SCIENCE-BASED ENCOUNTER PROTOCOL FRAMEWORK FOR CORALS AND SPONGES

Context

Canada is committed domestically and internationally to conserve, manage, and exploit fish stocks in a sustainable manner, as well as to manage the impacts of fishing on sensitive benthic areas and vulnerable marine ecosystems – including coldwater corals and sponges. Under the United Nations General Assembly Resolution 61/105, States and Regional Fisheries Management Organisations and Arrangements (RFMO/A) are instructed that they should have an appropriate protocol identified in advance for how fishing vessels should respond to encounters with vulnerable marine ecosystem in the course of fishing operations.

This Science Advisory Report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat national science advisory meeting of March 15-18, 2011 to develop guidance on a science-based encounter protocol framework for coldwater corals and sponges. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SUMMARY

- An encounter is defined as occurring when a fishing activity interacts, either directly or indirectly, with an ecological feature that meets the criteria of an ecologically or biologically significant area (EBSA) or a vulnerable marine ecosystem (VME), or is otherwise covered by a relevant policy. This interaction may or may not be evident onboard the fishing vessel.

- If properly designed and implemented, encounter protocols can be a valuable component of a management system, particularly if used in conjunction with appropriate area closures implemented to provide protection to VME from serious or irreversible harm.

- An encounter protocol must be practical, effective, and adaptable in a reasonable timeframe and should be guided by clearly defined objectives.

- Reliable and consistent bycatch data for commercial fishing operations are typically lacking, however such data are important when implementing and evaluating the encounter protocol.

- The necessary components of a science-based encounter protocol are as follows:
    - Clearly defined objectives;
    - A pre-fishery planning exercise;
    - Reliable, identified indicators of an encounter (e.g. thresholds/triggers);
    - Selection of appropriate management responses to an encounter;
    - Observer and data collection/sampling guidelines and protocols; and
    - An evaluation of the implementation of the encounter protocol in a timely manner.

More detailed advice on each of these points is provided throughout this science advisory report.

BACKGROUND

Canada is committed both domestically and internationally to conserve, manage, and exploit fish stocks in a sustainable manner, as well as to manage the impacts of fishing on marine ecosystems with particular priority given to sensitive benthic areas.

Endorsed by Canada, the United Nations General Assembly (UNGA) approved the *Sustainable Fisheries Resolution 61/105* in December 2006. This Resolution calls on States to directly, or through Regional Fisheries Management Organizations and Arrangements (RFMO/A):

i) apply precautionary conservation and management measures to protect vulnerable marine ecosystems (VME), which may include coldwater corals and sponges, from significant adverse impacts (SAI); and

ii) apply an ecosystem approach to sustainably manage fish stocks.

Under this Resolution, States and RFMO/A are instructed that they should have an appropriate protocol identified in advance for how fishing vessels should respond to encounters with a VME in the course of fishing operations (paragraph 86). In 2009, Canada also endorsed the *UNGA Sustainable Fisheries Resolution 64/72* which called for implementation of the objectives set out in 61/105 (paragraph 119).

Coordinated by the United Nations Food and Agriculture Organization (FAO) Committee on Fisheries (COFI), the *International Guidelines for the Management of Deep-sea Fisheries in the High Seas* were negotiated by States and RFMO/A for the sustainable management of deep-sea fisheries consistent with the precautionary approach and to guide the implementation of *UNGA Resolution 61/105*. The *FAO Guidelines* [http://www.fao.org/docrep/011/i0816t/i0816t00.htm] state that, if after assessing all available scientific and technical information, the presence of VME or the likelihood that fishing activities would cause SAI to VME cannot be adequately determined, States should only authorise fishing activities to proceed in accordance with:

i. precautionary conservation and management measures to prevent SAI as described in paragraph 65 of the *Guidelines*;

ii. paragraph 74 that refers to a protocol for encounters with VME consistent with paragraphs 67-69 and measures to reduce uncertainty, including ongoing scientific research, monitoring, and data collection.

In alignment with its international commitments, Canada (Fisheries and Oceans Canada; DFO) is domestically implementing the Sustainable Fisheries Framework (SFF). The SFF provides the basis for ensuring Canadian fisheries are conducted in a manner which support conservation and sustainable use by incorporating existing fisheries management policies with new and evolving policies. The framework also includes tools to monitor and assess those initiatives aimed towards ensuring an environmentally sustainable fishery and also identifies areas that may need improvement. Overall, the SFF provides the foundation of an ecosystem-based and precautionary approach to fisheries management in Canada.

A key component of the SFF is the *Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas* (released in April 2009). The purpose of the *Policy* is to help DFO manage fisheries to mitigate impacts of fishing on sensitive benthic areas or avoid impacts of fishing that are likely to cause serious or irreversible harm to sensitive marine habitat, communities and species. Under the SFF and for the purposes of this advisory process, consistent with the *FAO Guidelines*, serious or irreversible harm is defined as '*impacts that compromise ecosystem integrity (i.e. ecosystem structure or function) in a manner that: (i) impairs the ability of affected populations to replace themselves; (ii) degrades the long-term natural productivity of habitats; or (iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types*'.

In addition to the SFF, this scientific advice will also inform regional coral and sponge conservation plans/strategies that outline conservation, management, and research objectives that reflect fishing and non-fishing impacts on corals and sponges in Canadian waters.

ANALYSIS

Scope

This scientific advice responds to a specific request related to the development of guidance for a science-based encounter protocol framework for corals and sponges under the DFO *Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas.* However, it has been developed in the more general context of protecting VME as specified in UNGA *Resolution 61/105* and the FAO *Guidelines*, as well as Ecologically and Biologically Significant Areas (EBSA) as specified in *Decisions IX/20* and X/29 of the *Convention on Biological Diversity*. Encounter protocols for other ecosystem features would require additional science advice, but the concepts underlying the present advice would be appropriate starting points for framing the advice on encounter protocols for other types of ecosystem features.

In addition, this scientific advice refers to corals and sponges at the population scale and the habitats and functions they provide, not the specific species and communities associated with them. The associated species and communities, along with other features to be considered and included in actual encounter protocols, will be further defined in future regional science advisory processes.

For the purposes of the scientific advice provided here, VME refers to any coldwater corals and sponges found in Canadian waters and to which the encounter protocol or fishing closures may be selected to apply.

Defining an 'encounter'

An encounter occurs when a fishing activity interacts, either directly (e.g. total removal and/or damage) or indirectly (e.g. smothering by sedimentation), with an ecological feature that meets the criteria of an EBSA or VME or is otherwise covered by a relevant policy. This interaction may or may not be evident onboard the fishing vessel.

Whenever a single encounter removes or damages all or a large portion of an aggregation of corals and/or sponges the impact may be considered serious or irreversible, although there is little specific documented evidence that removals or damage on these scales has occurred in Canadian waters. Serious or irreversible harm can also result from the cumulative effect of multiple encounters eroding aggregations or sparsely distributed populations over time. This advice takes both types of encounters into account.

Encounters for which evidence is available to an individual on a fishing vessel will reflect a subset of the total number of all encounters that have occurred on the seafloor. At the present time, information about indirect and direct encounters may not be available simply from monitoring fisheries operations. However, information that can be collected onboard a fishing vessel and that may indicate an encounter has occurred includes:

- Presence of VME in the catch or the fishing gear;
- Photographic, acoustic, or other technological information (e.g. head-rope cameras, net transducers, etc.) collected in the course of fishing operations that indicates the presence of VME; and
- Presence of other taxa in the catch or the fishing gear that are considered reliable indicators of the presence of VME and for which scientific advice has been provided to confirm this.

It may be possible to use other types of information to indicate that an encounter had occurred, such as biochemical residue of the species of interest on the fishing gear or catch. However, the technology to practically apply this kind of method to identify encounters does not currently exist.

Interpretation of any of the aforementioned types of evidence can be informed by predictive habitat modelling, historical fishing records, and/or research/museum taxonomic collections.

When catches include VME that may be difficult to identify or that have not been documented in areas prior to that interaction, archiving or photographing these samples is useful for future refinement of the encounter protocol and/or improving knowledge of the location and species composition of corals and/or sponges.

Circumstances where encounter protocols are most effective

The performance of encounter protocols has not been well evaluated and the circumstances where they would afford the best protection to VME from serious or irreversible harm owing to fishing activities are not well defined. However, it is known that encounter protocols alone may not afford much protection for some types of VME, including corals and sponges. If properly designed and implemented, encounter protocols may be a valuable component of a management system that identifies areas that require mitigation measures (e.g. closures) to avoid serious or irreversible harm.

For encounter protocols to provide conservation benefits they must contain effective mitigation measures, otherwise they provide little protection and may even be harmful if they spread damage rather than reduce it (e.g. if they include an arbitrary move-on rule to “protect” a static VME). The value of encounter protocols may be enhanced when included or combined with actions such as area closures, gear and/or catch restrictions, pre-fishery surveys, risk assessments/analysis, and/or monitoring.

The conservation benefits resulting from encounter protocols as related to the size and distribution of the patches of VME is not fully understood. However, at the present time an encounter protocol is thought to be most useful where the likelihood of either exceptionally large catches of corals and sponges, or repeated smaller encounters within a localised area, are estimated to be substantially greater than zero in areas that have not been closed to fishing.

When effectively implemented, encounter protocols can contribute to the collection of data or information in areas where information is particularly incomplete and/or where fishing operations are not being monitored independently. However, they should not be considered a substitute for appropriate independent catch monitoring programs.

In order to evaluate the performance of an encounter protocol, the ecological and socio-economic implications of their use need to be considered against defined management objectives.

Framework for a science-based encounter protocol

The implementation of the encounter protocol must be practical, effective, and adaptable in a reasonable timeframe when new knowledge is available and/or emerging management and/or conservation needs arise. Areas deemed ‘most important’ should be closed to fishing activities that are likely to cause serious or irreversible harm to VME. Encounter protocols are intended to be applied outside such closed areas.

The encounter protocol must also be realistic in its application given the time and resource constraints of the fishery (e.g. the ability of harvesters/observers to identify species, availability of sampling techniques, etc.) and give consideration to the behavioural response of fish harvesters.

Any science-based encounter protocol should contain the following six components:

1) Clearly Defined Objectives

Although an encounter protocol may have more than one objective, objectives must be specific enough that their provisions (e.g. thresholds) provide clear and consistent direction on what ecosystem status must be maintained to achieve the conservation goals. The risk tolerance with respect to achieving the objectives should also be specified. In addition, the VME to which the encounter protocol applies should be clearly stated and take into account all relevant policies/legislation and available scientific advice.

Operational objectives for the ecological and economic outcomes of the fishery should be set within appropriate policy frameworks prior to the development of the encounter protocol. Objectives are considered “operational” when they have enough specificity to guide the trade-off between management and conservation goals as well as related risk analyses. Without such objectives, the ability to effectively determine the appropriate provisions of the encounter protocol will be limited.

2) Pre-Fishery Planning

A review and analysis of relevant information about the fishery and the VME to be protected should precede the selection of the provisions of the encounter protocol. The best result of a pre-fishery evaluation would be to identify ways to conduct the fishery economically with at least a moderately high probability that conservation objectives will be achieved and the use of an encounter protocol will be minimal.

The default assumption is that all analyses will be on the scale of the area where the encounter protocol will be applied. However, analyses and planning should aim to deliver conservation objectives at the scale of the functioning ecological units of the VME in question. This scale will often be incompletely known and targeted studies will often be needed. Where multiple fisheries that may affect the status of the VME operate within a single functional ecological unit, the outcomes of fishing with an encounter protocol must meet the conservation objectives of the protocol for all the fisheries in aggregate.

For the pre-fishery analyses described below, the history of fishing may affect the quantity and quality of information that will be available. It may also influence how results of the analyses are interpreted, for example one may be more risk averse if it is known that a lot of the VME to which the protocol apply have already been subject to serious or irreversible harm. Likewise, little or no information about the history of the fishery may equate to less information about the VME. Less information will mean outcomes of pre-fishery evaluations will be more uncertain, and management actions, including the provisions of the corresponding encounter protocols should take this uncertainty into account.

Information about the VME

Initially, the best available information regarding the ecology of the VME in question and its likely vulnerability to fishery impacts should be consolidated. Information currently available on the distribution and ecological functions of coldwater corals and sponges has been reviewed and summarized (see DFOc, 2010). This information will be useful in informing the development of encounter protocols for this type of VME in Canadian waters. However, knowledge will continue to be acquired on corals, sponges, and eventually other VME and it is important to always consider the most current information possible, including experiential and traditional knowledge and peer-reviewed primary literature.

Based on the best available information, maps should be prepared indicating the known and expected locations of the VME. Where information is adequate, these maps should be contoured to show how the expected density of VME varies spatially.

Predictive habitat modelling may add value to the observations of occurrences of the VME and will be particularly valuable where observational information is scarce. If encounter protocols will be used for fisheries in information-poor areas, generic predictive models should be developed for the specific VME of concern. These models should be parameterised using information from very large geographic areas and where possible, the performance of these generic models should be validated by comparison to the performance of models developed for the same VME in comparatively information-rich areas. The difference in performance between these models can provide insight into the scale of uncertainty expected.

Using the best available information, patterns in the size and spatial distribution of patches of the VME should be quantified. The quantification of patchiness of the VME should begin at the finest scales supported by the information available and lead stepwise to any larger scales that may be relevant to the management response provisions of the encounter protocol. If considered a concern, ‘source-sink’ dependencies of recruitment should be taken into account in these pattern analyses.

General information on the size and spatial distribution of VME can be used to predict these properties in information-poor areas. The use of such inference should be validated in a manner similar to that outlined above for predictive habitat models.

Information about the Fishery

The best possible information about past and planned fishing in the area where the encounter protocol is being considered for application should be consolidated. For corals and sponges, this would include data from fisheries that use bottom-contacting gear, or gear that is known to have potential impacts on the benthos. The frequency and intensity of the fishing should be mapped as completely as possible and for as long into the past as possible, and the interpretation of this information must be ecologically relevant (i.e. consistent with the known or purported fragility, resilience, and productivity, etc.) to the VME in question.

For the fishing gear(s) used by the fishery/fisheries to which the encounter protocol will apply it is necessary to consolidate the best available information on the ways each one may interact with the VME. For most fishing gears used in Canadian waters, scientific advice on the potential impacts of fishing gears on ecosystem features has already been provided (DFOa, 2006; DFOb, 2010). On a case-by-case basis it may be necessary to seek additional fishery-specific or area-specific advice to augment this general advice, particularly if the fishery or the area is considered to be quite specialized.

It is also necessary to inventory the full suite of management measures currently in place for the fishery/fisheries and those used over an appropriate historical period (where “appropriate” is interpreted in terms of the recovery time expected for the VME). This inventory should include which areas, if any, were closed to fishing, and when, where, and why they were closed. If the historical information on fishing activities and the occurrence of VME (determined either from data or inferred using models) allows, then it would be useful to investigate possible trends in historical baselines for the VME as these trends in baselines may be relevant when setting or adjusting existing conservation objectives.

An inventory should be prepared of all the management responses that are available for potentially mitigating impacts of the fishery on VME. For all the management responses in the inventory the information needed for effective implementation of each one should be itemized. More information on the types of potential management responses is provided in detail below.

Risk assessment of total sustainable impacts

Using the best available information on ecology, abundance, and patterns of distribution, including any modelling or analytical results that have been accepted as scientifically sound, a risk assessment should be done for the maximum amount of impact to the VME in question that is consistent with the defined conservation objectives and the risk tolerances. Results of such risk assessments will be necessary for many of the evaluations of the performance of possible provisions of the encounter protocol. Risk assessment should take into account historical and cumulative impacts.

3) Indication that an Encounter Occurred

When thresholds are set, both the protection of specific taxa and the economic and social aspects of a fishery are often considered. The thresholds and any related management decisions should be consistent with, and help to achieve, the objectives of the encounter protocol.

A threshold value is the level of a particular indicator that is taken as evidence that an encounter has occurred. The indicator itself can be associated with a single attribute of the catch or fishery operations, but it can also be constructed as a combination of a series of attributes. Observations that these threshold values have been exceeded are intended to trigger specific management responses (e.g. record and report the presence of a species/group in the catch, move-on rule, etc).

The specific value of a threshold is a function of the ecological features impacted by fishing activities, the standardized units of fishing effort considered, the expected available information on the vessel when the encounter occurs, and the management responses to be implemented when reaching the threshold. These factors imply that threshold values are expected to be both VME specific as well as fisheries specific (i.e. gear, target species, area, fishing operation).

In the context of encounter protocols for VME, the threshold is usually the presence and/or magnitude of the bycatch of specific taxon found in some standardized unit of fishing effort (e.g. the area impacted by a fishing event, a certain number of hooks, etc). However, other indicators may also be amenable to being used (e.g. acoustic profile of the bottom measured during fishing operations, level of genetic markers in the gear).

Threshold values should be derived from the best information available on the underlying distribution of the ecological features being impacted, the characteristics of the operations from which the indicator value will be measured (e.g. type of gear, catchability for the corals and/or sponges of interest, fishing behaviour), as well as the goals intended to be achieved by the management responses triggered by the threshold. Thresholds that are set which require more intensive sampling and/or instrumentation (e.g. use of head-rope cameras) will result in higher associated costs owing to both the hardware and data analysis requirements. The type of data being collected to determine whether an encounter has occurred will determine whether the data can be used in a real-time scenario.

Data availability on species distributions and densities tends to differ regionally, is of relatively coarse spatial resolution, and for some types of VME is not necessarily well resolved at the taxonomic level. In all cases, the best available information should be used to approximate VME distributions and relative densities to determine appropriate management measures. This type of information can be further refined and validated by carrying-out directed surveys using non-destructive methods for corals and sponges (e.g. remote operated vehicles). The use of habitat models can also provide an initial approximation of the expected distribution of VME.

Reliable and consistent data on coral and sponge bycatch in commercial fishing operations is typically lacking, but efforts are being made to improve this. Still, the current lack of adequate data on VME bycatch in commercial fisheries poses a challenge for deriving threshold values. Among the ways this shortcoming could be addressed is to simulate fishing operations in a GIS environment and estimate expected coral and sponge bycatch. To date, such simulations have been implemented for the Northwest Atlantic Fisheries Organisation (NAFO) Regulatory Area, but only for sponge bycatch in the groundfish trawl fishery. This type of analysis can be extended to corals and/or other areas and/or other gear types if the appropriate data are available. If reliable commercial data on coral and/or sponge bycatch are available, the distribution of catch rates can be used to derive empirical threshold values that can be taxon, area, and/or fisheries specific.

Currently implemented thresholds for corals and sponges worldwide are arbitrary and usually directed to protect areas of higher density first. Owing to current data and knowledge gaps, the underlining question of how this type of protection translates into protection of ecosystem function of VME still remains unanswered. Knowledge of the relationship between amount of habitat protected and ecosystem function retained could be improved if resources were available for such analyses. In the absence of such knowledge, choice of threshold metrics and values should reflect a risk-averse approach for addressing management objectives.

Spatially-explicit simulation models parameterised for particular areas allow for the simulation of encounters and the estimation of total catches of corals and sponges in a fishery. It is likely that results will vary by area and/or taxon. These models are appropriate techniques to inform the selection of thresholds for use in an encounter protocol, when spatially-explicit data on the distribution of corals and sponges in the fished area, or historical by-catches of corals and sponges in similar fisheries are available. The thresholds and any related management decisions should be consistent with, and help to achieve, the management objectives of the encounter protocol.

Validation of the model through confirmation of actual locations/distribution of corals and sponges, and using commercial fishing data on fishing practices (e.g. tow lengths, gear use and direction such as along depth contours or bathymetric features) is necessary. Such fisheries data are often not presently available, but could be readily obtained from logbooks and interviews with fish harvesters.

At present, specific distributions of VME species and associated thresholds of density and biomass have not been linked to the ecological structure or function of corals and sponges. However, previous scientific advice (DFOc, 2010) concluded that in general for aggregating species, larger aggregations are likely more important to ecosystem function than small aggregations. Although in some cases small concentrations may be remnant populations of a larger aggregation (i.e. *Lophelia pertusa* on the Stone Fence of the Scotian Shelf), in which case ecological structure or function of the residual aggregation may already have changed.

In addition to spatially-explicit simulation models, additional analyses are currently possible that would allow further refinement of thresholds. For example:

- Testing different thresholds to determine the range of possible outcomes (i.e. how ecological function and/or fisheries might be affected);
- Establishing the reliability of the protocol, such as determining the relative rates of misses vs. false alarms for particular thresholds (i.e. not identifying where species are located and thus offering them no protection vs. wrongly identifying species locations and unnecessarily restricting a fishery); and/or
- To the extent possible, determining the cost of implementing the encounter protocol vs. the conservation benefits provided to VME. For example, the amount of fishing effort or profit that would be impacted compared to the anticipated degree of harm reduction for the VME (e.g. in weight, area, number of species, etc.) protected.

4) Selection of Appropriate Management Responses

The information available for any given fishery should be reviewed relative to the information needed for application of each possible management response and within the existing management and policy framework. Subsequent analyses should focus on the responses which best match both the information needed and that which is available. Options that cannot be supported with realistic assumptions based on the information available should be given low priority.

The most complete Management Strategy Evaluations (MSE) that the information (including scientific data) can support should be completed for the management responses retained for consideration. The MSE should explore multiple scenarios for management measures, and take into account plausible major sources of ecological and implementation (including level of observation, catchability, etc) uncertainties. The MSE should also include an evaluation of fleet performance in each scenario considering expected catches and quantifiable costs to the fishing fleet, as well as issues with enforcement, and other impacts as deemed relevant in the simulations.

The benchmark of the MSE should be the risk of failing to achieve any of the operational objectives, guided by the risk assessment described above. The MSE should consider a long-term interpretation of impact and achieving the objectives, particularly for VME like corals and sponges, where impacts accumulate over time and recovery is expected to be very slow.

For management responses that appear likely to afford protection to the VME, sensitivity analyses should be done for the key operational parameters of the encounter protocol (e.g. observer coverage, reliability of detection of encounters, etc). For these options the MSE analyses can also inform the choice of decision parameters in the encounter protocols (e.g. triggers for defining an “encounter”, etc.) for the optimal trade-off of risks of not achieving the objectives of the fishery. The MSE should consider the risks associated with variation in response times and in the capacity of the fisheries system to respond. Depending on the mitigation measure, timing of its implementation will likely vary between the reporting vessel and the rest of the fleet.

Individuals responsible for applying the encounter protocol must be able to detect that an encounter has actually occurred in order to effectively implement any management response. The implementation of a management response should be based on explicit decision rules that the MSE results indicate are likely to meet the objectives of the encounter protocol. The decision rules and triggers of the encounter protocol should be selected considering the risks associated with response times and capacity of the management system to respond.

The selection of potential responses is based on the outcomes of the pre-fishery evaluation and MSE, and, if there is more than one response possible, each one will have its own trigger/threshold. Pre-fishery communication should include managers, science, and the fishing industry - particularly as in-season changes to the encounter protocol are likely to be difficult. If an encounter protocol has been triggered during any given fishing season, it should be evaluated at the end of the season in a timely manner to evaluate its effectiveness and practicality.

Any management response to an encounter should apply to all vessels within a fishery and should take into account the cumulative effects of all potential impacts, preferably in the context of regional coral and sponge conservation strategies.

Although there may be others, a suite of management responses that could be considered for inclusion in an encounter protocol are given below. Any one or more of these management responses may be appropriate for inclusion in an encounter protocol depending on its objectives and associated risk tolerance to fishing impacts on VME.

Reporting of the Encounter

Two primary reporting responses are possible: real-time/short term reporting vs. longer term. The nature of the reporting will depend on the information available and its interpretation/application in implementing the encounter protocol. Details regarding the nature of reporting will be particularly useful when setting objectives/tolerance levels for the encounter protocol and when conducting an evaluation of the encounter protocol with respect to achieving its objectives.

Closures

In order to effectively identify places where the objectives for protection of VME would be best achieved through the use of a closure, as much information as possible about the VME, particularly its patterns of occurrence are needed. If an encounter protocol will not be applied in areas that remain open to fishing, the closed areas may need to be larger compared to if an encounter protocol would be applied, in order to maintain any agreed upon risk tolerance for protecting VME.

A biological rationale should be presented which documents that the likely impacts of fisheries operating without encounter protocols in the open areas will not compromise the achievement of the conservation objectives and the application of the precautionary approach.

Move-On Rules

To achieve the objective(s) of the encounter protocol, it is logical that when a move-on rule has been 'triggered', all vessels using the same fishing gear should avoid the area of the encounter until further information and additional management responses can be determined; provided coordinates are made known this may be achieved on either a mandatory or voluntary basis. A variation to this approach may be contemplated by management if the encounter occurs near the boundary of an area that is already closed.

Considering the life history characteristics of corals and sponges there is little, if any, conservation benefit if any fishing vessel using the same gear and operation were allowed to continue fishing in an area where the move-on provision has already been triggered.

An analysis of the expected size and shape of the distribution of the VME, as well as the potential footprint of the fishery can inform how far a vessel should be expected to 'move-on' once the encounter protocol has been triggered. In addition, the proximity to closed areas, the size and characteristics of the closed areas, the expected tow duration, and amount of effort should also be considered. This information can assist in determining where vessels should move to reduce the risk of further damage to VME. It would be undesirable to displace the fishing effort to other areas that also contain VME in quantities great enough to trigger the encounter protocol, thus indicating that they too are likely "important".

When determining whether to apply a move-on rule, one must determine whether the patch affected was only part of a larger patch what was there prior to the impact, or if the entire patch has been removed. If it is the latter, a move-on rule will offer little conservation benefit as that particular patch no longer requires protection. Repeated encounters within a certain area may indicate the presence of a previously undocumented VME and require more lasting actions than just repeated application of a move-on rule.

Changes to Fishery Operations

Changes in how a fishery operates that eliminate the likelihood of an encounter occurring are a potentially useful response to an encounter rather than employing a move-on rule. Potential changes to the fishing operation include gear modifications, different gear types, change in fishing depth, reduction in the length of tow, reduction in the amount of gear deployed, etc.

When determining whether this is an appropriate management response, one must consider any other fisheries targeting different species and/or using different gears in the same area. In addition, consideration must be given to the ability of the fishery to implement the proposed changes and whether they will be able to effectively operate once the changes are implemented.

Limiting the extent or intensity of fishing could be implemented if the threshold for a response has been triggered from an impact where the exact location of the encounter cannot be discriminated because it occurred during a fishing set that swept a large area. The extent or intensity of all pertinent fishing activities in similar habitats as defined by those in the move-on rule or closures should be likewise limited.

Fleet Catch Limits/Quotas

Catch limits or quotas on the allowable quantity of the VME that can be caught by fishing gear should be based on the tolerance for fishery impacts on the VME to be protected. This tolerance level should be clearly defined and incorporated into the objectives of the encounter protocol. The catch limits/quotas should then specify the upper limit to the frequency and/or quantity of the VME that could be taken in all subsequent fishing events, such that the cumulative impact of all the encounters will be within the risk tolerance. Once the catch limit/quota has been reached, an alternate management response may be necessary to prevent further impacts that may cause serious or irreversible harm to VME.

Increased Observer Coverage

An increase in observer coverage would be appropriate if better data, higher compliance, and improved reporting (including but not limited to high risk areas and/or areas with little or no information) were deemed necessary to achieve the objectives of the encounter protocol. However, the ability to increase the observer coverage in any given fishery will depend on the availability of observers, the associated economics of the operations, and the capacity of the fleet to accommodate observers.

<u>5) Monitoring, Data Collection, and Sampling</u>

Monitoring

The goal of an encounter protocol is to have complete information for any given fishery, though this may be difficult to achieve in practice. Ensuring the efficacy of an encounter protocol requires some type and level of independent verification/monitoring, which may be best provided by at-sea observers.

As encounters with VME have been observed to be clustered in space and may occur sporadically in both space and time during the course of the fishery, a low level of monitoring may not properly characterize the scale and pattern of encounters and may compromise achieving the objectives of the encounter protocol. The level of coverage and the design of the monitoring program must be appropriate for the characteristics of the fishery and could include video monitoring. The potential for an "observer effect" should be taken into account when planning monitoring programs and using the information from them, as it has been shown that in some cases fish harvesters may operate differently in the presence of onboard monitoring. Under certain circumstances 100% observer coverage may be required to completely eliminate bias. Alternate means of observation using at-sea video monitoring have also been shown to eliminate such biases.

The level of observer coverage necessary to produce complete, reliable information will depend on a variety of factors (e.g. expected compliance, the level of cooperation within the fishing industry, availability of observers, etc.). Amongst other things, enhanced monitoring may be required under the following circumstances:

- areas where the distribution of VME has not been well characterized; or
- areas of known high concentration of VME that have yet to be closed to fishing.

The level of monitoring depends on the effectiveness of measures included in the encounter protocol, the expected level of compliance in the absence of monitoring, the risk tolerance associated with the objectives, the likelihood of encounters, and the degree to which they might compromise the objectives.

Fish harvesters and independent second party observers may be tasked with reporting under an encounter protocol. The required degree of specificity of the reporting should be explicit and may depend on who is expected to collect the information.

Data Collection and Sampling

The type of data to be reported depends on the conservation objectives underlying the encounter protocol. Key data will be the locations of encounters with VME for which the encounter protocol applies. If the encounter protocol includes a trigger based on a high density of small catches of VME in a region, or if an objective of the encounter protocol is to identify areas that might contain VME, then all/most encounters need to be recorded. Semi-quantitative recording could be used to simplify the task (e.g. presence, categories of estimated catch levels, etc). Other important data to report include the gear type, set duration and target species for any set in which a VME is encountered.

There are numerous existing reporting requirements for fishing operations, and reporting under an encounter protocol will contribute to this burden. In some circumstances the burden may be sufficiently large as to require prioritisation of reporting requirements (i.e. when, where, how often). Such prioritisation will depend on the priorities of the conservation/management objectives for the fishery and/or domestic/international commitments (e.g. monitoring for small fish protocol vs. monitoring for encounter protocol).

Appropriate guidelines are required for sampling and data collection under an encounter protocol; these directions will usually be fishery and/or gear specific. Protocols for sampling and data collection must deliver adequate information to implement the provisions of the encounter protocol and be sufficiently reliable to meet the objectives. In general, appropriate protocols for sampling and data collection should follow best practices, be publicly available, and should have the following properties:

- Practical and cost-effective;
- Concise; and
- Consistent within a fishery and between Regions, taking into account the differing risks within and among fisheries.

Accurate taxonomic identification of captured specimens is highly desirable and will assist in the effective implementation of the encounter protocol, however this may not always be possible in real-time owing to the capacity of the crew or the observer. As such, the minimum level of data collection needed should be specified (e.g. photographing key specimens in the catch). Furthermore, there should be a clear differentiation between the level of VME catch sorting and taxonomic identification required to implement the encounter protocol and the level that may be desired for increasing our knowledge base for that particular VME taxon.

Training and/or education on the implementation of the sampling guidelines and the identification of specimens may be necessary. The content and degree of specificity of the training will depend on who is expected to apply the encounter protocols (e.g. fish harvesters or observers) and the extent of their knowledge.

Photographic guides that are complete, yet simple to use at sea and written concisely in non-technical language are required. Furthermore, ensuring the accuracy of specimen identification may require verification by taxonomic experts on shore. Depending on the nature of required verification for the species identification, samples may include photographs and/or physical samples; appropriate meta-data must accompany any samples collected (e.g. location, date, catch weight, live vs. dead).

6) Evaluation of Encounter Protocol Implementation

The success of any encounter protocol at achieving its objectives can only be determined if there are periodic reviews of its performance that take into account risks and recent experience with the protocol and the fishery/fisheries, as new, relevant information is available. At the present time, experience with the implementation of encounter protocols is generally lacking and there will be value in evaluating, and if necessary, modifying them as more experienced is gained.

The periodic review of the encounter protocol should involve appropriate participants (e.g. DFO Science, Oceans, Fisheries Management, Conservation & Protection, the observer community, the affected fishing industry and other stakeholders) to evaluate the progress and effectiveness of the encounter protocol.

The periodic review should evaluate the information that has become available since the previous meeting, and should include reports of encounters, summaries of observers' experience, reports from fishery managers and the affected fishing industry, updates on recent research and any other pertinent information. As a minimum, DFO Science should analyze encounter reports received since the previous evaluation and make recommendations related to their effectiveness in achieving the conservation objectives. A scientific advisory process will likely only be conducted when shortcomings in the existing protocol have been identified or if substantial new information on the VME or fishery that may impact the implementation of the encounter protocol is available.

CONCLUSIONS

An encounter occurs when a fishing activity interacts, either directly or indirectly, with an ecological feature that meets the criteria of an EBSA/VME or is otherwise covered by a relevant policy. This interaction may not be evident onboard a fishing vessel.

An encounter protocol must be practical, effective, and adaptable in a reasonable timeframe, and should be guided by clearly defined objectives. If properly designed and implemented, encounter protocols can be a valuable component of a management system, particularly if areas considered 'important' have been closed to fishing activities that are likely to cause serious or irreversible harm to VME.

The necessary components of a science-based encounter protocol have been provided along with detailed descriptions of what each component entails. These components are:

- Clearly-defined objective(s);
- A pre-fishery planning exercise;
- Indicators that an encounter has occurred (i.e. thresholds/triggers);
- Selection of appropriate management responses;
- Observers and data collection/sampling guidelines; and
- A post-implementation evaluation of the encounter protocol.

SOURCES OF INFORMATION

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