700g. Grizzlies have a litter every third year and the young stay with the mother for 2 or 3 years. In Nunavut, female grizzlies usually have their first litter at 8 years of age. Compared to other grizzly populations, this is quite late and makes barren ground grizzlies more sensitive to over-harvesting.

Status Survival and Management

According to the Nunavut Wild Species 2000 report, the status of grizzly bears is sensitive. Grizzlies live up to 25 years in the wild. They have no natural enemies other than humans. An increase in the number of encounters between humans and grizzlies is resulting in more 'nuisance' bears being killed. Hunting regulations and bear safety programs continue to be enforced in an effort to protect the slow growing populations.

Horned Grebe *(Podiceps auritus)*

The Horned Grebe is a small duck-like waterbird 31-38 cm long with a short, pointed bill. In breeding plumage, the Horned Grebe has a black head with a distinctive patch of golden yellow feathers behind its eye called "horns." The front of its neck and upper breast are reddish. Males and females look similar, although males are typically brighter than females in breeding plumage.

Photo: Brian Small

Did you know?

Chicks are able to swim and dive immediately after hatching but usually spend the majority of time on their parents' backs during the first seven to 10 days. They nestle between their parents' wings and ride along while the parents swim. They may even stay onboard during dives.

Horned Grebes swallow their own feathers, a behaviour unique to grebes.

Habitat

The Horned Grebe usually nests in small ponds, marshes and shallow bays that contain areas of open water and emergent vegetation. Nests are usually located within a few metres of open water. This vegetation provides adults with nest materials, concealment, and protection for their young. The Horned Grebe occupies natural habitat more often than man-made reservoirs and artificial ponds.

Range

The Horned Grebe is found across North America and Eurasia. Most of its North American breeding range is located in Canada, extending from northwestern Ontario to British Columbia and north to Alaska (Western population). A small, isolated breeding population also exists in Quebec, where it is limited to the Magdalen Islands.

The Horned Grebe is a rare breeder in Ontario. Following the breeding season, most individuals migrate from inland freshwater nesting sites to coastal marine sites, although some individuals overwinter on large bodies of freshwater.

Threats

It is not known why the Horned Grebe is declining across North America. It is expected that populations are threatened by the permanent loss of wetlands to agriculture and development. Widespread and recurring droughts across the prairies have also resulted in loss of wetlands.

Protection

The Horned Grebe is a special concern species under Ontario's *Endangered Species Act, 2007*. A management plan will be prepared.

The Western and Magdalen Islands populations of Horned Grebe were assessed as special concern and endangered, respectively, by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Status: special concern provincially and national populations have been designated either special concern (western population) or endangered (Magdalen Islands populations)

What you can do to help the Horned Grebe

- Volunteer with a local nature club, stewardship council or provincial park to participate in surveys or stewardship work focused on species at risk. www.ontariostewardship.org
- As with all wildlife, don't disturb or harass the birds or nesting sites. Be respectful and observe from a distance.
- The Ministry of Natural Resources tracks species at risk such as the Horned Grebe. You can use an online form to report your sightings to the Natural Heritage Information Centre. Photographs with specific locations or mapping coordinates are always helpful! http://nhic.mnr.gov.on.ca/species/species_report.cfm
- Report any illegal activity related to plants and wildlife to 1-877-TIPS-MNR (847-7667).
- Bird Studies Canada is working to advance the understanding, appreciation and conservation of wild birds and their habitat, in Ontario and elsewhere. For more information on how you can help, visit: http://www.bsc-eoc.org

Did you know?

Horned Grebes are awkward on land and spend the majority of their time swimming or floating on the water. A sleeping Horned Grebe rests its neck on its back and tucks one of its feet under a wing. It uses the other foot to manoeuvre in the water.

In order to be concealed from predators, Horned Grebes build cryptic, floating nests in mats of emergent vegetation. Nests are affixed to aquatic vegetation or exposed rocks so that they don't float away. Some parents construct nests on exposed rocks or along the shoreline.

For additional information:

Visit the species at risk website at ontario.ca/speciesatrisk

Contact your MNR district office

Contact the Natural Resources Information Centre
1-800-667-1940
TTY 1-866-686-6072
mnr.nric.mnr@ontario.ca

ontario.ca/mnr

MNR # 52571

Canadian Geographic is a magazine of **The Royal Canadian Geographical Society**

Red Knot: Endangered Species

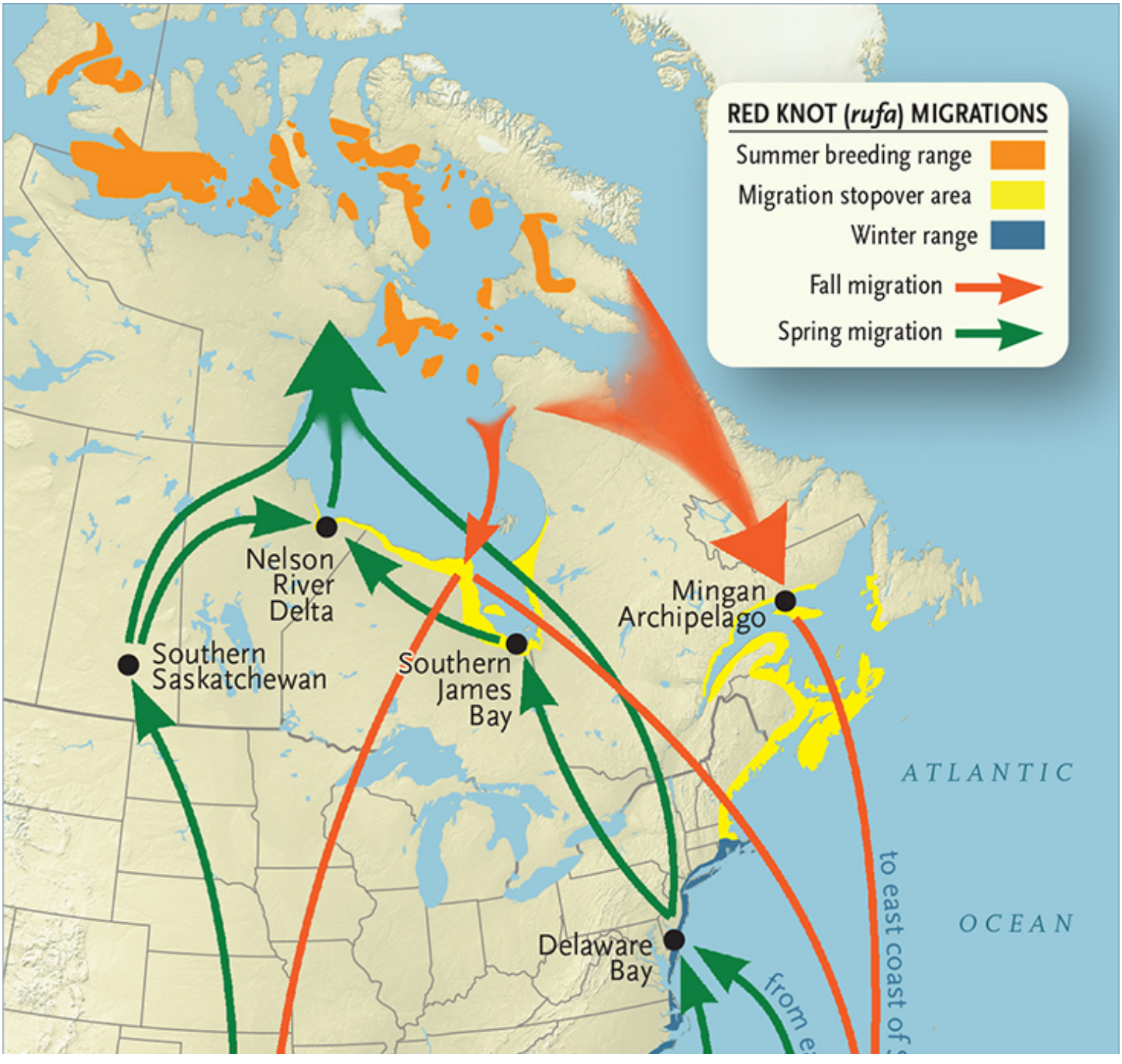
The red knot's population crash

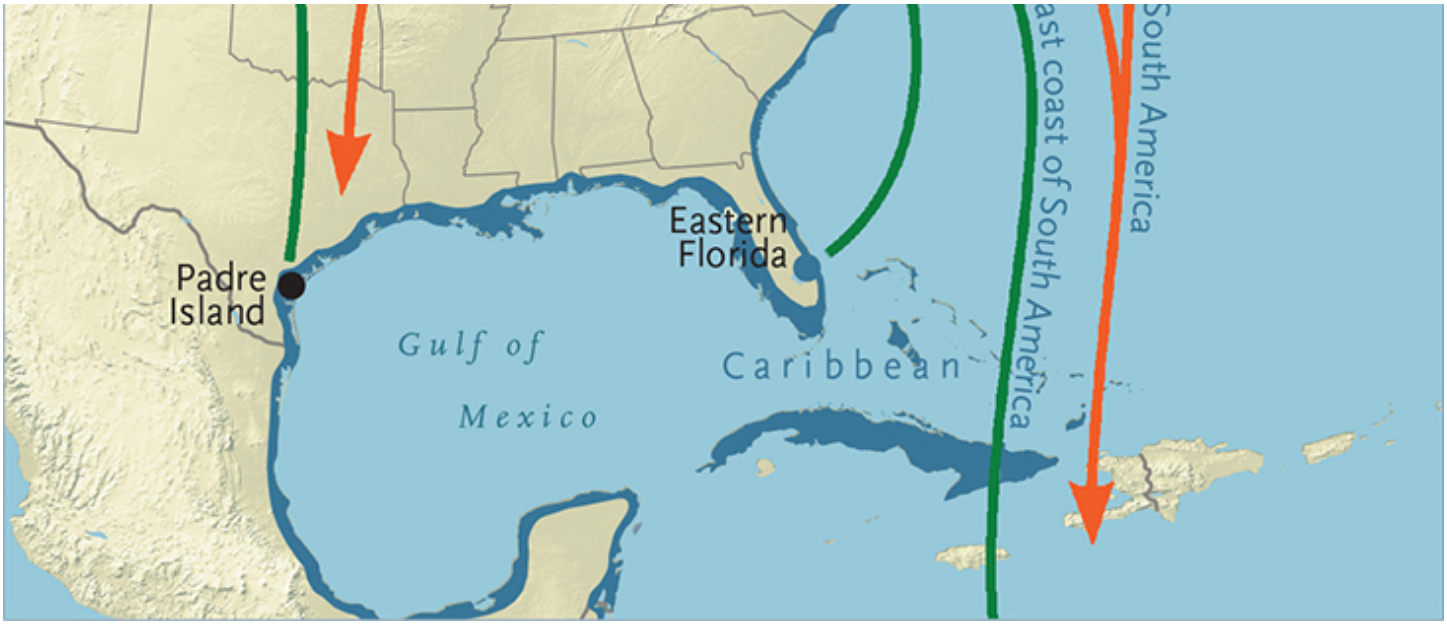
Photo: Robert McCaw

By Conor Mihell (/author/conor-mihell)

December 1, 2013

Each spring and fall, the *rufa* subspecies of red knot, a red-breasted shorebird scarcely larger than a robin, journeys up to 30,000 kilometres to and from the central Canadian Arctic and the southern tip of South America. Besides ubiquitous human development and climate change, the delicate balance between predator and prey is a principal threat. A population crash of 70 per cent between 1998 and 2007 is thought to be the result of overfishing of horseshoe crabs on the U.S. East Coast. About 25,000 rufa remain, a number that warrants endangered classification by the Committee on the Status of Endangered Species in Canada.





Red knot migrations
Map: Chris Brackley/Canadian Geographic. Map data: Migration and some range data developed in consultation with Yves Aubry and Ron Porter. U.S. Coastal, and Hudson Bay range data provided by Birdlife International. Range data for Arctic regions derived from COSEWIC Assessment and Status Report on the Red Knot (Calidiris Canutus) in Canada. COSEWIC, 2007

Late leavers

Southbound red knots depart the Canadian Arctic in three waves. Unsuccessful breeders leave in early July, along with females who've fledged a brood; their male counterparts depart in late July and early August; then the juveniles (with a few adult guides) take flight after mid-August. Canadian Wildlife Service biologist Yves Aubry says late migrants face two big threats: predatory migrating raptors and food shortages at fall stopovers. "That's why the adults want to get out of the Arctic as soon as possible."

Fuel shortage

Northbound red knots double their mass each spring during a two-week binge on horseshoe crabs around New Jersey's Delaware Bay. The unregulated harvest of the crabs in the late 1990s, however, triggered the demise of rufa, says Allan Baker, the head of natural history at Toronto's Royal Ontario Museum, who travels to Tierra del Fuego at the tip of South America each year to survey red knot populations. New Jersey subsequently outlawed the harvest in 2007. Baker says, "They're just starting to come back, but it's nothing like it was."

The whims of weather

Poor spring weather can delay the birds' arrival at their Delaware Bay feeding grounds, in turn cutting into breeding time in the short Arctic summer. Successful breeders and juveniles, meanwhile, are more likely to encounter tropical storms and hurricanes in September, something that can deplete their critical energy stores.

Red tide

Toxic algal blooms in the warm inshore waters of coastal Brazil and Uruguay — stopovers on the red knot's northbound migratory path — are likely to blame for several observed die-offs, including 300 birds in 2007, says Allan Baker of the ROM.

Islands in the stream

About one-third of rufa stop at Quebec's Mingan Archipelago National Park Reserve, in the Gulf of St. Lawrence. Here, expansive limestone tidal flats provide a cornucopia of snails, amphipods and blue mussels for hungry red knots, and there's minimal human disturbance.

Mystery stops

Ornithologists such as the Royal Ontario Museum's Mark Peck are using historical survey data and geolocators to identify and study lesser-known stopovers on the red knot migration route. Specifically, the extensive mudflats of Ontario's James and Hudson bays appear to be key areas where shorebirds rest and feed on small clams and nematodes.

Photo: Glenn Bartley/Vireo

Red-necked Phalarope

Phalaropus lobatus

Phalaropes reverse the usual sex roles in birds: Females are larger and more colorful than males; females take the lead in courtship, and males are left to incubate the eggs and care for the young. Red-necked Phalaropes nest around arctic tundra pools and winter at sea. During migration they pause on shallow ponds in the west, where they spin in circles, picking at the water's surface. However, most apparently migrate offshore, especially in the east. Despite their small size and delicate shape, they seem perfectly at home on the open ocean.

Conservation status	Population difficult to monitor. Some evidence of recent declines in some areas, such as off the coast of New England. Most alarming is the disappearance of former concentrations in the western Bay of Fundy. Fall gatherings there had been estimated as high as 3 million in the 1970s, but numbers began to drop sharply in the 1980s and the concentrations have largely disappeared.
Family	Sandpipers
Habitat	Ocean, bays, lakes, ponds; tundra in summer. At sea, often concentrates over upwellings or tide rips, sometimes around edges of kelp beds. Inland, stops on ponds or lakes with abundant small creatures to eat; often favors sewage ponds, where insects are numerous. Breeds in tundra regions, mainly on marshy edges of ponds and lakes.

Phalaropes reverse the usual sex roles in birds: Females are larger and more colorful than males; females take the lead in courtship, and males are left to incubate the eggs and care for the young. Red-necked Phalaropes nest around arctic tundra pools and winter at sea. During migration they pause on shallow ponds in the west, where they spin in circles, picking at the water's surface. However, most apparently migrate offshore, especially in the east. Despite their small size and delicate shape, they seem perfectly at home on the open ocean.

Photo Gallery

Feeding Behavior

Unlike any other sandpipers, phalaropes forage mostly while swimming, by picking items from water's surface or just below it. Often they spin in circles on shallow water, probably to stir things up and bring food closer to surface. In general, they feed very rapidly on very small prey.

Eggs

4, sometimes 3. Olive to buff, blotched with dark brown. Rarely 2 or 3 females will lay eggs in one nest. Incubation is by male only, 17-21 days. Young: Downy young leave nest within a day after hatching, go to shore of pond. Male tends young and broods them while they are small, but young feed themselves. Male departs after about 2 weeks, young are able to fly at about 3 weeks.

Young

Downy young leave nest within a day after hatching, go to shore of pond. Male tends young and broods them while they are small, but young feed themselves. Male departs after about 2 weeks, young are able to fly at about 3 weeks.

Diet

Insects, crustaceans, mollusks. Diet varies with season and habitat. On breeding grounds and on fresh waters in migration, eats mostly insects, including adults and larvae of flies, beetles, caddisflies. During stopovers on alkaline lakes, may eat many brine shrimp. Winter diet on ocean poorly known, probably includes small crustaceans and mollusks.

Nesting

Female seeking mate makes short flights, with whirring of wings and calling. In courtship, female swims around male, tries to make him follow her; male usually reluctant, shows interest only gradually. In some cases, after leaving male to care for eggs and young, female finds another mate and lays another clutch of

eggs. Nest site is on ground, usually in low vegetation near water. Nest is a shallow scrape lined with grass, leaves. Both sexes make scrapes, female chooses one, probably both sexes then help build nest.

Migration

Common in migration off both coasts. A common migrant through the interior of the west (locally abundant in fall), but quite rare inland in the east (where most records are in fall). Western birds winter at sea, mainly south of Equator off western South America; wintering areas of east coast migrants not well known.

Migration

Common in migration off both coasts. A common migrant through the interior of the west (locally abundant in fall), but quite rare inland in the east (where most records are in fall). Western birds winter at sea, mainly south of Equator off western South America; wintering areas of east coast migrants not well known.

All Seasons - Common

All Seasons - Uncommon

Breeding - Common

Breeding - Uncommon

Winter - Common

Winter - Uncommon

Migration - Common

Migration - Uncommon

Songs and Calls

A sharp twit or whit.

kett calls & rattles

kett calls & interaction sounds

various interaction calls

International Rusty Blackbird Working Group

RUSTY BLACKBIRDS

Helping a Species of Concern

Female in winter plumage. ©Tom Benson

Male in winter plumage. ©Laura Meyers

Female in summer plumage. ©Christian Artuso

Male in summer plumage. ©Christian Artuso

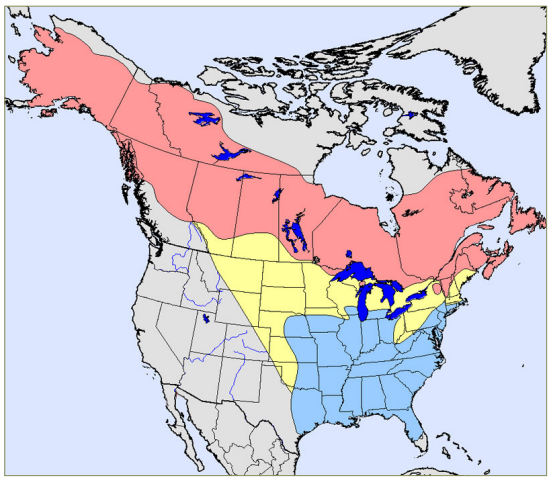
Background

Known for its vivid rust-tipped winter plumage as well as a song like a squeaky hinge, the once abundant Rusty Blackbird appears to be disappearing, and we don't understand why. Difficult to study due to the remote and inaccessible habitats they often favor, Rusty Blackbirds were widely overlooked by scientific study until the mid-1990s, when it became evident they were declining dramatically.

Rusty Blackbirds, or "Rusties," soon earned the unfortunate distinction of being one of the most steeply declining landbirds in North America, losing 85-95% of their population in just 40 years. Spurred by this alarming crash, scientists are striving to better understand Rusty Blackbirds to help conserve this vulnerable species.

Habitat

Rusty Blackbirds are migratory and are associated with shallow water throughout their annual cycle. In winter, they prefer wooded wetlands, swamps and wet margins, primarily in the southeastern U.S. They can also be found in open pastures, agricultural areas, and pecan orchards. In summer, they breed in the boreal forest wetlands of Canada and the northern U.S., preferring patchy wetlands interspersed with short conifer trees. During spring and fall, migrating Rusties can be found throughout North America. Look for migrating Rusties in flooded forests, wet fields, at the edges of ponds and lakes, or even in roadside ditches and neighborhood lawns.



Map data from NatureServe

Boreal wetland breeding habitat. ©Shannon Buckley Luepold

Identification

- Medium-sized blackbird, smaller than a Common Grackle
- Both sexes have bright yellow eyes
- Rust-tipped feathers on males and females in fall and winter
- During spring, rusty plumage fades
- By summer, males are glossy black and females are charcoal gray

Look-alikes

Brewer's Blackbird (overlaps mainly in western part of range) and Common Grackle are the most likely species to be confused with Rusties. Other potential look-alikes include Red-winged Blackbird, Brown-headed Cowbird and European Starling.

Visit rustyblackbird.org for more on Rusty Blackbird identification and look-alikes.

Rusty Blackbird Spring Migration Blitz

Over the last two decades, scientists have made huge strides in understanding Rusty Blackbirds on their breeding and wintering grounds. However, we still know surprisingly little about their migration. In 2014, the International Rusty Blackbird Working Group launched a three-year citizen science monitoring project, the Rusty Blackbird Spring Migration Blitz, to learn more about their spring migration.

Blitz Objectives:

- Learn about Rusty Blackbird migration patterns and timing
- Identify potentially important migratory sites for Rusty Blackbirds
- Assess how consistently Rusty Blackbirds utilize migratory sites within and among years
- Strengthen partnership efforts to recognize and address Rusty Blackbird conservation
- Promote awareness and engagement among birders and the public regarding Rusty Blackbirds

The project challenges birders throughout the range to seek and report Rusty Blackbirds during spring migration. The Blitz runs March 1-June 15 each year during 2014-2016. Visit rustyblackbird.org to identify the Blitz target dates for your specific region. To participate, bird as you normally do, focusing on appropriate habitats. It's important for us to know when and where you looked–***even if you don't find any Rusties***. Report your data via eBird using the "Rusty Blackbird Spring Migration Blitz" option.

How You Can Help

- Participate in the Blitz and report your data via eBird at ebird.org.
- Report Rusty Blackbirds using eBird whenever you see them, all year long. Every observation can help us learn more!
- Spread the word–tell a friend or your local Audubon chapter about the Blitz.
- Help the National Wildlife Refuge System learn more about how and when Rusties and other birds use refuges. Bird a refuge and report your sightings!

Rusty Blackbirds prefer shallow, flooded habitat in winter like this cypress bottom. ©Florida Fish and Wildlife

Common Grackles have thicker bills and longer, more graduated tails than Rusties. Both sexes have iridescent plumage. ©Ken Hansen

Male Brewer's Blackbirds are inkier and more iridescent black than male Rusties. Females have dark eyes with drab brown plumage. ©Bill Bouton

Blitz Partners

Alabama State Lands Division | Alaska Department of Fish & Game | Animal Wonders | Audubon Alaska | Audubon Arkansas | Bird Studies Canada | DC Audubon Society | Delaware Nature Society | eBird | Frasier Valley Birding | Green Mountain Audubon Society | Illinois Ornithological Society | Kentucky Department of Fish & Wildlife | Mass Audubon | Michigan Audubon | Minnesota Ornithological Union | National Aviary | New Hampshire Audubon | Ohio Ornithological Society | Pennsylvania Game Commission | Regroupement QuébecOiseaux | Roger Tory Peterson Institute of Natural History | Strawberry Plains Audubon Center | Tennessee Ornithological Society | The Cornell Lab of Ornithology | Truman State University | U.S. Fish & Wildlife Service | Vermont Center for Ecostudies | Virginia Society of Ornithology | Wisconsin Society for Ornithology

For more information visit: http://rustyblackbird.org/outreach/migration-blitz/

Short-eared owl

The **short-eared owl** (*Asio flammeus*) is a species of typical owl (family Strigidae). Owls belonging to genus *Asio* are known as the eared owls, as they have tufts of feathers resembling mammalian ears. These "ear" tufts may or may not be visible. *Asio flammeus* will display its tufts when in a defensive pose, although its very short tufts are usually not visible. The short-eared owl is found in open country and grasslands. The scientific name is from Latin. The genus name *Asio* is a type of eared owl, and *flammeus* means "flame-coloured".[3]

Description

The short-eared owl is a medium-sized owl measuring 34–43 cm (13–17 in) in length and weighing 206–475 g (7.3–16.8 oz).[4] It has large eyes, a big head, a short neck, and broad wings. Its bill is short, strong, hooked and black. Its plumage is mottled tawny to brown with a barred tail and wings. The upper breast is significantly streaked.[5] Its flight is characteristically floppy due to its irregular wingbeats. The short-eared owl may also be described as "moth or bat-like" in flight.[6] Wingspans range from 85 to 110 cm (33 to 43 in).[7] Females are slightly larger than males. The yellow-orange eyes of *A. flammeus* are exaggerated by black rings encircling each eye, giving the appearance of them wearing mascara, and large, whitish disks of plumage surrounding the eyes like a mask.

Separation from long-eared owl

Over much of its range, short-eared owls occurs with the similar-looking long-eared owl. At rest, the ear-tufts of long-eared owl serve to easily distinguish the two (although long-eared owl can sometimes hold its ear-tufts flat). The iris-colour differs: yellow in short-eared, and orange in long-eared, and the black surrounding the eyes is vertical on long-eared, and horizontal on short-eared. Overall the short-eared tends to be a paler, sandier bird than the long-eared. There are a number of other ways in which the two species the differ which are best seen when they are flying: a) short-eared often has a broad white band along the rear edge of the wing, which is not shown by long-eared; b) on the upperwing, short-eared owls' primary-patches are usually paler and more obvious; c) the band on the upper side of short-eared owl's tail are usually bolder than those of long-eared; d) short-eared's innermost secondaries are often dark-marked, contrasting with the rest of the underwing; e) the long-eared owl has streaking throughout its underparts whereas on short-eared the streaking ends at the breast; f) the dark markings on the underside of the tips of the longest primaries are bolder on short-eared owl; g) the upperparts are coarsely blotched, whereas on long-eared they are more finely marked. The short-eared owl also differs structurally from the long-eared, having longer, slimmer wings: the long-eared owl has wings shaped more like those of a tawny owl.[8] The long-eared owl generally has different habitat preferences from the short-eared, most often being found concealed in areas with dense wooded thickets. The short-eared owl is often most regularly seen flying about in early morning or late day as it hunts over open habitats.

Subspecies

As of 2009, there are ten recognized subspecies of the short-eared owl:[2][9]

- *A. f. bogotensis* – Chapman, 1915: found in Colombia, Ecuador and northwestern Peru
- *A. f. domingensis* – (Statius Müller, 1776): found on Hispaniola
- *A. f. flammeus* – (Pontoppidan, 1763): nominate, found in North America, Europe, northern Africa and northern Asia
- *A. f. galapagoensis* – (Gould, 1837): Galápagos Islands[10]
- *A. f. pallidicaudus* – Friedmann, 1949: found in Venezuela, Guyana and Suriname
- *A. f. ponapensis* – Mayr, 1933: found on east Caroline Island
- *A. f. portoricensis* – Ridgway, 1882: found in Puerto Rico
- *A. f. sandwichensis* – (A. Bloxam, 1827): Pueo or Hawaiian short-eared owl - found in the Hawaiian Islands[11]
- *A. f. sanfordi* – Bangs, 1919: found on the Falkland Islands
- *A. f. suinda* – (Vieillot, 1817): found from southern Peru and southern Brazil to Tierra del Fuego

Some authorities recognize a further subspecies:[9]

Short-eared owl

In Piraju, São Paulo, Brazil

Conservation status

Least Concern (IUCN 3.1)[1]

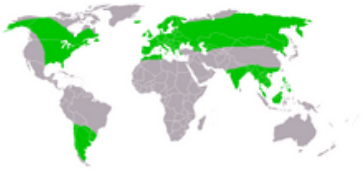
Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Aves
Order:	Strigiformes
Family:	Strigidae
Subfamily:	Asioninae[2]
Genus:	*Asio*
Species:	***A. flammeus***

Binomial name

Asio flammeus

(Pontoppidan, 1763)



Synonyms

Asio accipitrinus

- *A. f. cubensis* – Garrido, 2007: found in Cuba

Short-eared owl (Asio flammeus) in Mangaon, Maharashtra, India

Range

The short-eared owl occurs on all continents except Antarctica and Australia; thus it has one of the most widespread distributions of any bird. *A. flammeus* breeds in Europe, Asia, North and South America, the Caribbean, Hawaii and the Galápagos Islands. It is partially migratory, moving south in winter from the northern parts of its range. The short-eared owl is known to relocate to areas of higher rodent populations.[12] It will also wander nomadically in search of better food supplies during years when vole populations are low. (See a map of the short-eared owl's distribution across the New World.)

Behaviour

Nesting and reproduction

Sexual maturity is attained at one year. Breeding season in the northern hemisphere lasts from March to June, peaking in April. During this time these owls may gather in flocks. During breeding season, the males make great spectacles of themselves in flight to attract females. The male swoops down over the nest flapping its wings in a courtship display.[12] These owls are generally monogamous.

Asio flammeus flammeus from Pangolakha Wildlife Sanctuary in Sikkim from 13,500 ft near Lungthu. Such high altitude distributions can be found in Himachal Pradesh and Ladakh area of Higher Himalayas as well.

The short-eared owl nests on the ground in prairie, tundra, savanna, or meadow habitats. Nests are concealed by low vegetation, and may be lightly lined by weeds, grass, or feathers.[12] Approximately 4 to 7 white eggs are found in a typical clutch, but clutch size can reach up to a dozen eggs in years when voles are abundant. There is one brood per year. The eggs are incubated mostly by the female for 21–37 days. Offspring fledge at a little over four weeks. This owl is known to lure predators away from its nest by appearing to have a crippled wing.[5]

Diet and foraging habits

In Texel, North Holland, Netherlands

Hunting occurs mostly at night, but this owl is known to be diurnal and crepuscular as well. Its daylight hunting seems to coincide with the high-activity periods of voles, its preferred prey.[13] It tends to fly only feet above the ground in open fields and grasslands until swooping down upon its prey feet-first.[5] Several owls may hunt over the same open area.[14] Its food consists mainly of rodents, especially voles, but it will eat other small mammals such as mice, ground squirrels, shrews, rats, bats, muskrats and moles. It will also occasionally predate smaller birds, especially when near sea-coasts and adjacent wetlands at which time they attack shorebirds, terns and small gulls and seabirds with semi-regularity. Avian prey is more infrequently preyed on inland and centers on passerines such as larks, icterids, starlings, tyrant flycatchers and pipits. Insects supplement the diet and short-eared owls may prey on roaches, grasshoppers, beetles, katydids and caterpillars. Competition can be fierce in North America with the northern harrier, with which the owl shares similar habitat and prey preferences. Both species will readily harass the other when prey is caught.[15]

Pellets

Because of the high pH in the stomach of owls they have a reduced ability to digest bone and other hard parts, they eject pellets containing the remains of their prey.[16]

Calls

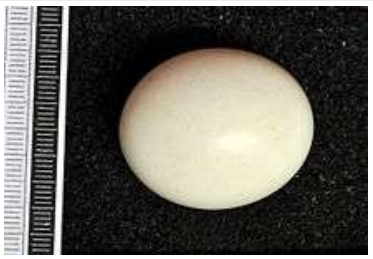
Short-eared owls have a scratchy bark-like call. Raspy *waowk, waowk, waowk* or *toot-toot-toot-toot-toot* sounds are common. A loud *eeee-yerp* is also heard on breeding grounds. However, short-eared owls are silent on the wintering grounds.[5]

Conservation status

It is listed as declining in the southern portion of its US range. It is common in the northern portion of its breeding range.[4]

It is listed as endangered in New Mexico. Its appearance at the Calverton Executive Airpark on Long Island has prompted the New York State Department of Environmental Conservation to take the lead on ruling whether a massive redevelopment of the airport will receive the necessary environmental permits.[4]

On the Galapagos Islands, Ecuador



Egg, Collection Museum Wiesbaden

In flight

In flight

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External links

- Short-eared Owl - *Asio flammeus* - USGS Patuxent Bird Identification InfoCenter
- "Short-eared owl media". *Internet Bird Collection*.
- Riverhead, NY *News Review* article about the appearance of short-eared owls at EPCAL
- Ageing and sexing (PDF; 3.7 MB) by Javier Blasco-Zumeta & Gerd-Michael Heinze
- BirdLife species factsheet for *Asio flammeus*
- "Asio flammeus". *Avibase*.
- Short-eared owl photo gallery at VIREO (Drexel University)
- Interactive range map of *Asio flammeus* at IUCN Red List maps
- Audio recordings of Short-eared owl on Xeno-canto.

Taxon identifiers	EoL: 915736 · GBIF: 2497295 · ITIS: 177935 · IUCN: 22689531 · NCBI: 56267 · Fossilworks: 161530 ·

APPENDIX V

WILDLIFE SIGHTING SHEETS

WILDLIFE SIGHTINGS FOR CAMP

Species	Age (Adult, calf)	Direction	Date	Time	Observed by

WILDLIFE SIGHTINGS FOR DRILL

Species	Age (Adult, calf)	Drill Hole	Direction	Date	Time

WILDLIFE SIGHTINGS FOR FIELD CREWS

Please fill in as much information as possible. If you don't know, please use a "U" for Unknown.

1. Animal sighted? _____
2. How many? _____
3. Age?
   ☐ Adult ☐ Calf/cub/pup ☐ Unknown
4. Sex?
   ☐ Male ☐ Female ☐ Unknown
5. What is the animal doing?

   _____
   _____
   _____

6. Date? ☐ Time ☐

7. Your location at time of sighting?
   GPS coordinate: ☐

8. Approximate distance to the animal? _____

9. Direction the animal is from your location? _____

10. Observed by? ☐

11. What task was being performed in the area of the sighting?

    _____

WILDLIFE SIGHTINGS FOR HELICOPTER PILOTS

1. Animal sighted? _____
2. How many? (approx.) _____
3. Date? _____ Time _____
4. Your location at time of sighting?
   GPS coordinate: _____
5. Direction the animal is from your location? _____

---

1. Animal sighted? _____
2. How many? (approx.) _____
3. Date? _____ Time _____
4. Your location at time of sighting?
   GPS coordinate: _____
5. Direction the animal is from your location? _____

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1. Animal sighted? _____
2. How many? (approx.) _____
3. Date? _____ Time _____
4. Your location at time of sighting?
   GPS coordinate: _____
5. Direction the animal is from your location? _____