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# Proceedings of the Zonal Peer Review for the Recovery Potential Assessment – Lumpfish, Atlantic Ocean

**March 12-13, 2019**
**St. John’s, NL**

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**Editor: Julia Pantin**

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**Foreword**

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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## SUMMARY

A Zonal Peer Review Process for the Recovery Potential Assessment (RPA) of Common Lumpfish in the Atlantic Ocean was held in St. John's, Newfoundland and Labrador (NL) March 12-13, 2019. The purpose of the process was to present scientific information on the current status of Common Lumpfish, threats to its survival and recovery, and the feasibility of recovery. The advice from the RPA may be used to inform the development of management scenarios as well as scientific and socio-economic aspects of the listing decision, development of a recovery strategy and action plan, and to support decision making with regards to the issuance of permits or agreements, and the formulation of exemptions and related conditions, as per sections 73, 74, 75, 77, 78 and 83(4) of the *Species at Risk Act* (SARA). The advice from the RPA may also be used to prepare for the reporting requirements of SARA s.55.

This Proceedings Report includes abstracts and summaries of meeting discussions, as well as a list of research recommendations. The meeting Terms of Reference, agenda, and list of participants are appended.

# INTRODUCTION

After the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses an aquatic species as Threatened, Endangered or Extirpated, Fisheries and Oceans Canada (DFO) undertakes a number of actions required to support implementation of the *Species at Risk Act* (SARA). Many of these actions require scientific information on current stock status, threats to its survival and recovery, and the feasibility of recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. This timing allows for consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

Common Lumpfish (*Cyclopterus lumpus*) was designated as Threatened by COSEWIC in November 2017, based on sharp declines in commercial landings and a decline in abundance in bottom trawl surveys over 19 to 20 years (COSEWIC 2017). A pre-COSEWIC meeting, which reviewed all the available information on this species, was held November 17-18, 2015 (Simpson et al. 2016). In addition, a single stock assessment of Common Lumpfish has also been conducted recently in the Quebec Region (DFO 2016).

In support of listing recommendations for Common Lumpfish by the Minister, DFO Science has been asked to undertake a RPA, based on national RPA Guidance. The advice from the RPA may be used to inform both scientific and socio-economic aspects of the listing decision, the development of a recovery strategy and action plan, to support decision making with regards to the issuance of permits or agreements, and the formulation of exemptions and related conditions, as per sections 73, 74, 75, 77, 78 and 83(4) of SARA. The advice may also be used to prepare for the reporting requirements of SARA s.55. The advice generated via this process will update and/or consolidate any existing advice regarding the Lumpfish Designatable Unit.

The objectives of the current RPA were:

- To provide up-to-date information, and associated uncertainties, to address the following elements:

**Biology, Abundance, Distribution and Life History Parameters**

**Element 1:** Summarize the biology of Lumpfish.

**Element 2:** Evaluate the recent species trajectory for abundance, distribution and number of populations.

**Element 3:** Estimate the current or recent life-history parameters for Lumpfish.

**Habitat and Residence Requirements**

**Element 4:** Describe the habitat properties that Lumpfish needs for successful completion of all life-history stages. Describe the function(s), feature(s), and attribute(s) of the habitat, and quantify by how much the biological function(s) that specific habitat feature(s) provides varies with the state or amount of habitat, including carrying capacity limits, if any.

**Element 5:** Provide information on the spatial extent of the areas in Lumpfish's distribution that are likely to have these habitat properties.

**Element 6:** Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.

**Element 7:** Evaluate to what extent the concept of residence applies to the species, and if so, describe the species' residence.

**Threats and Limiting Factors to the Survival and Recovery of Lumpfish**

**Element 8:** Assess and prioritize the threats to the survival and recovery of Lumpfish.

**Element 9:** Identify the activities most likely to threaten (i.e., damage or destroy) the habitat properties identified in elements 4-5 and provide information on the extent and consequences of these activities.

**Element 10:** Assess any natural factors that will limit the survival and recovery of Lumpfish.

**Element 11:** Discuss the potential ecological impacts of the threats identified in element 8 to the target species and other co-occurring species. List the possible benefits and disadvantages to the target species and other co-occurring species that may occur if the threats are abated. Identify existing monitoring efforts for the target species and other co-occurring species associated with each of the threats, and identify any knowledge gaps.

**Recovery Targets**

**Element 12:** Propose candidate abundance and distribution target(s) for recovery.

**Element 13:** Project expected population trajectories over a scientifically reasonable time frame (minimum of 10 years), and trajectories over time to the potential recovery target(s), given current Lumpfish population dynamics parameters.

**Element 14:** Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present and when the species reaches the potential recovery target(s) identified in element 12.

**Element 15:** Assess the probability that the potential recovery target(s) can be achieved under current rates of population dynamics parameters, and how that probability would vary with different mortality (especially lower) and productivity (especially higher) parameters.

**Scenarios for Mitigation of Threats and Alternatives to Activities**

**Element 16:** Develop an inventory of feasible mitigation measures and reasonable alternatives to the activities that are threats to the species and its habitat (as identified in elements 8 and 10).

**Element 17:** Develop an inventory of activities that could increase the productivity or survivorship parameters (as identified in elements 3 and 15).

**Element 18:** If current habitat supply may be insufficient to achieve recovery targets (see element 14), provide advice on the feasibility of restoring the habitat to higher values. Advice must be provided in the context of all available options for achieving abundance and distribution targets.

**Element 19:** Estimate the reduction in mortality rate expected by each of the mitigation measures or alternatives in element 16 and the increase in productivity or survivorship associated with each measure in element 17.

**Element 20:** Project expected population trajectory (and uncertainties) over a scientifically reasonable time frame and to the time of reaching recovery targets, given mortality rates and productivities associated with the specific measures identified for exploration in element 19. Include those that provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.

**Element 21:** Recommend parameter values for population productivity and starting mortality rates and, where necessary, specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts in support of the listing process.

**Allowable Harm Assessment**

**Element 22:** Evaluate maximum human-induced mortality and habitat destruction that the species can sustain without jeopardizing its survival or recovery.

# PRESENTATIONS

## INTRODUCTION – RPA PROCESS AND ELEMENTS, BACKGROUND

Presenter: M. Simpson

### Abstract

An overview of the RPA process was presented, which outlined how the process was developed by DFO Science to provide information and scientific advice needed to meet the various requirements of the *Species at Risk Act* (SARA). The RPA process is required when COSEWIC designates a species is Threatened or Endangered. The RPA is designed to support development of management scenarios for evaluating costs of recovery, inform public consultations, support decisions regarding SARA agreements and permits, inform decision to list a species on Schedule 1 of SARA, and, if listed, to assist Recovery Teams in developing a Recovery Strategy and/or Action Plan for the species. It was emphasized that addressing the 22 elements of the RPA in a timely manner is crucial for the successful completion of the SARA listing process, including additional requirements such as management scenario development, socio-economic analysis, public consultations and listing decision.

### Discussion

There was no discussion regarding this presentation.

## BIOLOGY AND LIFE HISTORY PARAMETERS (ALL AREAS)

Presenter: R. Collins

### Abstract

The Common Lumpfish is a globiform teleost fish that is broadly distributed in Arctic and Subarctic waters, found off 24 countries, and present on both sides of the Western Atlantic Ocean. There is evidence of genetic differentiation between several Common Lumpfish populations. In the northwest (NW) Atlantic, distribution is almost continuous, with the species being found off Greenland, Baffin Island, Hudson Bay, Quebec, and the Atlantic Provinces, right down to Chesapeake Bay in the United States.

The species is semi-pelagic, and found over a broad range of depths, from less than 20 m to over 1,000 m. Temperature tolerance ranges from -1 to 18°C, possibly more, but preference appears to be for cold water, less than 5°C. There is considerable sexual dimorphism, with males undergoing a colour change to red during the spring mating season, during which time at least a portion of the population in Canada moves inshore, where males establish nests into which females deposit eggs prior to fertilization. Males guard the eggs until hatching during the summer. Newly-hatched larvae are pelagic, and the species appears to rely heavily on eelgrass and macroalgae during early life stages.

In terms of interspecific interactions, Common Lumpfish are preyed upon by numerous species, especially seals, sharks, and Sperm Whales. They are subject to infection by a variety of bacteria, viruses, and parasites. The Common Lumpfish diet reveals opportunistic predation, and their tendency to consume Salmon Lice has resulted in widespread use as a cleaner fish in aquaculture operations in other countries.

In Canadian waters, most aspects of the species' life history are poorly understood. Size at 50% maturity ($L_{50}$) was previously estimated to be 34 cm, but recent research suggests a much lower $L_{50}$, especially for males. Estimate of maximum age is 13-14 years, based on otoliths, but the aging method has not been validated. There is considerable uncertainty surrounding estimates of generation time (G), natural mortality (M), and intrinsic rate of natural increases (r) for this species.

### Discussion

There was a question regarding whether there is migration of Common Lumpfish between the regions. It was explained that there is potential for exchange, but the extent is unclear. There is some tagging data that suggests that Common Lumpfish may move up to 500 km and it is known that they spawn inshore. As well, tag loss may be a limitation to addressing this issue with tagging studies.

## ABUNDANCE AND DISTRIBUTION

### Newfoundland and Labrador

Presenter: P. Upward

#### Abstract

Abundance and biomass indices for Common Lumpfish were estimated utilizing data from the DFO multispecies research vessel (RV) survey series. Abundance and biomass levels have declined substantially from those seen in the 1980s and 1990s. Some of the shifts could be attributed to changes in the survey trawl equipment which have not been standardized for the species. Over the time series the surveys shifted across three different trawl types; Yankee trawl (spring survey, 1972-1982), Engels trawl (Spring survey, 1983-1995; Fall survey, 1977-1994) and Campelen (Spring survey, 1996 to current; Fall survey, 1995 to current). Conversion factors for Common Lumpfish weren't or couldn't be calculated as the catches were too low across any comparative work that was carried out. Changes in the timing of the Spring survey also seems to have had an impact on the abundance and biomass of Common Lumpfish as the species is known to migrate inshore for reproduction during this time period. Since 1996, Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps has seen a precipitous decline in the abundance and biomass of Common Lumpfish in the spring survey. The Fall survey in Divs. 2J3KL saw increases in abundance from 1996 to 2004, followed by a period of decline to 2008, with little sign of recovery since.

#### Discussion

There was no discussion regarding this presentation.

### Newfoundland and Labrador Inshore (Newman Sound)

Presenter: D. Lancaster

## Abstract

Inshore Common Lumpfish data from a DFO long-term monitoring program in Newman Sound and other coastal Newfoundland fjords, located in 3L and 3K, provide a snapshot of inshore Lumpfish abundance (predominantly juveniles). Newman Sound long-term fish and habitat monitoring has been occurring annually since 1995. The program samples 12 seine sites bi-weekly, typically July to November, (a May sampling trip has occurred annually since 2002), with an average of 12 trips per year.

Common Lumpfish annual abundance in Newman Sound, NL from July to November increased marginally from 2002 onward, however there is considerable annual variability. Common Lumpfish catches in Newman Sound are highest in May, October, and November. Catches of larger Common Lumpfish (185 mm-260 mm) are highest in May which is consistent with a seasonal inshore breeding migration. However, the majority of the May catch is composed of juveniles (10 mm-35 mm). These juveniles may be young-of-the-year from an early breeding pulse or they could be small overwintering juveniles from the previous year.

Larger Common Lumpfish are rarely retained in seine sampling in Newman Sound, likely due to the shallow sampling depth. However, seven breeding males (displaying red breeding colouration) were identified in Newman Sound since 1995. Breeding male size ranged from 190 mm-240 mm.

The five sample sites associated with highest catches are located in the more sheltered inner sound. This may suggest breeding Lumpfish preferentially select sheltered nest sites, or that nests are more successful in more sheltered areas. More research on nest site selection is required.

Common Lumpfish abundance, length, and seasonal trends were consistent across a two-year east coast fjord expansion study. This suggests Newman Sound is representative of coastal fjord systems across the east coast of Newfoundland.

## Discussion

There was discussion regarding the presence of spawning Common Lumpfish in Newman Sound. It was explained that males guarding nests have been observed during dives (in very shallow areas); however, it may be that the nests are deeper in areas where seining occurs and that is why adult males have not been caught in the spring/summer sampling season. It may be possible that Common Lumpfish become sexually mature at a smaller size than previously thought. Large Common Lumpfish displaying mating colours (red and blue) have been observed in photos from Newman Sound and if the time stamps were analyzed, this would give an indication of whether there are males guarding nests (e.g., red Lumpfish in spring photos). It was noted that maturity is not recorded for Common Lumpfish caught in Newman Sound, but this may be something that could be added to the sampling protocol.

There was discussion surrounding the increase in eelgrass distribution observed in Newman Sound. It was explained that this increase was natural and there was no artificial propagation. At the start of the time series there were three sites that were not eelgrass habitat, but have changed to have eelgrass; therefore, all studied sites in Newman Sound are now eelgrass habitats. As well, all of the sites within the expanded study areas contain eelgrass habitat. In the early years of the Newman Sound survey program, the three originally non-eelgrass sites did not show markedly lower catches of Common Lumpfish than the nine original eelgrass sites. However, Common Lumpfish abundance at all sites was low in the early years of the survey program (i.e., before 2002). A study of Common Lumpfish abundance in eelgrass vs. non-eelgrass sites may yield different results now that overall Common Lumpfish catches are higher in Newman Sound. It was suggested that the timing of the habitat change (expansion of eelgrass) could explain why there has also been an increase in Common Lumpfish abundance in the inshore sampling. All fish species that are sampled in Newman Sound have increased in abundance with the increase in eelgrass habitat, possibly indicating that this habitat is very important for juvenile fish. There was a question as to whether too much eelgrass could be bad for juvenile Common Lumpfish, with respect to anthropic runoff and increased phosphorus resulting in decreased oxygen. It was noted that the data is available to investigate this by looking at percentage cover of eelgrass by year to see if there was a year with large percentage cover of eelgrass and decreased abundance of Common Lumpfish.

There was a question regarding the invasion of Green Crab in Newfoundland and whether these eelgrass habitats in Newman Sound are suitable for Green Crab. It was explained that these habitats are suitable for Green Crab and it is expected that they will arrive in Newman Sound at some point.

## Scotian Shelf

Presenter: M. Simpson

### Abstract

Data from three Maritimes Region RV survey time series, commercial fishery landings, at-sea observations of commercial fishing operations, and joint Industry-DFO surveys were presented. Common Lumpfish are distributed throughout the region with low abundance. Areas with the highest frequency of occurrence on the western Scotian Shelf (Divs. 4X5Y) were in the Bay of Fundy between Grand Manan and St. Mary's Bay, and Browns Bank. Common Lumpfish occur throughout the eastern Scotian Shelf (Divs. 4VsW) both inshore and spread across Banquereau Bank, and along the shelf edge. Few specimens were caught on Georges Bank (Div. 5Z). Common Lumpfish were caught more frequently by the spring RV survey conducted on the eastern Scotian Shelf (4VsW) than by the spring Georges Bank (Div. 5Z) or summer RV surveys (Divs. 4VWX), but none of the RV surveys showed any trends in Common Lumpfish abundance over the past 40 years.

### Discussion

There was no discussion regarding this presentation.

## Southern Gulf of St. Lawrence (4T)

Presenter: T. Tunney

### Abstract

Common Lumpfish occur in the southern Gulf of St. Lawrence (Div. 4T), but regional data on this species are limited. Data on abundance, biomass, and distribution are available from the annual September DFO-Gulf bottom trawl survey that has been conducted since 1971. Common Lumpfish were found infrequently in Div. 4T, with inter-annual variability in catch location and magnitude. The abundance index averaged 0.07 fish per tow and the biomass index averaged 0.066 kg per tow over the whole time series 1971-2017. Over time, the catch rates of Common Lumpfish greater than 34 cm (size at maturity in other locations) have decreased with very few specimens caught in recent surveys (2000-present).

There is no directed Common Lumpfish fishery in the southern Gulf, and Lumpfish are rarely observed in bycatch reported for other fisheries in this region. At-sea Observer (ASO) data (Div. 4T) report Common Lumpfish catches in cod otter trawls, plaice scottish seines, cod gillnets, Winter Flounder gillnets, redfish trawls, plaice gillnets, cod scottish seines, shrimp trawls, Winter Flounder trawls, and Greenland Halibut gillnets. It is important to note that availability of data was dependent on the percentage of ASO coverage of each fishery. Southern Gulf (Div. 4T) Zonal Interchange Format File (ZIFF) records suggest few Lumpfish were reported in recent landed bycatch, although they were most often observed where Winter Flounder was the dominant species caught.

#### Discussion

There was discussion surrounding the estimates of abundance presented for the southern Gulf of St. Lawrence and the assumptions associated with them. It was noted that most of the data (as in other regions) are based on benthic trawls; however, surveys that use surface trawls, such as for salmon, in other locations have reported that they see Common Lumpfish regularly. There are no pelagic or surface survey data available for the southern Gulf at this time. Therefore, if Common Lumpfish are more ubiquitous in pelagic waters of the southern Gulf, they may not be effectively sampled. On the other hand, it was argued that the average depth in the southern Gulf of St. Lawrence is ~40 m; therefore, it is possible that, because the water is shallower than in other regions, the benthic trawl is able to catch more of the Common Lumpfish that are present. It was reiterated that the benthic trawl data are used for an index and can still be informative, especially considering the consistencies with timing and location. Because the survey in this area takes place in September and there is no expectation of migration, the index from the benthic trawl should be a reasonable index of relative abundance.

### Northern Gulf of St. Lawrence

Presenter: J. Gauthier

#### Abstract

A winter DFO survey (1978-94) covering NAFO Subdiv. 3Pn, Divs. 4RS and part of Div. 4T showed that Common Lumpfish were present in 45% of the sets. They were more concentrated along the west (Div. 4R) and south (Subdiv. 3Pn) coasts of NL. Data presented for areas consistently covered indicated that in Subdiv. 3Pn, Common Lumpfish mean number per tow averaged 3.2 fish, and mean weight per tow averaged 7.8 kg overall. In Div. 4R, the abundance index averaged 3.3 fish per tow, and the biomass index averaged 4.5 kg per tow overall. These indices varied without trend over the survey period.

In the DFO summer survey (1990-2018) (Divs. 4RS and part of Div. 4T), Common Lumpfish were caught in 8% of the sets. Abundance and biomass indices were fairly stable and below the series average from 1990 to 2004. After, the yearly variations in these indices were larger and they showed an increase from 2012 to 2016. They have decreased since, but remain above their respective series average. Very few mature Common Lumpfish (≥34 cm) are caught in this survey and variation in the indices are driven by immature fish (<34 cm).

In the summer sentinel survey (1995-2018) (Subdiv. 3Pn, Divs. 4RS and part of Div. 4T), Common Lumpfish were caught in 5% of the sets. Over the time series, abundance and biomass indices varied slightly around their respective series average of 0.08 fish per tow and 0.09 kg per tow. There are no clear trends in these indices.

Both summer surveys showed recurrent concentrations of Common Lumpfish in the Bay of Sept-Iles, on the north shore of the Gulf and the head of the Esquiman Channel. Common Lumpfish are found at depths between 50 and 350 m, and at temperatures ranging from -0.5 to 5.8 °C.

Based on these three survey series, Common Lumpfish would be more available to bottom trawl surveys during winter and there has been no clear indication of either a decrease or an increase in Common Lumpfish abundance over the 1978-2018 period in the northern Gulf of St. Lawrence.

As well, there is preliminary data on length at which 50% ($L_{50}$) of Common Lumpfish are mature. Based on a limited number of fish analyzed, $L_{50}$ would be 22.5 cm for males, and 33 cm for females.

#### Discussion

There was no discussion regarding this presentation.

### Central and Arctic

Presenter: M. Treble

#### Abstract

DFO has conducted random depth-stratified bottom trawl surveys in portions of NAFO Divs. 0A and 0B in the fall (September-October) during 1999 to 2017, in collaboration with the Greenland Institute of Natural Resources and their research vessel *Paamiut*. An Alfredo III trawl with a 30 mm mesh liner in the cod end was used for deep water surveys (400 m to 1,500 m) and the Cosmos shrimp trawl for shallow water surveys (100 m to 800 m). Not all areas and depths have been surveyed each year. All fish were sampled for individual length and weight. The Northern Shrimp Research Foundation (NSRF) has conducted surveys in Shrimp Fishing Area (SFA) SFA2, SFA3, and Resolution Island Area from 2005 to 2017 during summer (July-August) at depths 100 m to 800 m. Several different vessels have been used for the NSRF surveys and the gear used is the Campelen 1800 shrimp trawl, which was modified in 2008 to minimize gear damage with the addition of larger footgear and floatation on belly seams. Fish caught in the NSRF surveys are identified, but only total count and weight data are recorded for each set.

A total of 73 Common Lumpfish have been caught across all surveys (1999-2017) with most of these coming from the Resolution Island and SFA2 Exploratory and Div. 0B areas. There are no observable trends in this data due to small catches and variability in survey area, gear, and vessels. The size of the Common Lumpfish caught in these surveys ranged between 7.5 cm and 41 cm (0.002 kg to 4.78 kg). Depth and temperature ranges at locations of fish capture were 143 m to 1,275 m, and -1.01°C to 4.21°C, respectively.

#### Discussion

There was a question regarding whether there is information on what is happening with Common Lumpfish on the Greenland side of the Central and Arctic Region, and whether Common Lumpfish may be moving from west Greenland to Canadian waters. It is unknown whether this may be the case because Common Lumpfish are not included in the Greenland presentations at NAFO meetings; however, other species such as redfish exhibit this kind of movement so there may be some connectivity between Greenlandic and Canadian populations of Common Lumpfish.

## ABUNDANCE AND DISTRIBUTION BULLETS

For Element 1, it was reiterated that the bullet should reflect the biology that is relevant to the RPA, particularly in how data collection could be affected by the species biology. There was some discussion regarding the certainty of the reported size at maturity. While some participants felt as though the size at maturity was poorly understood, other felt that even preliminary information should be mentioned as opposed to indicating that nothing is known.

There was a suggestion to add information on diurnal movements to the bullet for Element 1 as there is evidence from Newfoundland and Labrador, the southern Gulf of St. Lawrence, and Iceland that this occurs. This movement could make Common Lumpfish more vulnerable to bottom trawling during daylight.

Regarding Element 2, there was discussion highlighting the caveats around using demersal trawls and sampling in seasons where inshore migrations may be taking place. It was explained that the data from this sampling are used for interpreting relative changes. The data are used to calculate indices, rather than absolute values of abundance. However, it was stressed that there is confidence in the NL surveys due to the timing of the surveys in the spring in NAFO Divs. 3LNOPs and the fall in NAFO Divs. 2J3KLNO, but less confidence in the summer surveys in other regions. It is especially important that there is confidence in the estimates obtained from surveys where commercial fisheries for Common Lumpfish exist.

Regarding Element 3, it was acknowledged that some participants were uncomfortable with the values of G, M, and r provided by COSEWIC. It was noted that some of these parameters are possibly better understood in Iceland. Further work on this was suggested as a research recommendation.

## HABITAT AND RESIDENCE REQUIREMENTS

There was information presented for Newfoundland and Labrador and the northern Gulf of St. Lawrence on habitat and residence requirements.

### Newfoundland and Labrador

Presenter: M. Simpson

#### Abstract

General habitat requirements of Common Lumpfish were reviewed including the importance of eelgrass and macroalgae for early life stages. It was concluded that Common Lumpfish mating/nesting grounds constitute a residence, since the males construct dens for the eggs, and also modify and protect the area once the eggs are laid. These dens support reproduction (an essential life-cycle process) and are occupied by both adults and eggs/larvae.

In NL waters, based on research vessel surveys, Lumpfish were typically found in <400 m depths and prefer waters ≤4°C. Based on point maps from DFO-NL, standardized catch rates from spring and fall surveys indicated that Common Lumpfish distribution varies inter-annually. In Subdivs. 3Ps and 3Pn, they were distributed from inshore bays to the shelf edge in some years, and were caught in very limited locations in other years. Similarly, Common Lumpfish were found across the Newfoundland and Labrador Shelf from inshore to the shelf edge during fall surveys in some years, whereas their catches were more restricted to inshore areas in other years. Overall, the range of Common Lumpfish catches has declined in spring and fall surveys in relation to the reduction in Common Lumpfish density.

#### Discussion

There was no discussion regarding this presentation.

### Northern Gulf of St. Lawrence

Presenter: J. Gauthier

**Abstract**

Monitoring of eelgrass beds conducted between 2005 and 2010 in the Gulf of St. Lawrence showed the presence of juvenile Common Lumpfish in 5 of the 11 sites studied. This information supports the importance of eelgrass as habitat for juvenile Common Lumpfish.

**Discussion**

It was noted that Common Lumpfish were caught during eelgrass surveys conducted by beach seine from May to October in the southern Gulf of St. Lawrence between 2005 and 2010. This indicates that Common Lumpfish occupy eelgrass habitats in this area. Efforts are being made on an opportunistic basis to look into eelgrass as a habitat for juvenile Common Lumpfish, so when needed, the results could be evaluated.

## HABITAT AND RESIDENCE REQUIREMENTS BULLETS

With reference to Element 4, there was discussion surrounding whether specific habitats could be identified for life history stages. It was explained that data are limited and the only information available is for nesting habitat. There is only general information for offshore areas (e.g. Common Lumpfish exist in a range of salinities and temperatures) and it does not appear as though Common Lumpfish have specific habitats such as upwellings or offshore feeding area, nor do they form spawning aggregations. It was also noted that the Element text uses the word “need” and it was questioned whether these habitats (macroalgae and eelgrass) are needed or just a preference. It was explained that it is not known whether these habitats are required, but when young Common Lumpfish are observed, they are often associated with macroalgae and eelgrass. As well, there are not many young Common Lumpfish caught offshore and that habitat does not contain macroalgae or eelgrass.

There was discussion surrounding the concept of residence for Element 7. It was noted that in the guidance, an important aspect of residence is that the species modifies or creates it; however this is not specific in SARA. With this interpretation, residence would apply to nests, but not to macroalgae. Discussion ensued regarding whether the males actually build nests. It was thought that the use of nests is more opportunistic – that Common Lumpfish do not build nests, they find suitable areas and nest there. One participant suggested that they create a depression in small gravels, and it was added that pre-spawning males demonstrate nest cleaning as stated in Goulet (1985). Due to this modification, it was agreed that Common Lumpfish have a residence. It was noted that the only mating observations are from inshore areas; however, Common Lumpfish are caught offshore during the mating season, therefore it is possible they have residences offshore as well.

## THREATS AND LIMITING FACTORS TO SURVIVAL AND RECOVERY OF LUMPFISH

### Newfoundland and Labrador

Presenter: H. Rockwood

**Abstract**

Common Lumpfish in Atlantic Canada was designated as Threatened by COSEWIC in 2017, due to severe declines in both research survey abundance/biomass indices and commercial landings. The two quantified anthropogenic threats to the recovery of Common Lumpfish are fishing-related mortality from directed commercial fisheries and, to a lesser extent, bycatch that is retained/landed and/or discarded in commercial fisheries directing for other species. The

directed Lumpfish fishery began in the 1970s and targets females exclusively, collecting unfertilized eggs to be marketed as caviar. Males and immature Common Lumpfish are discarded at sea. There are three data sources used to quantify catch and bycatch in the Newfoundland and Labrador Region: DFO-NL ZIFF landings (1985-2017), Canadian ASO catch and discard data (1983-2017), and NAFO STATLANT-21A landings (1970-2017). However, the latter is inconsistent with published data from other sources and is considered incomplete and not employed in evaluating removals. Directed commercial landings increased over the 1970s and 1980s, but have been at low levels in more recent years, especially since 2001. Common Lumpfish are most often bycaught in gillnets, and less frequently in otter bottom trawls. Since 2007, the amount of Common Lumpfish bycatch has decreased significantly. However, this does not necessarily reflect the state of the stock because these data are dependent on ASO coverage which is often under 5% and has been 0% in Common Lumpfish-directed fisheries since 2010. Because of this lack of coverage, there is no way to quantify discards of male and immature Common Lumpfish in the commercial directed fishery. As the landed product is Common Lumpfish roe, this fishery cannot be dockside monitored and is monitored using fishers' self-reporting logbooks. Options for mitigating fishing threats include reducing fishing pressure through license buy-backs and fishing closures, prohibiting the Common Lumpfish roe fishery, and developing gear modifications to reduce bycatch.

#### Discussion

Clarification was requested regarding referring to the Common Lumpfish fishery as an input control fishery. It was explained that the fishery does not have a Total Allowable Catch; rather, it is managed using controls such as gear restrictions, limits on the number of harvesters, seasons, etc.

It was noted that there have not been any directed fishery Common Lumpfish logbooks in the database since 2006, even though logbooks are a license requirement.

### Scotian Shelf

Presenter: M. Simpson

#### Abstract

Commercial fishing is the only known threat for Common Lumpfish in the Maritimes Region. There is no directed fishery. They are caught as bycatch in bottom trawls and gillnets. Common Lumpfish bycatch must be landed in all groundfish fisheries, but only a few have been landed in recent years. No roe has been reported since 1997. At-sea observer reports of Common Lumpfish in commercial fisheries were compared for the time periods 1978-1993 and 1994-2018. Bycatch of Lumpfish declined following the 1993 moratorium on groundfish in Divs. 4VW and the implementation of the separator grate in Silver Hake fisheries and the Nordmore grate in Northern Shrimp fisheries. At-sea observer coverage for the more recent time period indicates that some Common Lumpfish are caught in redfish, Pollock, Silver Hake and sculpin fisheries. Observer coverage is low in groundfish fisheries, averaging 3% for Pollock and 8% for redfish in Divs. 4VW from 2015-2018. Common Lumpfish are also caught in inshore lobster and scallop gear, based on a single year of observer coverage for these fisheries.

#### Discussion

This information was presented in the abundance and distribution presentation. The following discussion took place following that presentation.

Clarification was required regarding some of the data used. MARFIS is the Maritimes Region fisheries database, which is equivalent to ZIFF in other regions. As well, the observer data used is not scaled in any way, it is taken straight from the database.

## Southern Gulf of St. Lawrence

Presenter: T. Tunney

### Abstract

Abstract not provided.

### Discussion

This information was presented in the abundance and distribution presentation. The following discussion took place following that presentation.

It was clarified that there is no directed Common Lumpfish fishery, so data are bycatch of Common Lumpfish from other fisheries. There is very little data on Common Lumpfish in this dataset and much of the data were missing latitude and longitude coordinates so it was not possible to create a distribution map with the data. It was noted, however, that these data can be useful for determining which fisheries interact with Common Lumpfish.

## Northern Gulf of St. Lawrence

Presenter: J. Gauthier

### Abstract

Information was presented on commercial fishery in Divs. 4RS. A commercial fishery directing for female Common Lumpfish commenced in the Gulf of St. Lawrence along the West coast of NL (Div. 4R) in 1970, and was followed by the start of a fishery on the Quebec's Lower North Shore (Subdivs. 4Sw and 4Sv) around 1986. Common Lumpfish roe landings peaked at 673 t in 1999 in Div. 4R and at 114 t in 1987 in Div. 4S. Between 2013 and 2018, roe landings averaged 17 t in 4R and there has been no directed Common Lumpfish fishery in Div. 4S. The number of participants in this fishery has decreased in Div. 4R from 664 in 1987 to 10 in 2017. For Div. 4S the maximum number of participants was 89 in 1989.

Bycatch of Common Lumpfish was looked at from two data sources. Reported bycatch of Lumpfish in Divs. 4RS from the ZIFF database is negligible. Based on the ASO database, the bycatch of Common Lumpfish in Divs. 4RS is also low. From 2000 to 2017, 39,826 fishing activities were observed during the program and bycatch of Common Lumpfish was reported in only 372 (0.9%) activities with 99% of Common Lumpfish bycatch discarded at sea. Common Lumpfish bycatch was mostly of less than 1 kg per activity. It occurred in fisheries targeting Winter Flounder (*Pseudopleuronectes americanus*), American Plaice (*Hippoglossoides platessoides*), redfish (*Sebastes spp.*), Northern Shrimp (*Pandalus borealis*), Witch Flounder (*Glyptocephalus cynoglossus*), Greenland Halibut (*Reinhardtius hippoglossoides*), Atlantic Cod (*Gadus morhua*), and Iceland Scallop (*Chlamys islandica*). Catches occurred using gillnets, otter trawl, shrimp trawl, seine and dredge. Common Lumpfish bycatch was not scaled to the total effort or total landings of the fisheries in which it was caught.

### Discussion

While not specific to the presentation about the Northern Gulf of St. Lawrence, there was discussion surrounding the issue of low observer coverage and the consequences this might have on identifying fisheries that have incidental catches of Lumpfish. For example, on the Scotian Shelf there may be high catches of Common Lumpfish in Sea Scallop (*Placopecten* *magellanicus*) and American Lobster (*Homarus americanus*) fisheries, however the observer coverage is extremely low. Similarly, there is no bycatch data of Common Lumpfish in the American Lobster fishery in the Southern Gulf of St. Lawrence because there is no ASO coverage. It was noted that these cases may not be a large threat for mortality; however, they must still be acknowledged. It was stated that low or no ASO coverage in many fisheries that may catch Common Lumpfish as bycatch most likely applies to all regions.

## Central and Arctic

Presenter: M. Treble

### Abstract

Common Lumpfish have been caught as bycatch and discarded in Northern Shrimp fisheries (Shrimp Fishing Areas [SFAs] 1, 2 and 3) and Greenland Halibut trawl fisheries (Divs. 0A and 0B). The trawl fleets in both fisheries have 100% ASO coverage. Bycatch levels were relatively low compared to southern fleets. Bycatch from the shrimp fishery during 1979 to 1993, prior to the introduction of the Nordmore grate (28 mm), varied from 1 kg to 1260 kg, and has been below 10 kg most years since 1994; a high of 120 kg was reported in 2016. Bycatch for the Greenland Halibut fishery was available for 1995 to 2017 and in most years Common Lumpfish bycatch was less than 10 kg; a high of 22 kg was observed in 2007.

### Discussion

There was no discussion regarding this presentation.

## Newfoundland and Labrador (non-fishing threats)

Presenter: M. Simpson

### Abstract

Non-fishing related threats to the survival and recovery of Common Lumpfish were considered. In particular, activities which potentially could affect Lumpfish directly or damage/destroy Common Lumpfish habitat, such as oil and gas activities, seismic, aquaculture, inshore anthropogenic disturbances and climate change were discussed. While many of these threats are known to occur, the level of impact and the extent of the threats on Common Lumpfish are unknown; therefore, the threat risk is unknown. Unlike fishing related threats which are easier to quantify, additional information is required to quantify the impact of non-fishing related threats on Lumpfish.

### Discussion

There was discussion surrounding the potential for aquaculture to pose a threat, in that escapement of Common Lumpfish from aquaculture sites could result in genetic introgression. However, it was noted that the Common Lumpfish currently in use at aquaculture sites are of local origin and are grown in a facility locally and distributed to aquaculture farms. It is unknown whether genetic introgression could occur under these conditions. Regarding aquaculture threats to habitat, it was noted that, in Newfoundland and Labrador, aquaculture activity occurs, and is often associated with use of medicated feed, which may have impacts on the habitat if overfeeding occurs. Overfeeding can result in a build up of organic materials/toxins in the benthos which would cover suitable nesting sites, as well as potentially decrease available oxygen.

There was a question as to whether predation is considered a threat, or whether it is just a natural process. It was noted that in the guidance document (DFO 2014), threats are defined as human-induced and therefore predation would not be considered a threat. It was argued that humans can control predation to a certain extent, for example with predation by seals. It was noted that there were very few Common Lumpfish in the NL Harp Seal stomach database (6 out of 20,000 stomachs); however, even though the proportion of seals with Lumpfish in their stomachs is small, the population of Harp Seals is large, meaning that could add up to a lot of Common Lumpfish consumed. It was also noted that there is predation by Grey Seals in the Gulf of St. Lawrence, particularly in April and May, whereby 85% of Grey Seal diets is Common Lumpfish. It was explained that the population of Grey Seals is increasing in the southern Gulf of St. Lawrence. It was decided that predation would not be included in the threats summary table, but will be described in length in the Research Document.

There was lengthy discussion regarding the table of threats presented, specifically the level of detail with respect to fisheries and gear types that catch Common Lumpfish as a bycatch. It was emphasized by many participants that separating the fisheries by gear types and species, as opposed to commercial fishery versus bycatch, is required for decision makers and end users, such as Fisheries Management. A finer level of detail will allow management decisions, such as permit requirements, to be made, as well as highlight areas that need more information, such as increased ASO coverage. It was noted that the table is a summary and the information will be described in more detail in the documents produced, including information on differences in gear effectiveness for catching Common Lumpfish, differences in post-release survival, etc.

## THREATS AND LIMITING FACTORS BULLETS

With respect to Element 9 and the concept of threatening habitat properties, there was discussion surrounding Green Crab having an impact on habitat. It was decided that invasive Green Crab would be considered an anthropogenic threat or limiting factor.

## RECOVERY TARGETS (ALL AREAS)

### Discussion

There was discussion surrounding whether a Limit Reference Point (LRP), as defined in DFO (2006), is a SARA recovery target. It was noted that the recovery target should be as close as possible to the natural state; however, the natural state is not known. There was a suggestion to use the Upper Stock Reference Point (USR) as the target, as it has been used as a recovery target for other species. Since the COSEWIC status is based on survey indices, it was agreed that the USR is a good starting point. There was a suggestion to set the LRP as an interim recovery objective and the USR as the recovery target. There was discussion regarding the issue of stocks outside the Newfoundland and Labrador Region that do not have survey indices and consequently no LRPs or USRs. It was agreed that maintaining current distribution would be the target for areas without survey indices (Divs. 4RST, Divs. 4VWX5Y, and Subarea 0) and increasing the distribution to historic levels in Subdiv. 3Ps and Divs. 3KL. It was noted, however, that the species is concentrated in Subdiv. 3Ps and Divs. 3KL.

## RECOVERY TARGETS (ALL AREAS) BULLETS

It was noted that Element 13 was not addressed because it is not possible without an analytical model and there is not one for this RPA.

Regarding Element 15, there was discussion surrounding what current fishing levels implies. It was noted that if the markets were to change, fishing effort could significantly increase. As well, since there is no directed fishery outside Newfoundland and Labrador and Quebec Regions, current fishery removals in these areas would be low.

## SCENARIOS FOR MITIGATION OF THREATS AND ALTERNATIVES TO ACTIVITIES (ALL AREAS)

### Discussion

There was discussion surrounding quantifiable threats. It was noted that fishing is the only threat where there is data on its effects on Common Lumpfish. For example, there is no direct information on threats to Common Lumpfish due to aquaculture or coastal development. There was a suggestion that data may exist in other DFO Programs, such as the Fish and Fish Habitat Protection Program (FFHPP) and coastal development (Small Craft Harbours).

## SCENARIOS FOR MITIGATION OF THREATS AND ALTERNATIVES TO ACTIVITIES (ALL AREAS) BULLETS

It was decided that bullets for Elements 16-20 were not required; available data were not sufficient to address many aspects of these elements.

## ALLOWABLE HARM ASSESSMENT

### Discussion

Discussion on allowable harm took place while addressing threats and limiting factors.

## ALLOWABLE HARM ASSESSMENT BULLET

There was no discussion regarding this bullet.

## RESEARCH RECOMMENDATIONS

- Most aspects of Lumpfish life history are poorly understood in Canadian waters. Further understanding of the following life history parameters are required:
  - Natural mortality (M)
  - Generation time (G)
  - Intrinsic rate of natural increase (r)
  - Size at maturity
  - Reproductive strategy (iteroparous vs. semelparous).
- Further work on the Newman Sound data in relation to temperature and % cover of eelgrass with respect to Lumpfish.
- Mapping of eelgrass distribution in all regions and further work on eelgrass utilization by Lumpfish.
- Distribution/inventory of Lumpfish nesting sites.
- Analysis of Small Craft Harbour Div.'s data regarding Lumpfish data from pre- and post-wharf building.
- Additional population modelling investigations.
- Further tagging studies to address questions of migrations, including investigation into tagging methods.
- Incorporation of Traditional Ecological Knowledge.
- Pelagic surveys in winter to address missing sampling in some regions.

- Refine the DU definition with ongoing genetic work.
- Explore eDNA as a way to address the lack of appropriate surveys. This could allow estimates of abundance based on genetic diversity.
- Studies in relation to potential management measures for the fishery (e.g., gear selectivity, roe removal, gear modifications, discard mortality).
- Broader ecological studies of the impacts of changes in temperature, dissolved oxygen, and salinity with respect to Lumpfish.

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# APPENDIX I: PROCEEDINGS OF THE LUMPFISH MODEL REVIEW MEETING TO PREPARE FOR THE UPCOMING RECOVERY POTENTIAL ASSESSMENT (RPA) FOR LUMPFISH

**December 3, 2018**
**St. John's, NL**

Chairperson: Eugene Lee
Rapporteur: Hilary Rockwood

These Proceedings summarize the relevant discussions and key conclusions that resulted from a DFO model review meeting held on December 3, 2018 at the Northwest Atlantic Fisheries Centre.

## INTRODUCTION

The meeting chair, Eugene Lee, welcomed participants and decided to skip through elements 1-11. He then asked about modeling efforts that have been done to date by each region. There is currently no model for Lumpfish in the Quebec Region. The Gulf Region tried using a Bayesian Model that was used for winter skate, but because the only data source in this region is from the research vessel (RV) survey, there were not enough data for a successful model. In half of the survey years, the Gulf Region had adult catches of zero. The representative from the Central and Arctic Region was not present, but the stock lead from the Newfoundland Region stated that their data are extremely spotty, so he had no expectation that they would have had a model. Very few Lumpfish are caught in the Maritime Region, so there are not enough data to put together a model.

## PRESENTATION SUMMARY

Dr. Mark Simpson from the Marine Finfish Species At Risk-Fisheries Sampling section of DFO NL Region was the lead on this stock and presented various models for different NAFO Divs. around Newfoundland. Elements 13, 15, and 19-22 were deemed to be the most model related. It was mentioned that Quebec (4RS) had a long data set in previous decades, along with a summer survey, and sentinel survey. The presenter used a stochastic Surplus Production in Continuous Time (SPiCT) model for the 4RS region. This model calculated one step ahead residuals, but was found to violate the assumption of normality in the catch index. Therefore this was a preliminary model that may not be describing what was going on in the population and had high levels of uncertainty. At present, it had potential, but could not be used in 4RS as a forecasting tool because it could not forecast long durations, required by SARA. The retrospective data used had issues, and could put the validity of the model results into question. The issue with forecasting was largely in the programming of the model. When the sentinel and winter survey data were removed, there was no convergence.

The stock lead next looked at the Newfoundland stocks. There are Lumpfish fisheries in 3Ps and 2J3KL, and survey work is also completed in the fall (2J3KL) and spring (3Ps). However, the time series was interrupted due to gear changes. Again, the retrospective data had challenges and the extreme volatility in the model did not reflect what was seen in the catch or survey patterns. The residuals of this model also violated the assumption of normality, and when removing the most recent years' data, problems developed in the model.

The stock lead tried using a Bayesian model on the 3Ps data, but there was a pattern in the residuals. Although he attempted many different inputs and transformations, the model fit and convergence was "terrible" and the process error was high. The model was not adequately explaining the data. A Bayesian model was used on the 3KL data and in this case there was no pattern in the residuals, the updates had a relatively good shape, the fit was reasonably good, and the convergence was relatively quick. However the process error was high, over 1. He concluded that the model was not perfect, but could be refined.

The presenter's conclusion was that 3KL and 4RS had some hope for a model, but there was no model for the other regions. He questioned what to do for terms 15-22 if there was no model for the Lumpfish Designated Unit with only 2 areas with a yet unproven model. A Multivariate Auto-Regressive State-Space (MARSS) model was discussed, as it calculated parameters of interest by fitting a state-space model to population abundance data that have process and observation error and could estimate extinction and quasi-extinction risk. This was an abundance, not biomass, model so its usefulness was called into question.

### DISCUSSION

The chair mentioned that the 3KL Bayesian model worked but others did not, and the presenter explained it was due to the quality of the data in that region. He said that due to limitations in the data, we could not use a quantitative approach to address elements or make projections. Overall, the 3KL survey data showed some patterns, but other areas had no obvious patterns which makes it difficult for models to make predictions. Every region has their own surveys and gear, some have fisheries, some only have the survey index and no catch data. In some years the survey data was incomplete. For example, in half the years in the Gulf region, there were no adults caught in the survey and last year that region caught only five juvenile Lumpfish out of 100 sets. Because of different methods and sporadic survey indices, the survey data could not be aggregated and used as a model input. COSEWIC considers the species as one Designated Unit with no metapopulations and no genetic work had been published to delineate the stock in Canadian waters at the time of the meeting. However, Dr. Ian Bradbury is currently researching genetics of Lumpfish in Canada, but the results would not be published in time for the March 2019 RPA meeting.

In most cases where there is a lack of sufficient quantitative data to model, qualitative information must be used. The consensus in the room was as we proceed, it will be without a model. While there was potential for the 3KL Bayesian model and there is time to work on it before the March meeting, the group felt less certain about other regions' models. The reviewer from Ottawa agreed to collect examples of RPAs that had insufficient data for modeling and find potential workarounds for model-dependent elements using qualitative data to describe the general population trajectory and other trends. These examples were sent to the group following the meeting. In the Southern Gulf, qualitative information could be used to conclude there had been a decrease in the adult and juvenile populations over the past 10-15 years. In Quebec, there had been a very slight increase over the same time series. Most groups agreed they could look at their data qualitatively in order to identify trends.

The chair led the group to discussing specific elements from the Terms of Reference. The chair concluded that the lack of modeling is going to negatively affect Elements #12 and #13, but qualitative information can be used to look at the data without modeling in order to make projections. For Element #14, the stock lead said that while we could propose targets, we may not be able to measure stock status against these. Element #15 could use qualitative data. The group agreed Elements #16 though #19 looked ok without a model. Because of the process error in the models, and COSEWIC's need for a 10-year or three-generation projection, a qualitative statement would have to suffice because the process error over that time period would be excessive. For Element #21, there was a problem with calculating mortality without a model, but like the other elements, a qualitative approach must be used. At the beginning of the meeting, there was an overall concern that lacking a model would hinder the process moving forward, but the group agreed that a qualitative method could be used instead and concluded that using qualitative data was better than using a quantitative model with significant flaws and uncertainties.

## APPENDIX II: TERMS OF REFERENCE

# Recovery Potential Assessment – Lumpfish, Atlantic Ocean

### Zonal Peer Review Meeting – Newfoundland and Labrador, Maritimes, Gulf, Quebec, and Central and Arctic Regions

**March 12-13, 2019**
**St. John's, NL**

Chairperson(s): Eugene Lee

### Context

After the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses an aquatic species as Threatened, Endangered or Extirpated, Fisheries and Oceans Canada (DFO) undertakes a number of actions required to support implementation of the *Species at Risk Act* (SARA). Many of these actions require scientific information on the current status of Lumpfish, threats to its survival and recovery, and the feasibility of recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. This timing allows for consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

Lumpfish was designated as Threatened by COSEWIC at their November 2017 meeting based on sharp declines in commercial landings, and a decline in abundance in bottom trawl surveys over 19-20 years. A pre-COSEWIC meeting, which reviewed all the available information on Lumpfish, was held November 17-18, 2015 (Simpson et al. 2016). In addition, a single stock assessment of Lumpfish has also been conducted recently in the Quebec region (DFO 2016).

In support of listing recommendations for Lumpfish by the Minister, DFO Science has been asked to undertake a RPA, based on the national RPA Guidance. The advice in the RPA may be used to inform both scientific and socio-economic aspects of the listing decision, development of a recovery strategy and action plan, and to support decision making with regards to the issuance of permits or agreements, and the formulation of exemptions and related conditions, as per sections 73, 74, 75, 77, 78 and 83(4) of SARA. The advice in the RPA may also be used to prepare for the reporting requirements of SARA s.55. The advice generated via this process will update and/or consolidate any existing advice regarding this Lumpfish Designated Unit.

### Objectives

- To provide up-to-date information, and associated uncertainties, to address the following elements:

### Biology, Abundance, Distribution and Life History Parameters

**Element 1:** Summarize the biology of Lumpfish.

**Element 2:** Evaluate the recent species trajectory for abundance, distribution and number of populations.

**Element 3:** Estimate the current or recent life-history parameters for Lumpfish.

### Habitat and Residence Requirements

**Element 4:** Describe the habitat properties that Lumpfish needs for successful completion of all life-history stages. Describe the function(s), feature(s), and attribute(s) of the habitat, and quantify by how much the biological function(s) that specific habitat feature(s) provides varies with the state or amount of habitat, including carrying capacity limits, if any.

**Element 5:** Provide information on the spatial extent of the areas in Lumpfish's distribution that are likely to have these habitat properties.

**Element 6:** Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.

**Element 7:** Evaluate to what extent the concept of residence applies to the species, and if so, describe the species' residence.

**Threats and Limiting Factors to the Survival and Recovery of Lumpfish**

**Element 8:** Assess and prioritize the threats to the survival and recovery of Lumpfish.

**Element 9:** Identify the activities most likely to threaten (i.e., damage or destroy) the habitat properties identified in elements 4-5 and provide information on the extent and consequences of these activities.

**Element 10:** Assess any natural factors that will limit the survival and recovery of Lumpfish.

**Element 11:** Discuss the potential ecological impacts of the threats identified in element 8 to the target species and other co-occurring species. List the possible benefits and disadvantages to the target species and other co-occurring species that may occur if the threats are abated. Identify existing monitoring efforts for the target species and other co-occurring species associated with each of the threats, and identify any knowledge gaps.

**Recovery Targets**

**Element 12:** Propose candidate abundance and distribution target(s) for recovery.

**Element 13:** Project expected population trajectories over a scientifically reasonable time frame (minimum of 10 years), and trajectories over time to the potential recovery target(s), given current Lumpfish population dynamics parameters.

**Element 14:** Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present and when the species reaches the potential recovery target(s) identified in element 12.

**Element 15:** Assess the probability that the potential recovery target(s) can be achieved under current rates of population dynamics parameters, and how that probability would vary with different mortality (especially lower) and productivity (especially higher) parameters.

**Scenarios for Mitigation of Threats and Alternatives to Activities**

**Element 16:** Develop an inventory of feasible mitigation measures and reasonable alternatives to the activities that are threats to the species and its habitat (as identified in elements 8 and 10).

**Element 17:** Develop an inventory of activities that could increase the productivity or survivorship parameters (as identified in elements 3 and 15).

**Element 18:** If current habitat supply may be insufficient to achieve recovery targets (see element 14), provide advice on the feasibility of restoring the habitat to higher values. Advice must be provided in the context of all available options for achieving abundance and distribution targets.

**Element 19:** Estimate the reduction in mortality rate expected by each of the mitigation measures or alternatives in element 16 and the increase in productivity or survivorship associated with each measure in element 17.

**Element 20:** Project expected population trajectory (and uncertainties) over a scientifically reasonable time frame and to the time of reaching recovery targets, given mortality rates and productivities associated with the specific measures identified for exploration in element 19. Include those that provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.

**Element 21:** Recommend parameter values for population productivity and starting mortality rates and, where necessary, specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts in support of the listing process.

### Allowable Harm Assessment

**Element 22:** Evaluate maximum human-induced mortality and habitat destruction that the species can sustain without jeopardizing its survival or recovery.

## Expected Publications

- CSAS Science Advisory Report
- CSAS Proceedings
- CSAS Research Document

## Participants

- Fisheries and Oceans Canada (Ecosystems and Oceans Science, and Resource Management sectors)
- Provincial/Territorial jurisdictions/Wildlife Management Boards
- Academia
- Indigenous communities/organizations
- Industry
- Other invited experts

## References


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## APPENDIX III: AGENDA

**Regional Peer Review Meeting:**
**Recovery Potential Assessment – Lumpfish, Atlantic Ocean**

**March 12-13, 2019**

**Memorial Room - Northwest Atlantic Fisheries Centre**
**80 East White Hills Road, St. John's, NL**

**Chair: Eugene Lee, DFO Science**

**Tuesday, March 12, 2019**

| Time | Topic | Presenter |
|---|---|---|
| 09:00 | Chair opening remarks, Terms of Reference, and introductions | Chair - E. Lee |
| - | Introduction – RPA Process and elements, background | M. Simpson |
| - | Biology and life history parameters (all areas) [ToR elements 1-3] | R. Collins |
| - | Abundance and distribution<br>[ToR elements 1-3]<br>• Newfoundland and Labrador<br>• Newfoundland and Labrador Inshore (Newman Sound)<br>• Scotian Shelf<br>• Southern Gulf of St. Lawrence<br>• Northern Gulf of St. Lawrence<br>• Central and Arctic | -<br>-<br>NL: P. Upward<br>NL: D. Lancaster<br>-<br>Maritimes: D. Themelis<br>Gulf: T. Tunney<br>Quebec: J. Gauthier<br>C&A: M. Treble |
| - | Habitat and residence requirements<br>[ToR elements 4-7]<br>• Newfoundland and Labrador<br>• Scotian Shelf<br>• Southern Gulf of St. Lawrence<br>• Northern Gulf of St. Lawrence<br>• Central and Arctic | -<br>-<br>NL: M. Simpson<br>Maritimes: D. Themelis<br>Gulf: T. Tunney<br>Quebec: J. Gauthier<br>C&A: M. Treble |
| **12:00-1:00** | **LUNCH** | **-** |
| 1:00 | Threats and limiting factors to survival and recovery of Lumpfish<br>[ToR elements 8-11)<br>• Newfoundland and Labrador<br>• Scotian Shelf<br>• Southern Gulf of St. Lawrence<br>• Northern Gulf of St. Lawrence<br>• Central and Arctic<br>• Newfoundland & Labrador (non-fishing threats) | -<br>-<br>-<br>NL: H. Rockwood<br>Maritimes: D. Themelis<br>Gulf: T. Tunney<br>Quebec: J. Gauthier<br>C&A: M. Treble<br>All |
| - | Recovery targets (all areas)<br>[ToR elements 12-15] | All |

| Time | Topic | Presenter |
|---|---|---|
| - | Scenarios for mitigation of threats and alternatives to activities (all areas) [ToR elements 16-21] | All |
| - | Allowable harm assessment [ToR element 22] | All |

**Wednesday, March 13, 2019**

| Time | Topic | Presenter |
|---|---|---|
| 09:00 | Review and discussion on conclusions | All |
| - | Drafting of summary bullets for Science Advisory Report | All |
| - | Research recommendations | All |
| - | Upgrading of working paper | E. Parrill |
| | Next steps | E. Parrill |
| - | **Adjourn** | - |

**Notes:**

- Breaks will usually occur at 10:30 and 2:30
- Lunch is not provided
- Food and beverages can be purchased from the cafeteria
- This agenda remains fluid

## APPENDIX IV: LIST OF PARTICIPANTS

| Name | Affiliation |
|---|---|
| Aimee Gromack | DFO Species at Risk Program, Maritimes Region |
| Brandon Ward | Provincial Department of Fisheries and Land Resources |
| Caroline Senay | DFO Science, Quebec Region |
| Chelsie Tricco | DFO Resource Management, NL Region |
| Connie Korchoski | Centre for Science Advice, NL Region |
| Craig Purchase | Memorial University |
| Darienne Lancaster | DFO Science, NL Region |
| Erika Parrill | Centre for Science Advice, NL Region |
| Eugene Lee | DFO Science, NL Region |
| Fred Phelan | DFO Policy and Economics, NL Region |
| Hilary Rockwood | DFO Science, NL Region |
| Jenna Makrides | DFO Science, NL Region |
| Joanne Gauthier | DFO Science, Quebec Region |
| Julia Pantin | DFO Science, NL Region |
| Julie Diamond | DFO Resource Management, NL Region |
| Justin Strong | Fish, Food, and Allied Workers (FFAW) Union |
| Katrina Sullivan | DFO, Species at Risk (SAR), NL Region |
| Koren Spence | DFO Resource Management, Maritimes Region |
| Margaret Treble | DFO Science, Central and Arctic Region |
| Marie-Pierre Veilleux | DFO Species at Risk (SAR), Quebec Region |
| Mark Simpson | DFO Science, NL Region |
| Mathieu Morin | DFO Resource Management, Quebec Region |
| Peter Upward | DFO Science, NL Region |
| Roanne Collins | DFO Science, NL Region |