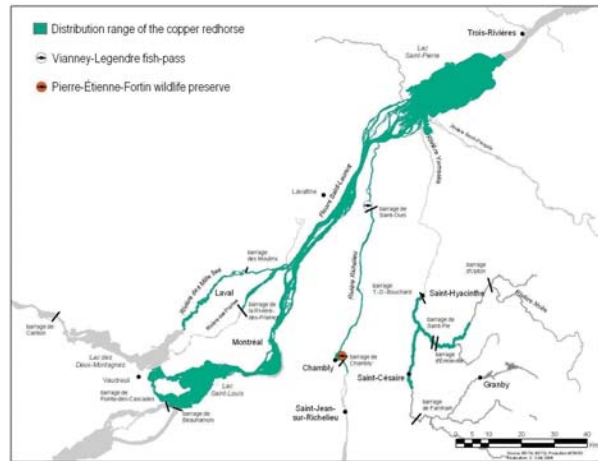




ADVICE RELEVANT TO THE IDENTIFICATION OF CRITICAL HABITAT FOR COPPER REDHORSE (*Moxostoma hubbsi*)



Source: Louis Bernatchez. *Les poissons d'eau douce du Québec et leur répartition dans l'est du Canada* © 2000

Figure 1: Distribution range for copper redhorse in Quebec. MRNF

Context

Since December 2007, the copper redhorse has been added to the Species at Risk Act (SARA) list as endangered species. Under the SARA, Critical Habitat must be identified to the extent possible based on the best information available in the Recovery Strategy for all threatened, endangered or extirpated species. If this Critical Habitat is unknown, the recovery strategy must include a schedule of studies that, when completed, would allow the species' Critical Habitat to be identified. Once identified as Critical Habitat in a Recovery Strategy or Action Plan, provisions of SARA and/or other federal legislations prevent activities that would destroy the species' Critical Habitat.

The recovery potential assessment produced in 2006 provided a review of important information, although somewhat incomplete, on the copper redhorse habitat. During two workshops held in 2009 and 2010, with the participation of the Ministère des Ressources Naturelles et de la Faune du Québec (MRNF) and Environment Canada, Fisheries and Oceans Canada (DFO) reviewed the information and considered the new data to define the habitat use of copper redhorse. This advice includes the most recent information.

SUMMARY

- Copper redhorse distribution is limited to Canada, more specifically to the south-western part of Quebec and the species forms a single population. The copper redhorse occurs in the St. Lawrence River between Lake Saint-Louis and Lake Saint-Pierre, and in the Richelieu, Mille-Îles and Des Prairies rivers, as well as in the downstream portions of the St. François and Acadie rivers. Its presence is now uncertain and even unlikely in the Yamaska and Noire rivers.
- The only two known spawning sites for copper redhorse are located in the Richelieu River, in the archipelago of the Chambly rapids and the downstream reach of the Saint-Ours dam. The size of these spawning grounds is likely sufficient to support the needs of a recovered population of 4,000 spawners. Other sites could potentially meet the requirements of copper redhorse spawning, but the presence of reproductive activities has never been clearly demonstrated.
- The Richelieu River is the only river where copper redhorse larvae have been observed. Littoral grass beds in the Richelieu River has been identified as playing a key role in fry rearing (growth, food and shelter) and also represent an important habitat for juveniles and adults. The littoral zone of 0-4 meters deep throughout the Richelieu River up to the Chambly basin and around the Islands are the preferred habitat of young redhorse and adults that frequent the Richelieu or use it as a migration corridor. Knowledge about the sub-adult habitat remains incomplete.
- The size of potential habitat as a feeding and adult growth area does not appear to be a limiting factor to achieving the recovery target in the St. Lawrence River (between Beauharnois and Trois-Rivières). However, the habitat size currently used in the river between Montreal and Sorel, appears more limited.
- The copper redhorse is a migratory species and free access between different habitats that provide critical roles for their life cycle should be maintained.
- Considering that the offer in terms of habitat may be limited by its quality, any measure aimed at improving habitat quality should be put forward, both in the Richelieu River and in the St. Lawrence. Given the major role that grass beds play in the survival and recovery of copper redhorse at different stages of life, and considering the vulnerability of these habitats to environmental degradation, actions must be undertaken quickly in order to ensure their protection.

BACKGROUND

Copper redhorse distribution is limited to Canada, more specifically to the south-western part of Quebec. The species occurs in the St. Lawrence River between Lake Saint-Louis and Lake Saint-Pierre, and in the Richelieu, Mille-Îles and Des Prairies rivers, as well as in the downstream portions of the St. François and Acadie rivers. Its abundance is considered very low and it is decreasing. The population is aging, recruitment is very low and they have difficulty reproducing in natural settings. Its presence is now uncertain and even unlikely in the Yamaska and Noire rivers.

The rivers where copper redhorse occur are in the most populous regions of Quebec. The deterioration and fragmentation of habitat affects the species' survival and recovery.

Since 1995, three 5-year intervention plans have been developed and implemented by the MRNF. These plans propose strategies and actions to accelerate copper redhorse recovery. Several actions have been undertaken including the construction of the Vianney Legendre fish-pass on the Richelieu River in 2001 to restore access to the Chambly rapids spawning site, the creation of the Pierre-Étienne-Fortin wildlife preserve in 2002 to protect the spawning area by limiting the disturbance of spawners and the trampling of eggs during incubation, and the implementation in 2004 of an artificial reproduction plan to renew the reproductive segment of the residual population. These interventions were implemented following well-targeted knowledge acquisition programs on the biology of the copper redhorse.

ANALYSIS

Under the SARA, critical habitat is the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species critical habitat in the recovery strategy or in an action plan for the species. These areas include nursery areas, rearing areas, feeding areas, migration routes or areas where the species formerly occurred. The premise underlying the designation of critical habitat is the existence of a positive relationship between habitat and population size and the need for a minimum habitat to achieve a recovery goal. The recovery target for the maintenance of a self-perpetuating population of copper redhorse, while maintaining 90% of genetic diversity, was estimated at 4,000 adults. This objective should be considered when identifying critical habitat.

Reviewing the knowledge about habitat use by the copper redhorse has helped identify preferred habitats for each stage of life: reproduction, juveniles, sub-adults and adults, from the MRNF sampling program and telemetric monitoring of adults in 2004 and 2007-2008. The current and potential habitat areas are evaluated according to the recovery target. The main threats that could affect the quality and extent of habitat are outlined.

Reproduction and Spawning Grounds

Habitat

From mid-May to mid-June, the majority of sexually mature copper redhorse migrate over 45 km to the only two known spawning sites located in the Richelieu River, specifically in the archipelago of the Chambly rapids and the downstream reach of the Saint-Ours dam. These spawning grounds are characterized by shallow waters (0.75 m to 2 m), exposed to low to moderate currents (0.6 m/s), by a heterogeneous substrate consisting of fine to coarse gravel, rocks and sometimes blocks embedded in the clay. The Vianney-Legendre fish-pass, at the Saint-Ours dam, ensures the free passage by a portion of copper redhorse to the spawning site at the Chambly rapids. The preservation of the two spawning sites, including rest areas, as well as free access to these spawning grounds are essential to the survival and recovery of copper redhorse.

Other sites could potentially meet the spawning requirements of copper redhorse, including the Grand Moulin rapids and the downstream reach of the Ile-des-Moulins dam in the Mille-Îles

River, the Dorion and Sainte-Anne-de-Bellevue channels at the head of Lake Saint-Louis, the Lachine rapids, the downstream reach of the hydro-electric station at Rivière-des-Prairies and Ile Hervieux near Lavaltrie. However, the occurrence of spawning activities at these sites has never clearly been demonstrated.

If other spawning sites in the St. Lawrence system were to be confirmed, these sites should also be considered in designating critical habitat for the Copper Redhorse in order to limit the impact in the event of a catastrophe in the Richelieu River (e.g. toxic chemical spill).

Habitat Size

Based on current knowledge of the copper redhorse and information from the literature on its congeners (*Moxostoma*) and other Catostomidae, the area required for spawning was estimated to be 1 m² per female, which corresponds to a minimum required area of 2,000 m² for 2,000 females. According to the criteria listed above (depth, current velocity and substrate type), the size of the potential spawning sites in the Richelieu River (Figure 2) is estimated at 583,064 m² (Chambly: 488,364 m² and Saint-Ours: 94,700 m²). Thus, the area associated with the known spawning sites in the Richelieu River appears sufficient to support the needs of a recovered population of 4,000 copper redhorse spawners. This area includes the location of the spawning grounds, but also the possible drifting of eggs, resting places for spawners, the variability of the substrate and hydrolicity conditions.

Threats to Habitat

Three main threats can affect reproductive function provided by the habitat; the disturbance caused by recreational boaters, the presence of contaminants and changes in physical and chemical characteristics of the spawning sites. The recreational boat traffic in the Chambly archipelago (swimming, kayaking, motorized boats), especially during the copper redhorse spawning season, increases stress in spawners and the risk of trampling of eggs. Moreover, given the late spawning season of copper redhorse, the presence of spawners on the spawning grounds of the Richelieu coincides with the drop of water flow and the most active period for spreading pesticides. Certain pesticides and other household and industrial products might act as olfactory disruptors by diminishing the spawners' capacity to perceive pheromones, substances involved in behaviour synchronization and final maturation of sexual products in both sexes. The toxic load increase in the water could be partly responsible for reproductive difficulties in copper redhorse. Copper redhorse require special flowing water conditions for spawning. These habitats are limited in their range and maintaining their integrity is essential. All interventions causing changes of physical, chemical and biological elements, such as siltation and changes in hydrolicity conditions are likely to jeopardize the reproductive success of the species.

The Pierre-Étienne-Fortin wildlife sanctuary was created to protect the Chambly rapids spawning site, which is a very busy area for vacationers and recreational boaters from late June to early July during the copper redhorse spawning season. According to recent observations, the boundaries of the wildlife sanctuary should be extended downstream because the most recent telemetric surveys have demonstrated the use of this area both for spawning and as a resting area. Given the early arrival of males, it would also be preferable to begin the protection measures of the Pierre-Étienne-Fortin wildlife sanctuary two weeks earlier.

The spawning site at the Saint-Ours dam is under no special protection for the moment. Other than the threat of contamination, no other imminent threat to copper redhorse spawning has been identified.

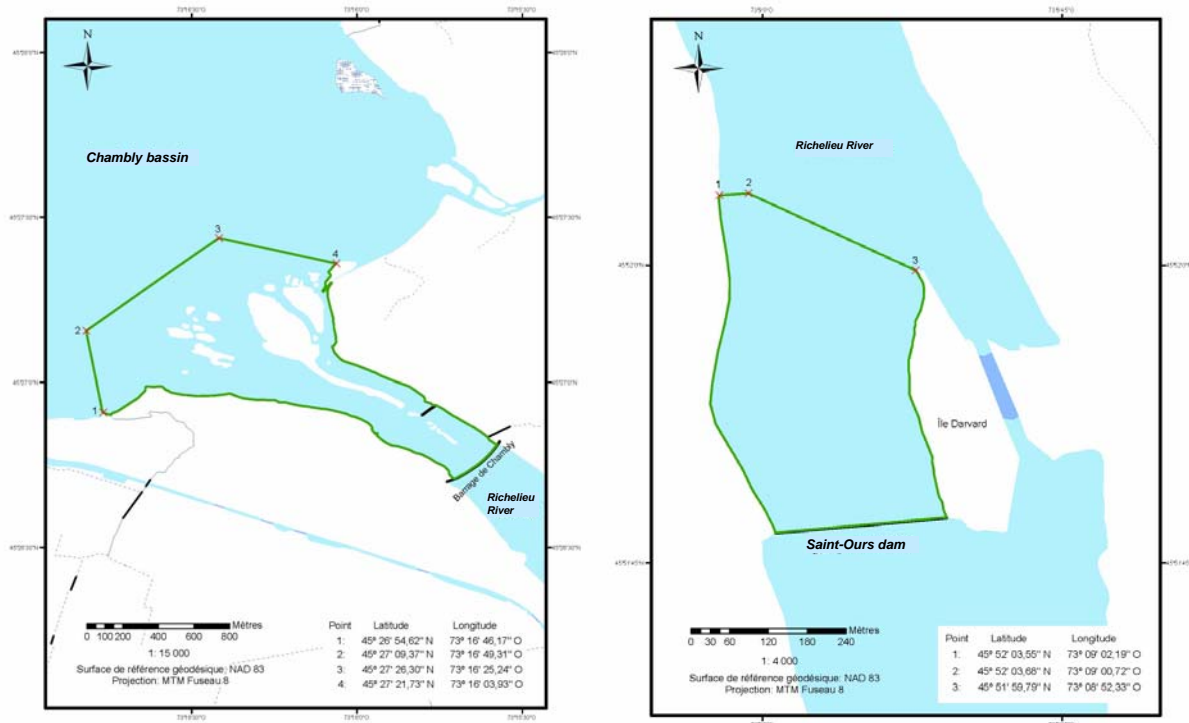


Figure 2: Potential spawning sites for copper redhorse in the Richelieu River (MRNF)

Young Stages (Larvae and Juveniles measuring less than 100 mm)

Habitat

The Richelieu River is the only river where larvae and young copper redhorse of the year have been observed. After remaining buried in the substrate for about ten days, newly hatched larvae are dispersed by the current and colonize shallow areas near the shores. While safe from predators, they find food in abundance, allowing them to grow enough to face their first winter. During their first summer and at the beginning of their second year, redhorse frequent these shallow littoral zones (average depth less than 1.5 m), with minor slopes (less than 20 degrees), exposed to a weak or very weak current, with vegetation and relatively fine substrate (mixture of clay-silt-sand). At this stage, they coexist with four other young redhorse species and share a diet composed of micro-crustaceans (cladocera, copepods), insect larvae (chironomida), worms (nematodes) and algae (diatoms and desmids). There have been no identified obstacles to the passage of larvae and juveniles during their downstream migration.

Juvenile redhorse of less than 100 mm, such as the copper redhorse, are confined to the grass beds of the littoral zone, i.e. the band of the Richelieu River between 0 and 3 m deep where the submerged aquatic vegetation is found. These grass beds, which play a key role during the rearing stage (growth, food and shelter) are not only an important habitat for juveniles, but also for adults who frequent the river or use it as a migration corridor. Observations suggest a spatial segregation according to depth based on the size of the redhorse. Even if the Saint-Marc-sur-

Richelieu area is a concentration area for young redhorse species, juvenile copper redhorse have been observed throughout the downstream portion of the Richelieu River from Sorel to the Chambly basin.

Habitat Size

The coastal shelf of the Richelieu River is very narrow compared to that of the St. Lawrence River. The grass bed area available for the early stages of copper redhorse in the Richelieu River still needs to be specified. Moreover, the decreased quality of these grass beds could affect the functions provided by this habitat.

Threats to Habitat

The quality and extent of grass bed habitats for the early life stages of copper redhorse can be altered by many human activities including poor agricultural practices, wave action and deterioration by passing boats and deforestation which contributes to increased sediment deposits, suspended matter and contaminants. Shoreline development also affects the integrity of grass beds and their extent as well as the introduction and presence of invasive and competing exotic species such as the water chestnut, round goby and tench. Eutrophication, which is the result of excess phosphorus and nitrogen, promotes the growth of filamentous algae and may also contribute to the degradation of grass beds.

Given the current hydrological conditions in the Richelieu River, it would be difficult to restore the lost grass beds. However, any conservation measure for the remaining habitats should be put forward.

Acquired respectively in 2007 and 2009 by the Nature Conservancy of Canada, an organization dedicated to the conservation of natural environments, and recently transferred to the MNRF, Jeannotte Island and Ile-aux-Cerfs offer some level of protection to the grass beds that surround the islands. Creating a wildlife refuge is also planned.

Sub-adults (100-500 mm)

The copper redhorse sub-adult stage is the least known. The largest catches (nearly 4 times higher than in other water bodies) and the most recent were made in the Richelieu River. Specimens from the Richelieu River are also more diverse in terms of size and age. It is also the only body of water where individuals whose size varies between 100 mm and 299 mm were recorded. The distribution of sub-adults measuring 100-299 mm in the Richelieu River seems to correspond to the young of the year and possibly to an area a little deeper. The few observations were spread across the Richelieu River up to the Chambly basin. The Saint-Marc area, however, shows higher productivity, possibly due to a natural downstream migration phenomenon and the presence of a retention area. Given the specialization of the pharyngeal apparatus, which occurs very early, it is possible that juveniles of more than two years of age move hastily looking for grass beds rich in gastropods.

Adults

Except for the Yamaska-Noire drainage basin, where the presence of the species is no longer detected, the distribution of adult copper redhorse has remained essentially unchanged over the last 50 years, the river corridor between Lake Saint-Louis and Lake Saint-Pierre, the Richelieu

River up to Chambly, the downstream portion of the Mille-Îles River and the Des Prairies River. Genetic characterization of copper redhorse from the Richelieu and St. Lawrence rivers showed that they form a single population. A study on flesh contamination of individuals from these rivers and telemetric monitoring from 2004 and 2007-2008 also lead to the same conclusions. The species is migratory and the connectivity between the different habitats that provide the functions that are essential to its life cycle must be preserved.

Spring Habitat

In April and May, increased occurrence of copper redhorse in the Contrecoeur islands area in the St. Lawrence is observed. Adults occur in shallow areas (less than 4 m) with low current velocity (less than 0.3 m/s), with little or no vegetation, a fine substrate with a low to average density of gastropods. Adult migration to the Richelieu River occurs from mid-May to mid-June using shallow areas (4 m or less).

Summer Habitat

Following their spawning period, copper redhorse travel up to 138 km, an average of 7 km/day over a period of 6-19 days, to reach the post-spawning habitats. During the summer, adult displacements are limited to home ranges of less than 1 km², near the banks. All listed copper redhorse summer locations were in grass beds rich in gastropods, which are the species' main prey, between Lake Saint-Louis and Lac Saint-Pierre and in the Mille-Îles, Des Prairies and Richelieu rivers. The Boucherville and Laval-Contrecoeur archipelagos, in the Montreal-Sorel reach, and in the grass beds of the Richelieu River, between Saint-Ours and Chambly, are the species' preferred areas. Grass beds near the shipping channel are also active areas. The scarcity of gastropod rich grass beds become significant summer feeding habitats for adults. Summer use of certain bodies of water by the copper redhorse, such as the Saint-François and Acadie rivers, is new.

The copper redhorse summer habitat is in shallow areas (less than 4 m), with low current (less than 0.5 m/s), somewhat clear water, consisting of a relatively fine substrate, with average to high vegetation, mainly composed of *Vallisneria americana* and *Potamogeton* sp., and with medium to high density of gastropods.

Fall and Winter Habitat

The available information suggests that the fall habitat for adult copper redhorse is similar to their summer habitat. Adults frequent shallow sites (less than 4 m), with weak current (less than 0.3 m/s), with little or no vegetation or gastropods. When there is some vegetation, it is dominated by *Vallisneria americana* and *Heterentera dubia*.

During winter, adult copper redhorse occupy sites characterized primarily of shallow areas (less than 4 m), with weak current (less than 0.3 m/s), a relatively fine substrate (sand and silt), and no vegetation or gastropods.

Habitat Size

Although the potential habitat area as a feeding and growth area for adults appears to meet the recovery target of 4,000 spawners throughout the St. Lawrence River (between Beauharnois and Trois-Rivières) and the Richelieu River (from Chambly to the St. Lawrence), the only habitat

area provided by the river corridor (2,500-3,500 ha depending on water flow) and the downstream portion of the Richelieu River are probably not sufficient to support such a spawning stock. The resourcing of 4,000 spawners should be supported by a population whose total biomass would be about 30 to 80 tons (180,000-300,000 immature individuals).

According to the telemetric monitoring in 2004, the average size of home ranges for the monitored specimens was 0.29 km² in summer (n = 16) and 2.34 km² in fall (n = 6). These calculations were made in a very low density situation, with a surface area of intensive use, as estimated during the 2004 monitoring, likely provides a better representation of the species' needs at higher densities: the area is 0.065 km² in summer and 0.4 km² in fall. By using the estimate obtained during the growth period (summer: 0.065 km²/adult redhorse), this represents a total rearing habitat area of at least 260 km², which is well above the available area in the river reach (between 25 and 35 km² depending on water flow) and the Richelieu River (17 km²).

The potential habitat in the fluvial lakes appears significant according to preliminary analysis (8,000-10,000 ha in Lake Saint-Louis and 15,000-25,000 ha in Lake Saint-Pierre depending on water flow).

Threats to Habitat

Capital and maintenance dredging operations, combined with poor management of dredged material as well as any new restriction to the movement or migration of fish represent threats to the quality and extent of habitat. Wave action from passing boats also represents a threat to the physical integrity of grass beds. The anticipated decline in water levels, whether related to climate change or to an adjustment to these changes, may also have a marked effect on habitat availability.

The increased sediment load and turbidity, caused by human activities, including shoreline hardening, poor agricultural practices and urbanization, as well as the excessive input of phosphorus, are also threats to habitat quality. Municipal, industrial and agricultural waste, which may contain various contaminants, must also be included as potential threats.

Finally, the introduction and presence of invasive and competing exotic species such as the zebra mussel, water chestnut, the common water reed, tench and the round goby could also affect the integrity of grass bed habitats.

The Contrecoeur National Wildlife Area, the Îles-de-Boucherville Park and the two wildlife refuges (Pierre-Étienne-Fortin and Rivière-des-Mille-îles) currently provide some protection to a few copper redhorse habitats.

Sources of Uncertainty

There are still issues regarding the habitat for the larval, juvenile and sub-adult stages for copper redhorse, including conditions concerning the downstream migration and survival of larvae and the presence or absence of other concentration sites in the Richelieu River. Additional research will be needed to identify and quantify the habitat that supports these life stages.

The limited number of adult individuals that are monitored and the fact that they come mostly, but not exclusively, from a tagging site on the Richelieu River could partly explain the disparity

between the frequent observations of adult copper redhorse in the river corridor and the few observations made in potential habitat areas in the fluvial lakes. Although it is possible that adults frequent the Laval-Contrecoeur area in winter, knowledge of copper redhorse habitat during this time of year is still incomplete. To refine our knowledge on the habitat of adult copper redhorse, some additional work is necessary, including the identification of grass beds in Lake Saint-Pierre, Lake St-Louis and the La Prairie basin, which correspond to the needs of the copper redhorse in terms of habitat, and a review of the summer hydrodynamic model of the St. Lawrence in order to complete the mapping of summer habitats.

It remains difficult for the moment to assess to what extent the current quality of the copper redhorse habitat is limited. Although the habitat used is protected, it is necessary to determine whether other threats can affect the recovery of the species. The physiological effects of suspected endocrine disrupters from municipal effluents, including the effluent from the city of Montreal, and agricultural waste are a problem that goes beyond habitat identification and it will have to become a priority. Some pesticides used in agriculture, including atrazine, are suspected of interfering with the natural process of sexual maturation, thus jeopardizing the reproductive success of the species.

CONCLUSION AND ADVICE

Significant efforts have been made so far to promote the recovery of the copper redhorse. Despite the sources of uncertainty mentioned above, the fact remains that the knowledge of the species is exceptional despite its scarcity and instability. Based on the best knowledge currently available, the following habitats appear important for the survival and recovery of the species:

- The two known spawning sites are the archipelago of the Chambly rapids and the downstream reach of the Saint-Ours dam on the Richelieu River, according to the areas assessed and the location of spawning grounds, the possible drifting eggs, the rest areas and the nature of the substrate in the Chambly rapids.
- The littoral zone of 0-4 meters in depth throughout the Richelieu River up to the Chambly basin and around the islands.
- The river section between Montreal and Sorel, where the potential habitats targeted by modeling for the three seasons (spring, summer, fall) are superimposed on the reported catches.

Regarding fluvial lakes, further work is planned to refine the model results and to better target the potential habitat for copper redhorse. The significance of the downstream segment of the Des Prairies and Mille-Îles rivers, where the species has been observed historically or reported during the telemetric monitoring, remains to be defined in terms of recovery.

Considering that habitat may be limited by its quality, any measure aimed at improving the quality of habitat should be put forward, both in the Richelieu River and the St. Lawrence. Given the major role played by grass beds in the survival and recovery of copper redhorse at different life stages, and considering the vulnerability of these habitats to environmental degradation, actions must be undertaken rapidly in order to preserve them.

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Internet Address: www.dfo-mpo.gc.ca/csas

ISSN 1919-5109 (Printed)

ISSN 1919-5117 (On Line)

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La version française est disponible à l'adresse ci-dessus.

**CORRECT CITATION FOR THIS PUBLICATION:**

DFO 2011. Advice relevant to the identification of critical habitat for copper redhorse (*Moxostoma hubbsi*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/072.