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Canadian Science Advisory Secretariat / **Secrétariat canadien de consultation scientifique**

Proceedings Series 2009/042 / **Compte rendu 2009/042**

Proceedings of the Central and Arctic Regional Science Advisory Process on the Assessment of Information Required for the Identification of Critical Habitat for Pugnose Shiner, Spotted Gar, Lake Chubsucker and Northern Madtom

Compte rendu du processus consultatif régional du Centre et de l'Arctique sur l'évaluation de l'Information requise pour la désignation de l'habitat essentiel du méné camus, du lépisosté tacheté,du sucet de lac et du chat-fou du Nord

29 May 2008
Canada Centre for Inland Waters
Burlington, ON

le 29 mai 2008
Centre canadien des eaux intérieures
Burlington (Ont.)

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November 2009 / **Novembre 2009**

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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November 2009

Novembre 20009

ISSN 1701-1272 (Printed / Imprimé)
ISSN 1701-1280 (Online / En ligne)

Published and available free from:
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
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Ottawa, Ontario
K1A 0E6

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Correct citation for this publication:

DFO. 2009. Proceedings of the Central and Arctic Regional Science Advisory Process on the Assessment of Information Required for the Identification of Critical Habitat for freshwater fishes; 29 May 2008. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2009/042.

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SUMMARY

A regional science peer review meeting was held on 29 May 2008 in Burlington, Ontario. The purpose of the review was to provide science advice on a conceptual framework to describe information required for the identification of critical habitat for freshwater fishes. The framework is meant to provide general guidance that may be adapted for broader usage. Science advice on the information and methods required for the identification of critical habitat for Lake Chubsucker (*Erimyzon sucetta*), Northern Madtom (*Noturus stigmosus*), Pugnose Shiner (*Notropis anogenus*) and Spotted Gar (*Lepisosteus oculatus*) was requested to inform the respective recovery strategies. Existing descriptions of critical habitat for some species and populations have been proposed by the recovery team and needed to be considered in range-wide recommendations to support the recovery team's decision on the identification of critical habitat for the four species. Science advice on a population-by-population basis was requested for each of the four species across their Canadian range, taking into account the limited data available for each population. It became apparent at the meeting that the same approach could be used to provide advice for other freshwater fishes.

Meeting participants included DFO Science, Fish Habitat Management and Policy sectors from Central and Arctic Region and Headquarters, and specialists from the Ontario Ministry of Natural Resources, Parks Canada Agency, Government of British Columbia, University of Guelph, and Trent University. This proceedings report summarizes the relevant discussions and presents the key conclusions reached at the peer review meeting.

This report will be published in the Canadian Science Advisory Secretariat (CSAS) Proceedings Series. There will be a CSAS Research Document produced in relation to the working papers presented at the workshop. The advice from the meeting will be published as a Science Advisory Report.

SOMMAIRE

Une réunion régionale d’examen scientifique par des pairs a eu lieu le 29 mai 2008 à Burlington, en Ontario. Le but de cet examen était de formuler un avis scientifique sur un cadre conceptuel servant à décrire l’information requise pour la désignation de l’habitat essentiel des poissons d’eau douce. Ce cadre a pour but de fournir des directives générales qui pourront être adaptées pour un usage plus large. Afin d’étoffer les programmes de rétablissement du sucet de lac (*Erimyzon sucetta*), du chat-fou du Nord (*Noturus stigmosus*), du méné camus (*Notropis anogenus*) et du lépisosté tacheté (*Lepisosteus oculatus*), on a formulé un avis scientifique sur les données et méthodes requises pour la désignation de l’habitat essentiel de ces espèces. L’équipe de rétablissement a proposé des descriptions d’habitat essentiel disponibles pour quelques-unes de ces espèces et populations. Ces descriptions doivent être prises en considération dans les recommandations concernant l’ensemble des aires de répartition afin d’appuyer la décision de l’équipe de rétablissement concernant la désignation de l’habitat essentiel de ces quatre espèces. Même si on dispose de peu de données sur chaque population, on a demandé de formuler un avis scientifique pour les quatre espèces dans leur aire de répartition canadienne. Cette réunion a mis en évidence le fait que cette même approche pouvait être utilisée pour fournir un avis scientifique sur d’autres espèces de poissons d’eau douce.

Parmi les participants, mentionnons des représentants des secteurs des Sciences, de la Gestion de l’habitat du poisson et des Politiques de la Région du Centre et de l’Arctique et de l’administration centrale du MPO ainsi que des spécialistes du ministère des Richesses naturelles de l’Ontario, de l’Université de Guelph et de l’Université Trent. Le présent compte rendu de la réunion résume les discussions pertinentes tenues au cours de cette réunion d’examen par des pairs et expose les principales conclusions formulées.

Le présent document sera publié dans la série des comptes rendus du Secrétariat canadien de consultation scientifique (SCCS). Un document de recherche du SCCS sera aussi produit en lien avec les documents de travail présentés à l’atelier. L’avis découlant de la réunion sera quant à lui publié en tant qu’avis scientifique.

INTRODUCTION

Critical habitat is defined under Section 2 of Canada's *Species at Risk Act* (SARA) as, "the habitat 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". SARA requires the development of recovery strategies for species listed as "Endangered" or "Threatened" under the act (SARA, Schedule 1). Once designated, SARA provides provisions to protect critical habitat of these species.

The Ontario Freshwater Fish Recovery Team has recently developed recovery strategies for four species of fishes: Lake Chubsucker (*Erimyzon sucetta*); Northern Madtom (*Noturus stigmosus*); Pugnose Shiner (*Notropis anogenus*); and, Spotted Gar (*Lepisosteus oculatus*). Science advice on the information required for the identification of critical habitat for these species is required for consideration and possible integration into their respective recovery strategies. (DFO 2007a) provides Science with guidance on the information needed to make decisions on critical habitat. Existing descriptions of critical habitat for some species and populations have been proposed by the recovery team and need to be considered in range-wide recommendations to support the recovery team's decision on the identification of critical habitat for the four species. Science advice on a population-by-population basis was requested for each of the four species across their Canadian range, taking into account the limited data available for each population. A conceptual framework to describe information and methods required for the identification of critical habitat for freshwater fishes would provide general guidance that may be adapted for broader usage.

The purpose of the meeting, as described in the Terms of Reference (Appendix 1) was to:

- Review methods and information required for the identification of critical habitat, particularly for species with limited data on habitat requirements.

- Review a proposed conceptual framework for identifying information required for the identification of critical habitat for freshwater fishes.

- Review the information required by the recovery teams to identify critical habitat for four freshwater fish species based on the proposed conceptual framework. Data permitting the information for each species will include: a) habitat requirements by life stage; b) an estimate of recovery target or minimum viable population size; and, c) area of occupancy of each population.

- Review a proposed schedule of studies to fill gaps in knowledge required to identify or refine information required for the identification of critical habitat for four freshwater fish species.

Meeting participants (Appendix 2) included DFO Science, Fish Habitat Management and Policy sectors from Central and Arctic Region and Headquarters, and specialists from the Ontario Ministry of Natural Resources, Parks Canada Agency, Government of British Columbia, University of Guelph, and Trent University. The meeting generally followed the agenda as outlined in Appendix 3.

This proceedings report summarizes the relevant discussions and presents the key conclusions reached at the peer review meeting. CSAS Research Document(s) will be produced from the working papers presented at the workshop and which provided the basis for the discussions. The Science Advisory Report is the synopsis of the advice from the meeting.

DETAILED DISCUSSION

The four fishes included in the discussions are considered data poor. Recovery strategies are being developed and, to the extent possible, the recovery teams are expected to identify critical habitat based on science. When there are sufficient data to make a case for critical habitat, it should be included as a schedule of studies.

Presentations were made on the methods that DFO Science is proposing to provide information to the recovery teams for their identification of critical habitat. Participants were asked to comment on the strengths and weaknesses of the each of the methods and discuss which methods were most appropriate. Following this, species-specific application of the methods was discussed.

The core assumptions from Rosenfeld and Hatfield (2006) are that there is a positive relationship between habitat and population size and a minimum habitat area is required to meet the recovery target. The minimum information needed to determine habitat requirements is basic life history information, recovery targets, the relationship between habitat and abundance (population-habitat models) by life stage, and habitat availability. The latter requires accurate information on quantity and distribution of different habitats.

Methods - Life history information

Presenter: N. Mandrak

One of the requirements from the framework (DFO 2007b) is to provide functional descriptions of the properties that a species' aquatic habitat must have to allow successful completion of all life history stages. This requires a summary of the basic life history for each life stage. This information may come from research or from the literature and may include information from related species. It should also include recent habitat preference analyses to help inform the habitat preference by life-stage.

Methods - Estimating population ranges

Presenter: N. Mandrak

Another requirement is to provide information on the spatial extent of the areas that are likely to have the necessary properties. Our understanding of the true distribution of each population of each species is not good. In general, point records are used as a basis for determining the extent of the population but there is a risk of not identifying critical habitat lying outside of the points. The true distribution of each population and information on how the functional habitat relates to the spatial area are needed.

An estimate of the population range is needed to determine the spatial extent. The challenge is that the range data varies from a single record to many records. The proposed methods can be divided into two main types. Recovery target-dependant methods include: minimum area for population viability based on area per individual (MAPV1); minimum area per viable population based on density (MAPV2); and, minimum area for conservation of aquatic habitat (MACAH). Recovery target-independent methods include: home range (HR) within which there are two proposals (waterbody scale independent and waterbody scale depend methods); ecological classification (EC) (i.e., Aquatic Landscape Inventory System (ALIS)); and, three area of occupancy methods - convex polygon, feature envelope, and whole waterbody. Each method was explained and discussed.

Methods - Minimum Area for Population Viability

Authors: A. Vélez-Espino and M. Koops
Presenter: A. Vélez-Espino

There are three dimensions of critical habitat: the minimum area for population viability for a single discrete population; the recovery target; and, the relationship between abundance and habitat. The minimum area for population viability is the area that is needed to support the recovery target. Another term from the literature is essential fish habitat, which relates to the stage-specific habitat that is most sensitive to recovery actions or to harm. The population structure is needed along with basic information about habitat preference by different life history stages. With this, there is the potential to measure the ratio between habitat supply and habitat demand.

Defining critical habitat in species at risk requires the determination of a population-based recovery target, the development of a relationship between habitat and abundance (or density), and the determination of the amount of habitat required to fit a population with size determined by the recovery target (Rosenfeld and Hatfield 2006).

Demographic sustainability was used to set abundance targets. Demographic sustainability is quantitative and is the most tractable approach available. It uses Population Viability Analysis (PVA). The abundance target is set to give a reasonable probability of maintaining the target over the long term. The long-term demographic sustainability is the 99% probability of persistence over 40 generations, a fairly conservative target based on Reed *et al.* (2003), a meta-analysis developed for all vertebrates. They found a relationship between minimum viable population size (Y-axis) and maximum population growth rate per generation (X-axis). The faster a population can grow in a generation, the lower the minimum viable population size will be. The assumptions of this analysis are that there is no habitat loss and that these are discrete and isolated populations (i.e., no immigration). The limitation with this analysis is that, while the meta-analysis is based on vertebrates, it is heavily biased towards mammals and birds and limited for fishes. The range in population growth rates that have been used to generate the analysis was compared to those of fish species at low abundances. The range of population growth rates overlapped quite significantly and the relative range of growth rates used in this analysis is consistent with what would be expected for fishes.

This relationship is used to generate minimum viable population sizes. Knowing the number of adults allows the prediction of how much area of appropriate habitat an animal of a particular body size needs. The minimum area for population viability (MAPV) is defined as the amount of exclusive and suitable habitat required for a demographically sustainable recovery target based on the concept of minimum viable population size (MVP). Therefore, MAPV is a quantitative metric of critical habitat that can assist the management and recovery of species at risk. The minimum area for population viability (MAPV) of four fish species at risk in Canada was estimated following two approaches: (1) predictive equations developed for freshwater fishes and relating area per individual with adult length; and, (2) an allometric equation between adult weight and density for aquatic organisms. These approaches were applied to Northern Madtom (*Noturus stigmosus*), Spotted Gar (*Lepisosteus oculatus*), Lake Chubsucker (*Erimyzon sucetta*), and Pugnose Shiner (*Notropis anogenus*).

Discussion

Q. Why did you use the Reed *et al.* equation to come up with population targets for fishes, when their recommended population target for all species averaged 7000 individuals, and the number you got using the equation for fishes only was much lower?
A. The assumption is that the intrinsic population growth rate for small and medium fishes is much larger than those of the mammals and birds that dominate the Reed dataset.

Q. What does Area per Individual (API) mean?
A. It is the area needed for individuals in the population; the exclusive area for a single individual without overlap. It is the inverse of density.

Q. How do you deal with API for migratory species?
A. It is part of the home range over an annual cycle.

C. You will have seasonal variation in home ranges as a result of the life histories. Most home ranges, however, are based on studies where the species is tracked for a few months or so. This might then be an underestimate of the annual home range. Ideally, the life-time tracking of an individual would be used. If the spawning areas are known, and there is site fidelity to these spawning areas each year, then home range can be estimated from spawning cycle to spawning cycle.

C. Specification of what habitat is being preserved is needed. Spawning habitat and juvenile habitat may be preserved for migratory species; whereas, for resident species, it would be areas needed to accomplish all stages of the lifecycle.
R. The area was calculated for both environments, for rivers and lakes. For migratory species, there is a metric of habitat for lakes and another for rivers for the same species.

Q. Shouldn't the migratory corridor during the migration be considered as critical habitat?
A. There is some consideration of connectivity as part of the Recovery Potential Assessment.

C. The issue may be connectivity. There could be changes in their habitat which would affect survivorship and this may not just be while migration is occurring. If there is a window for the migration to occur, that may be the most important time but there might be changes made outside that window that could permanently destroy the habitat and the ability for the fish to migrate and, as a result, part of the population might be lost.
R. A good estimate of the extent of the population range is needed. Within that extent of the population range, there is a subset of habitat that is important for different life stages. This is specific to adult habitat not necessarily adult spawning habitat. The migrations issue is an additional challenge that is not addressed by this initial analysis.

C. Most of the data is based on lake or river resident species. What happens for migratory species? If this was applied to anadromous salmon the area per individual would only apply to freshwater life stages.
R. The specification of what life history stage the habitat applies to should be more explicit. Participants agreed with this. For migratory species, the particular life stages may be layered and the habitat would then be the compilation of all of them.

Q. Is the differentiation between adults and spawners simply sexual maturity?

A. At this point in the analysis, they are not separated out. It would need to be done in a nested fashion as has been suggested. The analysis would have to be done on each of the life stages including partitioning the adults between spawners and non-spawners.

C. The minimum area for conservation makes sense. However, there are certain habitat patches that are so small that they may not have conservation value. The actual criteria used should be more explicit. This should be rationalized better in the document; the small patch in principle could support the minimum viable population but once the patch is so small it could be argued that to protect the patch at that scale might not be sufficient. Things that happen outside of it will actually affect the habitat within the patch because it is so small.

Q. There is uncertainty included for the minimum and maximum size of fish, but what about the uncertainty surrounding home range for any given size?
A. This is not taken into account. The data that go into the models are not robust data. Reed *et al.*, indicates that with short studies, extinction rates are systematically underestimated. It is important to understand that this is not just less precision. With better data, these models will give more robust results.

C. I like the approach because it is transparent and logical, but the uncertainty should be really explicit, there is some built in at different levels and some of this is captured by using several approaches which almost provides confidence intervals. There is also uncertainty about the allometric relationships, so there are multiple built-in uncertainties at each stage and there is also uncertainty in the precautionary approach. The overall document needs to have several paragraphs which explicitly discuss uncertainty, where it comes in, and also discusses why the precautionary principle is needed. This would make it more transparent and would make the document stronger. Uncertainties could be incorporated into the simulation output distribution.

C. When maximum size is used, this might overestimate the area required as the entire population won't be the maximum size. The minimum and maximum size and an estimator of natural morality could be used to apportion the values along the length.
R. The demographics are included in the MVP analysis.

C. The relationship between habitat quality and abundance hasn't been discussed. For some populations, the habitat might not be good, so you'd need four times the amount of habitat to hold the MVP, because it is not high quality habitat. The implicit assumption of the API relationship is that the habitat quality is equivalent for all habitats looked at.
R. Yes, the API is based on suitable high quality habitat.

C. In the Reed *et al.* paper, those were minimum viable populations for organisms that were in relatively good habitat. Here at the northern end of their distribution, most of the species are not at their maximum r (intrinsic rate of growth) and, in some cases, the habitat is degraded so they are probably below the maximum
R. It would be useful to undertake a sensitivity analysis and that would give a confidence interval of sorts. A realistic range of population growth rates from the literature, throughout the species distribution would change the MVP. The recommendations are for good quality habitat and if the habitat was degraded it would increase the amount of habitat needed. A sensitivity analysis, would give more confidence in the recommendations.

C. Care should be taken with the use of the term "buffer" in the report as "buffer" is a value-laden word. Often it is considered an area around a particular habitat but in the report the buffer seems to be discussed as being part of the habitat.

R. Within SARA, there is nothing that allows the identification of a buffer that can be protected. Only critical habitat is protected. So it is either critical habitat and it is protected or it is not. Although as part of the recovery strategy, areas outside the critical habitat can have activities managed so as to not cause damage within the critical habitat.

Methods - Scale-Dependent Home Range

Presenter: D. Woolnough

Freshwater mussels have patchy distributions with various types of connectivity (biological, water or ecological, genetic). Freshwater mussels are generally stationary but they do move during the glochidial stage when they attach themselves to the host fish, but information on how far mussels can move during this stage was unknown. To understand the connectivity of mussels, it is important to understand the fish host home ranges, their abundance and location to determine the transportation factor. This is challenging since there were 118 types of host fishes. In a single reach of river (36 km), a probability surface instead of a buffer zone was determined. The whole community of hosts was considered and the probability surfaces were overlaid to develop a probability model that shows likelihood of finding host fishes. Using this information allows development of pathways of connectivity which likely follow high probability areas rather than direct routes.

In the literature, there are a variety of approaches used to estimate home ranges. Home range data can be collected using telemetry, mark-recapture and spot surveys, and these are often combined to determine the home range of species which adds to the errors in some of the models. Linear home ranges (measured in m or km) are movement from cell to cell. Aerial home ranges (measured in km^2 or hectares) are more commonly collected in lentic (lakes and ponds) systems. For aerial home ranges, minimum convex polygons are commonly used. Variations such as percentage, probability minimum convex polygons and restricted polygons may also be used. One method which should be considered for home ranges of fish is kernel estimations. This takes into account how many times over a given period a species is found within certain areas. There is generally a core area, further out from which, the probability of occurrence is reduced. As a result of the variety of methods available, it is not surprising that, even for species specific-studies, there are variations in home ranges.

Home ranges can be used to determine population densities, habitat selection, interaction between species and is used for modelling. Foraging and resource distribution can also be important when discussing the quality of habitat. A home range may not equal the critical habitat. A home range represents the spatial utilization and mobility patterns that emerge over time to capture important areas that are used by individuals of a species. For this study, a home range is not a territory which can be as big as, or larger than, a home range. A home range is likely to underestimate the territory size which is the area defended (darting outside of the home range in defence of the territory). It is also important to know that the home range is not for the population but is for the individual. Home range can vary over season, which needs to be taken into account.

A study examined the estimates of home ranges of fish in linear (river) and lotic systems in aerial waterbody shapes with three objectives: to determine the effect of body size on home range; to determine the effect of waterbody size on home range; and, to determine if there are any joint effects i.e., interaction effects of waterbody size and body size on home ranges.

Fish body size was based on volume accounting for both length and shape. There are consequences to home range scaling, so there can be inaccuracies due to assumed body size scaling that would lead to erroneous predictions. When body size and waterbody size were incorporated specific to rivers with linear home range estimates, the logarithm of the home range was calculated by using river length and body size. There are not many studies from very large lakes.

Results of the examination of 71 studies with 66 fish species showed that home range increases with body size, and home range also increases with waterbody size (across the two different waterbody shapes). In all systems, there was a significant effect of waterbody size on home range; that is, home ranges were larger in larger systems so fish exploit more available ecosystem with increasing waterbody size. There was larger movement in lakes than in rivers. There was only one scenario where there were effects of waterbody size, body size and an interaction between the two. So, in conjunction, waterbody size and body size can provide an improved estimate of home range over just body size alone.

Pugnose Shiner was used as an example. Using the regression developed, home range predicted from waterbody size is 80 m^2 and, for linear systems (drains), its linear home range would be 18 m^2. Using the maximum body size and waterbody size, home range would increase from 80 to 260 m^2, and the linear home range would also increase. For a larger system, using the maximum body size, home range would be 410 m^2. For the larger Detroit River and largest St. Lawrence River, there is a potential to have the shiner move further. For lentic systems, the home range is predicted to be 1.7 km^2. Using the body size predictor, the estimate is 70 m^2. [In the provided documents], Lake St. Clair has a home range estimated at 32 km^2; however, the body size predictor still is 70 m^2.

Discussion

Participants discussed the difference between home range and territory and came to the conclusion that the size of the territory and home range and the comparison between them depended on the definition of the terms.

Q. Does the size of the population affect the home range?
A. For the purposes of this study, only individual home ranges were considered. The two scenarios where there was no interaction affect also had the smallest sample size.

Q. Was your model based on any fishes with a body size as small as Pugnose Shiner?
A. Pugnose shiner did fall within the body size for lake systems.

Q. Were the fish that you were working with as small as the Pugnose shiner?
A. Some were.

Q. Was the geographic range of the studies mostly temperate? Could there have been a productivity effect? If you were examining systems in northern Ontario versus southern Ontario, the productivity would be larger in the south and that might have an impact.
A. Yes, they were mostly temperate although there were five tropical ones included. All were completed within a single year and did not go into the winter season. We did not look at productivity, although it could be looked at with a probability rather than buffered zone.

Q. Can you use the lake model when you get to larger rivers?
A. Yes, when you get to larger rivers, the data overlaps, so the home ranges are similar, essentially fishes are using those large rivers like a lake.

Q. Do you have a sense of whether the observer expectations biased the home range results in you papers?
A. Yes, there was still observer bias, so the estimates are underestimates. There would be no bias with actual telemetry data.

C. The methodology may be confounded by the size of the system, for example a tracking study in a small lake versus a large lake could result in large differences, even though the same method is used.
R. The most robust data are from rivers with linear predictions using mark-recapture.

Q. Have you found anything that shows a relationship between the size of the population and the home range? If there is a smaller population, will it have a smaller or larger home range than a larger population? Similarly, is there a relationship with quality of habitat? Have you tried looking at the ecology of the fish, to see if that is related to home range i.e., pelagic versus benthic, etc.
A. We don't have information on that.

Q. Is there more attention to overlap now, could you estimate overlap between home range?
A. There has been more attention to overlap and to temporal scenarios which is why kernel estimators can be used when using telemetry tracking. The core area develops into the area for that individual and the core areas overlap. This might relate to the quality of the habitat. You need data on multiple species that have been tracked at the same time to determine overlap.

Q. In the paper, was your definition of home range the core area of use?
A. Yes, we only used the papers that used some defined home range and parsed out the ones that were actually territories or something other than [territories] and larger in scope than the home range (mobility or territory).

C. Territoriality theory suggests in situations where you have high competition, you would have smaller territories and you get a lot more intruders. You might expect to see the same thing with the area of core use. If you have more individuals, then the area that any one of those individuals can use would become compressed. Would that be part of the explanation for why you see smaller home ranges in smaller waterbodies? In larger waterbodies, there is more potential for all of the competitors to spread out and use more space.
R. That is part of it.

C. Some species relocate their home ranges, like salmonids, which will use a core area and then move and use another home range. If that isn't taken into account, you might overestimate home range.
R. Yes, this is why the kernel estimators are good.

C. From the standpoint of critical babitat, you are trying to estimate how much habitat you need for a population of a particular size. Care must be used when extrapolating from allometric relationships but some common sense is also needed. The idea that a small fish like the Pugnose Shiner needs 32 km^2 in Lake St. Clair doesn't make sense from an ecological standpoint. The modelling Antonio applied seems more credible.

Methods - Mapping Population Ranges

Presenter: N. Mandrak

It is important to keep in mind how to translate the area estimates using the two approaches to an actual spatial extent. The next examples are spatially explicit and include ecological classification and area of occupancy recovery target independent methods for estimating population ranges.

Ecological Classification

It is possible, if an ecological classification exists on a broad scale, that the population range could be estimated to include the entire extent of the class if at least one record is present. Northern Madtom was used as an example. If there is a single ecological class, it is assumed to represent a relatively homogonous unit at a certain scale. If you find the Northern Madtom at one part of that ecological class would you not expect to find it elsewhere in that ecological class? The assumption is that the classes are good predictors of Northern Madtom distribution. It could be tested, but this is difficult for rare species with small sample sizes. The Aquatic Landscape Inventory System (ALIS) has been tested to see how well it predicts species distributions and it doesn't work very well. If a class system is used, justification that the class is a good predictor of the distribution of the species would be needed.

Convex Polygon

Another potential method for estimating species or population ranges is the convex polygon method introduced earlier. The scale is somewhere between the movement of a single species and the extent of occurrence that COSEWIC uses to measure the overall range of a species. (Extent of occurrence includes land and water and all species occurrence points)

Feature Envelope

The feature envelope method overcomes some of the problems. It takes the maximum and minimum latitudes and longitudes and creates a box, and in the example used here, the box is buffered by 10%. All the water within the envelope is highlighted.

Discussion

C. The feature envelope doesn't consider habitat features some of which might not be suitable.
R. Yes, but we are trying to predict the spatial extent of the population, of which a subset of the habitat would be important or critical habitat.

Q. Is the feature envelope only looking at occurrences and not areas that have been sampled and not been found?
A. Yes.

Q. Are you suggesting a method could be used that would use the areas where it wasn't caught as well as sites where it was caught to determine critical habitat?
A. If where the species wasn't caught was known then the probability of them being there would be lower. Interpretation might be different depending on the intensity of sampling. Criteria would have to be developed to decide when each method would be used i.e., a decision tree approach. If an area has been sampled intensively and there is a good probability that the target might be there, then the feature envelope could be used. All methods could be considered to

give a better idea of the spatial range, given the uncertainty of each method. In some cases, there might be support for a whole waterbody to be considered as the population range.

Q. For the envelope approach, given the size of the Pugnose Shiner, does it make biological sense that there is only one population in the St. Lawrence River?
A. Deciding how to distinguish populations is part of the difficulty. Maybe there is not enough information about the species here to be able to put an envelope around them. More sampling is needed and more information is needed.

C. It is important to note whether there is enough information to provide to the recovery team to allow them to take the first stab at designating critical habitat. An important consideration with this approach is that that those locations where species have been found is assumed to be the most favorable for the species but that may not always be the case and is not necessarily the safest or most precautionary approach.
R. Participants were in agreement. In addition, the points are being looked at as if they were randomly distributed within the range of the species. One issue is the quality of the data where the fish are collected and what the data represent. The other issue is how to extrapolate from the current data. There is a difference between catching one adult and knowing that there is reproduction going on. If reproduction is observed, it provides more support for identifying it as a population.

Participants agreed that there should be a decision tree with the decisions based on how much information is available.

1. Population
Is it a population? How many populations are there within the species? What is the information that supports this (e.g., evidence for spawning individuals, juveniles).

Criteria for the minimum acceptable level of information are needed. Barriers may separate populations. For a small species that doesn't migrate, one or two individuals likely represent a population. Evidence of spawning may not be necessary, depending on the species. Determining whether there is a population is harder if, for example, you have a small fish that is found over 80 km of the St. Lawrence. Is it one population or is it multiple populations or is it even possible to decide?

NatureServe has a method to determine distinct populations for small fishes. It gives separation distances although some judgment is needed about whether the habitat between occurrences is suitable. It was suggested a probabilistic evaluation of the potential that there are populations between and beyond the known points should be considered. There is a general discomfort related to the number of observations. If there were 1000 observations, an envelope could be constructed and defended. It is much harder to do this with only one point.

2. Functional attributes
Provide the functional descriptions of the properties that a species' aquatic habitat must have to allow successful completion of all life history stages. What sort of habitat is needed and how it is used. This information may come from a literature search as habitat tends to be easier to study than fish.

3. Spatial Extent
Provide information on the spatial extent of the areas that are likely to have the necessary properties. What is the spatial extent of each of the populations? This might consider the

difference between historic and current spatial extent, population dynamics, and habitat requirements at each life stage. Meta-population dynamics and the species range would be considered. The spatial extent of all populations across the landscape throughout the range is needed not just the spatial extent for one population. Once the spatial extent has been determined then, within that spatial extent, what are the important habitats?

This is dependant on knowing something about habitat that can be represented spatially. Some of the natural history information including depth, temperature, vegetation, and some exposures preferred by Pugnose Shiner can be used as a course description. Using this and the sampling record would give a sense of what is understood of the distribution of the populations. Within that distribution there are important areas of habitat and which areas are likely to have that important habitat may be known.

Participants discussed this approach using the Pugnose Shiner as an example. There are several areas with clusters of points and, in these areas, there is greater confidence in constructing an envelope. For the isolated points, there may be a minimal estimate that could be applied as an interim measure in the absence of additional evidence based on the clusters. Ideally, there should be information on where the species was caught, and where it wasn't caught. The next layer would be data on habitat (<3 m and for the wetland areas), if available. It might then become intuitive where discrete populations are. So the range of the species is in a large geographic area and there are a whole lot of points to explore that are potential Pugnose Shiner populations. There would be known critical habitat and potential critical habitat within the larger area. It was suggested that analyses need to be developed further to identify spatial extent incorporating probability. There was general agreement that knowing where the species is found alone is not as useful as having both presence and absence data. There is a potential to provide quantitative (statistical regression) support for conclusions that is more convincing.

Once a population is known, how is the spatial extent of the population extrapolated? How would it be decided which one of the approaches presented would be used to identify the spatial extent? The scale of extent includes both different life stages within a population and multiple populations. The approaches are not mutually exclusive, so combinations could be used wherever possible. The body of methods can be used as the basis for constructing the distribution of values. The uncertainties associated with each method can be estimated internally to propagate the error. It might be expected that, as the amount of data increased, at some point all the methods would converge and would predict the same values. So each species would be considered on a case-by-case basis and the different scientific methods are essentially a toolbox of options to be applied so as to determine which has enough rigor to give the information that is needed. It may also be appropriate to use them in combination in certain circumstances. This may not allow definition of a complete set of critical habitat for the species with the information available but this can be added to later with the schedule of studies.

Northern Madtom
Presenter: A. Edwards

There is a draft recovery strategy for Northern Madtom awaiting information on critical habitat. The Northern Madtom is a globally rare species. In Canada, it is found in the Thames River, the St. Clair River, Lake St. Clair and the Detroit River. One specimen was found in the Sydenham River in 1975, although no one is sure if there was an established population there. One (YOY) individual was caught in the St. Clair River in 2003. There has been recent work done on the Thames and Detroit rivers. Mapping was done for the extant populations not including the Sydenham River.

The recovery strategy has a qualitative recovery goal as there is insufficient information with which to develop a quantitative recovery goal. Over the next five years, the goal is to maintain extant populations in Lake St. Clair, and the Thames, St. Clair and Detroit rivers. The long-term goal over the next 20 years is to sustain and enhance the existing viable populations in the Detroit/St. Clair River corridor, Thames River, and Sydenham River if the species has not been extirpated.

Information on functional habitat requirements of this species is limited. There is some spawning information from the Detroit River where it spawns from mid- to late-summer over a month-long period. It spawns in nests under rocks, logs, cans or bottles. In Lake St. Clair, the substrate was sand or cobble surrounded by lots of macrophytes. There is little known about YOY other than they scatter into the aquatic vegetation when the nest is disturbed. Most of the Thames River records were YOY where there were no aquatic macrophytes as it was too turbid and fast flowing. It appeared that YOY need cover, rather than specifically macrophytes. There is little know about requirements of juveniles, but they have been caught in the same location as adults. Adults have been found in lakes, large creeks and rivers, from tributary waters where the flow was from moderate to rapid with substrate of sand, gravel and rock at depths of 1-7 m. They are believed to avoid extremely silted areas. They are found next to the Peace Fountain (Detroit River).

Maps were developed for the known Northern Madtom locations. In each location, the most conservative method was used to estimate the size of the plotted population range. For example, the Lake St. Clair buffered population range was ~32 km^2 based on the home range method. In the St. Clair River, using the minimum area per viable population based on density and also buffered was~50,000 m^2.

Q. What was the reason for the difference between the area in Lake St. Clair and the St. Clair River?
A. Different methods were used and the methods are scaled by the size of the waterbody. The uncertainty around the home range size calculation relates to the uncertainty in the size of the area.

Q. What was sampled in the centre of Lake St. Clair, and what about the other two points?
A. It was one individual caught by a commercial fisherman in a trawl in the centre of the lake and individual captures for the other two sites. The sites in the Detroit River have known spawning populations.

C. Unless there is stronger supporting evidence that they represent populations it could be argued that they are strays. Evidence for populations based on reproduction and abundance is needed. And it doesn't appear to be the case here. Unless the point represents a population the concept of defining critical habitat doesn't make sense.

Q. Why are the circles different for the centre of the lake versus the shore?
A. The area within the water is the same for each. The shore sites would have included the land so [only] the area within the water was [mapped].

C. Most of the area of Lake St. Clair is shallow and vegetated, 3-4 m deep along the side of the lake. It would not be unexpected to have Northern Madtom throughout that area. The only deep part of the lake is where the shipping channel is dredged.

Q. Is it reasonable to expect that there are lots of places in the lake that have been sampled?
A. They have been sampled but have not specifically targeted Northern Madtom.

C. The maps only include sites where they were found not all sites sampled. There should be more information provided on the maps. If there was lots of sampling without captures, it may mean that the sites where they have been found may be special. Multiple captures would also be very important. More sites would point towards a whole waterbody approach.

Q. Are they picked up by electrofishing?
A. No, they are benthic and found in turbid waters making it difficult to sample effectively by electrofishing.

Q. Is there information from the American side?
A. There is some sampling in American waters related to Lake Sturgeon. A report by Thomas and Haas indicates Brindled and Tadpole but not Northern Madtom were captured with (extensive) trawl transects in each 2.5' grid which may have covered the Canadian side as well. It is an appropriate sampling method as demonstrated by the capture of the other species of madtom.

Q. Maybe the definition of critical habitat could be looked at from two directions. Based on spawning areas, what habitat should be included, but based on the trawl survey where none were found, what kind of habitat could be excluded?
A. The problem is the habitat data across the lake is not available.

Q. Part of defining critical habitat is the area and the functional description. Here you have the spatial extent. There has to be a habitat component within this.
A. Yes, the next step is to look at the habitat component within the spatial extent that is important for the species.

Q. So why, in the lake where you have indicated the habitat is fairly uniform, would you consider the habitat within the circles to be critical while the same habitat outside the circles is not?
A. We don't have the habitat information and we were coming up with the spatial extent of a population. The three sites could be a single population. Maybe there are lots out there and they just haven't been captured. Or maybe they are part of the Detroit River population and the population envelope of the Detroit River overlaps.

C. The assumption is that the dot on the map is randomly placed within the true distribution.

C. Maybe the method that J. Lynch used for home range might be adapted. There is a core site where they are found spawning; where they are known to be. Then, there are sites where they have been found once or twice, where there is less confidence and then there are sites that have been sampled and where they have not been found and where there is no information. So a probabilistic surface can be built within the home range concept. You would include 0s and 1s. You need to know where they have not been found. It might need a weighting system (include 0.5) based on sampling effort or gear.

C. There is little information with respect to habitat use for this species. A lot more information is needed. Even if the information was available, it would be difficult to model as there is no habitat mapping for these sites. Maybe a recommendation should be that larger scale habitat mapping is needed.

R. We are in agreement but this is easier said than done. Mapping using hydroacoustics was attempted but it didn't work. A more resource intensive method is needed. Additionally, the river systems are dynamic i.e., continually changing.

C. The idea of critical habitat for the locations with known spawning makes sense; whereas, it would be difficult to justify identifying critical habitat for the single point locations. It may make sense to identify a schedule of studies for these points.

C. It is important to consider the biology of the species. Madtoms are generally regarded as sedentary as are catfish in general. The presence of the YOY fish in the St. Clair River suggests that somewhere in that vicinity, the species is probably reproducing. Based on family characteristics, these fish are somewhat precocious, they are raised in a nest by the males but they are not known for dispersing huge distances. In that particular case, there is a population on the other side of the river at Elgin Act State Park but the area where the fish was found has not been well sampled. The precautionary approach would be to take some area around the site and identify it. Alternatively, identify that not enough is known and that sampling efforts will target that area in the next year. Where an adult fish is found in the middle of the lake is more problematic and it will be difficult to find out more. In the Lake St. Clair report, the lake was divided into 85 grids, with trawl transects in 15 of them.

C. On the St. Clair River, one juvenile does suggest there is a population that is breeding in the area but whether it is right where the juvenile was found or whether it was washed downstream is unknown. That would be an area where you would need to do more work.

C. With the Detroit River and Lake St. Clair, the mouth of the Detroit River is a known (observed) spawning area. Given the distances, it would not be unreasonable to expect that the points in the lake are adults that have dispersed out from the Detroit River spawning areas.

Q. But what if the distance is more than the estimated home range?
A. The home range is not necessarily the distance that an animal disperses from spawning to where they spend the rest of their lives. They may go to the mouth of the Detroit, spend a month, spawn and then go back to the lake where their home range is the area around the points in the lake.

Q. What if they are believed not to migrate to spawn?
A. There is migration and there is dispersal. In theory, there are some individuals that move large distances across inhospitable habitat but 25 km is not a huge distance.

It is important to show all the information that there is, combining sampling effort and occurrences. There would be a credible case for enclosing the Detroit River mouth with the other points along the lake in a polygon and another one with the points from the Thames River. Then the remaining odd points would be in a different class. There would be classes depending on degree of confidence (confidence level statements: e.g., highly likely, extremely likely). Develop a framework combining probabilistic and Bayesian analysis, multiple methods, etc. Then the map would have four or five different coloured zones. There would be areas where you are absolutely certain there is a viable population because it has certain attributes and these attributes would be included in a table. The rationale should be clear.

Data quality should also consider the data source. Targeted surveys for individuals would have higher importance than something from other sources. Sometimes the identification has been verified, but how accurate the GPS coordinates are should also be considered. The point from the centre of Lake St. Clair came from a commercial trawl with a researcher on the boat to verify the sample.

In terms of data quality, sites with adults, sites with YOY, and sites where spawning is observed, is the hierarchy to use in quantifying distinction between habitats surrounding a point. An area which has spawning would be an area to consider with a high probability that it is critical habitat. Once YOY are found along with spawning adults then the site moves higher on the scale. This would help with making decisions.

In the absence of any quantitative analysis, a weight of evidence approach is used to make an argument that there is or isn't a population in a particular spot. This approach is used until there is time and money to do a quantitative analysis. For the Lake St. Clair and Detroit River populations, the issue is whether there is a population at a sampling location and whether it is discrete from the others. In a qualitative sense, there is spawning in the Detroit population, if you removed all populations in the Detroit River, you could make a case that based on evidence for what is available in terms of occurrences, the population in Lake St. Clair could be at risk. It is unclear if the points on the shore represent separate populations or just strays and that they may represent a sink population. In the Detroit River, there is higher confidence that it represents a source population and so there is a strong case to argue there is critical habitat there. The argument is weaker for the other locations and there should be more sampling done to confirm their status.

The researchers working in the area have confidence that the Thames and Detroit rivers are populations and may be considered as critical habitat. There is a gradient of certainty for the other points. What information is enough? Would multiple year classes and many individuals be enough if it was from one point? If there is a high degree of certainty that this would represent a population, would we recommend that that it be buffered as a viable population and would we recommend that that it be considered critical habitat even though it is a single site? It was pointed out that two years ago, the same thing would have been said of the Thames. It may well be that the St. Clair River and those sites on Lake St. Clair are artifacts of sampling. More sampling is needed.

There was discussion about whether it would be possible to undertake a habitat assessment at the known site and the two possible sites and compare them. Unfortunately, it is unclear what habitat variables to measure. If there was a habitat suitability model built for the madtom then this would be possible. The important key habitat variables for the species are not yet know.

The Detroit and Thames rivers are certain populations so critical habitat can be identified. There is uncertainty with the south shore sites, but the fish and the fish habitat would still be protected under the *Fisheries Act*. For these other sites, a specific/detailed schedule of studies should be developed.

There was discussion about what the critical habitat would look like. Whether it was a map or a functional description or the two linked. There is an estimate of habitat quantity. We know the area where the species occurs. There is the start of a functional description of the type of habitat. There is an estimate of the size of the area needed. What is missing is where the habitat is and if there is enough for what is needed.

What spatial extent would be used? API limits the area estimate to "important" habitat, which is a subset of the home range or other area of occupancy approaches. Life history-based estimates of how large an area of habitat is needed could be used. Mapping habitat features allows a measure of the extent of those habitats. Habitat from the existing distributions is the starting point and habitat is identified out from there until there is sufficient based on the MVP. For species where all life stages share the same area (e.g., Northern Madtom), the focal area is centred in the area of highest probability in the probabilistic surface based on presence/absence. The MAPV is reached by including areas where there is low probability of occurrence in order to sustain the population in the long term. It is more complex for species where different life stages don't share the same areas.

For the Thames River, there was discussion about using ALIS versus MAPV. Both should be considered and compared. In the Thames River, the MAPV (for adults) was 4,371 m^2 and assuming a river width of 40 m, this would only mean a 100 m stretch of river and there was concern that this would be too small an area. ALIS would be larger and there was discussion about taking a precautionary approach by using the larger ALIS area. There was concern that although there is some biological meaning in ALIS, it is not meant to reflect fine scale habitat conditions. It is at a valley segment level. It was agreed that defaulting to a larger area might be reasonable but the rationale would have to be provided. Another approach was to use the MAPV at the ends of the population range as a buffer. Participants felt this might be a reasonable trade-off between the two approaches.

The lines on a map represent presence/absence which may be a sampling artifact. A feature based description accommodates additional information better than lines on the map. But there was also general agreement that lines on the map were needed from a management standpoint. The probabilistic surfaces can be used to inform where to put the lines or informing different scenarios about where to put the lines (i.e., at 50% probability or 30% probability). There can be a policy decision about what probability in the surface of declining probability of occurrence will be the boundary.

In Lake St. Clair the shipping channel differs from the rest of the lake where the habitat is all very similar. There is not much biological information to integrate into delineating the boundaries. The only thing available is the collection of sampling records some of which represent different sampling methods and objectives to the sampling. There is a detection probability issue with this species as it is very low. An absence from a single survey might not be meaningful.

There is also the challenge reading the habitat association of different life stages. Northern Madtom is not found below 7 m (for spawning), which is one boundary to their distribution. Adults may be using more than just the spawning habitat. The minimum area for the viable population must include habitat for all life stages to survive.

Summary

Lake St. Clair/Detroit River area

- There needs to be strong supporting evidence for population distinction.
- Consider populations versus strays.
- Populations are based on whether or not there is evidence of reproduction.
- They are weighted by abundance.
- Non-capture sample sites should be included.
- Build a surface with these added, weight the populations based on absence, and sample point and weight differently single versus multiple individuals, different life stages, weight reflecting sampling effort or gear, etc.

- Understanding of life history can be used to mask the surface
- Add to the surface, the MAPV area. Fill the highest value first and go out from there.

Thames River

- Detection probability for the species is low which means absence data (from a survey) may not be meaningful
- MAPV and ALIS should be computed and compared
- There was some concern about the ALIS scale (too large)
- MAPV might result in a very short reach (too small)
- Add MAPV to the end of the population range as a buffer
- Defaulting to biggest area would require a valid biological reason and the rationale should be provided
- A single point with all life stages should be dealt with through a specific schedule of studies

Schedule of Studies

1. Conduct studies to determine the habitat requirements of all life stages of Northern Madtom to increase understanding of functional habitat requirements by life stage.

2. Determine probability of detection by gear and effort for different life stages to allow better interpretation of the data.

3. Develop techniques to accurately estimate abundance. The first step is presence and absence but ultimately abundance by life stage and then abundance by habitat type. Develop techniques to increase probability of detection and sample accurately and quantitatively. Collect habitat data at the same time.

4. Identify which uncertainties have the greatest influence to allow prioritize research.

5. Survey and map areas of suitable habitat within historical and current sites and adjacent to currently occupied sites.
   - Use an adaptive sampling approach with adaptive sampling around suspected sites that will provide a variety of data. Building out from where they are known to be.
   - Stratify sites by habitat types. This will likely provide density by habitat type and habitat preference. This could then be extrapolated to the reach scale.
   - guidance on sampling, sensu Darryl Mackenzie

6. Develop habitat quality, population or abundance model for each life stage.

7. Determine connectivity of existing populations. Be specific about the type of connectivity (e.g., hydrological, ecological, biological, genetic)
   - Site-specific studies
   - Migratory ability

Clarify the priority for the studies. It should be tailored to the species e.g., for the Northern Madtom focus spawning study in the St. Clair River (prioritize based on uncertainties)

Spotted Gar and Pugnose Shiner

(the draft report was provided to participants but was not discussed at the meeting)

Lake Chubsucker

Presenter: S. Staton

Lake Chubsucker was part of two ecosystem recovery strategies, including the Ausable River recovery strategy where there was some proposed critical habitat identified. The overall species strategy did not include this but there was a commitment within the recovery strategy to complete the Ausable Channel habitat work within the year as part of the schedule of studies.

The Lake Chubsucker is not as scarce as some of the other at risk species, but population fragmentation occurs. There are isolated populations within dyked wetlands and several populations are thought to be extirpated.

Targets from the recovery strategy:
"*The long-term recovery goal (greater than 20 years) is to maintain existing distributions and densities of the Lake Chubsucker and restore viable populations to formerly occupied wetland habitats*."

"*Over the next five year period, maintain current densities and abundance of known extant populations in the Old Ausable Channel, Lake St. Clair (Walpole Island and St. Clair NWA), Lake Erie (Point Pelee, Rondeau Bay, Long Point Bay) and the upper Niagara River (Lyons Creek). More quantifiable objectives relating to individual populations are not possible at this time, but will be developed once the necessary sampling and studies have been completed.*"

There are general descriptions of the habitat requirements by life stage.

<u>Point Pelee</u>
For the Point Pelee population, there is a good dataset based on intensive sampling. Within the park, the area is already protected. Parks Canada has been working towards recovering the species and defining critical habitat to the extent possible. They took a straight occupancy approach and a partial identification of critical habitat based on an interim approach. The expectation is that this will change with more information.

The distribution map is based on historical studies and the recent 2003 study. Based on occupancy, the chubsucker is not in some of the ponds now. They used a 20-year time frame for current records. They looked at Girarden and Redhead ponds. They took an ELC approach at a high scale and basically identified the open and shallow waters. There were 25 records. Anthropogenic features were excluded. The area currently defined is about 0.3 km^2. The MAPV is 0.77 km^2. So based on this, there may not be enough critical habitat but if formerly occupied ponds were included there would be sufficient [critical habitat]. There are cattail mats which may be floating and may provide connectivity between the ponds, the significance of which is unknown. If they were historically in the other ponds and there was a desire to reintroduce them, then it might be considered as critical habitat (or potential critical habitat) if they were being reintroduce into [the historic ponds]. However, some habitats are degraded. There should be a definition of what the habitat attributes are that are needed.

There are more than the one species considered at risk in the ponds, which has implications for overlapping layers of critical habitat.

In a national park, there may not be a benefit to identifying critical habitat. Elsewhere, the benefit is to say that the habitat is presently degraded and is not actually used, but the goal is to rehabilitate it so the populations can be larger and can use it. It is protected from further degradation and is an area for potential restoration.

<u>The Old Ausable Channel</u>

There was some extensive sampling in this area over several years. It is a 15 km section of channel, which is good habitat for both Lake Chubsucker and Pugnose Shiner. It has been maintained and disconnected from the original watershed. It is spring fed and is maintained by a dam (1 m head). The main part of the original watershed is now agricultural. This channel is bypassed and doesn't receive any of the negative impacts from upstream agriculture. If it was still connected to the system, there would be too much sedimentation and nutrient inputs for the populations. The lower section below the dam is subjected to seasonal flooding, it is shallower and more degraded, and chubsucker densities are lower there. The data does suggest that there have been some declines and there are invasive issues although it is limited by the barrier. It is limited recovery and the population is being maintained.

This seemed like an ideal system to map habitat. It is about 20-30 m wide by 14 km long and, on average, 1 m in depth. There are two main habitats. A hydroacoustic survey was attempted for benthic classification but there was no correspondence with ground-truthing. The substrate was found to be homogenous and largely organic. There is a relatively uniform depth and relatively uniform submergent vegetation area. There was lack of correspondence of the species at risk to substrate, depth and vegetation. This is a strong argument that for those species, the area of occupancy is the whole channel. The recovery team would then use this advice. They might conclude that you can't subdivide this habitat any finer. The area of occupancy is smaller than the MAPV. This strengthens the argument to identify all of the area.

In general, there was agreement that when the MAPV is larger than the waterbody in which the population is found, then the whole waterbody would be most appropriate for the identification of critical habitat.

There was some discussion about the co-occurring Pugnose Shiner and that the MAPV and AO for it differed. How would the critical habitat for the two species be considered? One suggestion was to add the two MAPVs together. If there was partial overlap of habitat, then you might have to extend the critical habitat to conserve both. The critical habitat is defined on a species by species basis, but the problem comes when you decide how to manage for recovery.

Participants agreed that the water quality was important to consider within the context of habitat. That it has to be maintained within a specific limit, the range of which may be determined by the current water quality.

Next Steps

The documents resulting from the meeting will be revised based on these discussions. The results of the modelling by Vélez-Espino and Koops will be updated to include new information provided by participants and would be published as a Research Document. The supporting information for each of the four fishes would also be revised and published as a Research Document for publication on the CSAS website. A Science Advisory Report will be developed highlighting the advice developed at this meeting.

REFERENCES

DFO. 2007a. Documenting Habitat Use of Species at Risk and Quantifying Habitat Quality. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/038.

DFO. 2007b. Revised Protocol for Conducting Recovery Potential Assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/039.

Reed, D.H., J.J. O'Grady, B.W. Brook, J.D. Ballou and R. Frankham. 2003. Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates. Biological Conservation 113: 23-34.

Rosenfeld, J.S. and Hatfield, T. 2006. Information needs for assessing critical habitat of freshwater fish. Can. J. Fish. Aquat. Sci. 63:683-698.

APPENDIX 1: Revised[1] Terms of Reference

Regional Advisory Process Meeting

Assessment of Information Required for the Identification of Critical Habitat for Pugnose Shiner, Spotted Gar, Lake Chubsucker and Northern Madtom

May 29, 2008
Great Lakes Laboratory for Fisheries and Aquatic Sciences, Burlington, ON.
Chair: Dr. Nicholas E. Mandrak

Background
Canada's *Species at Risk Act* (SARA) requires the development of recovery strategies for species listed as "Endangered" or "Threatened" under the act (SARA, Schedule 1). As mandated by SARA, recovery strategies must include a description of critical habitat to the extent possible based on the best available information. When sufficient data are lacking, a schedule of studies may be included that, when completed, would allow critical habitat to be identified. Critical habitat is defined under Section 2 of SARA as, "the habitat 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". Once designated, SARA provides provisions to protect critical habitat of these species.

The Ontario Freshwater Fish Recovery Team has recently developed recovery strategies for four species of fishes - Lake Chubsucker, Northern Madtom, Pugnose Shiner and Spotted Gar (see below).

Common Name	Scientific Name	COSEWIC Status[1] (date assessed)
Pugnose Shiner	*Notropis anogenus*	END (2002)*
Northern Madtom	*Noturus stigmosus*	END (2002)*
Lake Chubsucker	*Erimyzon sucetta*	THR (2001)*
Spotted Gar	*Lepisosteus oculatus*	THR (2005)*

* Schedule 1, SARA

Science advice on the information required for the identification of critical habitat for these species is required for consideration and possible integration into their respective recovery strategies. Existing descriptions of critical habitat for some species and populations have been proposed by the recovery team and need to be considered in range-wide recommendations to support the recovery team's decision on the identification of critical habitat for the four species. Science advice on a population-by-population basis is requested for each of the four species across their Canadian range, taking into consideration the limited data available for each population. The science advice should include a conceptual framework for identifying information required for the identification of critical habitat for freshwater fishes and, thus, provide general guidance that may be adapted for broader usage.

[1] Revised May 20, 2008

Specific Objectives
1. To review information **required by the recovery teams** to identify critical habitat for four freshwater fish species based on the proposed conceptual framework. For each species, the information will include, data permitting: a) habitat requirements by life stage; b) an estimate of recovery target or minimum viable population size; c) area of occupancy of each population.

2. To review a proposed schedule of studies to fill gaps in knowledge required to identify or refine information required for the identification of critical habitat for four freshwater fish species.

Based on:

3. A review of methods for information required for the identification of critical habitat, particularly for species with limited data on habitat requirements.

4. A review of a proposed conceptual framework for identifying information required for the identification of critical habitat for freshwater fishes.

Working papers
A working paper will be developed that will outline:
- methods for identifying information required for the identification of critical habitat for freshwater fishes
- proposed conceptual framework for identifying information required for the identification of critical habitat for freshwater fishes
- information required for the identification of critical habitat for each of the four species on a population-by-population basis
- proposed schedule of studies to fill gaps in knowledge required to provide information required for the identification of critical habitat for four freshwater fish species

Output of the meeting
A proceedings document, science advisory document, and one or more research documents of the Canadian Science Advisory Secretariat (CSAS) will be produced that will provide information required for the identification of critical habitat for the four Ontario fishes.

The scientific information/advice issued from this meeting will be available for consideration by the Ontario Freshwater Fish Recovery Team that is involved in the identification of critical habitat for the four Ontario fishes. The conclusions regarding biologically based approaches to the determination of information required for the identification of critical habitat and recovery targets may also be useful for those who are involved in the recovery process for other species.

Participation
DFO experts from Science, Habitat Management, and Policy, experts from the Ontario Ministry of Natural Resources and invited participants from academia.

APPENDIX 2: List of Participants

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APPENDIX 3: Meeting Agenda

Assessment of Information Required for the Identification of Critical Habitat for Lake Chubsucker, Northern Madtom, Pugnose Shiner and Spotted Gar

Regional Peer Review Meeting – Central and Arctic Region
Library Guest Lounge
Canada Centre for Inland Waters
Burlington, ON
May 29th, 2008
9:00-5:30
Chair: Dr. Nicholas E. Mandrak

9:00 Introduction - Mandrak

9:30 Methods - life history information - Mandrak

- estimating population ranges - Mandrak
- minimum area for population viability - Vélez-Espino/Koops

10:30 Break

10:45 Methods - scale-dependent home range - Woolnough

11:30 Methods - mapping population ranges - Mandrak

12:00 Lunch (provided)

1:00 Pugnose Shiner - Edwards

2:00 Lake Chubsucker - Staton

3:00 Break

3:15 Northern Madtom – Edwards

4:15 Spotted Gar - Staton

5:15 Wrap-up - Mandrak

5:30 End