Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
National Capital Region
Canadian Science Advisory Secretariat
Science Advisory Report 2007/038

DOCUMENTING HABITAT USE OF SPECIES AT RISK AND QUANTIFYING HABITAT QUALITY

Figure 1: Department of Fisheries and Oceans' (DFO) six administrative regions.

Context:

The Canadian Species at Risk Act (SARA) *requires that Critical Habitat be identified to the extent possible based on the best information available in the Recovery Strategy for all threatened, endangered or extirpated species, or a schedule of studies be included that, when completed, would allow the species' Critical Habitat to be identified. Once identified as Critical Habitat in a Recovery Strategy or Action Plan, provisions of SARA prevent activities that would destroy the species' Critical Habitat. The Species Status Report used by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in its assessment of the risk of extinction includes a description of the habitat requirements of the species, which generally provides the starting information for identification of Critical Habitat.*

As the responsible jurisdiction for all aquatic species, DFO has a responsibility to provide all information possible for the development of the Species Status Report and the Recovery Strategy and Action Plan(s) to both of those SARA-related activities. DFO Science has had two previous workshops to better define and increase understanding of how to describe the habitat requirements of aquatic species and how to measure habitat quantity and quality. A third workshop was held in August 2007, to review the outcomes of those workshops and background papers on quantifying habitat quality and quantity that had been commissioned by both DFO and Parks Canada. This workshop included participants from DFO Science in every Region, all DFO Sectors, experts from two Provinces, and Parks Canada, which has also been developing guidelines and practices for jurisdictional actions following COSEWIC listing recommendations. The meeting resulted in guidance on how DFO Science should undertake a number of tasks to provide the necessary information and advice on aquatic species' habitats at both the pre-COSEWIC and post-COSEWIC stages of the processes specified in SARA.

SUMMARY

For the necessary information to be available to COSEWIC, terms of reference of the following types should be included in the generic template for the meeting Terms of Reference (ToRs) for pre-COSEWIC Science Advisory Meetings.

1. Provide functional descriptions of the properties that a species' aquatic habitat must have to allow successful completion of all life history stages.
2. Provide information on the spatial extent of the areas that are likely to have the necessary properties.
3. Identify the activities most likely to threaten the properties that give the sites their value, and provide information on the extent and consequences of those activities.
4. Recommend research or analysis activities that are necessary in order for an RPA, if needed for the species, to complete its Terms of Reference on habitat issues for the species.

For the necessary information to be available for consultations, listing recommendations, and commencement of recovery planning, ToRs of the following types should be included in the generic template of ToRs for RPAs.

1. Quantify how the biological function(s) that specific habitat feature(s) provide to the species varies with the state or amount of the habitat, including carrying capacity limits, if any.
2. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.
3. Provide advice on how much habitat of various qualities / properties exists at present.
4. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery targets for abundance, range, and number of populations.
5. Provide advice on feasibility of restoring habitat to higher values, if supply may not meet demand by the time recovery targets would be reached, in the context of all available options for achieving recovery targets for population size and range.
6. Provide advice on risks associated with habitat "allocation" decisions, if any options would be available at the time when specific areas are designated as Critical Habitat.
7. Provide advice on the extent to which various threats can alter the quality and/or quantity of habitat that is available.

Commentary is provided for addressing each proposed Terms of Reference.

In the process of developing these Guidelines for activities during the pre-COSEWIC and the RPA stages, the need for additional guidelines on other SARA-related tasks were identified. Key areas include:

- the biological functions that may be related to habitat features,
- what life history stages to consider,
- how to treat and report uncertainty,
- what to consider as a threat to a species and its habitat,

- how to treat habitat features that are not stable in space (and sometimes in time),
- how to treat habitat features that are not physical or chemical properties of the environment (such as food supply, sound, etc.).

In addition a decision tree is presented for choosing the analytical approach most appropriate for quantifying habitat quality, depending on the quantity and quality of data that are available regarding habitat features and species occurrences. Key questions in the decision tree are:

A. Are there insufficient data on key habitat features and abundance or distribution of the species of concern, such that it will be necessary to rely on expert opinion for any inferences on what habitats are important for a species?

B. Are the only data available the presence or absence of a species with no information whatsoever on habitat features of the sites where the species is present or absent?

C. Are data available on ecological gradients of habitat use and features of the habitats being used?

D. If only presence or absence data are available for a species' use of the habitats, are there at least ordinal level data on habitat features where the species was observed?

For each Yes, specific analytical approaches are recommended. Other relvant questions that influence the selection of analysis methods are:

E. Is the species so severely depleted that it is likely to have zero abundance at many sites where the habitat is capable of supporting substantial abundances of the species (i.e. much suitable habitat is thought to be unutilized).

F. Is the gradient in species' abundance so strongly determined by some threat other than habitat quality that differences in data on species use of various sites are likely to be uninformative about habitat quality?

INTRODUCTION

Information on habitats of aquatic species is necessary to fully inform the deliberations of COSEWIC regarding risk of extinction of a species, and the processes mandated by SARA should COSEWIC recommend a status of Threatened, Endangered or Extirpated for a species, and should the species be listed by the Governor in Council. The necessary information on habitats of aquatic species for areas where the species occurs or formerly occurred would include:

- the features of habitats used by aquatic species,
- the geographical extent and availability of such habitats,
- the location of those habitats,
- the patterns of usage of such habitats by the species, by life history stage, at present and historically,
- the types of activities that might destroy or alter the quality of those habitats,
- the consequences (effects) of such activities for the habitats and species.

From such descriptive information it would be necessary to infer both the quantity and quality of habitat(s) required to achieve recovery, and the relative importance and function of different types of habitats and habitat features in the life cycle of the species.

DFO is likely to be a major authoritative source of all these types of information. However, information often will also be available from experts in other Departments and levels of government, academic centres, private and public sector organizations, and stakeholders and communities. All these sources should be included, as appropriate on a case-by-case basis, in applying the guidance below.

The following Guidelines for practice have been developed to ensure that the information and advice provided by DFO on the habitat requirements and threats to the habitat for aquatic species is the best possible given the information available. The amount of information available as well as the nature and specificity of the habitat will vary greatly for different types of aquatic species. The Guidelines accommodate those expected differences, while laying out processes that ensure best science advice in each application.

ANALYSIS

Context for the Advice

Science is producing *information and advice* on habitat use, availability, requirements, and threats. Science is *not* making Critical Habitat designations. Such designations are policy and management decisions taken when Recovery Strategies and Action Plans are adopted by DFO. Consequently the science advice provided under these guidelines should avoid using the term "Critical Habitat" unless specifically called for in a formal request for advice. As explained in the separate Protocol for Recovery Potential Assessments (RPAs), the science information and advice is most useful when phrased in probabilistic and risk based language, rather then prescriptive and normative language.

Descriptive information on habitat requirements and threats needs to be available as part of the pre-COSEWIC RAP, so authors selected by COSEWIC can include the information provided by DFO in the draft Status Reports. More **quantitative** information on habitat usage, geographical extent, availability, and threats to this habitat needs to be available as early as possible in the "post-COSEWIC" process, to inform public consultations, support development of scenarios for evaluating the social and economic costs of recovery, and serve other jurisdictional functions regarding the decision to list. When a species is listed as Threatened or Endangered, the information is also needed to develop a Recovery Strategy and Action Plan(s) for the species, and by the Minister in making "Critical Habitat" designations.

Information on habitat usage, geographical extent, availability, and threats as well as on requirements of aquatic species usually will be incomplete. Uncertainties should always be communicated clearly in the advice. However, the science advice should also be as clear and specific as possible about the implications of the data and information (including experiential and traditional knowledge) that *are* available, rather than focus primarily on the knowledge gaps.

Guidelines for development and provision of advice on habitats of aquatic species

Guidelines for Pre-COSEWIC review and advisory meetings

For the necessary information to be available to COSEWIC, terms of reference of the following types should be included in the generic template for the meeting Terms of Reference (ToRs) for pre-COSEWIC Science Advisory Meetings. Like other ToRs in the template, the phrasing would be adapted to each specific species. Some could be dropped on a case-by-case basis if considered *biologically* irrelevant. However, these ToRs should be posed even in cases when relatively little information is expected to be available, to ensure that every effort is made to consolidate whatever knowledge and information does exist on an aquatic species' habitat requirements, and made available to COSEWIC.

1. Provide functional descriptions of the properties that a species' aquatic habitat must have to allow successful completion of all life history stages.
2. Provide information on the spatial extent of the areas that are likely to have the necessary properties.
3. Identify the activities most likely to threaten the properties that give the sites their value, and provide information on the extent and consequences of those activities.
4. Recommend research or analysis activities that are necessary in order for an RPA, if needed for the species, to complete its Terms of Reference on habitat issues for the species.

Commentary on the Guidelines

Guideline 1 – In the best cases, a "functional description" will report both the features of the habitat occupied by the species and the mechanisms by which those habitat features play a role in the survivorship or productivity of the species. However, in many cases the "functional descriptions" cannot go beyond reporting patterns of distribution observed or expected to be present in data sources, and general types of habitat features known to be present in the area(s) of occurrence. Information will rarely be equally available for all life history stages of an aquatic species, and even distributional information may be missing for some stages. Science advice needs to be careful in this regard (and throughout all its advice) to communicate uncertainties and knowledge gaps clearly.

Guideline 2 – Where geo-referenced data on habitat features identified under Guideline 1 are readily available, these data could be used to map and roughly quantify the locations and extent of the species' habitat. Generally however, it should be sufficient to provide narrative information on what is known of the extent of occurrence of the types of habitats identified under Guideline 1. Many information sources, including TEK and experiential knowledge, may contribute to these efforts.

Guideline 3 – COSEWIC's operational guidelines require it to consider both the imminence of each threat that it identifies, and the strength of evidence that the threat actually does cause harm to the species or its habitat. The information and advice from the Pre-COSEWIC RAP should provide whatever information is available on both of those points. In addition the

information and advice should include at least narrative discussion of the magnitude of impact caused by the threat when it does occur.

Guideline 4: Usually the work on the other Guidelines will identify many knowledge gaps. Recommendations made and enacted at this stage in the overall process could result in much more information being available should a RPA be required for the species.

Guidelines for RPAs

For the necessary information to be available for consultations, listing recommendations, and commencement of recovery planning, ToRs of the following types should be included in the generic template of ToRs for RPAs. The same considerations with regard to case-by-case adaptations that were presented for pre-COSEWIC Science review and advisory processes also apply here.

1. Quantify how the biological function(s) that specific habitat feature(s) provide to the species varies with the state or amount of the habitat, including carrying capacity limits, if any.
2. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.
3. Provide advice on how much habitat of various qualities / properties exists at present.
4. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery targets for abundance, range, and number of populations.
5. Provide advice on feasibility of restoring habitat to higher values, if supply may not meet demand by the time recovery targets would be reached, in the context of all available options for achieving recovery targets for population size and range.
6. Provide advice on risks associated with habitat “allocation” decisions, if any options would be available at the time when specific areas are designated as Critical Habitat.
7. Provide advice on the extent to which various threats can alter the quality and/or quantity of habitat that is available.

Commentary on the Guidelines

Guideline 1: A “decision tree” to guide selection of the “best practices” for analysis of habitat data of different qualities and quantities is provided later in this report. Uncertainties should be included with the quantitative estimates of how the value of a habitat varies with its properties.

Guideline 2: Barriers to access or fragmentation of habitat types may not be a consideration for many marine species, but are often important to freshwater, anadromous or estuarine species. In cases where these are not considered an issue for survival or recovery of a species, a statement to that effect in the advice could be helpful in later steps.

Guideline 3: At the RPA stage, effort should be made to quantify and geo-reference the amount of habitat of various types as thoroughly as possible. Advice on both the total amount and geographic location of the habitats is needed for the subsequent steps.

For marine species where habitat features identified under Guideline 1 may be as coarse as temperature, depth and salinity preferences, quantification of the extent of habitat with the suitable ranges is still warranted. For freshwater species, very different amounts of information are available on habitat features in different parts of the country, depending on the species. In all cases, the best and most complete information possible should be used, with the differences in quality and quantity of information reflected in the uncertainties reported in the advice.

Guideline 4: Habitat "demand" is estimated from the estimates of population size and the densities that the species can reach in different types of habitat using the habitat quantification steps described below. When a species can reach different densities in different types of habitats, the habitat "demand" of a population is a functional relationship along a habitat usage gradient or a surface in a multi-dimensional habitat space and not a single number of hectares or square km of "habitat". Habitat "supply" is the vector sum of the amount of habitats of each type that are known to exist, multiplied by the densities that each type of habitat can be expected to support, should the population of the species saturate the habitat.

Advice on the relationship of habitat "supply" to "demand" for the current population informs discussion about the degree to which habitat availability is currently limiting population growth. Advice on the relationship of "supply" to "demand" for the population when it has reached biologically-based recovery targets informs discussion about the degree to which habitat rehabilitation should be part of recovery planning, and the degree to which habitat managers will have options for protecting different subsets of all suitable habitat for a species while complying with SARA requirements regarding Critical Habitat.

Guideline 5: Advice under this guideline should include information on the types of actions that would be required for habitat restoration, not just an assessment of whether restoration would be hypothetically possible. Input from other Sectors, especially Habitat Management, should be sought in determining the types of actions that might be considered to achieve habitat restoration. Advice on a particular schedule for habitat restoration will usually not be necessary at this stage, but if habitat improvements are necessary for recovery to commence, that point should be clear in the advice.

Guideline 6: In cases where habitat "supply" is expected to exceed "demand" when recovery targets are reached, options will be available for designating various subsets of the "supply" as Critical Habitat. These habitat allocation decisions will legitimately take social and economic considerations into account. Although there will rarely be an ecological imperative to choose some options over others, the risks to achieving recovery targets will often vary among the options. (For example, two watersheds may contain suitable and accessible habitat for a recovering species. Extensive habitat alterations might be allowed in one watershed because the other is estimated to have sufficient "supply" of habitat for the population when it has recovered. However if one watershed is extensively altered the risk of catastrophic events affecting the species may be higher compared to ensuring both watersheds remain suitable for the species.) Advice on such risks can be part of the advice from the RPA.

Guideline 7: This advice should include as full a description as the information allows of the mechanisms by which the threats might alter the ability of the habitat to support survival and recovery of the species. It is likely that the Pathways of Effects approach developed by Habitat Management would provide a useful framework for investigating and providing advice on this topic, and should be considered for use at this step. It should distinguish to the extent possible, between threats that are expected to degrade habitat (reduce its biological value to the species)

and threats that are expected to destroy habitat (i.e., completely remove or alter it in such a way that it ceases to serve its ecological function for the species in question).

In the process of developing these Guidelines for activities during the pre-COSEWIC and the RPA stages, the need for additional guidelines on other SARA-related tasks were identified. Key areas for guidelines to ensure best practices and greatest consistency in provision of science information and advice include guidelines to ensure systematic treatment of:

- the biological functions that may be related to habitat features,
- what life history stages to consider,
- how to treat and report uncertainty,
- what to consider a threat to a species and its habitat,
- how to treat habitat features that are not stable in space (and sometimes in time),
- how to treat habitat features that are not physical or chemical properties of the environment (such as food supply, sound, etc.).

Additional background work is expected to be needed on these factors before specific guidelines could be developed.

Best Practices for Quantifying Habitat Quality

The goal in assessing habitat quality as part of planning for recovery of protected species, or more generally for managing habitats of aquatic species, is to quantify the value of each habitat type to the at-risk species. "Value" however, is a somewhat abstract concept. In practice some measurable property reflecting how the species uses the habitat is taken as an index of the value of the habitat to the species.

The measurable property will depend on the species at-risk and the information available. For species of regular occurrence, the measure could be density, productivity, catch per unit sampling effort, or other such continuous measures. For species seen infrequently due to rarity or pattern of distribution, the measure could be reliability of occurrence over a series of periodic surveys. In some cases, the only information available is whether or not a species has been recorded in a particular area. Such presence/absence data are the weakest basis for assessing habitat quality, and in such cases even qualitative ordinal indices of usage (never, occasional, often, usual) would allow more powerful analyses of habitat quality.

Guidance is not provided here on the best habitat measure to use for quantifying habitat quality, beyond encouragement to use the most quantitatively rich index that is available for a species. If multiple indices of potential habitat quality are available, many of the methods below can work with multivariate measures of habitat quality as well as many measures of the properties of a habitat. However, the sequence of analyses outlined below assumes that whatever measure(s) of habitat quality are being analysed, the measures have been chosen on sound scientific grounds, and the information content of the measure(s) has been tested and documented appropriately. This includes ensuring that the measure allows uncertainty about a species' habitat use to be captured in the analyses. The proposed "decision tree" further assumes that the survey or sampling methods used to collect the data were designed and implemented soundly, and take into account factors like seasonality of distribution, efficiency of sampling gears, and clustering and mobility of the species being sampled.

Assuming that the data on habitat use by a species are the best available, the appropriate analytical methods for quantifying habitat quality can be determined by working down the following "decision tree". The branching of the tree depends primarily on the type and amount of data that are available. However, there are some historical considerations about a species' status and past population trajectories that influence the best practices in analysis as well. Although these are listed at the end of the tree for operational reasons, decisions on the best analysis for a particular case should not be made until these latter questions are considered.

A. Are there insufficient data on key habitat features and abundance or distribution of the species of concern, such that it will be necessary to rely on expert opinion for any inferences on what habitats are important for a species?

YES – Use Bayesian Belief networks or similar formal and structured approaches.

- Experiential, traditional, and community knowledge can be part of "expert opinion"
- It may be appropriate to weight the opinions of different experts differently in the process, and some of the formal Bayesian processes accommodate such weightings.

NO – Continue with tree.

B. Are the only data available the presence or absence of a species with no information whatsoever on habitat features of the sites where the species is present or absent?

YES – Proceed with Bayesian Belief Networks (or equivalents), using the presence/absence information as empirical data contributed to the structured process for using expert opinion.

- Do NOT base conclusions on habitat use solely on pattern analysis of the presence/absence data. Such analyses have been shown to have high error rates – both misses and false alarms.
- Any research proposals for studies to better quantify a species' habitat must include activities to measure biologically appropriate features of the places being sampled, and not just check for presence of the species. Measuring the same features in places where the species is *not* found is also necessary, if the habitat characteristics that differentiate suitable and unsuitable habitats are to be differentiated analytically.

NO – Continue with tree.

C. Are data available on ecological gradients of habitat use and features of the habitats being used?

YES – Use Generalized Additive Models (GAMs) to fit data on species' abundance (or other measure of habitat value) to habitat features, unless there is reason to expect the abundance-habitat relationships to be linear (or transformable to linear) and consistent over the full range of the habitat feature. In that case, General Linear Models (GLMs) are appropriate and statistically slightly more powerful.

- Questions E and F should always be considered before proceeding with GLMs or GAMs.
- When there are many habitat variables available for each measure of habitat use by the species, some appropriate method of dimensionality reduction of the habitat data (frequently Multi-Dimensional Scaling [MDS] or Principle Components Analysis [PCA],

depending on the expected relationships among the habitat variables) are appropriate, and may increase the power of the subsequent analyses.

- The GAMs or GLMs are exploratory analyses to identify the major patterns in the abundance-habitat data. Depending on the time and information available, these can be supported by case-specific follow-up modelling studies, trying to elucidate the biological basis for the patterns present in the data. The process-based explanations can be used to adapt or augment the conclusions about habitat requirements of a species. However, the functional relationships from the GAMs or GLMs on their own can be a basis for quantifying how the value of a series of habitats change with changes in the features of the habitats.

NO – Continue with tree.

D. Are there at least ordinal level data on habitat features but only presence or absence data available for a species' use of the habitats, but there are at least ordinal level data on habitat features?

YES – Conduct GAMs or GLMs as per C, but ensure that the error distribution assumed for the observation in the model is appropriate for a binary dependent variable (often binomial error).

Additional considerations when applying the decision tree:

E. Is the species so severely depleted that it is likely to have zero abundance at many sites where the habitat is capable of supporting substantial abundances of the species (i.e. much suitable habitat is thought to be unutilized).

NO – Proceed with appropriate analysis from A-D.

YES – Apply a randomization test to the abundance/habitat data, such that it is possible to identify the habitat features where the species occurrences are non-randomly distributed relative to the pattern of occurrence of the features themselves.

- Many variants of randomization tests are available, depending on the nature of the data available.
- Of the randomization tests appropriate to a particular type of dataset, the ones of most power would test for non-random distribution of occurrences of a species' presence even if there are also many unoccupied sites that are similar to the sites that are occupied or have non-zero abundances.
- The randomization tests can be done on either the original habitat variables or on the results of dimensionality-reduction analyses as in C.
- If habitats may have zero abundance because of access barriers, then the analyses should take that factor into account directly. If barriers are a significant predictor of presence/absence, then the exploratory analyses in C should not include sites that cannot be accessed, although the results of the GAMs or GLMs can be used to predict habitat quality in sites above the barriers.
- In these circumstances habitat is not likely to be a limiting factor on population size, nor likely to be limiting at least in the early stages of recovery of abundance and range.

However, the current pattern of occurrences of the species will be an important consideration when Critical Habitat is designated for the species.

F. Is the gradient in species' abundance so strongly determined by some threat other than habitat quality that differences in data on species use of various sites are likely to be uninformative about habitat quality?

NO – Proceed with appropriate analysis from A-D.

YES – This situation can arise if a species suffers high mortality due to a factor such as fishing, and the fishing (or other mortality source) is concentrated on only a part of the population (such as where catch rates are highest or fishing is easiest). In such cases, the measure of abundance or density of the species may reflect only the survivors of the mortality source, and not the true value of that type of habitat to support the species. Areas of higher abundance may not be better habitats, but merely protected in some way from the mortality source. Clear guidance on how to quantify habitat quality from such data was not found in the literature. The following steps are proposed for evaluating habitat quality under these conditions, but the steps should be considered exploratory at this time and are not yet designated as "best practices".

Step 1 – Conduct an analysis of threats. Is there evidence for a dominant threat that is not primarily habitat related (i.e. high bycatch rate or fishing mortality)?

Step 2 – Assess the likelihood that the dominant threat may be applied differentially in different types of habitats (i.e. perhaps fishing effort is higher on smooth bottoms than rough ones).

Step 3 - Explore the possibility of using data on the incidence of the threat to reconstruct the population that would be present in each site, were the threat not there. (i.e. use historical catch and effort data in space to estimate abundance or productivity of an area from the individuals removed as well as individuals recorded in the surveys as surviving the fishery).

Step 4 –

a) If there is no evidence that the dominant mortality source has any relationship to habitat, or Step 3 allows some pre-threat population to be reconstructed, conduct suitable analyses as per C and see if the results make sense.

b) If it is plausible that the mortality source is not independent of habitat features but reconstruction of a measure of habitat value (productivity, pre-threat abundance, etc.) is not possible, then the science advice should emphasise that habitat availability is not likely to be the major determinant of species' status at present, and until recovery efforts address the other threats effectively, it is unlikely to be scientifically feasible to determine the relative value of different types of habitats to the species. Under those circumstances descriptive information on habitat is the best information available for supporting consultations and planning the Recovery Strategy.

CONCLUSIONS AND RECOMMENDATIONS

The Guidelines provided for pre-COSEWIC RAPs and RPAs should improve the consistency and quality with which habitat is treated in the science advice on SARA-related issues. It is acknowledged that implementation may take some time, and will move at different rates for different types of species and different types of habitats. However, for all pre-COSEWIC RAPs and RPAs, the Guidelines should be enacted as swiftly and fully as practical.

The decision tree for analysis of species-habitat relationships also should improve the consistency and quality with which habitat usage patterns and requirements are treated in Science advice, whether for SARA-related applications or other needs for habitat advice. Expertise currently exists to undertake all these analytical tasks, but the capacity is likely to be inadequate in all Regions. It should be a priority to increase capacity to apply and interpret these analytical methods.

These analyses are intended to quantify as fully as possible the habitat use patterns of a species. By themselves they are NOT the determinant of Critical Habitat as specified in the Act. Critical Habitat under the Act is the result of a management and policy-led process which is informed by the results of these analyses.

Once the relative quality of different habitats has been quantified as fully as possible, these results have to be combined with the availability of the different habitat types and the biologically-based recovery target for the species to determine whether or not enough habitat exists for there to be a high likelihood of achieving the recovery target. Critical Habitat designations under the Act are understood as requiring that sufficient habitat is designated and protected to have a high likelihood of achieving the specified recovery target. There is no biological basis to require that the habitats that appears “best” in these quantitative analyses are the ones that receive designation as Critical Habitat.

FOR MORE INFORMATION

Contact: Jake Rice
National Senior Ecosystem Science Advisor
Ecosystem Science Directorate
Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario K1A 0E6

Tel: (613) 990-0288
Fax: (613) 954-0807
E-Mail: RiceJ@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, ON K1A OE6

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