ASIAN CARP STATUS REPORT

Figure 1: Map of DFO's six administrative regions.

Photo credits (from top to bottom): Grass Carp, Ontario Federation of Anglers and Hunters; Bighead Carp, David Riecks, University of Illinois; Silver Carp, lloushin@acesag.auburn.edu; and Black Carp, Leo G. Nico.

Context

The intentional or accidental release of non-native species into Canadian waters poses a threat to native species and overall biodiversity. Non-native species can alter habitat, compete with native species for food or habitat, prey upon native species, and act as vectors for new diseases or parasites that could spread to native species. There is also a risk of introducing non-native genes into native populations through hybridisation. Any of these effects could have further widespread, detrimental impacts on native species and communities.

Four species of Asian carp (grass carp (Ctenopharyngodon idella), bighead carp (Hypophthalmichthys nobilis), silver carp (H. molitrix), and black carp (Mylopharyngodon piceus)) have been imported into the United States for use in aquaculture, and for the biological control of aquatic vegetation and parasites. Although all species were brought in for culture, and often triploid strains were developed and maintained, all four species have escaped into the wild. Self-sustaining populations of three of these species (grass, bighead and silver carps) have been established, particularly in the Mississippi drainage.

Grass and bighead carps are the two species reported to be imported live into Canada for the live food fish industry, particularly in Toronto, Montreal and Vancouver. Black carp has been historically reported as imported and silver carp has been observed for sale, but not officially reported. Triploid strains of grass carp are also used for vegetation control in the Prairies. Occasionally, individual Asian carps have been found in Canadian waters, but there are no known established populations. However, concern is

growing that native biodiversity would be affected if numbers of live Asian carps were to escape or be released in Canadian lakes or rivers.

In October 2004, a group of experts reviewed the risks associated with the live importation of Asian carps into Canada, and developed scientific advice on risks and potential mitigation measures.

SUMMARY

- Four species of Asian Carp (grass carp, bighead carp, silver carp, and black carp) have been imported alive into Canada for the live fish food markets in urban centres or, in the case of grass carp, for control of aquatic vegetation. Reporting of live importation is mandatory, but compliance is low. Hence, the total number or weight of live fishes imported annually is not known accurately, although grass carp and bighead carp are certainly the dominant species in recent years.

- A risk analysis was conducted of the threat posed by each of the four species were they to escape into Canadian waters. The risk analysis addressed both risk of establishment (survival, reproduction, spread) were the species to be introduced in the wild, and risk of ecological and genetic consequences for native biodiversity were the species to become established. A risk analysis was also conducted of the threat posed by these species as vectors for diseases and parasites.

- Risk of survivorship, reproduction, and spread was considered high and reasonably certain or very certain for all four species. Risk of introducing new parasites or diseases was considered moderate but only moderately certain to moderately uncertain in all cases.

- The risk assessment concluded that it is reasonably certain to very certain that the ecological consequences of establishment of all four species would be high. The risk of detrimental genetic consequences would be low for all four species.

- Mitigation measures are available to reduce the risk posed by live important of Asian carps, but some would result in fewer live carp available to the markets , which might be an incentive for the sellers to seek other new species. Triploid strains are available for grass carp, which is the species used for vegetation control, and this reduces the risk of establishment.

DESCRIPTION OF THE ISSUE

The intentional or accidental release of non-native species into Canadian waters poses a threat to native species and overall biodiversity. Non-native species can alter habitat, compete with native species for food or habitat, prey upon native species, and act as vectors for new diseases or parasites that could spread to native species. There is also a risk of introducing non-native genes into native populations through hybridisation. Any of these effects could have further widespread, detrimental impacts on native species and communities.

Four species of Asian carp (grass carp (*Ctenopharyngodon idella*), bighead carp (*Hypophthalmichthys nobilis*), silver carp (*H. molitrix*), and black carp (*Mylopharyngodon piceus*)) have been imported into the United States for use in aquaculture, and for the biological control of aquatic vegetation and parasites. Although all species were brought in for culture,

and often triploid strains were developed and maintained, all four species have escaped into the wild. Self-sustaining populations of three of these species (grass, bighead and silver carps) have been established, particularly in the Mississippi drainage.

Approach Taken

Risk assessments of the potential ecological, genetic, parasite, pathogen and "fellow traveller" (for example, species which may be in the water in which the carp are transported) impacts were developed separately for each of the species. Each risk assessment in this report is divided into three sections: 1) background information used to determine risk level and scientific certainty of the risk; 2) a tabular risk assessment with an indication of both risk level and scientific certainty; and, 3) narrative conclusions relevant to the risk assessment. For both the tabular and narrative conclusions sections, risk is evaluated relative to the likelihood of survival were individuals to be released, likelihood of reproduction were individuals to survive, and likelihood that a reproducing population could spread further in Canada. Considerations regarding ecological impacts and mitigation are also provided in the narrative conclusions for each species. Narrative conclusions pertaining to the genetic impacts and the parasites, pathogens and fellow travellers were combined for all Asian carps and follow the risk assessments for the individual species.

ASSESSMENT

Grass Carp

Background

Grass carp are herbivorous fish maturing in about 1-10 years, and reach a maximum size of over 50 kg. Their native range is from southern China to the Amur River basin of Russia, where mean annual air temperatures range from +25 to -6^{o}C. They spawn in large rivers with moderate currents,. Egg survival and larval development is best in waters about 18^{o}C. Vectors of grass carp introduction into Canada may include natural colonization from the Mississippi River basin, and deliberate (e.g. weed control, prayer fish, animal rights activism) or accidental (e.g. live fish tanker spill) release related to the availability of grass carp in the weed control and live food fish industries. In the mid-1990s, slightly less than 100,000 kg were imported into the Greater Toronto Area (GTA). From April 2003-March 2004, Ontario retailers reported close to 140,000 kg sold during this same time period, although less than 50,000 kg were reported by the Canadian Food Inspection Agency (CFIA) as entering Ontario.

Tabular Risk Assessment – Grass Carp

Table 1: Ecological – Genetic

Component		**Rating**	**Certainty**
Probability of Establishment	Survival	High	Very Certain
	Reproduction	High	Reasonably Certain
	Spread	High	Reasonably Certain
Consequences of Establishment	Ecological	High	Very Certain
	Genetic	Low	Very Certain

Table 2: Parasites, Pathogens & Fellow Travellers

Component		**Rating**	**Certainty**
Probability of Establishment	Introduction	Med	Reasonably Certain
	Encounter	Med	Reasonably Certain
Consequences of Establishment	Ecological	Med	Reasonably Certain
	Genetic	Med	Very Uncertain

Conclusions and Advice

Considerations Regarding Release

- There are numerous vectors for release, including accidents during transport, liberation for cultural reasons, and intentional release for control of vegetation.

- Transportation accidents are low probability events but could result in large numbers of grass carp being released. The other vectors are likely to result in only small numbers of grass carp being released per event, but events may be repeated.

- Regulations to control the vectors for release are unlikely to be completely effective in every case, unless there was high personal motivation to comply.

Considerations Regarding Survival

- Suitable thermal regimes, habitat (depth and vegetation), and food are widely available in Canada. Evidence was reviewed for the Canadian Great Lakes basin including the St. Lawrence drainage, and Prairie river systems.

Considerations Regarding Reproduction

- There is conflicting evidence about the likelihood that grass carp could spawn successfully in Canada:

- Negative –
  - To date, in areas where grass carp occur in the wild in North America and Europe, final gonadal development and egg production has only been observed in regions with more degree-days (shorter, milder winters and warmer overall temperatures) than occur in Canada, other than southwestern Ontario.
  - In culture facilities in Alberta, grass carp can only achieve final gonadal development and produce eggs when water is artificially warmed and feeding is enhanced.
  - As best as can be determined, the broodstock for the North American grass carp in aquaculture were taken from the southern (warmer) part of its native range in Asia.

- Positive –
  - In their native range in east Asia, grass carp reproduce successfully in large areas with thermal regimes and habitats similar to those found in Canada.
  - Juvenile grass carp have been found regularly in the lower Illinois River, where climatic conditions are similar to southwestern Ontario
  - Culture conditions differ from the normal habitat of grass carp in many ways and, in the wild, grass carp may be able to select local habitats with much warmer conditions than

the average temperature for a waterbody, for example warm water effluents in the Great Lakes.

- o Geographic variation in genetic strains has not been documented in Asia, so there is no evidence that the source of the broodstock will necessarily determine the thermal conditions under which individuals can mature and spawn.

- Overall, the absence of evidence of spawning in much of the northern US, Canada, or northern Europe is not proof that spawning is impossible throughout the range of suitable habitats in Canada. However, there was an absence of evidence that natural reproduction has occurred north of the 5^{o}C mean annual isotherm. The weight of evidence suggests that south of the 5^{o}C isotherm, reproduction may be possible.

Considerations Regarding Spread

- If reproducing populations of grass carp were to be established in Canada, much suitable habitat in the Great Lakes basin is inter-connected and lacks barriers that would deter movement, so range expansion could occur readily. The same is true for many Prairie waterways.

Considerations Regarding Ecological Impacts

- Most studies of ecosystem effects of grass carp have been under conditions where juvenile fish have been stocked for vegetation control.

- Where effects of grass carp have been studied to examine effects of stocking density, they often have resulted directly in substantial changes to the species composition and density of aquatic vegetation, and on water quality for periods of three to fifteen or more years.

- These studies found that changes to aquatic vegetation and/or water quality often have been large enough to result in large indirect changes to the species and/or size composition of the plankton and fish communities. All trophic levels may be affected.

Considerations Regarding Genetic Impacts

- This factor is dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Parasites, Disease & Fellow Travellers

- These factors are dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Mitigation

- All risks would be reduced to extremely low if no live carp were allowed to be transported into Canada. However, this would remove live grass carp as a food product for which there is a substantial market in Canada that began in 1981, and as a means of biological control of vegetation in ponds, water gardens, etc. This might prompt the market to search for other species of fish that might be effective in control of vegetation, which could also present a risk to Canadian biodiversity. In the search for alternative fish species for

use in vegetation control, emphasis might be given to species which cannot overwinter in Canada, as a strategy to reduce risk to native biodiversity.

- Regulations requiring that grass carp be killed at the time of sale would reduce risks substantially, but would be difficult to enforce. There is some likelihood that individual buyers would attempt to circumvent the regulation to obtain live grass carp for control of aquatic vegetation, although fish of a size preferred by food markets are not as effective as smaller carp at biological control of vegetation.

- Requiring triploid certification (as required by the US Fish and Wildlife Department for triploid grass carp in commerce in the US) of all live imports would greatly reduce the risk of reproducing population becoming established in Canada. However, this might trigger regulatory oversight from the Canadian *Food and Drug Act* and under Canadian *Environmental Protection Act*, and might increase cost to the consumer.

- Regulations requiring only single sex importations would reduce the risk of reproducing populations being established in Canada. At present it is much more feasible to produce female-only populations, so escapees still could present some threat.

- Making triploid grass carp more widely available in Canada for vegetation control would reduce risks of reproducing populations becoming established. However, it would signal that it is acceptable to use grass carp for vegetation control, and if triploid grass carp were more expensive than live grass carp in food markets, an incentive to obtain grass carp from food markets would remain. Also ecological impacts of the individual fish would still occur.

- If reproducing populations of grass carp were to become established in the wild, eradication would not be feasible.

Bighead Carp

Background

Bighead carp are voracious predators, eating a wide range of zooplankton and small invertebrates. They mature in 3-4 years, and reach a maximum size of up to 40 kg. Their native range is from southern China to the southern Russia, where mean annual air temperatures range from +22 to -2oC. They are found in rivers, reservoirs and lakes and spawning can take place in many waterbodies including moderate to large rivers and lakes with areas of slow current.

Vectors of bighead carp are generally the same as for grass carp, although they are not used for vegetation control. The ratio of availability of bighead to grass carp in this industry is about 2:1. In the mid-1990s, between 375,000 to more than 500,000 kg were imported annually to the live fish markets of the GTA. In 2003, almost 300,000 kg were reported sold by Ontario retailers, although only approximately 14,000 kg were reported to CFIA as imported.

Tabular Risk Assessment – Bighead Carp

Table 3: Ecological and Genetic

Component		**Rating**	**Certainty**
Probability of Establishment	Survival	High	Very Certain
	Reproduction	High	Reasonably Certain
	Spread	High	Reasonably Certain
Consequences of Establishment	Ecological	High	Reasonably Certain
	Genetic	Low	Very Certain

Table 4: Parasites, Pathogens & Fellow Travellers

Component		**Rating**	**Certainty**
Probability of Establishment	Introduction	Med	Reasonably Uncertain
	Encounter	Med	Reasonably Certain
Consequences of Establishment	Ecological	Med	Very Uncertain
	Genetic	Med	Very Uncertain

Conclusions and Advice

Considerations Regarding Release

- Vectors are similar to grass carp, except bighead carp are not used for control of aquatic vegetation. They only occur in Canada in the live food markets, where they have been available since 1981. This could make the likelihood of release of bighead carp lower than the likelihood of release of grass carp. However, bighead carp outnumber grass carp by 2:1 in the live fish markets in the GTA, could make probability of release of bighead carp higher than the probability of release of grass carp.

Considerations Regarding Survival

- Compared to grass carp, bighead carp have a somewhat warmer temperature preference. However, there are still many waterbodies of suitable temperature in the Great Lakes basin and southern Prairie waterways.

- Compared to grass carp, bighead carp occur in a much wider range of habitats and spend much more time in open waters, indicating that there is a great deal of suitable habitat in Canada, particularly in the Great Lakes.

Considerations Regarding Reproduction

- Bighead carp feed on a wide range of phytoplankton and zooplankton and feed throughout the year rather than only seasonally. All these factors increase the potential to acquire sufficient energy over a year to mature and produce eggs, compared to grass carp.

- The warmer temperature preference for bighead carp, compared to grass carp, may mean that that bighead carp require even more degree days than grass carp before spawning. However, successful reproduction of bighead carp in the wild has been documented at

least as far north in the US as for grass carp, suggesting that reproduction would be possible in, at least, southwestern Ontario.

Considerations Regarding Spread

- Compared to grass carp, the likelihood of expansion could be the same, or greater, due to wider habitat preferences and documented extensive movements of individual bighead carp in American waters.

Considerations Regarding Genetic Impacts

- This factor is dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Parasites, Disease & Fellow Travellers

- These factors are dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Ecological Impacts

- Where bighead carp have become established elsewhere, they often have resulted directly in substantial changes to the species composition and reduction in abundance of the larger phytoplankton and zooplankton communities, and sometimes changed water quality.

- The changes to the plankton community sometimes have been large enough to result in large indirect changes to the species and/or size composition of the entire plankton community and portions of fish communities.

Considerations Regarding Mitigation

- Generally the same as for grass carp. Bighead carp are not used for control of large aquatic plants, but they are used for control of zooplankton and sometimes phytoplankton control in aquaculture facilities.

- Triploid bighead carp are not currently available in Canada, but it is likely that they could be developed if desired.

- The US is investing over $10 million in technical deterrents to expansion of bighead, silver, and black carps from the Mississippi drainage system into the Great Lakes. This program will affect the mitigation measures which are optimal for Canada. Failure of Canada to regulate live trade in these carps could negate the ecological benefits of this program.

Silver Carp

Background

Silver carp feed primarily on phytoplankton but do take small zooplankton as well, and can compete intensively with juveniles of many native fishes. They mature in 3-5 years, and reach a maximum size of up to 40 kg. Their native range is from southern China to the southern Russia, where mean annual air temperatures range from +24 to -6^{o}C. Their preferred habitat is the standing waters of river, canals and lakes, and escaped established populations have reached high densities in some parts of the upper Mississippi drainage. Vectors of silver carp are similar to the grass carp, although the use and value of silver carp in Canada is unknown. It is not reported to be imported into Canada, but has been observed to be available for sale in the live food fish markets in Toronto.

Tabular Risk Assessment – Silver Carp

Table 5: Ecological and Genetic

Component		**Rating**	**Certainty**
Probability of Establishment	Survival	High	Very Certain
	Reproduction	High	Reasonably Certain
	Spread	High	Reasonably Certain
Consequences of Establishment	Ecological	High	Very Certain
	Genetic	Low	Very Certain

Table 6: Parasites, Pathogens & Fellow Travellers

Component		**Rating**	**Certainty**
Probability of Establishment	Introduction	Med	Reasonably Certain
	Encounter	Med	Reasonably Certain
Consequences of Establishment	Ecological	Med	Very Uncertain
	Genetic	Med	Very Uncertain

Conclusions and Advice

Considerations Regarding Release

- The extent of their use in the live food trade is undocumented in trade records, but sale of silver carp has been observed in Canada. They are not known to be produced in the US for the live market. They were recommended for use in phytoplankton control programs in reservoirs and water treatment facilities, but it is reported that they are not effective and use has been discontinued in many areas.

- Silver carp do not survive transport well as adults, but there is reasonable survival of eggs and juveniles.

Considerations Regarding Survival

- Generally the same as for grass carp. There are extensive areas in Canada with suitable temperature regime. Silver carp do not use the smaller ponds and streams where grass carp may occur, but large waterbodies are numerous in Canada.

Considerations Regarding Reproduction

- Generally the same as for grass carp regarding temperature requirements, and similar to bighead carp for feeding niche, so with the greater tolerance on both dimensions the risk of successful reproduction must be higher than for either of the other species.

Considerations Regarding Spread

- Similar to bighead except silver carp are able to jump barriers and have tolerance for colder temperatures, so likelihood of expansion can only be higher than for the other Asian carp species.

Considerations Regarding Genetic Impacts

- This factor is dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Parasites, Disease & Fellow Travellers

- These factors are dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Ecological Impacts

- Similar to bighead carp.

Considerations Regarding Mitigation

- Generally similar to grass carp and bighead carp. Silver carp are not currently available from the aquaculture industry in the US, but are common in the wild in some watersheds.

- Barriers to expansion would have to be higher than for other species. Lamprey control barriers may not deter spread.

- Leaping behaviour poses safety threat to boaters in areas where silver carp occur in the wild in the US, and this threat would require mitigation were populations of silver carp to become established in Canada.

Black Carp

Background

Black carp feed exclusively on molluscs and are used primarily in parasite control in freshwater aquaculture facilities. They mature in 6-11 years, and reach a maximum size of up to 60 kg. Their native range is from southern China to the southeastern reaches of the

Amur River basin in Siberia, but are absent from the vicinity of the Korean peninsula. In their native range, mean annual air temperatures range from +23 to -4^{o}C. Their preferred habitat is the lower reaches of rivers and lakes, with areas of high turbulence for spawning. Vectors of black carp introduction may include deliberate (e.g. prayer fish, animal rights activism) or accidental (e.g. live fish tanker spill) release related to the availability of black carp in the live food fish industry. Over 3,500 kg of black carp were imported into the GTA by wholesalers in 1996, and only 191 kg in 1997. However, recent import statistics do not list black carp. The probability of introduction of black carp through these vectors is largely unknown.

Tabular Risk Assessment - Black Carp

Table 7: Ecological and Genetic

Component		**Rating**	**Certainty**
Probability of Establishment	Survival	High	Very Certain
	Reproduction	High	Reasonably Certain
	Spread	High	Reasonably Certain
Consequences of Establishment	Ecological	High	Reasonably Certain
	Genetic	Low	Very Certain

Table 8: Parasites, Pathogens & Fellow Travellers

Component		**Rating**	**Certainty**
Probability of Establishment	Introduction	Med	Reasonably Certain
	Encounter	Med	Reasonably Certain
Consequences of Establishment	Ecological	Med	Very Uncertain
	Genetic	Med	Very Uncertain

Conclusions and Advice

Considerations Regarding Release

- Methods of release similar to other carps, except currently only cultured for use in North America for biological control programs for molluscs (especially snails) in freshwater aquaculture. Currently, black carp is not documented as being produced or used in live food trade in the US, but was recorded in Toronto markets in the mid-1990s.

Considerations Regarding Survival

- Temperature tolerances of black carp are similar to grass carp.

- Preferred habitats of black carp are large river systems and embayments. Ample habitat of this type is available in parts of the Great Lakes basin and larger Prairie watersheds.

- Plenty of food available: native and introduced molluscs. Although black carp cannot eat encrusted dreissenids.

Considerations Regarding Reproduction

- Black carp growth rate and size at maturity varies latitudinally. Those in cold temperate climates grow slower and reach maturity at an older age than those inhabiting warmer regions. Fecundity also is quite variable, some authors report that black carp have a higher fecundity than that of other Asian carp species, but results from other studies suggest otherwise. Black carp are less active and may slow or stop feeding during the coldest parts of the year, so the period when they accumulate energy for reproduction may be narrower in Canada than in the south-central US.

- Currently both diploid and triploid black carp may be used for parasite control in US aquaculture. Current regulations in states that allow black carp require triploid fish, and biosecurity measures are required at facilities which maintain broodstock. However, demand is exceeding supply, so there are incentives for reproductively capable fish to be placed in the markets. Moreover, regulations concerning use of triploid versus diploid black carp vary across states.

- Adult black carp have been captured in open waters of the lower Mississippi drainage over the past 12+ years and in the upper Mississippi in the last two years. Some of these fish were determined to be diploid. Since there are no observations of black carp spawning or larval fish in the wild, successful reproduction in the wild in North American is uncertain but possible, based on the increased reports of black carp in the wild and past experiences with bighead and silver carps escaping from culture.

Considerations Regarding Spread

- Similar to grass carp and bighead carp.

- Length of river required for successful reproduction is a function of river temperature and velocity.

Considerations Regarding Genetic Impacts

- This factor is dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Parasites, Disease & Fellow Travellers

- These factors are dealt with for all species of Asian carp at the end of the individual species sections.

Considerations Regarding Ecological Impacts

- Black carp feed nearly exclusively on molluscs (snails, mussels, etc), where at stocking densities used in aquaculture ponds (~25 fish per ha) they can reduce the abundance of such species to very low levels.

- Documentation of impacts of black carp on wild mollusc communities is lacking, but this is likely due to the relatively short time that black carp have been present in the wild in North America, and corresponding lack of study.

- The community of mussels in the Great Lakes basin is rich in species, and many of them either have been designated as at risk of extinction by COSEWIC, or are likely to be designated so in coming years. Black carp is likely to be an effective predator on native mollusc species, and thus pose a threat to these endangered species. Because of their relatively long life span (>12 years), even triploid or sterile black carp may pose a threat to mollusc populations.

Considerations Regarding Mitigation

- Similar to other Asian carps.

OTHER CONSIDERATIONS

All Asian Carp Species

Narrative Conclusions

Considerations Regarding Genetic Impacts

- There is little threat that there would be genetic consequences for native species from any of the four Asian carps as they are not known to hybridize.

Considerations Regarding Parasites, Disease and Fellow Travellers

- The various species of Asian carp do carry parasites and diseases which can be transferred to native fauna and even humans. Examples of documented taxa include: Asian tapeworm (*Bothriocephalus opsarichthydis*) in grass, bighead, and silver carp; *Lernaea* sp. in bighead carp; spring viremia of carp (SVC) in silver carp; *Centrocestus formosanus* in black carp; and, Chinese liver fluke (*Clonorchis sinensi)* and small intestinal fluke (*Metagonimus yokagawa)* in black carp. To this point 5 bacteria, 2 fungi, 1 myxozoa, 12 protozoa, 5 digenea, 3 monogenea, 2 cestoda, 1 nematoda, 8 copepoda and 2 branchiura have been found in introduced Asian carps.

- A number of these parasites are already established in Canada due to introductions of other Asian fish species, and others require intermediate hosts not known to occur in Canada. The incomplete knowledge of the parasite and disease burdens in introduced Asian carps, the life cycles of these parasites, and the current Canadian presence of these species makes it very difficult to quantify this risk reliably.

- Many diseases to which native species are vulnerable have been documented in Asian carps. Risk of transfer of these diseases would be reduced if importations were restricted to regulated and inspected culture facilities.

- In the Virgin River and Little Colorado River in the United States, it has been documented that there was a transfer of Asian tapeworm from grass carp to baitfish to native fish fauna, resulting in a major dieoff of native fishes, including endangered species.

- Risks due to fellow travellers in the transport water would be decreased if the modes of disposal of transport water were regulated and enforced. Disposal in sanitary sewers would be safer than the current practice of disposal in storm sewers. Treatment of the

transport water with approved therapeutics would also be effective. Disposal of dead fish carcasses and offal should be conducted in a manner which ensures that diseases would not be introduced into the wild.

- Careful and complete documentation of species composition of imported carps would be important for reducing the risk of fellow travellers becoming established in Canada. It is difficult for laypersons to differentiate between carp species.

SOURCES OF INFORMATION

Cudmore, B. and N.E. Mandrak. 2004. Biological synopsis of grass carp (*Ctenopharyngodon idella*). Can. Ms. Rept. Fish. Aquat. Sci. 2705.

Mandrak, N.E., Cudmore, B. 2004. Risk Assessment for Asian Carps in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2004/103. In Press.

FOR MORE INFORMATION

Contact: Dr. Nicholas E. Mandrak
Fisheries and Oceans Canada Great Lakes Laboratory for Fisheries and Aquatic Sciences
867 Lakeshore Rd.
Burlington, Ontario
L7R 4A6

Tel: (905) 336-4842
Fax: (905) 336-6437
E-Mail: mandrakn@dfo-mpo.gc.ca

This report is available from the:

Canadian Science Advisory Secretariat
National Capital Region
Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario
K1A 0E6

Telephone: (613) 990-0293
Fax: (613) 954-0807
E-Mail: CSAS@DFO-MPO.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1480-4913 (Printed)

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

CORRECT CITATION FOR THIS PUBLICATION

DFO, 2005. Carp Status Report. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/001.