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ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSA) IN THE ESTUARY AND GULF OF ST. LAWRENCE: IDENTIFICATION AND CHARACTERIZATION

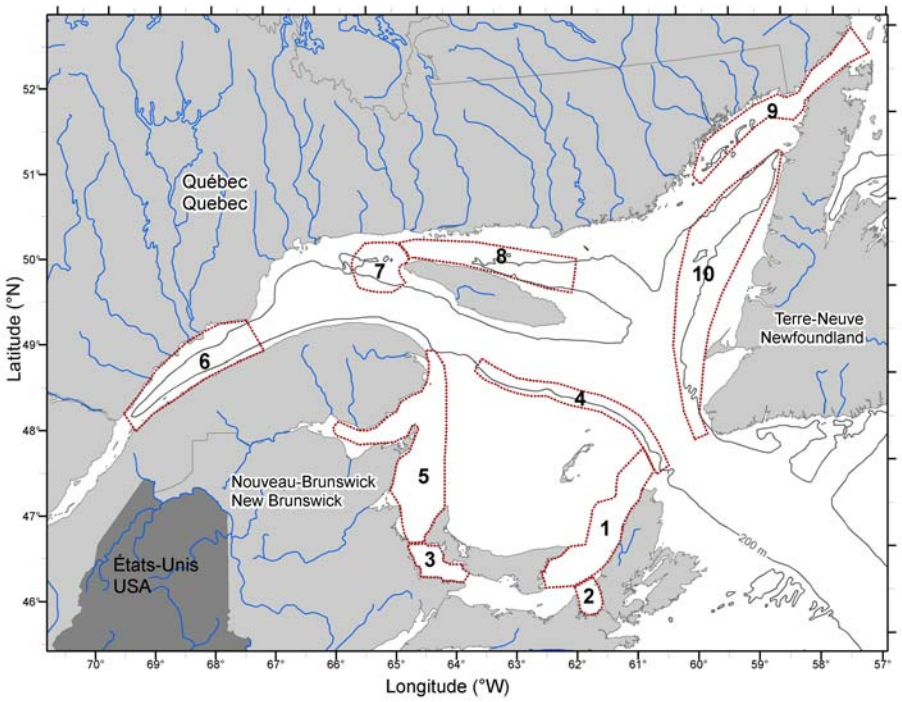

Figure 1. EBSA distribution in the Estuary and Gulf of St. Lawrence: EBSA (1) western Cape Breton, (2) St. George's Bay, (3) Northumberland Strait, (4) the southern fringe of the Laurentian Channel, (5) the south-western coast of the Gulf, (6) the lower estuary, (7) western Anticosti Island, (8) northern Anticosti Island, (9) the Strait of Belle Isle, (10) the west coast of Newfoundland.

Context

A zonal workshop with science experts from the Department of Fisheries and Oceans (Newfoundland and Labrador, Quebec and Gulf regions) was held at the Maurice-Lamontagne Institute in Mont-Joli from December 5-7, 2006, to identify ecologically and biologically significant areas (EBSA) in the Estuary and Gulf of St. Lawrence (EGSL). As provided for in the oceans action plan (2005), their identification represents a step towards specifying objectives for integrated oceans management and for the Gulf of St. Lawrence integrated management (GOSLIM). The exercise also helped identify research needs. The territories covered by the EBSA play a remarkable ecological and biological role and therefore special treatment is required when managing activities that may affect them.

Identifying EBSA was part of a sustained effort over the last two years. Experts first identified significant areas based on their expertise "delphic approach" (DFO, 2006). In the December 2006 workshop, based on a more analytical approach, they determined significant areas for each biological component (primary production, secondary production, meroplankton, benthic invertebrates, pelagic fish, groundfish and marine mammals). Finally, in a major effort for integrating available data and information, experts identified the ten EBSA illustrated in Figure 1.

SUMMARY

- Ten (10) ecologically and biologically significant areas (EBSA) in the Estuary and Gulf of St. Lawrence (EGSL) were identified, mapped and described during a science workshop in December 2006 (Figure 1). Overall, these EBSA cover 77,184 km^2, i.e. 30% of the EGSL.
- Considering the extremely complex and dynamic nature of the EGSL, the perimeter of these EBSA was presented only as a reference.
- Areas in the upper estuary, Saguenay as well as the coastal area (0-30 m) were not included in the analysis. In addition, certain groups of data were not processed, such as those concerning marine mammals and Atlantic mackerel for example, while other groups did not cover the lower estuary (meroplankton, pelagic fish).
- Sensitive populations as well as certain exceptional areas are not included or entirely included in the EBSA. The fact that a significant component of the ecosystem is not included or only partially included in an EBSA must not be interpreted as a lack of ecological significance. Other management tools will have to be developed and/or used to account for key elements of the biodiversity and productivity of the EGSL that are not included in the current EBSA.

BACKGROUND

The current science advisory report characterizes the ten EBSA in the EGSL, mainly from the working documents presented during the science workshop in December 2006. These documents describe the physical topography and oceanography, as well as significant areas for each biological component accounted for in the analysis (primary production, secondary production, meroplankton, benthic invertebrates, pelagic fish, groundfish and marine mammals). Most of the information contained in the working documents as well as the details from the analytical synthesis process which led to the EBSA are presented in the CSAS research document (Savenkoff *et al*. 2007 [in preparation]). In addition, this document discusses in detail the methodological limits associated with the analysis, although some of these limits are presented briefly in the current advisory report.

EBSA were identified based on an analytical approach, using maps created by georeferencing the available data for each biological component in the ecosystem. Furthermore, excluding the layer of physical data used to support the analysis, a relative value (on a scale of three) was given to significant areas for each biological layer. As recommended during a previous workshop (DFO, 2004), the value of each significant area was given according to 1) its uniqueness, 2) the concentration of the biological component in this area and 3) the function (consequence on the adaptive value) of the area in question for this biological component. This work let to the identification and characterization of the EBSA in the EGSL. This characterization is the basis of the current advisory report. Some elements, if they weren't considered in the analysis, might be missing in the characterization.

ASSESSMENT: EBSA CHARACTERIZATION

The Western Cape Breton EBSA (1)

The Western Cape Breton EBSA (Figure 1) covers 8,198 km^2, or 3.2% of the Estuary and Gulf of St. Lawrence (EGSL). The bottom's structure varies considerably from north to south. The southern part of the area is located in shallow water (<60 m) which is typical for the southern Gulf, while in the north, the area includes a deeper depression (150-200 m): The Cape Breton Channel. Modeling reveals the lack of importance in terms of physical phenomena, which are confined to 274 km^2 or 3.3% of the area (retention potential at the southern margin of the area and significant mixing by tides at the eastern tip of Prince Edward Island). One of the two Gaspe current channels cross the area from west to east and exits the Gulf in Cabot Strait. Furthermore, in the area, the water surface temperature (annual average) is relatively high.

The area is distinguishable mostly for its major role for meroplankton as well as for groundfish, at every level (maximum uniqueness, concentration and adaptive values). Concerning meroplankton, the area is located in a southern section of the Gulf where the largest array of meroplanktonic species is observed (witch flounder exclusively north of the area, Atlantic cod, winter flounder, American plaice, yellowtail flounder, decapod crustaceans, etc) as well as the highest meroplankton abundance (eggs and larvae) among all the identified areas in the Gulf. This wealth shows the critical significance of the area for the sustainability of many biological components in the Gulf's ecosystem. As for groundfish, the northern part of the area has an important biodiversity and high biomasses. The Cape Breton Channel serves as a migration corridor (spring and fall) towards the Atlantic for Atlantic cod (southern Gulf stock – population of special concern according to the COSEWIC) and for the white hake (coastal component of the stock) as well as for other groundfish species. It is also a significant summer feeding area for witch flounder (adults) and white hake (deep water components of the stock), where, in this area, are recorded the largest concentration in the southern Gulf. Ecosystem disturbance in the area, and in the surrounding area in some cases, (e.g. migration corridor), could have severe consequences especially with the large proportions of various groundfish species populations that are concentrated there, during certain periods, according to the seasonal cycle.

There are also significant areas for all the other biological components. A small part of the area, north, is under the influence of the Gaspe current and it is sometimes possible to observe significant biomass and a strong phytoplanktonic production. Still north of the area, in the deeper valley waters, there is a likely potential for the accumulation of strong biomasses of mesozooplankton (>1mm), biomasses identified as "sources" for high trophic level species that feed there. The southern part of the area is located in a sector (southern Gulf) where there are large concentrations of mesozooplankton (<1mm). Throughout the Gulf, there is no greater area for small mesozooplankton production. The area is also favourable for very significant concentrations of macroinvertebrate species such as brittle stars, starfish, basket stars, hermit crabs, whelks and squid. The southern part of the area is a spawning and nursery area for Atlantic herring (forage species of great ecological significance) and a wintering area for juveniles. It is also a very significant feeding area where most pelagic fish species in the southern Gulf concentrate (alewife, spiny dogfish, adult and juvenile Atlantic herring, Atlantic mackerel, capelin, rainbow smelt and silver hake). Because of this preference, this area probably has a high adaptive value for pelagic fish. Data on marine mammals were incomplete for this area even though it represents a well known significant area for the reproduction of grey, hooded and harp seals. There are only two or three known reproductive areas in the North-west Atlantic, such as the ice in the southern gulf where the area is located.

The St. George's Bay EBSA (2)

The St. George's Bay EBSA (Figure 1) covers 1,216 km^2, or 0.5% of the EGSL. The area is shallow (<40 m). This is where, as in the adjacent Northumberland Strait, the water temperatures are warmest in summer. This is also where the ice cover lasts the shortest time (<60 days) during the year. Besides these details, there are no distinctive phenomena in terms of physical processes.

The area is distinguishable mostly for its major role for meroplankton as well as for groundfish and pelagic fish (maximum uniqueness, concentration and adaptive values). Concerning meroplankton, as in the adjacent area, this EBSA is part of the southern section of the Gulf where the largest array and abundance of meroplanktonic species in the Gulf are observed (see details from EBSA #1). As for pelagic fish, the area is located in one of the rare sectors in the Gulf where several pelagic fish species (alewife, spiny dogfish, Atlantic herring, Atlantic mackerel, and silver hake) gather to feed. For juvenile Atlantic herring, the area not only serves as a nursery but also as a wintering area. For the butterfish population, this area which is larger than the area itself represents its only feeding area in the Gulf, which suggests the presence of a key prey not found elsewhere. Pelagic fish probably prefer this EBSA and the Western Cape Breton EBSA because of their significance in terms of adaptive value for pelagic fish in the southern Gulf. Several groundfish species also visit the area in large numbers. For white hake (coastal component of the stock), St. George's Bay is actually the main spawning and rearing area for the entire Gulf. It is also its main summer feeding area where most adults concentrate along with the larger concentrations of juveniles. Consequently, white hake are particularly vulnerable in this area, especially in the critical periods of their seasonal cycle, i.e. during spawning. The scientific data for this small area are erroneous, particularly in the case of primary production, zooplankton, benthic invertebrates and marine mammals. However, for zooplankton, conditions could be similar to the adjacent area where secondary production is very high with high concentrations of small mesozooplankton (<1mm). For benthic invertebrates, the area is still significant and their concentration is at its highest. *Illex coindetti* are found in large concentrations. In addition, the area only has a few giant scallop beds left. The area is located inside a well known significant area for marine mammals. Furthermore, the Gulf ice in this area represents a significant reproductive area in the North-west Atlantic for grey, hooded and harp seals.

The Western Northumberland Strait EBSA (3)

The western Northumberland Strait EBSA (Figure 1) covers 2,194 km^2, or 0.9% of the EGSL. It is shallow (<20 m). Modelling reveals distinctive physical phenomena (significance of the retention potential, tidal mixing and annual temperature cycle amplitude) for the entire area (99.3% of the area). East-bound currents are weaker in the Gulf, which contributes to the long residence period for cold water in this area. This area of the Gulf has the highest annual water temperature and annual temperature cycle amplitude.

An isolated calico crab population (endemic subspecies) persists in this area where they spend their entire life cycle. For winter skate, the largest aggregation, i.e. half of the total population is concentrated in this area (including the southernmost part of adjacent area 5) in summer and early fall. The area is very significant for this species because their numbers have been dropping for twenty years (endangered according to the COSEWIC). These elements give this

area a unique character (maximum uniqueness, concentration and adaptive values for benthic invertebrates and groundfish). Several other groundfish species with limited range can be found in large quantities in the area, such as white hake and windowpane. There are also giant scallop beds as well as particularly favourable conditions for an array and abundance of meroplankton (these conditions occur in much of the southern Gulf, see details of the Western Cape Breton EBSA). The area represents a well known significant area for marine mammals such as seals.

The Southern Fringe of the Laurentian Channel EBSA (4)

The southern fringe of the Laurentian Channel EBSA (Figure 1) covers 5,941 km^2 or 2.3% of the EGSL. It covers almost the entire Gulf west to east, from the Gaspe Peninsula to Cabot Strait. The southern slope of the channel has a steep vertical drop from almost 100 m to over 300 m. In terms of physical phenomena, modelling didn't reveal any particular phenomenon, except for a small area with a retention potential (87 km^2 or 1.5% of the area) offshore from Cape Breton. However, modelling of the surface currents showed the influence from the Gaspe current with its northern channel crossing the area from west to east, reaching the southern channel, and then exiting towards the Atlantic through Cabot Strait. In deeper waters, as in other large channels, oxygen drops from east to west, a concerning phenomenon that's been growing for several decades.

This EBSA is characterized by its great significance for pelagic fish (average to maximum uniqueness, average concentration and adaptive values), and on a larger scale, for groundfish (low to average uniqueness and average concentration and adaptive values). However, the EBSA only partly covers the significant areas for groundfish. The southern slope in Cabot Strait is a critical area for the entire Atlantic cod population in the southern Gulf (of special concern according to the COSEWIC); it is the only wintering area. The population gathers there in large numbers in a relatively small area (this area extends east outside the EBSA and the study area). Atlantic cod are especially vulnerable to disturbance because their entire population gathers there at that time of the year, their energy balance is negative (their food intake does not compensate for energy losses). Around the area towards the middle of the channel are located the only wintering areas in the Gulf for many other groundfish species whose entire populations aggregate there in large numbers. On the fringe of the EBSA, the Cape Breton Channel serves as a migration corridor (spring and fall) to the Atlantic for Atlantic cod (southern Gulf stock), for white hake (coastal component of the stock) as well as for other groundfish species. It is also the principal summer feeding area for witch flounder and white hake (deep water component). For many resident pelagic species in the southern Gulf, the EBSA is unique in that it remains their only corridor to the Atlantic. For most of these species (Atlantic herring, capelin, ribbon barracudina, spiny dogfish, pollock and silver hake), the EBSA is a rare and significant area that serves multiple purposes (feeding ground, refuge).

Besides these characteristics, the EBSA also has significant areas where phytoplankton and zooplankton gather sometimes in large numbers. The EBSA might also be significant as a wintering area for zooplankton. The eastern part of the EBSA is a significant area for marine mammals (relatively well visited by several bottom diving species such as the pilot whale). Benthic invertebrates often use the area compared with the northern part or middle of the channel (concentration index from low to high – species such as soft coral, anemones, Icelandic scallop, shortfin squid, lesser bobtail squid, northern Atlantic octopus, *Pasiphaea multidentata* shrimp, friendly blade shrimp and deepsea king crab).

The South-Western Coast of the Gulf EBSA (5)

The south-western coast of the Gulf EBSA, including Chaleur Bay, extends from the Gaspe Peninsula to Northumberland Strait (Figure 1). The area covers 13,506 km^2, or 5.3% of the EGSL. Depths under 100 m can be found which are typical of the southern Gulf. The area is influenced by the Gaspe current with a bifurcated channel in the south, crossing the area from the tip of the Gaspe Peninsula to Northumberland Strait. The Miramichi and Restigouche rivers empty into the area, creating big estuaries in the Gulf. In summer, these rivers have a major impact on the salinity of surface water in the southern Gulf. Modelling indicates that there are special physical processes in the area (over 1,969 km^2 or 14.6% of the area). These include a retention potential over a specific area in Chaleur Bay and in another area west of Prince Edward Island; resurgence along the Gaspe Peninsula, in Chaleur Bay; and finally, the mixing by tides is significant at the tip of Shippagan as well as in the Restigouche estuary.

The EBSA, in particular the entire southern part of the area starting at Chaleur Bay, is characterized by its rare significance for several pelagic fish species (maximum reaching uniqueness, concentration and adaptive values). Zooplankton production and accumulation is considerable in the area (average uniqueness, average to maximum concentration, and low to maximum adaptive values), likely significant for high trophic levels. These high concentrations of prey (calanus, euphausids) explain why most significant pelagic fish such as Atlantic herring, capelin, Atlantic mackerel and American smelt feed in the area. For adult and juvenile Atlantic herring in the southern Gulf, it's their main feeding area. The area also includes several spawning sites for Atlantic herring. For juvenile Atlantic herring, Chaleur Bay represents their principal wintering area. The area also serves multiple purposes (spawning, refuge, feeding) for many other species (large concentrations of alewife, spiny dogfish, capelin, Atlantic mackerel and American smelt. For groundfish, the Shediac Valley area is a summer feeding area and a significant rearing area for several species (Atlantic cod, winter flounder, yellowtail flounder). These are significant areas where uniqueness, concentration and adaptive values can reach their maximum values. Species with limited range can also be found in large quantities in the area, in particular white hake and windowpane. In addition, the southernmost part of the area is unique for the winter skate (distinct and endangered population in the southern Gulf). Half the population is concentrated, in summer and early fall, along the southern margin of the EBSA and in the adjacent Northumberland Strait EBSA. As for meroplankton, the EBSA is located in the area south of the Gulf where the widest array of species is found (Atlantic cod, winter flounder, American plaice, yellowtail flounder, decapod crustaceans, etc) as well as the greatest abundances among all the identified areas in the Gulf (maximum uniqueness, concentration and adaptive values).

The area also has significant sections for other biological components. With the influence of the Gaspe current, which carries nutriments and phytoplankton cells, high phytoplankton concentrations can be observed in the area. Invertebrates are also very high in numbers north of the area (ascidians, brittle stars, basket stars, *Pandalus montagui*, *Eualus macilentus*, *Spirontocaris spinus*, *Lebbeus polaris*, *Argis dentata*, snow crab, arctic lyre crab). Also in the area there are Icelandic scallop beds as well as shrimp whose ranges are limited (*Eualus fabricii, Sclerocrangon boreas, Lebbeus groenlandicus*). Offshore from the Gaspe Peninsula, there is a significant feeding area for several marine mammal species (opportunistic, planktivorous) such as the harbour seal in winter (population subject to assessment by the COSEWIC but for which there is insufficient data) and the blue whale (endangered species according to the Species at Risk Act).

The Lower Estuary EBSA (6)

The lower Estuary EBSA (Figure 1) covers 9,046 km^2, or 3.5% of the EGSL. It is characterized by an estuarine water circulation and by the Laurentian Channel that crosses the area's entire length. The channel reaches depths of around 300 meters. The head of the channel, near the mouth of the Saguenay, has a significant vertical drop (from 300 m, the bottom rises to 40 m). In addition to the freshwater outlet from the river estuary, a number of streams flow into the lower estuary, especially along the north shore with the Saguenay, Manicouagan, Aux Outardes and Betsiamites rivers. Ice forms early in the season in this area but starts to disappear as early as mid-March.

The lower Estuary EBSA is characterized by the very peculiar occurrence and intensity of certain physical phenomena (modeling indicates the occurrence of such phenomena over two-thirds of the area). Many consider the lower estuary as the motor of the ecosystem. A vigorous mix of tides and deep water resurgence occur year-round at the head of the channel and abundant vertical water movements in the EGSL have been observed in this area. Other very significant deep water resurgence can also be seen on the lower estuary's north shore. The surface water outlet is diverted towards the estuary's south shore, where upon entering the Gulf, it contributes to the Gaspe current. Plumes from the Manicouagan, Aux Outardes and Betsiamites rivers can easily be seen. Finally, an important part of the area has a retention potential. In addition, the deep, dense and cold water (>200 m) from the Atlantic ocean, along with water from the cold intermediate layer, form a progressive current towards the head of the Laurentian Channel. Within this progression, the dissolved oxygen is reduced in bottom water. In certain areas of the lower estuary, oxygen content is only half of what it used to be 75 years ago. Therefore, deep waters across the estuary have less than 30% oxygen saturation and some areas only have 20%. This low saturation level is lethal for certain species, such as Atlantic cod (Gilbert *et al.* 2005).

The exceptional hydrographical conditions at the head of the channel provide a considerable nutriment input. These water dynamics are regarded as nutriment pumps. A portion of the nutritional elements support local production while nutriments that are not consumed on site are exported to the north-western and southern part of the Gulf. The EBSA therefore is characterized by the remarkable intensity of its primary production (maximum uniqueness and concentrations) and secondary production (maximum uniqueness, concentration and adaptive values). This intense production provides for the accumulation of high phytoplankton and zooplankton biomasses (mesozooplankton >1mm and macrozooplankton). A very high secondary production (production and recruitment) and the accumulation of mesozooplankton and possibly macrozooplankton also occur the deep water wintering period. This phenomenon is not only significant for the area, but for the entire Gulf. The lower estuary EBSA also plays a very significant role for groundfish (maximum uniqueness, concentration and adaptive values). According to perennial and multispecific surveys conducted in late summer, the largest concentrations of juvenile Greenland halibut, witch flounder and thorny skate in the entire EGSL are found there. This remarkable accumulation of juvenile flat fish is probably related to the estuarine water circulation in this area. The estuary is also one of the well known significant areas for marine mammals, especially St. Lawrence belugas which live their entire life cycle there (threatened species according to the Species at Risk Act). The area is abundantly visited by marine mammals year-round. There are at least a dozen planktivorous and piscivorous species, including the occasional deep water species such as the sperm whale. Large baleen whales such as the blue whale, fin whale and the minke whale come to replenish their fat reserves before winter. The area is obviously significant for meroplankton and for pelagic fish

but because of the lack of data, it was impossible to show it during the analysis.

The lower estuary is also a significant area for benthic invertebrates (concentrations can reach maximum values), Icelandic scallop beds can be found along with heavy concentrations of anemones, starfish, basket stars, brittle stars, sea urchins, northern Atlantic octopus, snow crab and arctic lyre crab. The area is also one of three EGSL areas where mysid *Boreomysis arctica* was observed. This deep water species could serve as prey for groundfish occurring in the area.

The Western Anticosti Island EBSA (7)

The western Anticosti Island EBSA (Figure 1) covers 3,822 km^2, or 1.5% of the EGSL. There are various depths and oceanographic conditions, while major oceanographic phenomena occur, around the periphery of the area (the Anticosti gyre in the west, the Gaspe current in the south, resurgence along the coasts). In the west, (partially covered by the area) the Anticosti gyre emerges spectacularly with the modelling (resurgence shown by high salinity between 30 and 100 m). North-east of the area, along with the Jacques-Cartier Strait, there are strong tidal currents and significant vertical water movement. Consequently, the area has complex current dispersion patterns and modelling shows a retention potential for most of the area (99% of the area), in association with the Anticosti gyre.

The area is characterized by primary production (wider area where uniqueness is at its maximum and concentration is average). In spring (April-May), there are heavy phytoplankton accumulations and production. The deep water resurgence associated with the Anticosti gyre, south of Anticosti Island and on the north shore, can spontaneously support a high phytoplankton biomass in the area. The area is also characterized by its great significance for secondary production (wider area where uniqueness and adaptive values are at their maximum and concentration is average). Various studies indicate that this area could be very significant for production (reproduction and recruitment) and for maintaining (retention) mesozooplankton in the north-west of the Gulf and in the lower estuary. There are very high zooplankton concentrations and production (macrozooplankton and mesozooplankton >1mm). In this area, in fall, the highest macrozooplankton biomass levels of the entire EGSL are recorded. As for meroplankton, the entire periphery around Anticosti Island represents an exceptional area (maximum uniqueness, concentration and adaptive values for this area). The area captures a portion of this area rich in exceptional species for the abundance of fish and decapod crustacean eggs and larvae (abundant fish egg concentrations and more specifically Atlantic cod and winter flounder, high concentrations of Arctic shanny as well as several shrimp species and snow crab). These observations show the significance of the area for the emergence and development of northern shrimp in the north-western Gulf, for spawning and reproduction as well as for many biological components of the ecosystem.

The area also has significant sections for other analyzed biological components. The area is home to benthic invertebrates (anemones, sponges, sea urchins, *Pasiphaea multidentata, Lebbeus polaris* [near the du 200 m], *Pandalus borealis, Pandalus montagui* [shallower part], snow crab and hermit crab), mainly in its southern part (average to maximum concentration). There is also a significant area for soft coral (partly covered by the area) and for *Boreomysis arctica,* two marginally represented taxons in the EGSL. In addition, the area covers most of a feeding area regularly used by several marine mammal species. There are six species of which a sporadically high number of blue whales and opportunistic species as well as piscivorous species.

The Northern Anticosti Island EBSA (8)

The northern Anticosti Island EBSA (Figure 1) covers 7,620 km^2, or 3% of the EGSL. It is located in one of the five sectors of the EGSL that were identified as under-sampled. The western part of the area covers the shallower water in the Jacques-Cartier Strait and some of it covers most of the Anticosti Channel. The strait forms a stranglehold where there are strong tidal currents and heavy vertical water movements. A significant portion of the area (41%) has a retention potential.

The periphery of Anticosti Island, especially the Jacques-Cartier Strait area west of the area, is remarkable for its abundance of meroplankton species as well as fish and decapod crustacean eggs and larvae (Atlantic cod and winter flounder eggs, sand lance, capelin, Arctic shanny and crab larvae). These observations show the significance of the area (maximum uniqueness and adaptive values) for spawning and reproduction as well as for several biological components in the ecosystem. In shallower water (<200 m), west of the area, there are dense benthic invertebrate communities (maximum concentration for this area - brittle stars, sea urchins, sea cucumbers, *Pandalus montagui, Argis dentata, Eualus fabricii, E. macilentus, Spirontocaris spinus, Lebbeus polaris, Arctic lyre crab, hermit crab*). There are also several important Icelandic scallop beds as well as species not frequently found elsewhere (ascidians, *Lebbeus groelandicus, L. microceros, Eualus gaimardii belcheri*, *Sclerocrangon boreas*).

The area includes significant sections for the other analyzed biological components. Heavy concentrations of phytoplankton and zooplankton have been observed in the area (macro- and mesozooplankton >1mm). Zooplankton is likely to winter there. The area, particularly around the Anticosti Channel, is a concentration and reproduction area for Greenland halibut (likely a distinct sub-population) and a feeding area for several other pelagic fish species (capelin, Atlantic herring and ribbon barracudina). Several (6+) marine mammal species (piscivorous, opportunistic and krill eaters) feed in the area. There are a sporadically and relatively high number of blue whales there (varies from one year to the next).

The Strait of Belle Isle EBSA (9)

The strait of Belle Island EBSA (Figure 1) covers 7,403 km^2, or 2.9% of the EGSL. This north-eastern part of the Gulf has a particularly complex topography. There are several islands along its coasts. The Mecatina trough is located east of the Strait and the Strait of Belle Isle opens into the Atlantic with a depth under 100 m.

Because of the stranglehold effect in the strait, the area represents an area in the Gulf where the currents are the strongest. Furthermore, the tidal currents from the Atlantic are felt throughout the Gulf, greatly contributing to water mixing and deep water resurgence. The area is influenced by water from Labrador which enters the Gulf by way of these tides and currents. Modelling shows physical processes for almost a third of the area (31.9% or 2,359 km^2). The Mecatina trough has a retention potential and deep water resurgence occurs along the north shore and finally, there is heavy tidal mixing in the strait. Temperatures in the area are the coldest of the entire EGSL (surface water in the strait in winter 0-30 m and in the north-eastern part of the Gulf in summer). Ice forms early in the season and persists a long time (until mid-May and up to 140 days). Contrary to the situation in larger channels, water from the Mecatina trough contains plenty of oxygen.

This area is particularly characterized by its significance for marine mammals. It is the only area where uniqueness, concentration and adaptive value are at their maximum. Throughout the north-western Atlantic (EGSL included), this area has no equal in terms of the number of piscivorous marine mammals (reported as early as Jacques Cartier's first visits). There are many piscivorous species as well as large cetaceans (at least 9 mammal species such as harp seals in winter and other species when there is no ice). The abundance of capelin in the area, which is observed simultaneously, probably contributes in a large way to the marine mammal diet. In fact, for most pelagic fish in the northern Gulf, the Strait of Belle Isle represents one of the rare areas with such significance (maximum concentration, average uniqueness and adaptive values). Several species (such as spiny dogfish, Atlantic herring, sand lance and capelin) feed there in large aggregations. This area is also the main spawning ground for Atlantic herring (fall spawning). The area, in particular the Strait of Belle Isle, also has certain significance for benthic invertebrates (maximum concentration and adaptive values). They have a very high concentration index (ascidians, sponges, stars, basket stars, lesser bobtail squid, *Sclerocrangon boreas*, *Eualus fabricii*, *E. macilentus*, *Spirontocaris spinus*, *Lebbeus polaris*, *Pandalus montagui*, *Sabinea septemcarinata*, *Argis dentata,* arctic lyre crab). Also in the strait, the strongest concentrations of shrimp are found, which are only marginally present in the rest of the EGSL (*Eualus gaimardii gaimardii, E. gaimardii belcheri, Lebbeus groenlandicus*, *Spirontocaris phippsi*, *Lebbeus microceros)*. There are Icelandic scallop beds around the Mecatina trough. For groundfish such Atlantic cod, the Mecatina trough could be highly significant. It is a production and concentration area for juvenile Atlantic cod (4S sub-stock) and the significance is difficult to assess. In fact, because of the heterogeneous bottom, trawl sampling of groundfish is impracticable. In a more general way, the whole Middle and Lower North-Shore is under sampled and was identified accordingly during the December 2006 workshop.

The West Coast of Newfoundland EBSA (10)

The west coast of Newfoundland EBSA covers 18,238 km^2, or 7.1% of the EGSL. The area runs along the west coast of Newfoundland, Cabot Strait in the south and up to the Esquiman Channel in the north. It covers mostly coastal waters as well as deeper water at the head of the channel. Modelling did not reveal any significant physical phenomena. Only a small portion of the area has a retention potential (645 km^2 or 3.5% of the EBSA). South of the area, Atlantic water enters the Gulf through Cabot Strait (30-100 m). Contrary to what is generally observed in the EGSL, water temperature in this area is slightly above the freezing point. On average, the ice-cover period is minimal (<60 days). The northern part of the area is mostly influenced by water from Labrador and surface water temperatures are at their lowest (30-100 m). The area includes one of the five areas in the EGSL that is listed as under documented (lack of data).

The area is mostly characterized for the role it plays for groundfish (maximum uniqueness, concentration and adaptive values). Certain sections that are partially covered by the area are somewhat unique and essential for the fact that entire populations concentrate there. Whether in the Esquiman Channel or in shallower waters, western Newfoundland remains the main concentration area for juvenile Atlantic cod, redfish, American plaice and Atlantic wolfish. In addition, entire populations (Atlantic cod, redfish and others) use the Esquiman Channel (overall including the Cabot Strait escarpment) as their principal migration corridor in the Gulf. It does not entirely cover this significant area. These populations have very dense concentrations during certain periods in spring and fall.

The area is also significant for pelagic fish (low to average uniqueness, average to maximum concentration and adaptive values). The channel in Cabot Strait represents a migration corridor and refuge for several species. In winter, the head of Esquiman Channel is the refuge for the Gulf's capelin population and the entire Esquiman Channel is the refuge for a large portion of the northern Gulf Atlantic herring population. These critical refuges are the only ones known for these populations. Many pelagic fish species (Atlantic herring, capelin, ribbon barracudina, spiny dogfish, silver hake and pollock) concurrently use the area as a summer feeding area (head of the Esquiman Channel, channel in the vicinity of the strait offshore from Port-au-Port). There can be large aggregations, especially in the southern half of the area. For most of the pelagic fish species in the northern Gulf, these feeding areas are among the rare locations with such significance.

The significance of this area for fish is reflected through its meroplankton component (maximum uniqueness, average to maximum concentration and adaptive value). North of the area, the meroplankton includes several fish species. In spring, there is a high concentration of Atlantic cod eggs. Since 1993, the area offshore from St. George's Bay is regarded as Atlantic cod's principal area for early spawning (northern Gulf stock entering the Gulf from wintering areas). There are also capelin and Atlantic herring larvae in abundance in this area, especially in the coastal area north of the Port-au-Port Peninsula.

The area also has significant sections for marine mammals (low to maximum uniqueness, concentration and adaptive values). The most important are located in the northern margin of the area (see details concerning the Belle Isle Strait EBSA) and south of the area, where St. George's Bay represents a potentially significant feeding area for many species (blue whale, divers, krill eaters) that enjoy the ice-free water most of the time.

Sources of Uncertainty

The St. Lawrence marine ecosystem represents an extremely complex and dynamic environment. The sampling conducted so far has provided enough information to characterize the environment while highlighting existing uncertainties and gaps in terms of time related coverage as well as knowledge of certain sectors and biological components. Based on the available and processed data and on the tight deadlines given to the approach, the EBSA analytical identification exercise was conducted. The EBSA characterization text shows the main gaps in terms of analyzed information.

During the workshop, the analytical exercise helped identify five sectors for which there has been less overall data available due to a lack of sampling (Savenkoff *et al.* 2007). It is the shoreline including the coastal waters of the Magdalen Islands, the upper estuary, the Middle and Lower North Shore, the south-western part of Anticosti Island, and a portion of western Newfoundland. The difficulty in trawling heterogeneous bottoms or the relative distance of certain areas represents methodological sampling limits that are difficult to contend with.

Concerning the sectors that weren't covered by the analysis, there are the Saguenay River, upper estuary as well as the EGSL's 5,000 km shoreline (0-30 m). One of the reasons why these sectors weren't considered in the analysis was the lack of data or recent data. In addition, the people responsible for the marine mammal component mentioned that the deadline did not provide them with enough time to process all the existing data. They mentioned four known

significant areas that weren't generated by the analysis; the lower estuary (nevertheless included in an EBSA), the eastern and western part of Prince Edward Island (included in two EBSA) and a portion of Jacques-Cartier Strait (included in an EBSA).

As for the ecosystem species and communities, there are also gaps in terms of the analyzed information. In fact, in order to avoid any bias, some data that didn't cover the whole EGSL was excluded from the analysis. As for meroplankton and pelagic fish data, it did not cover the lower estuary. Due to a lack of data, benthic invertebrates were particularly under represented in the analysis regardless of their remarkable diversity and their significant contribution to the ecosystem. An expert regretted that only 2% of the listed benthic invertebrates (Brunel *et al.* 1998) were considered in the analysis. Furthermore, the commercially landed species were over-represented in the data.

In the EGSL, the seasonal and multiyear variability is significant. The productivity of the ecosystem cannot be addressed without considering the temporal variability. In addition, in a management perspective, considering the seasonal variability can provide for example a way to avoid disturbing a species during a critical period in their life cycle. Nevertheless, many stakeholders remind us that sampling often doesn't provide an adequate temporal coverage of the EGSL. With the approach, it was difficult to account for temporal variability in the analysis.

CONCLUSION AND ADVICE

At the end of their analysis, the stakeholders identified ten EBSA for the EGSL. They cover 77,184 km^2, or 30% of the EGSL. There is a link between identified areas based on the analytical approach and those previously documented according to scientific expertise. However, the upper estuary, the Anticosti gyre, the south-eastern part of Anticosti Island, the eastern part of the Magdalen Islands as well as the entire North-Shore were identified according to the expertise but were not based on the analytical approach. The difference between the two exercises was mostly due to the refinement provided by the analytical approach in terms of defining significant areas but also because of a lack of data, particularly concerning the upper estuary.

The analysis was confined by a tight deadline and a lack of available data. Therefore, the EBSA boundaries should not be strict and definite. However, it is crucial that these boundaries be refined in order to effectively use this tool in a management approach. Furthermore, the lack of information, particularly within some of the EBSA and in less documented sectors, requires an increase in terms of sampling effort and documentation. It will be critical to reiterate the analytical exercise in order to consider new data and information as well as data that was not available at the time of the analysis. In this respect, the stakeholders believe it is crucial that in the short or medium term, the shoreline area and the related species be part of an analysis equal to the one that is mentioned here.

Finally, the EBSA do not cover all the areas or species that contribute in a significant way to the EGSL's dynamic. The fact that a significant ecosystem component is not included or partially included in an EBSA cannot be considered as an ecologically significant absence. Sensitive populations as well as certain exceptional areas were not – or not entirely/always – included in the EBSA. Other management tools such as marine protected areas or the Species at Risk Act have to consider ecosystem elements that require special treatment, beyond what is provided by the EBSA.

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