



Identification of Ecologically and Biologically Significant Areas

Background

Canada's Oceans Act authorizes DFO to provide enhanced protection to areas of the oceans and coasts which are ecologically or biologically significant. As DFO progresses with integrated management approaches to ocean areas, it is necessary to operationalise the term "significant" in this context. Consistent standards are needed to guide selection of areas where protection should be enhanced, while allowing sustainable activities to be pursued where appropriate.

Ocean areas can be ecologically or biologically "significant" because of the functions that they serve in the ecosystem and/or because of structural properties. Although structure and function are inter-dependent, an area can be "significant" for either reason. Many of the functional activities like feeding and spawning of fish occur widely throughout the ocean. Operationalising the term requires first establishing whether or not specific areas are particularly important for each function (i.e. "significant"), and thus warrant enhanced protection.

A workshop was held from 17-19 November, 2004, to develop a priori criteria to differentiate areas which are "particularly important" or "significant" with regard to specific ecosystem structural or functional properties from all other areas where the structure may occur or the function may be served, but which are not justifiably designated as "significant".



Figure 1: Administrative regions of the Department of Fisheries and Oceans.

Summary

- Identifying Ecologically and Biologically Significant Areas is not a general strategy for protecting all habitats and marine communities that have some ecological significance. Rather, it is a tool for calling attention to an area that has particularly high Ecological or Biological Significance, to facilitate provision of a greater-than-usual degree of risk aversion in management of activities in such areas.
- There is a continuum of activities in the process of bringing Ecologically and Biologically Significant areas into management. All steps are science-based, in the sense that they work from scientifically sound information. However, the role of science changes along the continuum from being science-led in identifying such areas to management and stake-holder led processes for developing and implementing management plans accommodating such areas.
- At a conceptual level, there are three main dimensions along which specific areas can be evaluated with regard to their Ecological and Biological Significance – Uniqueness, Aggregation, and Fitness Consequences.

Interpretation of specific cases on these three dimensions should take account of two additional dimensions on which specific areas can be evaluated – Resilience and Naturalness.

- Evaluation of sites within this framework is a relative process, and not an absolute one. Both ecological conditions and information about ecological areas are so variable around Canada's oceans that it would be inappropriate to set a specific "score" which would automatically qualify an area as Ecologically and Biologically Significant. Rather, the framework is to be used to identify areas as especially "Ecologically and Biologically Significant" compared to other areas in the region.
- Evaluation of sites within this framework should be based on the biological and ecological properties of areas, and not consider threats and risks to those sites. However management of areas selected as Ecologically and Biologically Significant should take full account of threats to the ecological areas.
- The framework and the concepts of Ecological and Biological Significance work best when applied to geographic sites. Nonetheless the locations of some features, particularly physical and biological oceanographic ones, may vary substantially seasonally and inter-annually, and still be Ecologically and Biologically Significant. Spatial and temporal scale are both important to application of the framework to identify boundaries of areas considered Ecologically and Biologically Significant.

Introduction

1. Fisheries and Oceans (DFO) has many tools for protecting habitats and ecological areas, and adheres to federal policies and practices of good risk management and application of precaution. Identifying Ecologically and Biologically Significant Areas is not a general strategy for protecting all

habitats and marine communities that have some ecological significance. Rather, it is a tool for calling attention to an area that has particularly high Ecological or Biological Significance, to facilitate provision of a greater-than-usual degree of risk aversion in management of activities in areas of especially high ecological and biological significance.

2. Throughout this document "significance" refers to the role of a species, habitat feature, community attribute, area, etc. in the ecosystem, and is used in a relative sense. All species, habitat features, areas etc. have *some* ecological function. However, to identify an area or species as "significant" is to conclude that if the area or species were perturbed severely, the ecological consequences (in space, in time, or outward through the foodweb) would be greater than an equal perturbation of most other areas or species, although the nature of those consequences could differ greatly among specific cases. The term "value" is used to refer to the special utility or importance of a species, habitat feature or area to humans. This is *not* a major consideration in identifying an area as *biologically or ecologically* significant.

3. An area does not have to qualify as an Ecologically and Biologically Significant Area to justify protection as a Marine Protected Area or under the National Marine Conservation Areas Act. In particular one justification for giving an area legal protection is to protect some *representative* marine areas, which, exactly by being representative, may not be especially unique, host particularly high concentrations of species or habitat features, or be the site for critical life history activities.

4. The concepts of Ecologically and Biologically Significant Areas under the Oceans Act and critical habitat under the Species-at-Risk Act (SARA) overlap but are not identical. A species need not be designated as Threatened or Endangered for sites that are particularly critical to its life history to qualify as Ecologically and

Biologically Significant. Likewise when a species is greatly reduced in abundance most of the areas it occupies during its life cycle may be critical habitat. However if many alternative similar areas are readily accessible to the remnant population and the population is highly mobile, the presence of a SARA-listed species does not, of itself, make an area Ecologically and Biologically Significant. The presence of rare individuals may make the area unique and therefore Ecologically or Biologically Significant, but not because the *habitat* is Critical Habitat in the sense of SARA.

5. A habitat classification system may facilitate using this framework – and many other aspects of spatial management. However a habitat classification system is not the same as identification of areas of Ecological and Biological Significance. Some patches of a particular habitat type may be Ecological and Biological Significant because animals cluster there to conduct some important life history function, and other patches of the same habitat type may not be Ecological and Biological Significant because they are not regularly used for that function. Likewise, because the mosaic of habitat types present varies across Canada’s marine areas, a particular habitat type may be Ecological and Biological Significant in one region but much less Ecological and Biological Significant than other types of habitat in another region.

6. There is a continuum of activities in the process of bringing Ecologically and Biologically Significant areas into management. All steps are science-based, in the sense that they work from scientifically sound information. However, the role of science changes along the continuum:

a. The first steps should be a *Science-led* process, wherein the area(s) of interest are evaluated within the framework that has been developed. “Experiential knowledge” (a term including “Aboriginal traditional knowledge”, “fishermen’s knowledge”, and other ways that ecological knowledge is acquired through extensive experience

with the marine environment) should be fully included in these steps. These steps should lead to some structured output, such as a quantitative or qualitative ranking of different areas relative to their Biological and Ecological Significance.

b. The output of the science-led process is used by an even more inclusive *Oceans-led* process that considers how to match degree of management protection to sites along the ranking of areas on their Biological and Ecological Significance. Societal values and potential threats play a role in determining how much risk aversion to apply to sites in various positions in the ranking, although they are not considerations in the first phase (6a). Where Ecosystem Objectives have been adopted or are under development for an area, they may play an important role in this phase, and the results of the science-led process may influence the Objectives-setting process.

c. The results of the inclusive Oceans-led process is implemented by managers and regulators, who must specify clearly what management measures will be used at the various sites, and under what conditions.

7. Concluding that an area is Biologically and Ecologically Significant does not give it any special legal status. Rather, the identification provides guidance on the standard of management that is considered to be appropriate. In the first phase of the identification process (6a) the output is likely to be a gradient of areas from those ranking very highly on Biological and Ecological Significance to those ranking as unexceptional (but *not* necessarily unimportant). The subsequent phases (6b and c) will have outputs which are successively more black-and-white, such that by the time management is in place (6c) specific measures either will or will not be implemented in each area. The gradient nature of Biological and Ecological Significance can still be preserved in the management phase, however, through the diversity of measures implemented, and the

extent of application in space or time (for example longer closures in areas of very high significance).

General Evaluation Framework

8. When possible Ecologically and Biologically Significant Areas should be identified based on knowledge of *both* the characteristics of the particular area *and* a process-based understanding of the importance of those characteristics in terms of the ecosystem structure and function.

9. In reality science rarely has a full process-based understanding of ecosystem structure and function, so the conditions in 8 often cannot be met. Areas can still be identified as Ecologically and Biologically Significant on the basis of descriptive information, without full knowledge of ecosystem relationships and the functional significance of specific areas. However, the descriptive evidence that structural features or life history functions rank highly on the dimensions in 11a-c and/or 12a-b needs to be stronger than when there is in-depth knowledge of the relationships and functional roles of ecosystem components, so that the ecological importance of the area can be assessed.¹

10. At a conceptual level, there are three main dimensions along which specific areas can be evaluated with regard to their Ecological and Biological Significance. Interpretation of specific cases on these three dimensions should take account of two additional dimensions on which specific areas can be evaluated.

11. The main dimensions are continua of:

¹ For example, if scientists know the functional significance of an area to a number of species, its significance plays a major role in assessing its Biological and Ecological Significance – usually along dimension 11c. In such cases the evidence that the area is also truly unique, or that many species do aggregate there reliably, does not need to be as strong as when the *only* thing known about an area is that we haven't seen others like it, or several species seem to use it.

a. Uniqueness – Ranked from areas whose characteristics are unique, rare, distinct, and for which alternatives do not exist to areas whose characteristics are widespread with many areas which are similar in most important features. Uniqueness may be considered in regional, national and global context, with increased importance at each scale. (In Europe a similar property is called rarity, but this differs from the usage here because rarity may include species or features which are widespread but never common.)

b. Aggregation – Ranked from areas where:

- i. most individuals of a species are aggregated for some part the year; OR
- ii. most individuals use the area for some important function in their life history; OR
- iii. some structural feature or ecological process occurs with exceptionally high density

to areas where:

- iv. individuals of a species are widespread and even areas of comparatively high density do not contain a substantial portion of the total population; OR
- v. individuals may congregate to perform a life-history function, but the area in which they perform the function varies substantially over time; OR
- vi. structural property or ecological process occurs in many alternative areas.

c. Fitness Consequences - Ranked from areas where the life history activity(ies) undertaken make a major contribution to the fitness of the population or species present to areas where the life history activity(ies) undertaken make only marginal contributions to fitness. (This dimension generally applies to functional properties of areas, and in most cases

reflects contributions to reproduction and/or survival of a species. However, “fitness consequences” is considered to be a more inclusive term, to include cases which may influence survival or reproduction indirectly as well as directly.)

12. The two additional dimensions to be considered when evaluating sites on the three major dimensions are:

- a. Resilience – from areas where the habitat structures or species are highly sensitive, easily perturbed, and slow to recover to areas where the habitat structures or species are robust, resistant to perturbation, or readily return to the pre-perturbation state. (This dimension more readily applies to structural properties of habitats and ecological communities, but can apply to functional properties of species as well.)
- b. Naturalness – from areas which are pristine and characterised by native species to areas which are highly perturbed by anthropogenic activities and/or with high abundances of introduced or cultured species.

13. Areas should be evaluated on all five dimensions of 11 and 12. Areas located in several different parts of the multidimensional space can be Ecologically and Biologically Significant (See Tables 1 & 2 for illustrations):

- a. Areas which rank highly (to the “left”) on even one of 11a-c (i.e. highly unique, highly concentrated or an activity with very high fitness consequences) for a single species or habitat feature may be considered Ecologically and Biologically Significant Areas.
- b. Evaluations also should consider cumulative importance for a wide range of attributes. Hence, areas which rank towards the “right” on 11a-c may also be considered Ecologically and Biologically Significant Areas, but only if a large number of species are at or above average (in abundance or in terms of performing an

important function in the area) on the dimension(s) of relevance.

- c. The justification for identifying an area as Ecologically and Biologically Significant is stronger when an area is towards the “right” on several aspects of 11a-c and 12a-b, rather than on a single dimension.

14. Areas may not qualify as Biologically and Ecologically Significant within this evaluation framework, but that does not mean they are ecologically of no importance at all. The distinction is that such areas may not warrant an *enhanced* level of protection relative to many other similar areas, although good management should be practiced everywhere. Areas may also have high cultural or economic value to humans, and society may choose to give them enhanced protection to preserve the properties they value. This is sound management, but does not make such areas *biologically or ecologically* significant.

Considerations in Use of the Framework

15. Evaluation of sites within this framework should use the best scientific information available, while following the federal Framework on the Application of Precaution. Those conducting the evaluation should be aware that information sources may be clustered in space, and thus provide a biased view of the uniqueness of the well-sampled areas. Areas may be comparatively well studied for logistical reasons such as ease of access, and not because they are necessarily Ecologically and Biologically Significant.

16. Evaluation of sites within this framework is a relative process, and not an absolute one. Both ecological conditions and information about ecological areas are so variable around Canada’s oceans that it would be inappropriate to set a specific “score” which would automatically qualify an area as Ecologically and Biologically Significant. Rather, the framework is to be used to identify

areas as especially “Ecologically and Biologically Significant” compared to other areas in the region.

17. Evaluation of sites within this framework should be based on the biological and ecological properties of areas, and not consider threats and risks to those sites. However management of areas selected as Ecologically and Biologically Significant should take full account of threats to the ecological areas. Knowledge of potential threats also can be an important consideration in setting priorities among areas to evaluate.

18. Vulnerability of an area has many dimensions, and the technical language in dealing with ecological vulnerability is complex. Key considerations of vulnerability relative to the identification of Ecologically and Biologically Significant areas are;

- a. The relative vulnerability of *species* or structural *habitat features* to disturbance: This type of vulnerability should be taken into consideration when evaluating the significance of areas particularly on the dimensions of Fitness Consequences and Resilience.
- b. The relative exposure of *sites* to likelihood of perturbations: This should not affect the Ecologically and Biologically Significance assigned to an area, but will be an important consideration in selecting management measures for the area.

19. The framework and the concepts of Ecological and Biological Significance work best when applied to places; i.e. work with maps and geographically referenced sites. Nonetheless the locations of some features, particularly physical and biological oceanographic ones, may vary substantially seasonally and inter-annually, and still be Ecologically and Biologically Significant. Some of the approaches discussed in Points 20-23 may help identify strategies for dealing with such situations. However, if a location of the ecologically significant features is truly unpredictable from year to year or season to

season, management tools other than labelling areas as Ecologically and Biologically significant may be necessary for ensuring the necessary conservation and protection.

20. Spatial scale is important in determining the appropriate boundaries of areas being evaluated within the framework, and will always be a source of uncertainty in evaluations. Spatial scale should always be considered explicitly in 11 and 12, and the best choices may not be the same across all dimensions.

- a. When an Ecologically and Biologically Significant area is justified by a structural feature of the habitat, the spatial scale of the feature usually will provide ready guidance on the appropriate spatial scale of the Ecologically and Biologically Significant area.
- b. When an Ecologically and Biologically Significant area is justified by the importance of the life history function being performed in the area, then the scale of the function must be considered in determining the spatial scale of the Ecologically and Biologically Significant area. This may be larger than the scale of activity of individuals of the species.
- c. When an Ecologically and Biologically Significant area is justified by a feature of community structure, determining spatial scale requires integrating the relationships of the individuals and species in the community which are responsible for the feature of community structure, and not solely a reductionist evaluation of the spatial distribution of the populations comprising the community.
- d. When considering the appropriate spatial scale for Ecologically and Biologically Significant areas, connectivity among sites needs to be taken into consideration, particularly on the dimension of Fitness Consequences.

- i When an Ecologically and Biologically Significant area is justified by a structural feature of the habitat, the ecological literature on fragmentation of habitats needs to be considered in determining spatial scale.
- ii When an Ecologically and Biologically Significant area is justified by a function being performed in the area, then ecological relationships and processes necessary for the function to be served needs to be considered in determining spatial scale. This means connections among sources, sinks, and transport mechanisms for feeding, breeding, etc. are part of determining the proper spatial scale for an Ecologically and Biologically Significant area.

21. Temporal scale is also relevant for determining the boundaries of an Ecologically and Biologically Significant area. Except for some fixed structural habitat features, many of the properties which justify identifying an area as Ecologically and Biologically Significant are not *guaranteed* to occur in a specified place all the time. However, the framework and associated considerations can deal readily with this source of uncertainty.

- a. In all cases the comparative evaluation (see 16) should emphasise a probabilistic view of the properties being considered, and give higher “scores” to areas where the structural or functional property has a comparatively high probability of being used. This can be done on annual, seasonal, and even shorter-term scales.
- b. When an Ecologically and Biologically Significant area is justified by a feature or a function being performed in the area, and the feature or function is inherently seasonal (upwelling, breeding, migration, nursery area, etc.), then the management approach or plan may include different protection measures for different seasonal conditions. However, the area is still considered Ecologically and Biologically Significant area in all seasons. It may receive some level of enhanced protection

during seasons where a species may not even be using the area, to ensure it is not altered in ways which affect its suitability for the function(s) in the season when the species is present.

- c. Temporal variation on time scales of decades or centuries, including effects of climate change, usually will be better addressed through periodic reviews of how regions and areas have been evaluated with the framework and informed adaptive management, rather than guessing at what areas may become Ecologically and Biologically Significant some time in the future.

22. Cases where a region has been greatly altered by human activities provide special challenges to identifying Ecologically and Biologically Significant areas.

- a. Current information may be a very incomplete guide to the true Ecological and Biological Significance of an area. Historical information is relevant to consider applying this framework, particularly part of the long-term goal of identifying Ecologically and Biologically Significant areas is to facilitate rehabilitation of communities or habitats.
- b. Historical information is particularly important when the justification for calling an area Ecologically and Biologically Significant involves occurrence or functional importance to a species-at-risk. Although the historical patterns of occurrence of such species is relevant to evaluations of areas as Ecologically and Biologically Significant, this needs to be balanced with a pragmatic view of what is realistic to achieve with a recovery plan for the species.
- c. Management plans are likely to be quite different for areas which have been identified as Ecologically and Biologically Significant on the basis of historical information than for those identified on the basis current usage.

23. The evaluation of areas as Ecologically and Biologically Significant is biased towards having a higher likelihood of considering data-rich areas to be Ecologically and Biologically Significant than comparatively data-poor areas, whether this evaluation framework is used or not. The better-studied an area, the more likely it will appear to be unique in some way, support high aggregations of something, or be a site for some functionally important activity.

- a. Some qualitative and semi-quantitative methods were discussed for reducing this bias, compared to the bias that would be present if all evaluations required application of highly quantitative tools. However, a more focused review would be necessary before recommending particular approaches or methods.
- b. It was also acknowledged that incorporation of individuals with experiential knowledge in the first phase of this process (6a) could reduce this bias to some extent.
- c. It is unlikely that the bias can be fully eliminated, and participants in all phases of the process should be aware of the risk that it is present and deal with it as best the circumstances allow. However, excessive use of "precaution" to argue for enhanced protection of an area just because someday something important may be found there is not justified. Adaptive management, learning-by-doing, and standard risk management should guide management in such situations.
- d. Model predictions of the Ecological and Biological Significance of an area may contribute information for an evaluation. The weight these should be given will depend on how well the reliability of model predictions has been tested, the extent to which the model has been ground-truthed for the particular area of interest, the availability of other relevant information independent of the model, and the other standard considerations in good practice

in the use of models in provision of scientific advice.

- e. There is a need for a "user's guide" to analytical methods for qualitative, semi-quantitative, and fully quantitative risk analysis to be used in various parts of the framework (for example 11-13, 16, 20-22), where the methods are matched to the quality of data and information which may be available.
- f. Monitoring programs should be designed with consideration of the information needed for evaluation of the Ecological and Biological Significance of areas.

24. It is noted that the overall process does not end even with the development of a management plan (6c) intended to provide appropriate protection to the Ecologically and Biologically Significant areas in a region. Subsequent monitoring of the status of the properties which made the area Ecologically and Biologically Significant will usually be necessary, to establish that the management plan is actually providing the desired protection. This monitoring should be based on Conservation Objectives set for the areas, and indicators appropriate for monitoring progress towards the objectives. There is need for a second "user's guide" for selecting indicators for such tasks, addressing appropriate strategies and methods for different types of knowledge, different capacities to monitor ecosystem properties, and different types of objectives.

References

- DFO, 2004. Proceedings of the National Science Advisory Meeting on Section 73 Permits under the Species at Risk Act; March 8-10, 2004, Moncton, New Brunswick. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2004/005.

Table 1: The continua of properties that would be expected to be captured along each dimension from 11a-c and 12a-b, for the ecological FUNCTIONS being considered in the evaluation of areas for Biological and Functional Significance.

		Uniqueness	Aggregation	Fitness Consequences	Resilience	Naturalness
Spawning / Breeding	High	Only one suitable spawning site known to exist for a species; Site used for spawning by many species	High percentage of total population use the area; Noteworthy percentage of many species use the area	Semelparous, so loss of one spawning event poses risk of loss of lineage; or a single site's quality or quantity of breeding habitat greatly affects the productivity of the population.		
	Low	Suitable spawning sites are widespread over a large number of at least partially disjunct areas	Only a small portion of the population(s) is present at any given time.	Continuous reproduction throughout the year, over many years. Reproduction occurs at many sites. A single site's quality or quantity of breeding habitat has little effect on the productivity of the population		
Nursery / Rearing	High	Only a single nursery/rearing area exists for the species	Larvae/juveniles are found in high concentrations in an area or a number of species use the area as nursery grounds/rearing	Larvae/juveniles have increased survivorship/fitness compared to other areas, especially if for reasons which can be tied to characteristics of the site.		
	Low	Multiple nursery/rearing sites for the species	Larvae/juveniles widespread or found evenly over a large area or single species uses area for nursery/rearing purposes	Larvae/juveniles fitness is comparable to adjacent habitats		

Table 1 (continued)

		Uniqueness	Aggregation	Fitness Consequences	Resilience	Naturalness
Feeding	High	Favors the production of a key food source that isn't found in other areas and can't be easily substituted / Provides a major food item not found elsewhere to a highly specialized consumer / No alternate area being used by this population or segment of a population	High concentration of prey, both a large biomass and a high productivity / An intense feeding area for a wide variety of species or for a large proportion of an important population / For sessile animals, a feeding area where a species occurs at higher densities	Feeding takes place in periods or in a manner that is more critical to an organism's fitness, productivity and/or short-term and long-term population sustainability / Consumers are known to use the area consistently / Contribution to annual growth, condition and maturation is great	Production of prey organisms depends on large-scale dynamic mechanisms unlikely to be affected by local events / Consumers have a varied diet and are attracted to an area to feed on a variety of prey in a complex food web	Introduced or cultured species are not major components of the food web / Production of food does not depend on man-made structures or processes initiated or sustained by anthropogenic activities.
	Low	Prey have a wide distribution / Major consumers known to feed in other areas as well / Consumers are omnivorous	Prey have a low standing biomass with very low productivity / Few species use the area / Species using the area are known to forage in many other locations or very wide areas / Sessile animals are not abundant	Presence of prey is sporadic and use of the area for feeding is occasional / Feeding in the area has marginal impacts on growth, condition and maturation	Production of preys dependent on very local irregular small scale processes / Consumers are highly specialized and the food web is very simple	Energy flow through the food web is channeled through an exotic species / Human activities have altered the food web by stimulating the production of alternate prey or artificially sustaining the production of top consumers.

Table 1 (continued)

		Uniqueness	Aggregation	Fitness Consequences	Resilience	Naturalness
Migration	High	The route is an obligatory passage (e.g. narrow strait, estuary) for a single species, population or life stage. OR The route is travelled by many species or populations.	Most individuals in the population travel along the route. OR Noteworthy percentages of several species use the route.	The route itself or its endpoints favour population fitness (reproduction and survival). Alternate routes represent a much greater cost or risk to migrants.	A disruption to the migration pathway would result in an irrevocable loss of the route. Example: cases where juveniles learn migration routes from adults.	The migration is carried out by a native species and is cued by natural (as opposed to anthropogenic) factors.
	Low	The migration is carried out using several routes, which are chosen indiscriminately.	Only a small fraction of a population uses the route.	The migration has no effect on fitness, or the route taken is variable and not constrained by any known factors.	If temporally disrupted, the route could be re-established readily. Example: when navigation is controlled by large-scale processes (sun position, magnetic field).	The migration is carried out by an introduced species and is cued by anthropogenic activities.

Table 1 (continued)

		Uniqueness	Aggregation	Fitness Consequences	Resilience	Naturalness
Seasonal Refugia	High	Refuge utilized by a rare, endemic or unusual species or population; refuge utilized by many different populations or species; refuge utilized for an unusual purpose or under unusual conditions.	Refuge contains a high proportion of a single population or species during adverse conditions (e.g. low or high temp); refuge demonstrates greater than average biomass under adverse conditions.	Refuge necessary for survival of the species, population, or individuals (listed in order of significance) using it; survival of individuals within a refuge important for survival of a dependent species or population (e.g. survival of overwintering <i>Calanus</i> important for other species); use of refuge coincides with other important life-history events, such as spawning or breeding. Note: more than one refuge may be necessary.	Conditions inside the refuge demonstrate a high level of stability compared to conditions outside the refuge (e.g. limited seasonal or inter-annual variability).	Refuge exists independent of human intervention; refuge not influenced by human activities.
	Low	Refuge utilized by commonly occurring species or populations; evidence of many similarly utilized sites with no evidence of site preference.	Only utilized by a small proportion of a population or species.	Alternate refugia are available, suitably distributed and easily accessible; conditions outside the refugia are not sufficiently adverse to cause mortality.	Conditions inside refuge demonstrate the same level of stability as conditions outside refuge; refuge demonstrates characteristics that increase its susceptibility to human disturbance, e.g. greater sound transmission during winter.	Refuge created or maintained by humans.

Table 2: For the **STRUCTURAL FEATURES** which may be considered in evaluating Biologically and Functionally Significant area, illustrations of how some typical features would be judged along the dimensions of 5a-c and 6a-b. In real applications those conducting the evaluation would agree on a manner of scoring which would be augmented by the type of narrative presented in the table.

Table 2: Reference Table coupling a) physical features b) biological oceanographic features, and c) biodiversity features with the five defined dimensions of Ecologically and Biological Significant Areas. These examples show the types of factors that could be considered against the five dimensions of significance, with more of the factor supporting a higher ranking. Not all dimensions are equally relevant in all cases, but each is important in some examples. Real applications of this approach would require a priori decisions on the relative importance (weight) to be assigned to each dimension.

a) Physical Oceanographic features

Feature	Uniqueness	Aggregation	Fitness Consequences	Resilience	Naturalness
Tidal mixing zones	Benthic and water column productivity and dynamics important to many species or populations.	Both convergence and divergence, vertically and horizontally. Could define the role of tides in defining biological population distributions.	Productivity can be very locally determined. Key areas for adult feeding.	Degree of temporal stability. The dynamics of the stability could be directly determined.	Dams, runoff, and tidal power facilities can have significant influences
Convergence zones (e.g. banks on continental shelves)	Convergence zones, and water properties, provide key conditions for limited species	Aggregation of prey and nutrients for production, and minimal dispersal of larvae	Reproductive success related directly to physical dynamics. Key areas for larval growth.	Dynamical system with changing characteristics modifying	
Polynyas (open waters zones in sea –ice)	Heat exchange and circulation create unique physical conditions that have direct biological consequences	Planktonic organisms concentrate leading to food chain convergence.	Availability of prey lead to local and variable fitness consequence issues.	Persistence and variability vary. Timing of appearance and duration would be important characteristics.	Some such features (e.g. hot water from a power plant would look dynamically similar)
Upwelling zones	Generate locally well-defined oceanographic properties	Can lead to both convergence and divergences. Spatial scale would determine the ecological importance	Has both direct (metabolic) and indirect impacts on ecosystem function. Coupled with uniqueness and aggregation to determine importance.	Highly dynamic, spatially and temporally and hence has potential to be crucial to fitness but unpredictable	Driven primarily by wind-forcing coupled with topography and coastline where human influences can occur.
Strong topography (e.g. canyons on the continental shelves, fjords)	Canyons can generate locally important circulation that generates habitat conditions unique on the continental shelf	Can lead to both convergence in some zones and divergence in others	Can have both direct and indirect impacts on ecosystem function	Relatively stable (much more so for example than upwelling features)	Benthic habitat can be disrupted by deep sea trawling or oil exploration

Table 2 (continued)

b) Structural Habitat Features

Feature	Uniqueness	Aggregation	Fitness Consequences	Resilience	Naturalness
Sponge reefs	Extent to which the feature is globally unique	density and size of bioherms	older/larger individuals provide greater population fecundity and community structure	long-lived habitat-forming species, exposed to very little disturbance and therefore unlikely to have resilience	Relatively undisturbed and extremely old. Most reefs are pristine; limited impact from trawling
Deep water corals	Geographic scale and species composition of the coral assemblage	density and variety of species	older/larger individuals provide greater population fecundity and community structure	slow growth, deep water habitat and therefore little exposure to disturbance, therefore unlikely to be resilient to disturbance'	undisturbed by virtue of deep location, some areas subject to increased disturbance from trawl fishing
Macrophyte beds	Geographic scale and species composition of macrophytes	density and variety of species	older/larger individuals provide greater population fecundity and community structure	annual or perennial species; temporal or spatial stability	presence of exotic species;

C) Biodiversity

Feature	Uniqueness	Aggregation	Fitness Consequences	Resilience	Naturalness
Presence of endangered or threatened species	Number of rare or endangered species present.	Proportion of the total population present in the area	Degree to which area is important for survival or reproduction of species	Score depends on biology of the species	
Presence of highly diverse or productive communities	Extent to which species or communities are not common elsewhere	Percentage of total populations of species present	Degree to which area is important to the survival or reproduction of many species	temporal occurrence of most species	Number of exotic species present, and proportion of community comprised of exotic species.

For more Information

Contact: Jake Rice
Science Sector
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

Henry Lear
Science Sector
Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario
K1A 0E6

Tel: (613) 998-5171
Fax: (613) 954-0807
E-Mail: LearH@DFO-MPO.GC.CA

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200 Kent Street
Ottawa, Ontario
K1A 0E6

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

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