Using Fish Harvesters' Local Ecological Knowledge (LEK) in Support of Identifying Ecologically and Biologically Significant Areas (EBSAs) on the Offshore Eastern Scotian Shelf

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Oceans and Habitat Report
2009-01

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada

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February 2009

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ACKNOWLEDGEMENTS
The Oceans and Coastal Management Division would like to thank all the fish harvesters who participated in the Local Ecological Knowledge (LEK) Survey. The input provided by fish harvesters is valuable and will be incorporated into the Ecologically and Biologically Significant Areas (EBSAs) process.

EXECUTIVE SUMMARY

The identification of Ecologically and Biologically Significant Areas (EBSAs) is an important component of integrated management and the ecosystem approach to management. EBSAs are defined as those areas for which the ecological consequences of severe perturbation are greater than an equal perturbation in most other areas or for most other species (DFO 2004). Areas are evaluated against three main criteria: uniqueness, aggregation and fitness consequences. The identification of EBSAs requires a vast amount of knowledge about the ecosystem. It is recognized that fish harvesters possess valuable knowledge that can be incorporated into the EBSA identification process.

Across Canada, EBSAs are being identified using a variety of information such as scientific expert opinion, scientific data, local ecological knowledge (LEK) of commercial fish harvesters and traditional knowledge of Aboriginal peoples.
Part I of this paper describes the methodology used in collecting fish harvesters' LEK and documents LEK in support of the identification of EBSAs in the offshore Scotian Shelf. Part II describes areas that have been previously identified using LEK and scientific expert opinion and compares these areas to the results of the fish harvesters' survey.

For Part I, the LEK fish harvesters' survey focused on the offshore portion of the Scotian Shelf. Fish harvesters selected to participate were identified by their peers. Interviews were conducted by Oceans and Coastal Management Division staff. Interview questions focused on the EBSA criteria and participants were asked to identify the areas on the charts provided.

Eleven face-to-face interviews were conducted. Seventy-five areas were identified as ecologically significant by participants and approximate boundaries were drawn on the charts by the participant or by the interviewer under the direction of the participant.

The extent to which areas identified met the EBSA criteria were inferred by the interviewer from transcript notes. Most areas were identified based on the aggregation criterion (47/75), followed by the fitness criterion (22/75). Six areas met both the aggregation and fitness criteria: the area north of Misaine Bank, Emerald Basin, The Gully, Laurentian Channel, Middle Bank, and Northeast (Fundian) Channel. Areas meeting the fitness criteria were spawning areas, nursery grounds, feeding areas and migration routes. None of the areas identified met all three of the main EBSA criteria.

Challenges were encountered during the LEK survey. The main challenges were difficulty in contacting fish harvesters and their reluctance to participate in the survey.

Part II briefly reviews other methods of identifying EBSAs and compares the results to the present study based on fish harvesters LEK. Other methods included a literature review of LEK pertaining to the offshore and identification of EBSAs through scientific expert opinion.

When comparing the areas identified using scientific expert opinion and through a literature review of LEK studies with the areas identified through the directed LEK interviews, there were definite areas of convergence. Six areas were identified by all three methods and for similar reasons: the Northeast Channel, the shelf edge, Western Bank, the Gully, Emerald Basin and the Patch, and the Stone Fence.

The results of the LEK survey provide a good basis for continuing discussions with fish harvesters to gain a better understanding of how they use the ocean and its importance to them. Comparing the results of the LEK study and areas identified by other sources provided a certain level of validation. The convergence of areas identified by both fish harvesters and scientists confirms that fish harvesters' knowledge and scientific opinion can work together and complement one another.

SOMMAIRE

La délimitation des zones d'importance écologique et biologique (ZIEB) est un aspect important de la gestion intégrée et écosystémique. Les ZIEB sont des zones dans lesquelles des perturbations graves ont des conséquences écologiques supérieures à celles que des perturbations égales produisent dans la plupart des autres zones ou chez la plupart des autres espèces (MPO 2004). Les ZIEB sont évaluées en fonction de trois grands critères, soit l'unicité, la concentration et les conséquences sur la valeur adaptative. Pour définir une ZIEB il est nécessaire d'avoir de vastes connaissances sur l'écosystème. Or, il est notoire que les pêcheurs possèdent des connaissances utiles qui peuvent être intégrées au processus de définition des ZIEB.

Dans tout le Canada, les ZIEB sont définies en fonction de divers éléments d'information, comme l'opinion d'experts scientifiques, des données scientifiques, les connaissances écologiques locales des pêcheurs commerciaux et les connaissances traditionnelles des peuples autochtones. La partie I du présent document décrit les méthodes utilisées pour recueillir les connaissances écologiques locales auprès des pêcheurs et les étayer en vue de définir des ZIEB dans les eaux du large du plateau néo-écossais. La partie II décrit des zones qui ont été préalablement définies d'après des connaissances écologiques locales et l'opinion d'experts scientifiques, et elle les compare aux résultats de l'enquête effectuée auprès des pêcheurs.

L'enquête sur les connaissances écologiques locales des pêcheurs décrite dans la partie I a été axée sur le secteur extracôtier du plateau néo-écossais. Les pêcheurs participant à l'enquête ont été désignés par leurs pairs et les entrevues ont été réalisées par le personnel de la Division de la gestion côtière et des océans. Les questions étaient axées sur les critères de définition des ZIEB et les participants devaient cerner les zones sur les cartes qui leur étaient présentées.

Onze entrevues face à face ont été réalisées. Soixante-quinze zones ont été définies comme zones d'importance écologique par les participants et les limites approximatives de ces zones ont été dessinées sur les cartes par les participants eux-mêmes ou par l'enquêteur selon les instructions des participants.

La conformité des zones cernées aux critères de définition des ZIEB a été établie par l'enquêteur d'après les notes prises. C'est le critère de concentration qui a servi à définir la plupart des zones (47/75), le critère concernant la valeur adaptative venant en deuxième place (22/75). Six zones répondaient à la fois au critère de concentration et au critère sur la valeur adaptative : la zone située au nord du banc de Misaine, le bassin d'Émeraude, le Gully, le chenal Laurentien, le banc du Milieu, et le chenal Nord-Est (chenal de Fundy). Les zones qui satisfaisaient au critère sur la valeur adaptative étaient des frayères, des alevinières et des routes de migration. Aucune des zones cernées ne satisfaisait aux grands trois critères applicables aux ZIEB.

L'enquête sur les ZIEM n'a pas été sans quelques difficultés, la principale étant celle posée par le contact avec les pêcheurs et leur réticence à prendre part à l'enquête.

La partie II du document expose brièvement les autres méthodes permettant de définir des ZIEM et compare leurs résultats avec ceux de l'étude axée sur les connaissances écologiques locales des pêcheurs. Parmi les autres méthodes, il faut citer une analyse documentaire des connaissances écologiques locales se rapportant aux eaux extracôtières et la définition de ZIEM en fonction de l'opinion d'experts scientifiques.

Quand on compare les zones définies d'après l'opinion d'experts scientifiques et d'après une analyse documentaire des connaissances écologiques locales avec les zones cernées à partir d'entrevues directes sur les connaissances écologiques locales, on trouve assurément des terrains de convergence. Six zones ont été définies selon les trois méthodes et pour des motifs semblables : le chenal Nord-Est, le bord du plateau néo-écossais, le banc Western, le Gully, le bassin d'Émeraude et le Patch, ainsi que Stone Fence.

Les résultats de l'enquête sur les connaissances écologiques locales forment une bonne base pour la poursuite des discussions avec les pêcheurs en vue de mieux comprendre comment ils utilisent l'océan et l'importance qu'ils lui accordent. La comparaison des résultats de l'étude sur les connaissances écologiques locales avec les zones définies en fonction d'autres sources représentait un certain degré de validation. La convergence entre les zones cernées par les pêcheurs et celles qui l'ont été par des scientifiques confirme que les connaissances des premiers et l'opinion des seconds sont compatibles et même qu'elles se complètent mutuellement.

1. INTRODUCTION

Canada's *Oceans Act* mandates Fisheries and Oceans Canada (DFO) to lead and facilitate the integrated management of activities within Canada's coastal and ocean waters, while applying an ecosystem approach to management (EAM). EAM takes account of ecosystem dynamics when determining how a human activity is managed, with the goal of controlling all its impacts on the ecosystem, not just its impact on the resource being used. Integrated management is the governance mechanism through which EAM is implemented.

The identification of Ecologically and Biologically Significant Areas (EBSAs) is an important component of integrated management and EAM. EBSAs are defined as those areas for which the ecological consequences of severe perturbation are greater than an equal perturbation in most other areas or for most other species (DFO 2004). Areas are evaluated against three main criteria: uniqueness, aggregation and fitness consequences. Identifying EBSAs is not a general strategy for protecting all habitats and marine communities that have some significance, "rather it is a tool for calling attention to an area that has particularly high ecological and biological significance, to facilitate provision of a greater-than-usual degree of risk aversion in management of activities" (DFO 2004).

EAM and the identification of EBSAs require a vast amount of knowledge about the ecosystem. It is recognized that fish harvesters possess valuable knowledge regarding marine resources and changes that have occurred in the ocean. Although it has often been difficult to incorporate this knowledge, there are now more efforts focused on collecting and incorporating fish harvesters' knowledge into management and decision making. Canada's Oceans Strategy includes a commitment to incorporate local and traditional knowledge into oceans management (Government of Canada 2002). Similarly, the National Ecosystem Status Report on the Identification of Ecologically and Biologically Significant Areas states that "Experiential Knowledge (including fish harvesters' knowledge) should be fully included in the ranking of Ecologically and Biologically Significant Areas (EBSAs)" (DFO 2004).

Across Canada, EBSAs are being identified using a variety of information such as scientific expert opinion, scientific data, local ecological knowledge (LEK) of commercial fish harvesters and traditional knowledge of Aboriginal peoples. The identification of EBSAs provides an opportunity for the different types of knowledge to be used collectively. Combining the knowledge of scientists and fish harvesters allows for validation of both the biophysical data and the fish harvesters' observational data. LEK may also provide additional details on areas identified through scientific research or identify areas that may have otherwise been overlooked. Incorporating LEK may smooth the progress of the management and decision making process as it provides a concrete opportunity for commercial fish harvesters to play a part in EAM, as well as to contribute to what is known about the marine ecosystem.

Part I of this paper describes the methodology used in collecting fish harvesters' LEK and documents LEK in support of the identification of EBSAs in the offshore Scotian Shelf (Figure 1). Part II describes areas that have been previously identified using LEK and scientific expert opinion (SEO) and compares these areas to the results of the fish harvesters' survey.

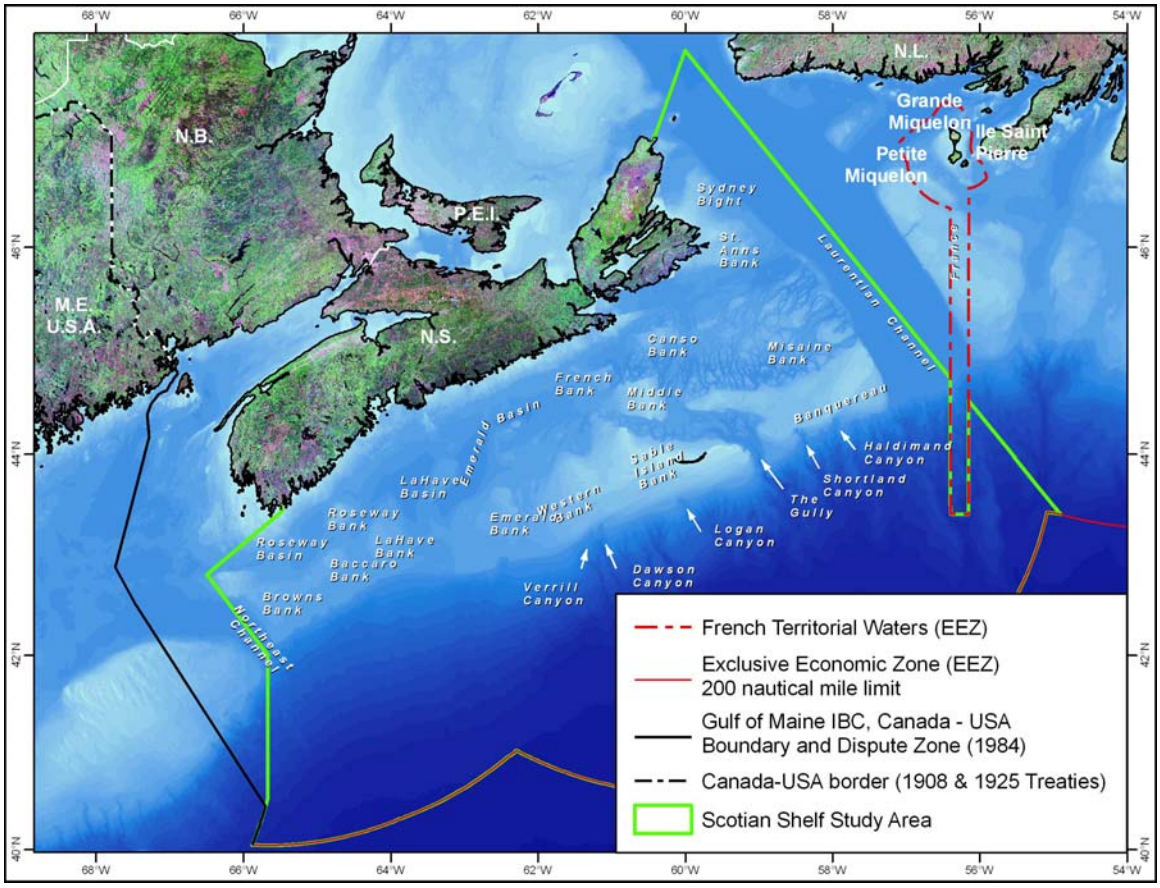
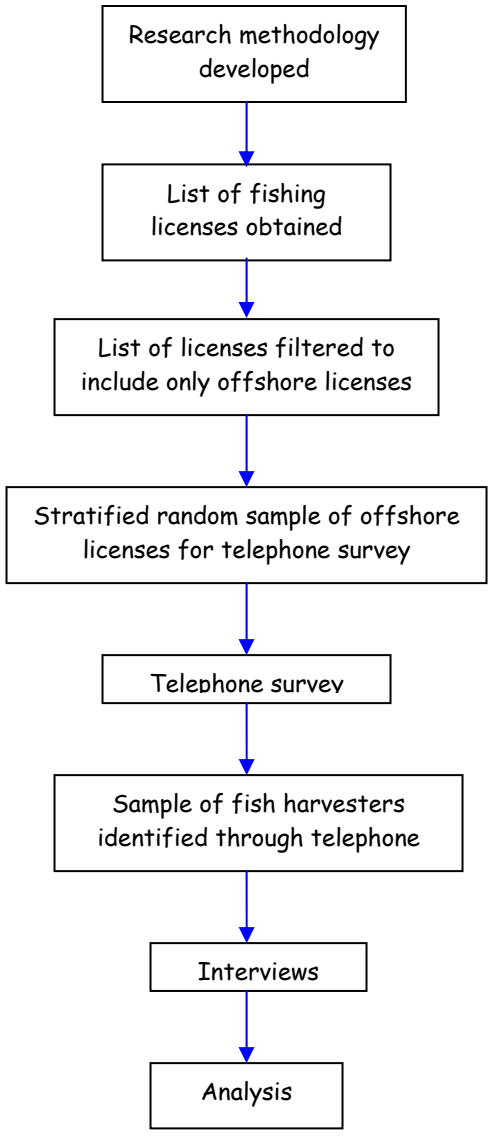


Figure 1: Study area: Scotian Shelf. (Georges Bank and the Bay of Fundy are not part of the study area.)

2. PART I: RESEARCH METHODOLOGY

A research committee established within the Oceans and Coastal Management Division guided the LEK project.

The population of interest for this study were fish harvesters who had knowledge of the offshore Scotian Shelf and Slope. The study area did not include the Bay of Fundy or Georges Bank. The offshore was defined as the area extending beyond 12 nautical miles from the coast out to the 200 nautical mile limit of the exclusive economic zone. Interviews were conducted in two phases. A separate project was conducted for the inshore portion of the Scotian Shelf (see McCormick and Kennedy unpublished).



In phase 1, telephone surveys were conducted with a random sample of fish harvesters. They were asked to identify fish harvesters who were particularly knowledgeable about the offshore Scotian Shelf (Appendix 1). Phase 2 consisted of face-to-face interviews with fish harvesters who had been identified via the telephone interviews.

For phase 1, the sample of all offshore licenses was stratified by gear type and a minimum sample size of 281 was estimated using the method of Cochran (1977). The estimate of the sample size included a finite population correction factor, as the initial estimated sample size was greater than 5% of the population from which it was being selected. The sample was then stratified by area. Fish harvesters were contacted and asked to complete a brief telephone survey to identify fish harvesters who were particularly knowledgeable about the offshore (Appendix 1). All those contacted by telephone were given the opportunity to refuse to participate in the survey. To ensure the minimum sample was reached, fish harvesters were added from a second random sample, where necessary.

The fish harvesters identified via the telephone survey were listed in a spreadsheet. If known, the gear type used and area fished were included. This population was sorted by area and gear type and individuals were selected for phase 2 interviews based on the number of times they were identified in the telephone survey and by gear or area if gaps existed. For example, if a fish harvester had knowledge of a particular area that no other fish harvester

had knowledge of or was using a particular gear type that no other fish harvester was using, they were included in the survey).

During phase 2, semi-structured interviews that included a variety of open-ended questions were conducted with the identified fish harvesters. This interview format was chosen as it has been successful in a variety of traditional knowledge projects (see e.g., Neis *et al.* 1996, Neis *et al.* 1999, Gendron *et al.* 2000). It allows for interaction between the interview participant and interviewer and for detailed information to be provided, and is generally considered a very effective method for collecting traditional ecological knowledge (Mailhot 1993 cited in Neis *et al.* 1999).

An interview guide was developed to aid the interviewer and to ensure consistency in the way the questions were asked (Appendix 2). The interview questions focused on the three main EBSA criteria: uniqueness, aggregation and fitness consequences. These were translated into terms more familiar to fish harvesters. For the purpose of identifying EBSAs, uniqueness was defined as the degree of distinctness or rareness (DFO 2004). Questions on areas of uniqueness were designed to gather information on the areas that fish harvesters thought were truly unique. Aggregation refers to the degree to which members of a particular species aggregate in an area and/or where a structural feature or ecological process occurs there in exceptional density. Aggregation questions focused on areas with a high abundance of species. Fitness consequences refers to areas where the life history functions that occur in that area make a major contribution to the fitness of a population or species in the area (DFO 2004). Questions on fitness consequences were designed to gather information on spawning, juvenile and nursery areas, along with feeding areas and migration routes.

A one-page description of the project was also developed and provided to the participant for information purposes. All participants were given a consent form explaining the objectives of the study (Appendix 3). Participants were advised that their information would be anonymous. They were given an opportunity to ask questions about the project before providing their consent. Participants were also asked for their permission to record the interviews; for those who did not wish the interviews recorded, detailed notes were taken. Participants were asked if they wished to review their transcript and were given the opportunity to do so if they desired.

Hydrographic charts and photos of wildlife were made available for reference at each interview. Participants were encouraged to indicate areas they considered ecologically significant on the charts. A separate chart was used for each participant to ensure that their responses would not be biased by other participants.

Interviews were conducted by two employees of the Oceans and Coastal Management Division, Fisheries and Oceans Canada, Maritimes Region. Interviews were transcribed and provided to study participants for their review.

Areas identified on the charts were digitized (freehand). The areas and accompanying text describing why the area was identified were stored in a Geographic Information System

(GIS), ArcGIS. Transcripts were also entered into NVivo, software designed to amalgamate and analyze qualitative information. Transcript text was coded in NVivo based on the reason for the identification of the area. For example, all areas identified as spawning locations were coded "spawning." Summary reports were produced by category. Additional coding was done using place names, to obtain additional information on areas that were identified on the charts.

Materials Used

Canadian Hydrographic Service Charts 8006, 8007, 4012, 4013, 4003, 4045
Markers (multi-coloured)
Photographs of marine species
Copies of the description of study and consent form
Notebooks
Copies of the interview guides
Tape recorder

3. RESULTS

One hundred and seventy six licence holders were contacted with 162 agreeing to participate in the Phase 1 telephone survey and 15 refusing. This was less than the original sample size of 281 fish harvesters, which was determined statistically to be a representative sample of the total fish harvesters' population. Fish harvesters were added from the second random sample to increase the response to the telephone survey. Attempts were made to contact the remaining 104 fish harvesters at three different times, in the morning, afternoon and evening, and phone messages where left when possible.

The 162 fish harvesters who participated in the telephone survey identified a list of 273 "experts." Identified experts were sorted by area fished. Interview efforts focused on the Eastern Scotian Shelf as this is currently the focus of an Integrated Ocean Management Initiative. For the Eastern Scotian Shelf, 64 experts and 3 organizations were identified.

The experts identified were contacted by phone to set up interview times, with priority being given to experts that had been identified multiple times. Challenges were encountered during this stage of the project, which are discussed in greater detail in the Challenges section of this report. In an attempt to alleviate the difficulties encountered, a letter was mailed to participants explaining the project and was followed up with a phone call asking if they would like to participate in the study.

Eleven face-to-face interviews were conducted. Interview times ranged from 45 minutes to 2.5 hours with an average of 1.5 hours. All experts interviewed were fishing captains who held multiple licences and had 26 to 50 years of experience with an average of 37 years (see Table 1).

Table 1: Participants fishing profile

Interview Code	EB01	EB02	EB03	EB04	EB05	EB06	EB07	EB08	EB09	EB10	EB11
Years fished	35	26	46	50	34	28	26	32	49	45	40
Years fished offshore	35	18	46	30	34	28	20	26	40	45	40
Full time fish harvester (y/n)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Captain (y/n)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gear used	harpoon, pelagic longline, bottom longline	bottom longline	traps	traps, otter trawl	harpoon, pelagic longline, bottom longline	harpoon, pelagic longline, bottom longline	traps, otter trawl	traps, bottom longline	gillnet, traps	otter trawl	traps, otter trawl
Area known best	Entire Scotian Shelf	Western Bank, shelf edge	Snow crab fishing areas	NAFO 4X/4W line to Stone Fence	Sable Island area, the Gully, the Stone Fence	Sable Island area, the Gully, the Stone Fence	Georges, Western and Sable Island Banks, Emerald Basin, Scotian Slope	LaHave Bank to Laurentian Channel	Emerald Bank to the Gully	Banquereau, Browns Bank, NAFO 4VsW	LaHave, Sable Island, Western, Browns and Georges Banks, Banquereau

Seventy-five areas (Table 2, Figures 2a and 2b) were identified as ecologically significant by participants and approximate boundaries were drawn on the charts by the participant or by the interviewer under the direction of the participant. The scale at which areas were identified varied by participant. In some instances participants were reluctant to draw on the charts but mentioned areas of significance which were recorded in the transcripts. Twelve areas were identified multiple times by participants (Table 3). Many of the areas overlap (Figure 3) and summaries of the prominent areas identified can be found in Table 3. Summaries include all information on that area from the transcript, which includes information that may have been mentioned at another point in the interview.

The reasons supporting the identification of a particular area as ecologically significant were often inferred based on transcript notes. For example, a participant would identify an area as a good fishing ground for a certain species; this could indicate that there is a high abundance of that species in that area. Participants were most knowledgeable about the species for which they fished, however they would often indicate areas where other species, such as whales, turtles and seabirds, had been observed during fishing trips.

The extent to which areas identified met the EBSA criteria were inferred by the interviewer from transcript notes. Most areas were identified based on the aggregation criterion (47/75), followed by the fitness criterion (22/75). Six areas met both the aggregation and fitness criteria: the area north of Misaine Bank, Emerald Basin, Gully, Laurentian Channel, Middle Bank, and Northeast (Fundian) Channel. None of the areas identified met all three of the main EBSA criteria. Areas meeting the fitness criteria were spawning areas, nursery grounds, feeding areas and migration routes.

Many of the fish harvesters had fished Georges Bank and discussed areas in that region. For that reason, some of the areas identified as potential EBSAs are on Georges Bank. However, since our study area did not include that region and fish harvesters living in nearby communities were not contacted for interviews, the list of EBSAs identified for that area is in no way comprehensive. The same applies for the Western Scotian Shelf. If we had interviewed fish harvesters from communities adjacent to the Western Scotian Shelf, places such as Browns Bank, Georges Bank and other portions of the Western Scotian Shelf may have been identified more frequently.

Table 2: Areas identified by fish harvesters through the LEK interviews (U=uniqueness, A=aggregation, FC= fitness consequences)

Id	Location	Rationale/ Interview notes	Criteria		
			U	A	FC
79	Area north of Misaine Bank	Important feeding area. Area where shrimp and krill are abundant.		√	√
89	Area north of Sable Island Bank	Area where blue whales have been observed.		√	
17	Area northeast of Sable Island	Area where cod with spawn have been observed in September.			√
32	Area off Cape Sable	Area where halibut are abundant.		√	
82	Area off the coast of Glace Bay	Area where whales have been observed.		√	
81	Area off the coast of Northern Head	Area where whales have been observed.		√	
76	Artimon Bank (western edge)	Feeding area: squid, billfish and herring are found here. whales have been observed, humpbacks and dolphins in the fall; finbacks, minkes, potheads in the summer.			√
45	Baccaro Bank (southern edge)	Spawning area for haddock in February.			√
67	Banquereau (area north of Haldimand)	Historic feeding area for haddock.			√
66	Banquereau (area north of Shortland)	Historic feeding area for cod. Area where you would find a lot of mature cod. They would go there to feed on clams, sandlance, capelin.			√
53	Banquereau (northern part)	Area where a pod of 15 northern bottlenose whales was observed in the 1980s.		√	
27	Banquereau (southern edge) to the Stone fence	Area that used to be abundant with codfish in the 1980s. Codfish would be full of sea mice.		√	
65	Banquereau (small area on the southern edge)	Historic area where you used to find mixtures of cod and haddock. Have not been there since the 1980s.		√	
16	Browns (tip) to Baccaro (tip)	Area where haddock go to spawn in the fall and winter. Haddock move west from LaHave.			√
22	Browns Bank (shoal water)	Area where sea cucumbers are found.		√	

Table 2 (cont'd): Areas identified by fish harvesters through the LEK interviews (U=uniqueness, A=aggregation, FC= fitness consequences)

24	Canadian portion of Georges Bank	Any shoal water on Georges Bank in the winter months haddock and codfish are full of spawn. Haddock spawning in February. Halibut usually have some spawn in them too.			√
83	Canso Bank and surrounding area	Feeding area.			√
34	Cow Pen and Bull Pen	Area where hagfish fishing is taking place.		√	
90	Crowell Basin	Area where whales, sea turtles and dolphins have been observed.		√	
4	Emerald Bank	Area where a high number of female porbeagle sharks have been observed in March.		√	
70	Emerald Bank (munitions dump area)	Area where cod with milk [spawn] have been observed.			√
36	Emerald Basin	Area where a lot of fish species are found: redfish, silver hake, cod, haddock, herring, mackerel, squid. Feeding area for swordfish, sharks (blue, porbeagle), all types of marine mammals, tuna, marlin. Used to be an area abundant with swordfish. Everything gets funnelled through the Basin from the edge. Area where sea turtles have been observed. Species come in during the spring and leave in the fall. Some stay there. It is an important area year-round. Not much cod or halibut in the area anymore. Migration route.		√	√
44	Emerald Basin (Northern part)	Has the biggest concentration of Russian Hat sponges. Used to get a lot of Russian Hats on the southwest part of Emerald Bank.		√	
37	Emerald Basin and the Patch	Area where hagfish fishing is taking place.		√	
14	Emerald Basin (munitions dump area)	Area where whales have been observed. Area where pollock have been observed. Area where sea turtles have been observed in the summer.		√	
5	Emerald Western Bank	Nursery area, juvenile area. Lots of small fish in the area, small haddock. Fish are smaller now than before the area was closed. Trend that fish are getting smaller from east to west.			√
46	Emerald Western Bank (southern edge)	Spawning area for haddock in February.			√

Table 2 (cont'd): Areas identified by fish harvesters through the LEK interviews (U=uniqueness, A=aggregation, FC= fitness consequences)

43	Georges Bank (northern edge)	Area where haddock seem to be spawning in February.			√
50	Gully (center only)	Area where male halibut with milk [spawn] are observed from July to November. August is one of the main months.			√
56	Gully (east edge)	Area where you find a mixture of cod, haddock and hake when historically it was primarily hake only.		√	
64	Gully (east trough)	Historic area where you used to find mixtures of cod and haddock. Have not been there since the 1980s.		√	
39	Gully (including trough)	Important feeding area. Lots of diversity of life. Area abundant with corals.		√	√
78	Gully (tip of trough) to the northwest edge Sable Island Bank	Crab spawning area			√
15	LaHave Bank	Area where haddock are found in March. Large codfish are also found in this area.		√	
31	Laurentian Channel	Migration route for halibut and large pelagics. Area where swordfish harpoon fishing took place 30-40 years ago. Area where whales have been observed. Halibut at the mouth of the Channel.		√	√
12	MacKenzie Spot (west edge)	Area where whales have been observed.		√	
33	Middle Bank	Area where cod was abundant in the 1980s, important for spawning. Area where minke and fin whales are observed in the summer until October.		√	√
84	Middle Bank (shoal water)	Area where cod with milk [spawn] are observed.			√
77	Misaine Bank (deep holes and shallow banks)	Water mixing areas with lots of krill and shrimp. Everything comes here to feed (small and big fish).			√
74	Misaine Bank and Banquereau	Area where shrimp and krill are abundant.		√	
75	Misaine Bank (Middle area)	Feeding area for everything. Important cod spawning area.			√
42	Northeast (Fundian) Channel	Important feeding area. Area with a high diversity of marine life. All different species there, birds, mammals, fish.		√	√
25	Northeast Channel (mouth)	Area where two draggers cut a road through corals in 1983.		√	

Table 2 (cont'd): Areas identified by fish harvesters through the LEK interviews (U=uniqueness, A=aggregation, FC= fitness consequences)

26	Northeast Channel and shelf edge (US line to south of LaHave Bank)	The slope to the Northeast Channel to the inner gully (area near Browns) is an important migration route for swordfish and tuna.			√
86	Patch	Area where Russian Hats (sponges) are found.		√	
35	Patch and Banana	Area where there are a lot of pollock.		√	
49	Sable Island Bank	Historic area for haddock and cod. Winter months little fish are near deeper water near the edge of Sable Island Bank.		√	
87	Sable Island Bank (center)	Cod spawning area July-October.			√
62	Sable Island Bank (southeast corner)	Historic area where you used to find mixtures of cod and haddock. Have not been there since the 1980s.		√	
63	Shallow area east of the Gully	Historic area where you used to find mixtures of cod and haddock. Have not been there since the 1980s.		√	
60	Shelf edge east of Haldimand canyon	Area where a mixture of cod and haddock are found.		√	
61	Shelf edge east of Halidimand canyon	Area where you found a mixture of cod, haddock and hake when historically it was primarily hake only.		√	
59	Shelf edge east of Shortland canyon	Area where you found a mixture of cod, haddock and hake when historically it was primarily hake only.		√	
52	Shelf edge Gully to Shortland canyon	Area where whales have been observed, most likely fin whales.		√	
30	Shelf edge Logan to Halidimand canyon	Good sets for halibut west of the Gully to the middle of the Gully MPA and mid-Gully to the east. Lots of halibut fishing in Shortland Canyon.		√	
29	Shelf edge Shortland canyon to Laurentian Channel	Area with an abundance of halibut. Area by Roseway is better than it was in the 80s. Halibut at the mouth of the Laurentian Channel.		√	
18	Shelf edge south of Emerald Bank	Area where sea pens are found.		√	
20	Shelf edge south of Emerald Bank to Browns Bank	Identified as a whale migration route. East of Big Cove see very few whales, more from Logan Canyon eastward. Whales come up south of LaHave Basin.			√

Table 2 (cont'd): Areas identified by fish harvesters through the LEK interviews (U=uniqueness, A=aggregation, FC= fitness consequences)

21	Shelf edge south of LaHave Bank	Porpoises [likely dolphins] found in the general area of the shelf edge.		√	
48	Shelf edge south of Sable Island	Area where sperm whales have been observed in February-March. Deep water of shelf edge.		√	
1	Shelf edge south of Sable Island (includes Logan Canyon)	Area where whales have been observed in the summer.		√	
10	Shelf edge south of Sable Island Bank	Area where swordfish fishing occurs.		√	
3	Shelf edge south of Western Bank	Area where whales have been observed in the summer.		√	
85	Shelf edge US line to Northeast Channel	Historic area for hammerhead sharks.		√	
38	Shelf edge US line to south of Sable Island Bank	Area where red crab spawning occurs 200 fathoms [366 metres] and deeper.			√
55	Shelf edge west of Gully	Area where you found a mixture of cod, haddock and hake when historically it was primarily hake only.		√	
58	Shelf edge west of Shortland canyon	Area where you found a mixture of cod, haddock and hake when historically it was primarily hake only.		√	
51	Shelf edge: 1000m contour east of the Gully	Area where male halibut with milk [spawn] have been observed from July to November. August is one of the main months.			√
88	Shortland Canyon (peak)	Historic area where you used to find mixtures of cod and haddock. Have not been there since the 1980s.		√	
80	St Ann's Bank (east tip)	Area where sea turtles have been observed.		√	
28	Stone Fence	Patches of coral found at the corner of the shelf edge, about half a mile long and then none.		√	
68	Stone Fence and Channel (cod)	Historic area where cod used to be abundant.		√	
69	Stone Fence and Channel (haddock)	Historic area where haddock used to be abundant.		√	
11	Western Bank (northern edge)	Area where whales have been observed in July.		√	
47	Western Bank (south edge)	Historic area where cod used to be abundant.		√	

Table 3: Summary of areas identified through LEK interviews

Area	Rationale/ Interview notes	Number of times identified
Gully	The Gully is a unique area and it comes alive with life. It has a high abundance of corals. Hell's Kitchen, the deep part of the Gully has many corals. The Gully is an important area for feeding and has a high abundance and diversity of species. It is a main feeding area for whales. It is an area where small halibut have been observed. The Gully is also identified as an important crab spawning ground.	7
Sable Island Bank Area	Hagfish fishery occurring in the area. Not many fish left, just halibut. Area used to be abundant with cod and haddock. Sable Island has lots of fish, mostly haddock. In the winter months little fish (cod and haddock) tend to come out near deeper water near the edge of the bank. Area where whales are abundant. Area where beaked dolphins have been observed. Area where codfish with spawn have been observed. Cod spawn from July to October in this area. Feeding area because herring are found there and lots of plankton, mackerel, young haddock and sandlance. Observe sea turtles around Sable Island, when swordfish fishing (June to September).	6
Western Bank	Haddock spawning area, February/March until the end of June. Area where small fish have been observed, a lot of small groundfish (haddock). Fish are smaller now than before the area was closed. Area is not improving. More haddock there then ever before, maturing smaller. Western Bank has always had an abundance of haddock, other fish species are found there too. Some parts of Western Bank have sea cucumbers. Whales observed at the edge of Western Bank in July.	6

Table 3 (cont'd): Summary of areas identified through LEK interviews

Shelf edge	Area where silver hake are found. Porpoise [probably dolphin] in the general area of the shelf edge. Good halibut area all along the edge. See patches of coral along the edge. The whole edge 300-500 fathom you find corals. Not as many from Sable Island Bank to Emerald Bank. Area where whales have been observed. Along the edge water at 120 fathom south of Banquereau whales have been observed. Area where sunfish have been observed. Area where sea pens have been observed. The edge is an important area for migration. Important area for red crab spawning. Sea turtles have been observed along the edge.	6
Banquereau	Area where there are very few fish left. Historically had a good mixture of fish. Historically you could catch cod, pollock, haddock and flounder. It was a great place for flounder. Doubt the fish will come back, the habitat has changed so much. Feeding area where sandlance are found. Used to be a good feeding area for haddock. Area where sea cucumbers have been observed. Area where crabs are said to be increasing.	5
Stone Fence	Area where corals are found. Area of high diversity. Area where halibut fishing occurs. Area where dolphins have been observed.	5
Middle Bank	An area where cod used to be abundant and groundfish in general. Area where lots of whales have been observed in the summer until October (minke and fin whales). Spawning area for cod (area with cod with milk in them).	4
Browns Bank	Spawning area for haddock. Area where sea cucumbers have been observed. Important feeding area. Area of high abundance.	4
Patch	Area where pollock is abundant. Area where Russian Hats have been observed. Area where cod and haddock juveniles have been observed.	3

Table 3 (cont'd): Summary of areas identified through LEK interviews

Emerald Basin	The area is important year round. Everything gets funnelled through the basin from the edge. All types of species travel the basin; they come in during the spring and move out during the fall. Everything is observed there: marine mammals, swordfish, tuna, marlin, sharks (blue and porbeagle). Important feeding area for swordfish, tuna and shark (bluedog, porbeagle and thrasher). Squid are abundant. Billfish are abundant, important prey items are found there. Sharks are not as abundant there now. Turtles have been observed there. There are plenty of jellyfish in the basins from May to August, important for the turtles. Haddock and cod not as abundant in the area as they used to be. Good area to catch pollock. Pollock are spawning September to November. Northern part of Emerald Basin has the biggest concentration of Russian Hat sponges. Sunfish aggregate in the basin in the summer. Minke whales have been observed in the basin. Important migration route.	3
Emerald Bank	Area where a high number of female sharks have been observed in March. The southwest part of Emerald Bank used to have an abundance of Russian Hats. Haddock spawn in February.	3
LaHave Bank and Basin	Area where cod and haddock are found. Area where silver hake fishery occurs. Area where a variety of species have been observed.	2
Misaine Bank	Important crab spawning grounds. Feeding place for everything. Squid, billfish and herring found in the area. Deep holes and shallow banks of Misaine Bank are big water mixing areas with lots of shrimp and krill, everything comes there to feed, small and big fish.	1
Northeast Channel	Area of high diversity, all different species there birds, mammals, fish. Area where swordfish and tuna have been observed in the spring. They come from the south and follow the edge of water where cold meets hot. Northeast peak of Georges Bank has a high abundance of corals (bubblegum, primnoa), coral conservation area only covers part of those corals.	1

The summary of the areas indicates that there is some contradiction between responses from fish harvesters, specifically for the Sable Island and Western Bank areas. There was indication that the areas were abundant with fish and improving, while in contrast to that it was indicated that the area was not improving and that very few fish were found there. These are areas that would require further investigation.

Although Georges Bank was outside the study area participants often mentioned Georges Bank during the interviews. It was described as a unique area and one of the richest fishing grounds. It was described as an important juvenile area for cod and haddock in the winter months. It was also described as an area of high diversity with the Northeast peak having a high abundance of coral. It was also noted that Georges Bank is an important feeding area. Participants also mentioned other areas found on the Western Scotian Shelf. Areas on the Western Scotian Shelf and Georges Bank may have been identified more frequently had fish harvesters from adjacent fishing communities been interviewed.

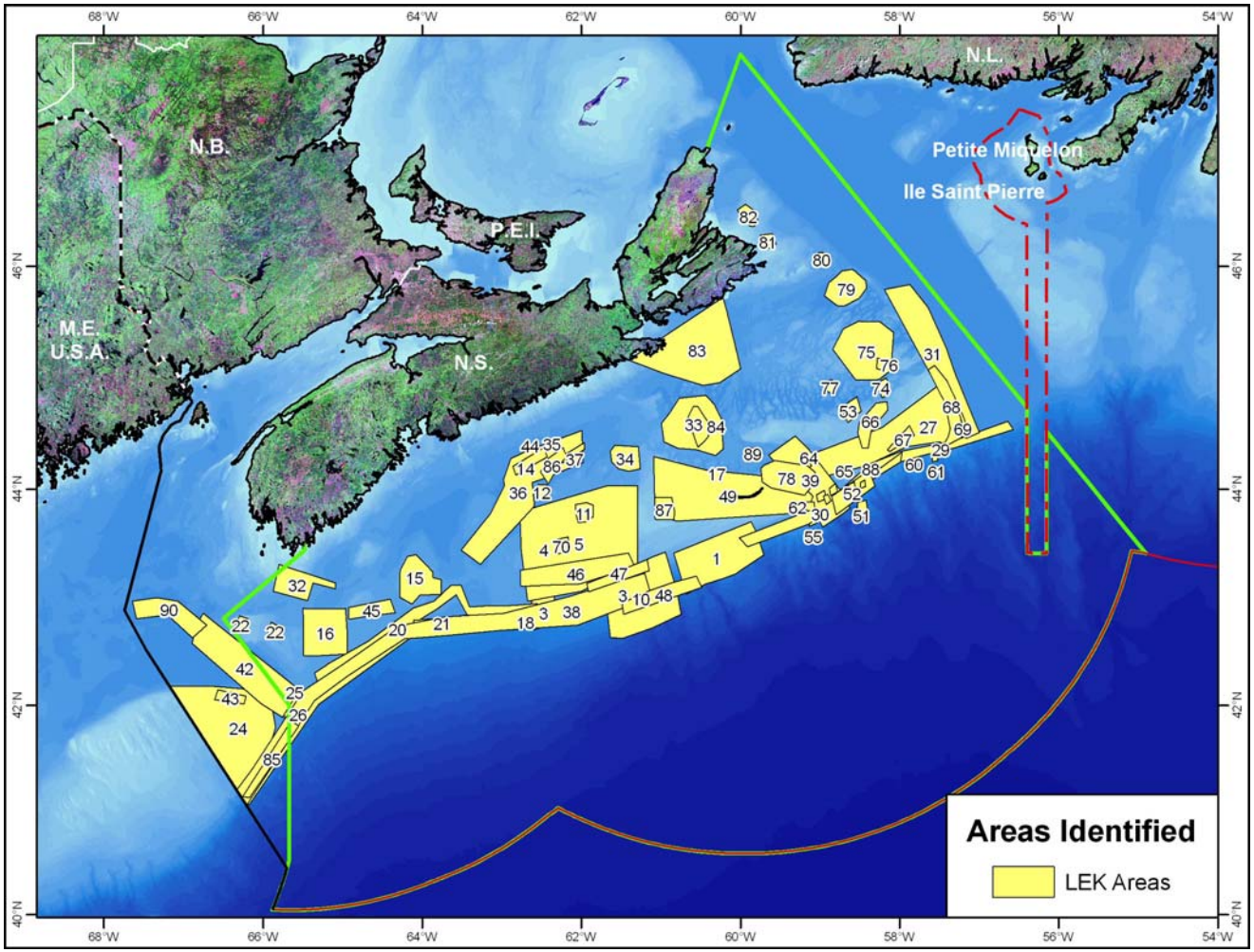


Figure 2a: Offshore areas identified by fish harvesters during the Local Ecological Knowledge (LEK) survey. (Numbers correspond to areas identified in Table 2)



Figure 2b: Eastern Scotian Shelf areas identified by fish harvesters during the Local Ecological Knowledge (LEK) survey. (Numbers correspond to areas identified in Table 2)

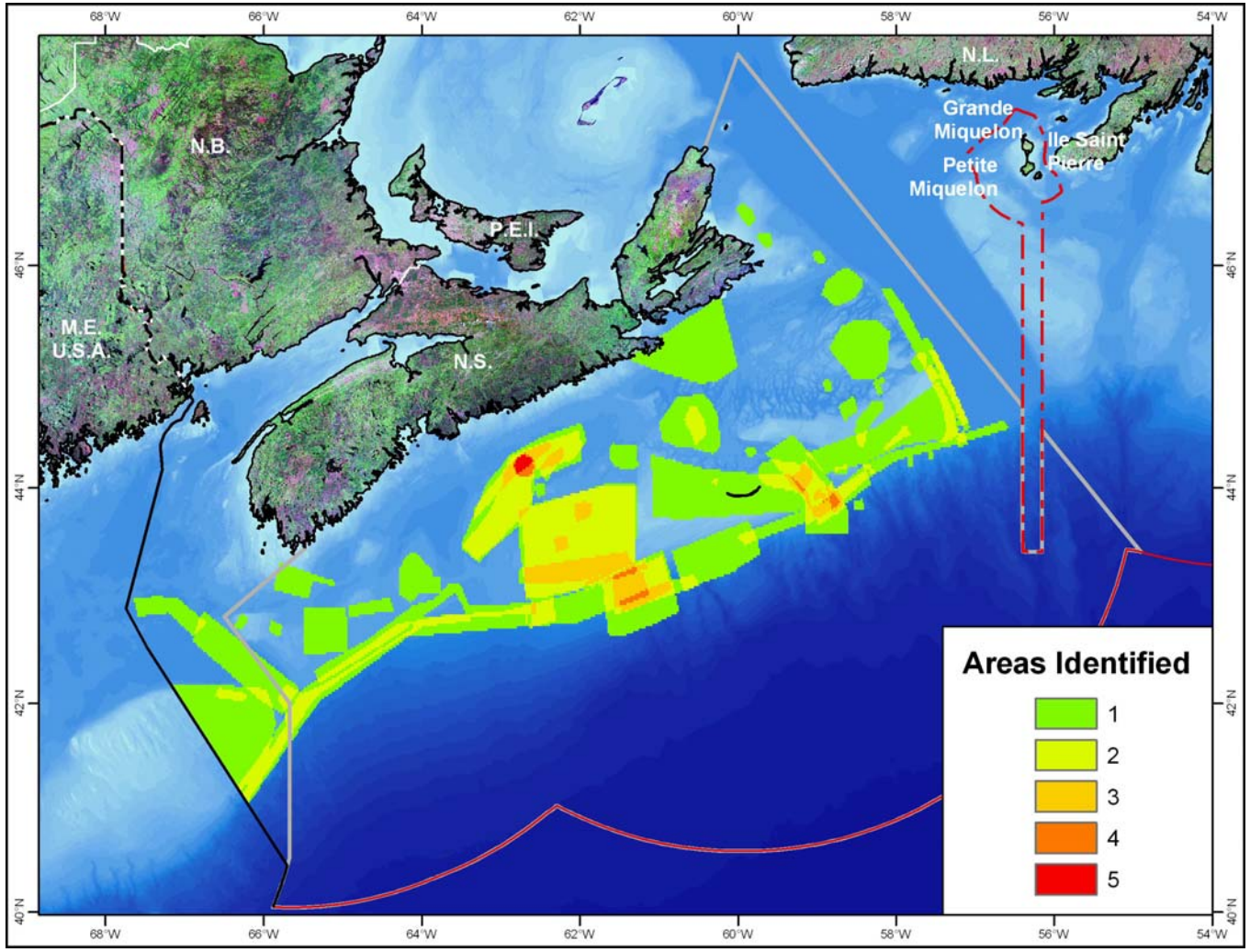


Figure 3: Map indicating the number of times an area was identified by fish harvesters during the Local Ecological Knowledge (LEK) survey.

4. DISCUSSION

Fish harvesters possess a vast amount of knowledge; however their knowledge is often specific to the areas they fish. It is important to be cognisant of this, when considering the areas that fish harvesters identified as significant. The areas may be significant from a fishing perspective; however, they may not be more ecologically significant than similar areas elsewhere on the Scotian Shelf as required by the EBSA definition.

The areas identified by fish harvesters have been summarized based on how they meet the EBSA criteria.

4.1 Fitness Consequences

Spawning Grounds

Many participants indicated that it was difficult to identify where fish spawn and that exact spawning grounds for many species are not known. When discussing spawning grounds, participants talked generally about areas where fish ripe with spawn had been observed, admitting that these areas may not necessarily be spawning grounds. Spawning grounds identified for haddock and cod included Baccaro Bank, Browns Bank, Georges Bank, Emerald and Western Banks, Sable Island Bank and Misaine Bank. The Gully and the shelf edge were identified as important crab spawning grounds. Participants indicated that it was difficult to identify where halibut spawned because the fish do not bite when they are spawning. In general, participants felt that known spawning grounds and nursery areas are being sufficiently protected, although some indicated that they desired access to the closed areas.

Juvenile and Nursery Areas

Juvenile and nursery areas were often identified as areas where small fish of a certain species are present. Most fish harvesters focused on cod and haddock. It is not clear whether fish harvesters identified areas where the fish are in the juvenile stage or areas with small mature fish. Emerald and Western Bank areas were identified as a juvenile area. It was often noted that in general, cod and haddock tend to be smaller and mature at a smaller size compared to previous years. Several participants stated that the trend of smaller fish seems to be progressing further west. Fish harvesters are starting to observe smaller fish on the western part of the Scotian Shelf, when generally fish on the Western Shelf were larger than those on the Eastern Shelf.

Feeding Areas

Areas where aggregations of bait fish were known to occur were identified as feeding areas. “Bait fish” included species such as herring, capelin, sandlance, billfish, squid, jellyfish and krill. Sharks, large pelagic fish and marine mammals were identified as

feeding on the “bait fish.” Banquereau, Misaine Bank, Canso Bank, Emerald Basin, the Gully and the Northeast Channel were identified as important feeding areas.

Migration

Migration routes were determined by water temperature and food availability. The Laurentian Channel, Northeast Channel, Emerald Basin and the shelf break in general were identified as important migration routes.

4.2 Aggregation

When discussing areas of species aggregations, areas were usually identified based on the best fishing spots and areas where a diversity of species was observed. Many of the areas identified were areas of aggregation.

4.3 Unique areas

Unique areas identified were areas that are known to be highly productive and support a variety of species. These areas were the Gully and the Northeast Channel.

5. CHALLENGES

5.1 Scheduling Interviews with Fish Harvesters

Fish harvesters that were identified as experts often fish multiple licences and were thus often difficult to contact. An attempt was made to contact experts by phone. After being unable to reach many of the experts by phone, a letter was drafted and sent to the identified experts. This letter introduced the project to the expert and informed them that someone would be telephoning them to ask them to participate in an interview. It was also difficult for two Oceans and Coastal Management Division staff members to coordinate times for interviews. Although a call for bids was let to identify a contractor to carry out interviews, none of the proposals met the criteria for the project. Contracting someone to aid with the interviews would be valuable for future projects of this nature.

5.2 Participation

Fish harvesters were sometimes reluctant to participate and to draw boundaries on maps. There may be an issue of lack of trust and a perception that the information provided may be used to limit their access to an area. DFO Science partnered with the Fishermen and Scientists Research Society (FSRS) to conduct a similar project for the inshore. The FSRS is a well-known and respected organization in the fishing community, which may increase the willingness of fish harvesters to participate in the project.

The original methodology for this project was based on standard social science methods and used a random sample to identify fish harvesters. Although it is important to use a

defensible methodology, it would have been valuable to build relationships with key fishing organizations and DFO Conservation and Protection staff that already have a close working relationship with many fish harvesters and fishing organizations. Collaborating with fishing organizations could provide fish harvesters a greater sense of ownership of the project and lessen the reluctance of fish harvesters to participate.

6. SUMMARY

Although the number of fish harvesters interviewed is small compared to the original sample size of offshore licence holders, together the participants have 411 years of knowledge of the Scotian Shelf and have fished multiple licences and gear types. The areas fished by the interviewees covered the entire extent of the Eastern Scotian Shelf and beyond, including some areas of the Western Scotian Shelf. Many areas were identified by more than one fish harvester, as shown in Table 3. By interviewing more fish harvesters, more detailed information would have been obtained, but it is difficult to determine if many new areas would have been identified.

7. PART II REVIEW OF AREAS IDENTIFIED BY OTHER SOURCES

Part of the reason for gathering LEK to identify EBSAs is to validate the information provided by scientists in the identification of EBSAs and to provide more details. This section briefly reviews other methods of identifying EBSAs and compares the results to the present study based on fish harvesters LEK.

7.1 Areas Previously Identified Using Local Ecological Knowledge

To further incorporate LEK into the identification of EBSAs, Millar and Doherty (unpublished) carried out a review of the literature pertaining to LEK of the offshore Scotian Shelf. The information reviewed includes locations of spawning grounds (Goode 1887, Younger *et al.* 1996, Benham and Trippel in press), nursery grounds (Benham and Trippel in press), feeding areas (Goode 1887), areas of concentrations of corals (Collins 1884, Goode 1887, Whiteaves 1901, Breeze *et al.* 1997, Gass and Willison 2005), whale distributions (Sutcliffe and Brodie 1977), bottom habitat type (Fuller and Cameron 1998) and physical oceanographic features (Goode 1887, Fitzgerald 2000). Most of the LEK information from the literature is based on interviews with fish harvesters, logbook data and/or fish harvesters' reports. Table 4 provides an overview of the LEK literature that may be helpful in identifying EBSAs on the Scotian Shelf.

Although the locations of some of the areas identified in the reports are unclear or imprecisely delineated, locations of corals and whales are available and may contribute to the identification of EBSAs. Whales aggregate in areas where zooplankton and/or pelagic fish are abundant, thus whale aggregations may indicate areas of biological significance (Sutcliffe and Brodie 1977). Information on locations of corals on the Scotian Shelf and the spatial correlation between areas of high coral density and productive fish habitat (Breeze *et al.* 1997, Gass and Willison 2005) may also contribute to the identification of EBSAs. In addition, historical reports of coral locations based on LEK (Collins 1884, Goode 1887) may provide a reference point for assessing changes that have occurred over the last century and are useful resources for the identification of EBSAs on the Scotian Shelf.

Table 4: Summary of LEK literature that is relevant to EBSA identification on the Scotian Shelf

Location	Ecological significance	Reference	Source of Information
Gully	High coral abundance associated with aggregations of fish, important halibut feeding grounds (1887)	Breeze *et al.* 1997 Gass and Willison 2005 Goode 1887	Interviews with fish harvesters, fish harvesters' reports
Mouth of the Northeast Channel	High coral abundance associated with aggregations of fish, aggregations of whales	Breeze *et al.* 1997 Sutcliffe and Brodie 1977	Interviews with fish harvesters, log books and records from a whaling plant at Blandford, Nova Scotia

Location	Ecological significance	Reference	Source of Information
Stone Fence	High coral abundance associated with aggregations of fish	Breeze *et al.* 1997 Collins 1884 Gass and Willison 2005	Interviews with fish harvesters, fish harvesters' journals/records
Edge of the continental shelf, especially canyons and channels between banks	High coral abundance associated with aggregations of fish, aggregations of whales	Breeze *et al.* 1997 Gass and Willison 2005 Sutcliffe and Brodie 1977	Interviews with fish harvesters, log books and records from a whaling plant at Blandford, Nova Scotia
Middle Prong of Banquereau Southern and southeastern borders of Banquereau	High coral abundance	Collins 1884 Goode 1887 Gass and Willison 2005	Interviews with fish harvesters, fish harvesters' journal, fish harvesters' reports
Banquereau	Gorgonian corals, important fishing ground for halibut and cod Cod spawning area	Verrill 1878 Goode 1887 Younger *et al.* 1996	Fish harvesters' reports, interviews with fish harvesters
The Edge: the zone where cold shelf water intersects with warm water from the Gulf Stream, roughly along the 100 fathom [183 metre] isobath of the shelf edge	Prime location for swordfish fishing on the Scotian Shelf	Fitzgerald 2000	Interviews with Nova Scotia swordfish fish harvesters
Deep water bordering the southern side of LaHave Ridges	Gorgonian corals	Goode 1887	Fish harvesters' reports
South and east of Browns Bank Browns Bank	Presence of corals Cod spawning area	Goode 1887 Younger *et al.* 1996	Fish harvesters' reports, interviews with fish harvesters
Southeast of Sable Island Bank	Presence of corals	Goode 1887	Fish harvesters' reports
Off Sable Island	Gorgonian corals	Verrill 1878	Fish harvesters' reports
Sable Island Bank (Western Bank)	Important fishing, feeding and spawning grounds for cod and halibut (1887)	Goode 1887 Younger *et al.* 1996	Fish harvesters' reports, interviews with fish harvesters
Seal Island Ground (off western part of Nova Scotia)	Important fishing and feeding grounds for cod	Goode 1887	Fish harvesters' reports
Roseway Basin	Aggregations of whales	Sutcliffe and Brodie 1977	Logbooks and records from a whaling plant in Blandford, Nova Scotia

Location	Ecological significance	Reference	Source of Information
Emerald Basin	Aggregations of whales, corals	Sutcliffe and Brodie 1977 Gass and Willison 2005	Interviews with fish harvesters, log books and records from a whaling plant at Blandford, Nova Scotia
LaHave Bank	Cod spawning area	Younger *et al.* 1996	interviews with fish harvesters
Depression between St. Georges' and Le Have Banks in 100 to 200 fathoms [183 to 366 metres]	High abundance of corals	Verrill 1878	Fish harvesters' reports
Outside of Brown's Bank	High abundance of corals	Verrill 1878	Fish harvesters' reports
Misaine Bank Edges of holes on Misaine Bank	Cod spawning area Corals	Younger *et al.* 1996 Gass and Willison 2005	Interviews with fish harvesters
On banks off Cape Breton	Corals	Gass and Willison 2005	Interviews with fish harvesters
Edge of Laurentian Channel	Corals	Gass and Willison 2005	Interviews with fish harvesters

7.2 Areas Identified Using Scientific Expert Opinion (SEO)

In 2006, a science expert opinion workshop was held where scientists gathered to apply their knowledge of the Scotian Shelf to the identification of areas that met the EBSA criteria (den Heyer *et al*. 2006). During the workshop scientific experts from government, academia and non-government organizations were asked to identify areas that met the EBSA criteria during small group breakout sessions. Results of the workshop are presented in den Heyer *et al*. (2006). Following the workshop additional scientific expert opinion was incorporated and areas where refined. Combined results of the workshop and interview are presented in Doherty and Horsman 2007.

8. COMPARISON OF AREAS IDENTIFIED BY FISH HARVESTERS' LOCAL ECOLOGICAL KNOWLEDGE (LEK) INTERVIEWS, LEK LITERATURE REVIEW AND SCIENTIFIC EXPERT OPINION (SEO)

When comparing the areas identified using SEO and through a literature review of LEK studies with areas identified through the directed LEK interviews, there were definite areas of convergence (Figure 4). Table 5 identifies areas that were identified by at least two of the three methods (i.e., Science Expert Opinion workshop, LEK interviews and literature review of LEK). Six areas (Table 5, #1-6) were identified by all three methods and for similar reasons.

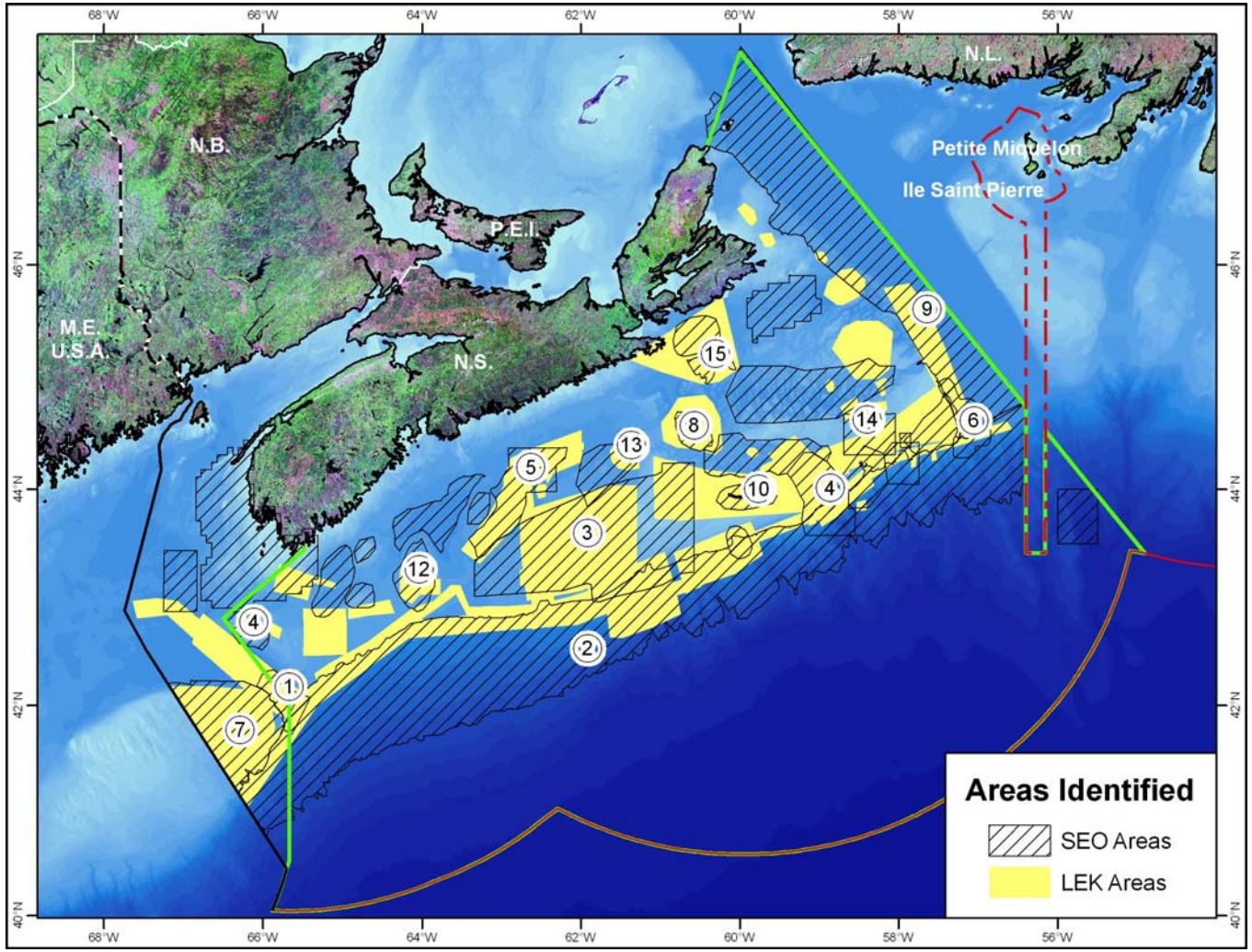


Figure 4: Areas identified by scientific expert opinion and fish harvesters LEK survey.
(Numbers correspond to areas numbers in Table 5)

Table 5: Areas identified by SEO, fish harvester interviews and through literature review of LEK

	Area	Rationale		
		LEK	**SEO**	**Literature**
1	Northeast Channel	Area of high diversity: birds, mammals, fish. Area where swordfish and tuna are observed in the spring. A high abundance of corals (bubblegum, Primnoa).	Productive area where corals (Gorgonian) are found. Well known swordfish aggregating area (Hell Hole).	High coral abundance associated with aggregations of fish, aggregations of whales.
2	Shelf edge (general)	Area where silver hake are found. Porpoise [probably dolphin] in the general area of the shelf edge. Good halibut area all along the edge. See patches of coral along the edge. Area where whales, sunfish, sea pens and sea turtles have been observed. The edge is an important area for migration. Important area for red crab spawning.	High finfish diversity, corals, primary migration route for large pelagics, whales.	High coral abundance associated with aggregations of fish, aggregations of whales.
3	Western Bank	Haddock spawning area. Area where small fish have been observed, a lot of small groundfish (haddock). Western Bank has always had an abundance of haddock, other fish species are found there too. Some parts of Western Bank have sea cucumbers. Whales observed at the edge of Western Bank in July. One indication that the area may not be improving.	High concentrations of fish, particularly juvenile fish. Concentration of spawning gadoids. Nursery area for cod, haddock and other groundfish.	Important fishing, feeding and spawning ground.
4	The Gully	The Gully is a unique area. It has a high abundance of corals. Hell's Kitchen has many corals. The Gully is an important area for feeding and has a high abundance and diversity of species. It is a main feeding area for whales. It is an area where small halibut have been observed. The Gully is also an important crab spawning ground.	Unique geological feature. Highly productive area. Very high diversity and density of cetacean species. Largest abundance of northern bottlenose whales. High finfish diversity. High diversity of deepwater corals.	High coral abundance associated with aggregations of fish, important halibut feeding grounds

Table 5 (cont'd): Areas identified by SEO, fish harvester interviews and through literature review of LEK

	Area	Rationale		
		LEK	**SEO**	**Literature**
5	Emerald Basin and the Patch	Important feeding area for swordfish, tuna and shark (bluedog, porbeagle and thrasher). Squid, jellyfish and billfish are abundant, important prey items. Turtles have been observed there. There are plenty of jellyfish in the basins from May to August, important for the turtles. Haddock and cod not as abundant in the area as they used to be. Pollock are spawning Sept. to Nov. Northern part of Emerald Basin has the biggest concentration of Russian Hat sponges. Sunfish aggregate in the basin in the summer. Minke whales are found in the basin. Important migration route.	Overwintering ground for basking and porbeagle sharks. Residence for whales and dolphins. Summer residence for tuna and swordfish. Hot spot for glass sponges known as Russian Hats.	Aggregation of whales and corals
6	Stone Fence	Area where corals are found. Area of high diversity. Area where halibut fishing occurs. Area where dolphins have been observed.	Only confirmed location of Lophelia coral on the Scotian Shelf. Other corals also found there. Important habitat for juvenile fish. Expect a high diversity of whales.	High coral abundance.
7	Canadian Portion of Georges Bank	Georges Bank is a unique area, one of the richest grounds. Shoal water of Georges Bank in the winter months is an important juvenile area, every haddock and codfish are full of spawn. Temperature on Georges Bank stays constant from summer to winter. Haddock seem to be spawning there in February. Area with a high diversity of life. Northeast peak of Georges Bank has a high abundance of corals. Also an area where sea pens might occur. Georges Bank is a great feeding ground. No sharks on Georges Bank.	Area of high productivity. Spawning and nursery grounds for a variety of gadoids.	

Table 5 (cont'd): Areas identified by SEO, fish harvester interviews and through literature review of LEK

	Area	Rationale		
		LEK	**SEO**	**Literature**
8	Middle Bank	An area where cod used to be abundant and groundfish in general. Area where lots of whales have been observed in the summer until October (minke and fin whales). Spawning area for cod.	Strong evidence for sub-population of cod.	
9	Laurentian Channel	Migration route. Halibut and corals found there.	Overwintering area for 4Vs cod and other gadoids. Migration route. High diversity of demersal, pelagic and mesopelagic fishes.	Corals
10	Sable Island Bank Area	Hagfish fishery occurring in the area. Not many fish left, just halibut. Area used to be abundant with cod and haddock In the winter months little fish (cod and haddock) tend to come out near deeper water near the edge of the bank. Area where whales are abundant. Area where codfish with spawn have been observed. Cod spawn from July to October in this area. Feeding area because herring are found there and lots of plankton, mackerel, young haddock and sandlance. Area where beaked dolphins have been observed. Sable Island has lots of fish, mostly haddock. Observe sea turtles around Sable Island, when swordfish fishing (June to September).	Supports higher concentrations of fish. Area of high fitness consequences for seals. Area with high concentrations of juvenile fish (haddock).	Corals; important fishing, feeding and spawning grounds
11	Browns Bank	Haddock spawning area. Sea cucumbers have been observed in the area. Important feeding area. Area of high abundance.	Known concentrations of large lobster. Cod and haddock spawning, gadoid nurseries.	Corals, cod spawning

Table 5 (cont'd): Areas identified by SEO, fish harvester interviews and through literature review of LEK

	Area	Rationale		
		LEK	**SEO**	**Literature**
12	LaHave Basin	Area where cod and haddock are found. Area where silver hake fishery occurs. Area where a variety of species have been observed.	Strong evidence for sub-population of cod.	Cod spawning area.
13	Cow Pen and Bull Pen	Hagfish fishing area	Highly productive area, possible white hake spawning area.	
14	Banquereau	Area where there are very few fish left. Historically had a good mixture of fish. Historically you could catch cod, pollock, haddock and flounder. It was a great place for flounder. Feeding area where sandlance are found. Used to be a good feeding area for haddock. Area where sea cucumbers were observed. Area where crabs are said to be increasing.	Very productive snow crab bottom. High density of commercial size snow crab. Lots of shellfish living in sediments. Sub-population of cod.	Corals, cod spawning
15	Canso Bank	Feeding area	Strong evidence for sub-population of cod.	
16	Misaine Bank	Important crab spawning grounds. Feeding place for everything. Squid, billfish and herring found in the area. Deep holes and shallow banks of Misaine Bank are big water mixing areas with lots of shrimp and krill, everything comes there to feed, small and big fish.		Corals, cod spawning area.
17	Roseway Basin		Feeding area for North Atlantic right whale. Highly productive area. Other species of whales observed there. High concentrations of juvenile redfish.	Aggregation of whales

9. CONCLUSION

The results of the LEK survey provide a good basis for continuing discussions with fish harvesters to gain a better understanding of how they use the ocean and its importance to them. Comparing the results of the LEK study and areas identified by other sources provided a certain level of validation. The convergence of areas identified by both fish harvesters and scientists confirms that fish harvesters' knowledge and scientific opinion can work together and complement one another.

Next steps in the identification of EBSAs include analyzing data from various sources (including DFO research and industry surveys) to further validate the areas identified. Concluding that an area is ecologically or biologically significant does not give it any legal status. However, such a conclusion provides guidance on the appropriate attention to management that is expected in those areas (Doherty and Horsman, 2007). Doherty and Horsman (2007) outline management implications for EBSAs.

The identification of EBSAs will play a role in ocean planning. It can be considered when providing advice during an environmental assessment process and during the Marine Protected Area network planning process. EBSAs, however, are only one data source and will need to be combined with other knowledge.

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Appendix 1 Telephone Survey Questionnaire

Identification of Offshore EBSAs

Fish harvesters Ecological Knowledge Study

Tier 1 Survey: Identifying Local Experts

INTRODUCTION

May I please speak with Mr./Mrs./Ms._____

(Notes for interview callbacks if the person is not available.

1st Callback (date and outcome) _____

2nd Callback (date and outcome) _____

3rd Callback (date and outcome) _____

My name is _____. I work with Fisheries and Oceans Canada in the Oceans and Coastal Management Division.

We are working on a project to identify biologically important areas of the Scotian Shelf. The intent of the project is to find out where the most important areas are so that we can take them into account when we are planning and managing human activities in the ocean.

Our research project is about the offshore portion of the Scotian Shelf, specifically the area beyond 12NM from shore.

As part of our project, we are asking fishermen to help us identify members of their fishing community that are knowledgeable about the offshore. After this, we will conduct interviews with many of these identified experts to discuss and map fishermen's knowledge of important areas. All information you provide will be anonymous and treated as confidential.

Would you be willing to answer a few questions to help us identify people who are knowledgeable about the offshore? It will take about 5 minutes.

1. Yes
2. No

[*If no, ask:* Would you mind telling me why you don't want to participate in this study? *Record a summary of the reasons in the space provided, and thank them for their time.*]

_____

_____

_____

_____

If you have any questions about this research project please feel free to interrupt me at any time. [*pause and wait for a reply, answering as completely as possible any questions asked.]*

Date of Interview: _____
(dd/mm/yy)

Time Interview Started: _____

SECTION I: FISHING HISTORY

To start, I am going to ask you several questions about you and your fishing experiences.

1. Are you currently fishing (e.g., this year)? _____

a) If yes, are you currently fishing in the offshore? _____

b) If no, have you previously fished in the offshore? _____

[If it is a company and the person with whom you are speaking is not a fisherman: Could you recommend someone in your company that we can contact that would know who is knowledgeable about the offshore? _____

If no ask to provide reasoning _____
_____
_____
_]

2. How many years have you fished in the offshore? If previously fished in the offshore, how many years and during what time period?
_____

3. Would you please tell me, what is the name of the harbour or wharf from which you are currently fishing or used to fish?

_____
(Name of harbour or wharf)

SECTION III: LOCAL KNOWLEDGE EXPERTS

We want to learn more about the offshore portion of the Scotian Shelf. Specifically, we are interested in the general location of areas that fishermen consider to be important, such as areas where fish, shellfish, birds, whales, and turtles tend to be found.

As an important part of this study we will be interviewing people, either currently fishing or retired, who are knowledgeable about their local fishing area. Other than yourself, who would you say knows the most about the offshore fishing area?

13a. Name of Most Knowledgeable _____
[*prompt for initials and/or nick(local)names*]

Would you tell me, is this person currently fishing _____ or retired _____
(check the response category indicated)?

What port does (or did) this person fish out of? _____

What community does this person live in? _____

What types of fish does this person fish for? _____

What gear type is used? _____

How do you know this person?

How do you know this person?

	(circle as many as indicated)……	Yes	No
a.	as a friend?……..……1		2
b.	as an immediate relative?…… …….	1	2
c.	as someone you fished with?……	1	2
d.	by their good fishing reputation?……..…	1	2
e.	by their success at fishing?…….....	1	2
f.	as a leader within the fishing community?……..	1	2
g.	as a person quick to adopt new fishing techniques and approaches?	1	2
h.	as a person who is knowledgeable about or who participates in fisheries science?…….	1	2

Other_____

Why do you think they are an expert?

_____

Are there any other persons currently fishing or retired from fishing who you think are very knowledgeable about the fishing ground? (*print the names mentioned in the space provided and in the order in which they are mentioned*)

13b. 2nd Person Named _____

How about this person, are they currently fishing_____ or retired _____?

What port does (or did) this person fish out of? _____

What community does this person live in? _____

What types of fish does this person fish for? _____

What gear type is used? _____

How do you know this person?

	(circle as many as indicated)……	Yes	No
i.	as a friend?……..……..	1	2
j.	as an immediate relative?…….	1	2
k.	as someone you fished with?……	1	2
l.	by their good fishing reputation?……..…	1	2
m.	by their success at fishing?…….....	1	2
n.	as a leader within the fishing community?……..	1	2
o.	as a person quick to adopt new fishing techniques and approaches?	1	2
p.	as a person who is knowledgeable about or who participates in fisheries science?……	1	2

Other_____

Why do you think they are an expert?

_____

13c. 3rd Person Named _____

How about this person, are they currently fishing_____ or retired _____?

What port does (or did) this person fish out of? _____

What community does this person live in? _____

What types of fish does this person fish for? _____

What gear type is used? _____

How do you know this person?

	(circle as many as indicated)…….	Yes	No
a.	as a friend?……..……..	1	2
b.	as an immediate relative?…….	1	2
c.	as someone you fished with?……	1	2
d.	by their good fishing reputation?……..…	1	2
e.	by their success at fishing?…….....	1	2
f.	as a leader within the fishing community?……..	1	2
g.	as a person quick to adopt new fishing techniques and approaches?	1	2
h.	as a person who is knowledgeable about or who participates in fisheries science?…….	1	2

Other_____

Why do you think they are an expert?

_____

SECTION IV. CLOSING QUESTIONS

Before we finish, we would like to find out what you think about this kind of research.

17. Do you think that the use of fishermen's knowledge will improve oceans science.

Yes…….1
No……..2
Not sure….3

18. Do you have any questions or comments?

_____

_____

_____

_____

_____

Thank you for your time.

Time Interview Completed: _____

Appendix 2: Offshore Local Ecological Knowledge Fish Harvesters Interview Guide

Identification of Offshore EBSAs – Interview Guide

Instructions for Interviewers
Review the information/consent form with the interviewee prior to each interview and fill out the required information. Fill out two forms.
Instructions pertaining to each question are shown below [in brackets].

SECTION I: FISHING HISTORY

Thank you for agreeing to participate.
This mapping exercise may take some time. We may need to take a break or two.
Do you have any questions before we begin?

1. What is the name of the harbour from which you are currently fishing?
    - Have you always fished from this harbour?
    - If not, what other harbour(s) have you fished from?
2. About how many years have you been fishing for a living?
3. How many of these years were spent fishing offshore?
4. Did you fish in the offshore in the last year?
5. Currently, would you describe yourself as a fulltime fisherman? If not, please explain.
6. Are you currently the captain of the vessel?
    - If yes, how many years have you been the captain?
    - If no, are you currently crew?
        - If yes, how many years?
        - Have you ever been the captain of a vessel?
            - If yes, how many years?
7. What areas of the Scotian Shelf do you know best?
    - When did you last fish there? [each of the areas]
    - How many years have you fished there? [each of the areas]
    - Do you fish this area at any particular time of year?
        - If yes, which time of year do you fish this area?
    - What species do you fish for in this area?
        - With what type of gear?
    - How long have you fished there? [in years]

SECTION II. EBSA QUESTIONS

Areas Important for Fitness Consequences

Current spawning areas
I am going to ask you about spawning areas that are important right now and areas that were important in the past, but are no longer as important.

8. Are there any spawning areas that you consider to be of particular importance currently?

If yes, please draw an approximate boundary of the area(s) on the map.
For what species is this area important? [ask for each area]
Why do you consider this area important? [ask for each area]
During what time of year is this area important? [ask for a response by month]
Have there been any changes in the time of year the area is important?
As well as being important currently, was this area important in the past? [ask for each area]

Historically important spawning areas

9. Are there areas that you might have considered important for spawning in the past but not now?

If yes, please draw an approximate boundary of the area(s) on the map.
For what species was this area important? [ask for each area]
Why?
When was it an important spawning area? What years and at what time of year? [ask for a response by month]
Why do you think this area is no longer an important spawning area? [ask for each area]

Current nursery areas

Now I'm going to ask you questions about nursery or juvenile areas. These are areas where young fish or the young of other species are known to concentrate or aggregate. I will be asking questions both about areas that are still important and ones that once were important.

10. Are there any nursery or juvenile areas that you consider to be of particular importance currently?

If yes, please draw the boundary of the area(s) on the map.
For what species is this nursery/juvenile area important? [ask for each area]
Why do you consider this area important? [ask for each area]
During what time of year is this area important? [ask for a response by month]
Have there been any changes in the time of year the area is important?
As well as being important currently, was this area important in the past? [ask for each area]

Historical nursery areas

11. Are there areas that you might have considered important nursery/juvenile areas in the past but not now?

If yes, please draw an approximate boundary on the map. [ask for each area]
For what species was this area important for juveniles or as a nursery? [ask for each area]
Why do you think this area was important?

When was it an important nursery/juvenile area? What year(s)? At what time of year? [ask for a response by month]
Why do you think this area is no longer an important nursery/juvenile area?

Current feeding areas
Now I'm going to ask you about current and past feeding areas.

12. Are there any feeding areas that you consider to be of particular importance?
If yes, please draw the boundary of the area(s) on the map.
For what species is this an important feeding area? [ask for each area]
Why do you consider this area important?
During what time of year is this area important? [ask for a response by month]
Have there been any changes in the time of year the area is important?
As well as being important currently, was this area important in the past? [ask for each area]

Historical feeding areas
13. Are there areas that you might have considered important feeding areas in the past but not now?
If yes, please draw an approximate boundary of the area(s) on the map.
For what species was this area important for feeding? [ask for each area]
When was it an important feeding area? [what years] [ask for each area]
At what time of year? [ask for a response by month]
Why do you think this area is no longer an important feeding area?

Current migration routes
Migration routes are the geographic route along which birds, fish and other animals customarily migrate. These routes are important because they provide access to areas for feeding and breeding. I'm going to ask you about current and past migration routes.

14. Are there any migration routes/areas that you consider to be of particular importance currently?
If yes, please draw the boundary of the area(s) on the map and indicate the direction of migration and time of year.
For what species is this area important for migration? [ask for each area]
Why do you consider this area important? [ask for each area]
During what time of year is this area important? [ask for a response by month]
Have there been any changes in the time of year the area is important?
As well as being important currently, was this area important in the past? [ask for each area]

Historically important migration routes
15. Are there areas that you might have considered important for migration in the past but not now?
If yes, please draw an approximate boundary on the map and indicate the direction of migration and time of year.

For what species was this area important for migration?
When was this area an important migration route? [what years] [ask for each area]
At what time of year? [ask for a response by month]
Why do you think this area is no longer an important migration route?

Areas of High Abundance

Current areas of high abundance
Now I'm going to ask you about current and past areas of high abundance for species. We are interested in fish and other species, such as whales, seals, shellfish and other invertebrates, birds, turtles, and so on.

16. Are there areas that you know of that have very high numbers of one particular species? This could be either part of the year or year round.
If yes, please draw the boundary of the area(s) on the map.
What species uses this area? Why do you think this species is there? [ask for each area]
What time of the year is this area used? [if more than one species is mentioned; ask for each species mentioned. ask for a response by month]
Have there been any changes in the time of year the area is used?
As well as having a high abundance of this species currently, was this area important in the past? [ask for each area]

Historical areas of high abundance
17. Are there areas that you might have considered as having a high number of a certain species in the past but not now?
If yes, please draw an approximate boundary of the area(s) on the map.
What species used this area? Why do you think this species was there? [ask for each area]
What time of the year was the area used? [if more than one species is mentioned, ask for each species mentioned; ask for a response by month]
Why do you think this area no longer has high numbers of this species?

Areas of High Diversity

Current high diversity areas
Now I'm going to ask you about areas of high diversity. High diversity areas are areas that have many fish and other species, such as whales, seals, shellfish and other invertebrates, birds, turtles, and so on.

18. Are there areas where you would see many different species either part of the year or year round?
If yes, please draw the boundary of the area(s) on the map.
Which species use this area and for what purpose? [ask for each area]
What time of the year is this area used by the various species? [ask for each species mentioned; ask for each area; ask for response by month]

Historical areas of high diversity

19. Are there areas where you might have seen many different species in the past but not now?

If yes, please draw the boundary of the area(s) on the map.
Which species used this area and for what purpose? [ask for each species]
What time of the year was this area used by the various species? [ask for each species; ask for response by month]
Why do you think this area is no longer an area of high diversity?

Areas with important structural features

I'm going to ask you about current and past areas with structural features.

Current areas with important structural features

20. Are there areas you know of where there are distinct structural habitat features such as corals, sponges, or macrophyte beds in high numbers or density?

If yes, please draw the boundary of the area(s) on the map.
What feature(s) occur in this area? [ask for each area]
Are there any species that appear to be associated with this feature? Which species? [ask for each area]
What time of year are these species associated with this feature? [ask for response by month]

Historical areas with structural features

21. Are there areas that you might have considered important because of structural features in the past but not now?

If yes, please draw the boundary of the area(s) on the map.
Why was this area important in the past?
When was it an important area?
Why do you think this area is no longer important (i.e., what happened to the features)?

Unique Areas

Current unique areas

I'm going to ask you about unique areas. These areas may be unlike any other areas that you know about because of the species, habitats, or environment found in that area. They may include some of the areas we've already talked about.

[If example is needed: For example, they may be the only place you know about where a particular seabird nests or where the ocean bottom has a particular feature.]

22. Are there areas that you consider to be unique, rare or distinct?

If yes, please draw an approximate boundary of the area(s) on the map.
Why do you consider this area to be unique, rare or distinct? [ask for each area]
Has this area always been unique? [ask for each area]

Is it still unique?
If no, why not? when was it unique?
Is (was) this area unique/rare/distinct all year round or at particular times of year? what times of year? [ask for each area; ask for response by month]

23. Are there areas that you might have considered to be unique in the past but not now?
If yes, please draw an approximate boundary of the area(s) on the map.
Why do you think this area was unique/rare/distinct? [ask for each area]
Why do you think the area is no longer unique/rare/distinct?

Other Important Areas

24. Are there any other offshore areas that you consider important or significant that we haven't talked about?
If yes, please draw an approximate boundary of the area(s) on the map.
Why do you think they are important?

The interviewer should now revisit all the areas that have been mapped and make sure they've captured all the information about them. For example, "You've said that Area A is important for spawning haddock and because there are lots of whales there in July and August. Is there anything else you would like to say about this area?"

SECTION III. CLOSING QUESTIONS

Before we finish, we would like to find out what you think about this kind of research.

25. Do you think that the use of fishermen's knowledge will improve management of the oceans?
26. Do you have any questions or comments about the study?
27. We would like to incorporate fishermen's knowledge into various aspects of ocean management. Would you be willing to be interviewed for other studies in the future?

Thank you for your time.

The interviewer should enter the time the interview ended on the consent forms. Provide one copy of the form to the interviewee.

Appendix 3: Consent Form

Identification of Offshore EBSAs
Fish harvesters Offshore Ecological Knowledge Study
Tier II Survey: Identifying EBSAs

***[Interviewers**: Fill in relevant blanks as indicated before interview starts.]*
Interview code: _____

Interview date: _____

Interview location: _____

Interview start time:_____

Interview end time: _____

INTRODUCTION

My name is _____. I work with Fisheries and Oceans Canada in the Oceans and Coastal Management Division. Thank you for agreeing to meet with me.

We are working on a project to identify ecologically and biologically important areas of the Scotian Shelf. The intent of the project is to find out where the most important areas are so that we can take them into account when we are planning human activities in the ocean. For example if there was a proposal for oil and gas development, a new pipeline or a new fishery, a biologically important area might require special consideration.

Today I'd like to ask you questions about biologically important areas. I would like you to keep in mind that we are not necessarily looking for areas that are important for fishing, but rather for areas that are important for fish as well as for other species such as whales, dolphins, seabirds, invertebrates and turtles.

Our research project is about the offshore portion of the Scotian Shelf, specifically the area beyond 12NM from shore.

If you agree to participate in our research project, all the information you provide today will be anonymous. Transcripts and any recordings will be kept in a secure location and will be kept confidential. You may stop the interview at any time. I will give you a copy of this consent form today and I will send a copy of your interview transcript for you to verify. The information you provide will be combined with that of other fish harvesters to produce a map and report that will contribute to the identification of ecologically and biologically significant areas.

Do you have any questions about this research project?

Are you willing to be interviewed? [Circle one]

Yes No

Are you willing to have the interview recorded? [If not, detailed notes will be taken.]
Yes No

Signature:

_____

Name:

_____

Address (for interview transcript):

_____

_____

Name of Interviewer:

_____

Contact Information:
Oceans and Coastal Management Division,
Fisheries and Oceans Canada, PO Box 1006,
Dartmouth, NS B2Y 4A2
tel: (902) 426-1446
e-mail: hurlburtm@mar.dfo-mpo.gc.ca