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Proceedings of the Zonal Peer Review - Pre-COSEWIC Assessment for Lumpfish

November 17-18, 2015
St. John's, NL

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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 meeting of the Zonal Peer Review Process on the Pre-COSEWIC (Committee on the Status of Endangered Wildlife in Canada) Assessment for Lumpfish was held November 17-18, 2015 in St. John's, Newfoundland and Labrador (NL). The overall objective of this meeting was to peer-review existing Fisheries and Oceans Canada (DFO) information relevant to the COSEWIC status assessment for Lumpfish in Canadian waters, considering data related to the status and trends of, and threats to this species inside and outside of Canadian waters, and the strengths and limitations of the information.

These Proceedings include an abstract for each presentation and a summary of the relevant discussions and the key conclusions reached at the meeting. In addition, a Research Document (2016/068) resulting from the meeting was published on the DFO Canadian Science Advisory Secretariat's (CSAS) Website.

Compte rendu de l'examen zonal par les pairs – Examen pré-COSEPAC concernant la lompe ; du 17 au 18 novembre 2015

SOMMAIRE

Une réunion du processus d'examen zonal par les pairs sur l'examen pré-COSEPAC (Comité sur la situation des espèces en péril au Canada) concernant la lompe a eu lieu du 17 au 18 novembre 2015 à St. John's (Terre-Neuve-et-Labrador). L'objectif global de la réunion était de permettre à des pairs d'évaluer l'information actuelle de Pêches et Océans Canada (MPO) pouvant aider le COSEPAC à établir le statut de la lompe dans les eaux canadiennes, y compris les données sur la situation de l'espèce, les tendances observées et les menaces qui pèsent sur elle, tant dans les eaux canadiennes que dans les eaux étrangères, ainsi que les points forts et les limites de cette information.

Le présent compte rendu comprend un résumé de chaque présentation de même qu'un sommaire des discussions pertinentes et des principales conclusions tirées lors de la réunion. De plus, un document de recherche (2016/068) découlant de la réunion a été publié sur le site Web du Secrétariat canadien de consultation scientifique (SCCS) du MPO.

OVERVIEW

LIFE HISTORY CHARACTERISTICS

Lumpfish are sexually dimorphic with mature, smaller, and more brightly coloured males tending the nest until the eggs are hatched. Lumpfish are iteroparous oviparous batch spawners. Mature females are larger than males.

The pelagic phase, encompassing both larval and juvenile stages is lengthy and could result in considerable dispersal. Settlement of juveniles occurs in the inshore on eelgrass and macro algae and in the offshore on floating objects such as kelp and other structures.

Tagging data suggest a degree of general site fidelity. Lumpfish nest sites may equate to a "residence" as defined by the *Species at Risk Act* (SARA). No data were available to confirm actual nest site fidelity from one year to the next, although unpublished information from SCUBA studies have demonstrated usage of the same nest site in more than one year.

Although many tagged females are subsequently recovered one year later near their tagging site, some returns are from a considerable distance away, indicating substantial movements. Tagging programs on lumpfish depend on recapture of fish by the commercial fishery. Since lumpfish males are not targeted by the fishery, no males have been tagged in Atlantic Canada.

Total fecundity (sum of batches per season) may be as high as 400,000 eggs. This is thought to be high for a nest-tending species and might indicate high, and possibly variable, egg mortality.

There is evidence of males failing to hatch any eggs as a result of predation by species such as sea urchins, whelks, and cunners on the eggs, or predation on the male by Grey Seals. Nest abandonment has also been observed. This may be due to mortality of the tending male or another unknown reason.

Weight-length relationships indicate very little variation among Newfoundland, Northern Gulf, Southern Gulf, and Scotian Shelf stocks. Lumpfish that are 55 cm in length weigh about 8 kg.

Age-length data for Atlantic Canada are restricted to 87 aged mature female fish from 28 cm to 47 cm which were sampled from Torbay Bight, NL in 2000. These data are considered to provide uncertain information on age at length. The oldest age in the sample was 11 years. An age 7 fish was between 55 cm and 60 cm. A discontinuity in the otoliths occurred around age 4 to 7, which was interpreted to indicate the onset of spawning.

A length of 34 cm can be used to separate mature (sexes combined) lumpfish from immature individuals in the absence of reliable length-based maturation ogives for males and females. Length frequency data for NL are available by sex. Application of a length of 38 cm to the female portion of the data and 31 cm for males was considered appropriate for separating mature lumpfish from immature individuals.

The von Bertalanffy growth equation parameters from the Torbay Bight area data and from other growth studies on lumpfish in the North Atlantic were applied in empirical relationships to determine natural mortality (M) and generation time (G). One of these relationships also required a value for ambient temperature, which was assumed to be 5 °C.

The consensus view of the meeting based on the various estimates from empirical relationships was that M=0.3 and G=7 for Atlantic Canadian lumpfish.

RESEARCH VESSEL BOTTOM TRAWL SURVEY DATA

Lumpfish data from bottom trawl multi-species surveys are uncertain because spawning fish are in shallow water inshore of the surveys and also because lumpfish are partially pelagic.

Bottom trawl winter surveys may provide better data than spring or summer surveys because lumpfish have a more offshore distribution at this time and tend to be more aggregated at the bottom. Even though lumpfish exhibit some pelagic behaviour it was agreed that the demersal surveys could be used as a measure of change in abundance.

A variety of survey bottom trawl gear has been used in Fisheries and Oceans Canada (DFO) surveys in Atlantic Canada over the years. Trawls such as the Yankee 36, Western IIA and Engel may be less effective at catching lumpfish than the Campelen trawl in use off NL since the mid-1990s and in the Northern Gulf since 2004.

Lumpfish catches in bottom trawl surveys are highest in waters around Newfoundland, and are particularly sparse on the Georges Bank, Scotian Shelf, Southern Gulf and Arctic areas. In areas where abundance is generally higher, bottom trawl survey data provides information on general trends in spatial distribution and relative population size.

There are some data available from pelagic surveys but these tended to be only of short duration and were not considered useful to follow trends in abundance.

Data for the Flemish Cap (Northwest Atlantic Fisheries Organization [NAFO] Div. 3M) were not considered by the Pre-COSEWIC meeting, although lumpfish are known to occur in this area. It would be useful to know if these fish move to coastal NL to spawn or whether they spawn on the shallow areas of the Flemish Cap.

CHANGES IN EXTENT OF OCCURRENCE AND AREA OF OCCUPANCY

Areas of occurrence or Design-Weighted Area of Occupancy (DWAO) for lumpfish in the Northern Gulf do not show evidence of a contraction over time.

DWAO at the center of mass of the species in NAFO Divs. 3LNO, 2J3KL and Subdiv. 3Ps show contraction from the mid-2000s to the present, a period consistently surveyed with the Campelen gear.

DECLINING POPULATION

Data for determining decline in population from the surveys were not in a consistent format across areas. Data for the Scotian Shelf and Southern Gulf were in the form of mean weight per tow. In NAFO Divs. 3LNO, 2J3KL and Subdiv. 3Ps, data were in the form of mean numbers per tow and mean weight per tow. For the Northern Gulf, both total survey numbers and number of mature fish were presented, which is the desired format in the context of SARA. Numbers of mature females would also be of consideration where the sex ratio departs from 50:50. In the case of lumpfish, the number of mature males may actually be more important than the number of females.

Bottom trawl survey data for Northern Gulf of St Lawrence, and 2J3KLNOPs were considered potentially useful for examining population declines.

There was no evidence of a declining trend from bottom trawl survey data in the Northern Gulf of St. Lawrence during 1990-2015. In comparison, 2J3KLNOPs provided evidence of a strongly declining trend since 1995/96 (almost three generations). Evidence was particularly compelling for 3Ps.

COMMERCIAL FISHERY

It was noted that conversion from lumpfish roe weight to round fish weight included multiplying by a factor of four. This factor is based on a few studies indicating that gonad weight represent on average 25% of total fish weight.

In the Northern Gulf fishery, the divergence in the trends in effort and landings (effort high, landings low) in the period of 2006-09 supports concern about the status of the resource over this period. This divergence occurred at a time of peak market prices. Subsequently, both catch and effort have been low while price has been average. It was recognized that multiple competing economic factors may influence this outcome. Nevertheless, a population decline to low levels cannot be ruled out as a cause.

In terms of threats to lumpfish in the Northern Gulf or Newfoundland, where the fishery occurs, management is not science-based and existing regulations are not considered sufficient to prevent the fishery being a potential threat to the resource. Bycatch is not considered to be a major issue.

The lack of data on absolute amount landed each year in the 2J3KLNOPs area (because of DFO privacy to economic benefit rules) was considered a hindrance in the Pre-COSEWIC evaluation by meeting participants.

Based on historical data, there is potential for considerable bycatch in American Plaice and other fisheries within some areas should these fisheries again become large.

It was noted that in both the Northern Gulf and 2J3KLNOPs, males are not heavily impacted by the fishery because of smaller size. This could be important given the role of males in nest tending.

There has been a major decline in fishing effort directed at lumpfish in all of Atlantic Canada since 1998.

Concomitant declines in fishing effort, catches and population abundance point to population decline in Atlantic Canada being the major cause for the collapse of the lumpfish fishery. Economic factors, beyond resource shortfall, may also have played a role but there was no evidence of this in the limited data examined during the Pre-COSEWIC meeting. It was recognized that review of economic factors was beyond the purview of the meeting.

THREATS

It was concluded that fishing poses a potential threat to the lumpfish population in all areas. The increasing Grey Seal population in the Gulf and 3Ps may also be a potential threat to lumpfish. Although seismic testing was determined by meeting participants to be a potential threat, there were no data available to evaluate this assumption. To date, no direct evidence exists regarding linkages between potential non-anthropogenic threats and lumpfish abundance trends.

DESIGNATABLE UNITS (DUS)

There was support amongst meeting participants for a single DU. There is some evidence of discontinuity on the Scotian Shelf in terms of demersal distribution although pelagic 0-group surveys suggests continuity.

It was noted that the rescue of Canadian populations by populations off Greenland and on Flemish Cap may be possible, though highly unlikely.

PRESENTATIONS

A PRE-COSEWIC ASSESSMENT OF THE COMMON LUMPFISH (*CYCLOPTERUS LUMPUS*) IN CANADIAN ATLANTIC AND ARCTIC WATERS

Presented by: M.R. Simpson, C. Miri, R. Collins, J. Gauthier, and K. Hedges

Abstract

The Common Lumpfish is a semi-pelagic fish found on both sides of the North Atlantic Ocean, as well as in the Arctic Ocean, at depths up to 1000 m, or more. It most commonly occurs from shallow coastal waters to depths of up to 400 m. The pelvic fins are modified to form an adhesive disc which is present at hatching, and is employed by all life-stages to avoid being displaced by strong currents. The species is characterized by pronounced sexual dimorphism, with females being larger. During the spring, males undergo a colour change and migrate to shallow waters where they establish breeding territories. Females follow afterward, and deposit egg masses which are fertilized externally, and then tended to by the males for 1-2 months, until hatching occurs.

Most catches of Common Lumpfish in demersal surveys carried out by DFO occur in NAFO Divs. 3P (NL Region) and 4RS (Quebec Region). Catches of Lumpfish in surveys carried out in Subarea 0 (Central and Arctic Region), Divs. 4VWX5YZ (Maritimes Region), and Div. 4T (Gulf Region) are relatively infrequent. Abundance and biomass indices in Div. 3P have declined considerably since the mid-2000s. The indices for Divs. 4RS varied without trend in recent years, but remained below the peak observed in 2006. Since the mid-2000s, the area occupied index in Div. 3P has decreased dramatically, and has fluctuated without trend in Divs. 4RS.

Directed fisheries for Lumpfish roe (and, less frequently, whole females) occur in NL and Quebec Regions, which are managed by input controls via Conservation Harvesting Plans. The fisheries are conducted from May-July, usually in shallow, coastal waters by vessels less than 35 ft., using gillnets. From 1978-2007, most of the roe landed came from Subdiv. 3Ps; in more recent years, most roe landings were taken from Div. 4R. Bycatches of lumpfish occur in commercial fisheries directing for a variety of other fish and invertebrate species, and are generally low.

Discussion

Overview of Distribution, Biology and Ecology of Lumpfish (*Cyclopterus lumpus*)

Discussion started amongst meeting participants with the statement that the available literature on lumpfish age is contradictory.

Some literature, including but not limited to studies on lumpfish diets, suggests that lumpfish are located on the Shelf and near the surface. It was stated that lumpfish move offshore during the summer.

Participants discussed how lumpfish can be known to hatch in areas with eelgrass, but not exclusively. Lumpfish are known to attach themselves to objects located both inshore and offshore, and in particular to seaweed. A participant stated that some studies on eelgrass in the Bay of Sept-Îles (Quebec) found lumpfish in 2 out of 6 eelgrass samples. Meeting participants suggested that eelgrass may not be critical habitat for lumpfish and that eelgrass is one of only multiple habitats available for them.

It was clarified for a participant that the total fecundity for a female during one season ranges from 50,000 to 400,000 eggs. It is well documented that spawning occurs inshore, however,

extent of offshore spawning is unknown. A participant highlighted that Thorsteinsson (1981) concluded that maturation is linked more to length rather than age. A suggestion was made to look at the length of lumpfish documented in literature and try to determine the common size of maturity over a broad area. Although COSEWIC prefers data related to age, it was noted by a participant that scientists may be more successful working with data related to length.

A participant inquired about batch spawning and how many eggs there are per batch. It was clarified that available roe is stripped from follicles and that more roe is able to be stripped from smaller rather than larger fish. It was suggested that there may be more batches from larger fish and that further research could be done to calculate the number of eggs per batch.

It was questioned whether lumpfish spawn where their ovaries ripen. A participant articulated that during one study lumpfish migrated northwest towards Conception Bay and Trinity Bay. A suggestion was made to look at Blackwood's tagging data (Blackwood 1982, 1983) on the south coast and Codroy Valley. It was proposed that future research should look at reproductive conditions during tagging. If tagging was to occur prior to spawning (i.e., lumpfish located offshore while swimming inshore to spawn), it was noted that the lumpfish would be swimming along the coast. A participant mentioned that lumpish generally travel east in Subdiv. 3Pn but travel west within the Strait of Belle Isle. Overall, meeting participants felt that most lumpfish travelled to spawn. It was highlighted that recaptured fish which were returning to spawn were smaller fish.

Participants discussed the International Young Gadoid Pelagic Trawl (IYGPT) Survey that was surveying salmon from Labrador to Greenland and questioned whether lumpfish were measured. It was unsure whether lumpfish were young of the year (YOY). Participants articulated that it was interesting to see that lumpfish are widespread. It was suggested that the estimates were minimal as the survey does not cover the full distribution of lumpfish. A participant stated that Greenland is applying for Marine Stewardship Council (MSC) certification of their lumpfish fishery and has gillnet data available.

There was some discussion about the United States' spring and fall surveys which started in 1963. The few catches in Georges Bank during the fall correspond with the Canadian Georges Bank survey. These surveys are demersal and it was noted that quite a few lumpfish are being caught in the survey. Participants found it important to note that the surveys are contiguous with Canadian surveys as immigration to Canadian lumpfish populations would occur from lumpfish populations in the United States.

Participants further highlighted that DFO does not have access to Portugal's Flemish Cap data and that the data could be useful during future research.

Survey Distributions and DWAO: Divs. 2J3KLNO

It was indicated that there is a lot of inter-annual variability in lumpfish in Subdiv. 3Ps. Participants questioned whether the lumpfish population has declined. If either of those circumstances were true, perhaps that is why lumpfish are caught infrequently. Discussion ensued regarding the 2005-14 set of plots. A participant stated that 1,243 m was the deepest a lumpfish was recorded during their studies.

Survey Distributions and DWAO: Maritimes Divs. 4VWX

In regards to the Central Scotian Shelf, it was noted that there is a continuous distribution within eastern 4V. Participants highlighted that there was quite a large gap on the Scotian Shelf, and also that there were larvae in the water column.

It was clarified for participants that the survey does not use a Campelen trawl. Rather, the survey uses a Western IIA.

Participants discussed how no lumpfish were caught in 5Z, and that perhaps there is a signal that suggests that the fish are concentrated in the east and Bay of Fundy. The meaning of the absence of lumpfish caught in 5Z is unknown. Participants discussed the accuracy and questioned whether criticisms of the survey are unfounded for reasons such as whether the survey is not able to catch lumpfish.

Survey Distributions and DWAO: Central and Arctic Region

A short discussion amongst meeting participants concluded that the mouth of Frobisher Bay is not a hot-spot of lumpfish. Trawl surveys for lumpfish cannot be completed during the winter in this Region.

Lumpfish in the northern Gulf of St. Lawrence

Participants discussed the evolution of sexual dimorphism in lumpfish. It was questioned whether the more colourful males are more likely to mate but also more likely to be eaten by Grey Seals. The discussion regarding male vs female lumpfish predation by Grey Seals ended when a participant noted that seals are colour blind.

Although some participants concluded that Grey Seals are a natural threat to lumpfish, other participants believed that population assessments should be made before that conclusion could be drawn. It was stated that future research has to look at the trajectory of the lumpfish population to see if there is a corresponding downward trend of lumpfish. There is currently no good measure for assessing lumpfish in the Gulf; and therefore that comparison cannot be made. Participants asked further questions such as how were the seals sampled and whether Grey Seals were eating dead lumpfish caught in nets. A participant inquired whether there were any long term trends in the percentages found in the stomachs. It was concluded that there was no trend as all of the years were assessed together.

Participants discussed fecundity of lumpfish in the Gulf and it was stated that fecundity averaged 100,000-130,000 eggs and could vary between 50,000 to 400,000. It was highlighted that the fecundity of lumpfish in NL could reach 400,000. However, a participant noted that the NL study was older than the Gulf. Another participant suggested that lumpfish in Torbay Bight, NL have similar fecundity to the lumpfish in the Gulf. Participants concluded that the root question to be answered was whether fecundity levels make lumpfish more susceptible to anthropomorphic threats? Other questions posed by participants included whether the fecundity of survivor fish is not as high as other nesting males, and whether lumpfish are affected by large changes to sex ratios.

A participant inquired about possible information on sea urchins, which are known to eat lumpfish eggs. Participants discussed whether sea urchins are a potential threat or a natural predator to lumpfish.

It was noted that male lumpfish are aggressive when protecting their nests. Participants suggested that early stage mortality could be a factor for lumpfish. A participant asked if increased nest abandonments were caused by increased Grey Seal predation. It was concluded that there is not enough information to determine whether the increase in the Grey Seal population has had a significant adverse effect on lumpfish.

Studies in the Gulf showed that most tagged lumpfish were re-captured within 25 km of the area of original tagging. Other studies show that lumpfish move and return to previous locations. Another participant highlighted that in another study in which lumpfish were tagged at spawning sites, the tagged lumpfish were recaptured in the same area. It was questioned whether lumpfish have homing tenancies or whether they are exhibiting similar behaviour to other species such as mackerel. It was suggested that future research should look at spawning

conditions (e.g., whether tagged lumpfish spawned prior to re-capture).Overall, consensus could not be reached by participants on the matter of lumpfish migrations and homing abilities.

The DFO (2011) Science Advisory Report (SAR) from the Quebec Region was discussed. Participants concluded that the surveys outlined in the 2011 SAR occurred close to lumpfish spawning time and as such the surveys cannot be heavily replied upon.

Participants discussed the market conditions for lumpfish. Lumpfish caught in NL waters are the last to hit the market. As such, buyers have already purchased a great deal of lumpfish by the time NL lumpfish are ready for purchase. This has led to a lower price for lumpfish caught in NL waters. Participants questioned how increases and decreases in fishing opportunity within other fisheries such as crab and cod have affected the lumpfish fishery. Participants could not tell from summer bottom trawl surveys whether there was a trend for mature lumpfish. It was suggested by one participant that there does seem to be a trend as there are decreasing participants and landings, although the price for lumpfish has remained high. A participant pointed out that during the decline in price in the mid-1990s fishers flooded the lumpfish market.

It was mentioned that the lack of a management plan could be a potential threat to lumpfish (i.e., lumpfish is a self-regulating fishery). For example, if the price for lumpfish increases but the stock is low fishers can still continue to try to fish for the same amount of lumpfish. A participant explained that the fishery season lasted 4 weeks for Divs. 4R and 3Pn. Managing the lumpfish fishery via length and harvesting window may not allow for the protection of a negatively affected stock. A participant explained that the lumpfish fishery is currently managed by net, season, and mesh size restrictions. It was highlighted that the management measures are not science-based. It was asked whether those measures are able to protect a declining fishery. A participant noted that some harvesters may feel that the timing/season constraints are effective management measures for the protection of the stock. It was explained that the timing restriction does not allow fishers to know the best timing to fish for lumpfish. It was concluded by participants that without additional management measures, the current management plan has the ability to be a potential threat to lumpfish.

The overall conclusions amongst participants were that catch per unit of effort (CPUE) is declining. It was noted that there may be periods when the price of lumpfish was not correlated with CPUE. It was highlighted that landings have decreased more than participants over the last five years. It was hypothesized that perhaps the window of the four-week lumpfish fishery during the past five years was not ideal for landings. Participants questioned whether the crab fishery had overlapped and if there were issues with marketplace such as a lack of buyers. It was suggested that future research should be completed on these economic conditions. It was noted that in 2012 there were large stockpiles of roe in Iceland and that there was a heavy push for product development of lumpfish roe (e.g., flash freezing roe for the fresh-roe market in Japan and collagen cream). Participants also highlighted the need for more research on the availability of crab and cod and value ($/kg) in regards to price of lumpfish and landings. It was also concluded that by-catch is not an issue in the lumpfish fishery.

Distribution Abundance Trends

It was stated that most of the fish are caught below the cold intermediate layer (CIL) during the winter trawl survey. It was hypothesized that the reason why fewer lumpfish are caught during the summer survey may be because they are moving for spawning purposes. A participant stated that the distribution by size classes is similar to the Barents Sea, Baltic Sea and Divs. 4VPn. Although bottom trawl surveys have been used to assess distribution, participants felt that making conclusions may be erroneous, and especially for age-class distribution. While the demersal surveys help scientists propose general distribution patterns, participants stated

that the demersal surveys were not ideal and that they had more confidence in the winter survey.

Data were presented for the 1990-2015 Northern Gulf of St. Lawrence survey bottom trawl survey showing lumpfish distribution by size classes. The map showed that there were not many small fish located in Subdiv. 3Pn. Since 2004, NAFO Subdiv. 3Pn is no longer covered by the Northern Gulf survey. It was suggested by participants that an outline of the survey area be provided on a map. The distribution looked to be confined to the survey area. Participants discussed whether there was an underlying reason why lumpfish have never been caught during the 22 years of demersal surveys near the Gros Morne area of Western NL. A participant highlighted that lumpfish are no longer YOY when they reach 12 cm.

Lumpfish have both inshore and offshore movements and distribution. Participants agreed that the quantity of lumpfish moving inshore and offshore, and general migration patterns remain unknown. It was stated that annual inshore surveys are repetitive in regards to location and timing of the year and this repetition should allow for the development of an indication of migration patterns. However, a participant disagreed with the repetition theory for offshore surveys. It was suggested that migration patterns should be analyzed by looking at an average of years rather comparing years in isolation. This was agreed by participants due to movements and inter-annual variability.

Participants concluded that there are no signs of a decline in lumpfish. Even with the uncertainties in the data, there are no trends for a decline of lumpfish in the northern Gulf of St. Lawrence. Participants also concluded that the extent of occurrence is not an issue.

Common Lumpfish Survey Abundance, Biomass, Size and Maturity for Newfoundland and Labrador (Div. 2J3KLNOPs), Maritimes (Div. 4VWX5Z), southern Gulf of St. Lawrence (Div. 4T), and Central and Arctic (SA 0) Waters

Participants noted that there was a large difference in YOY within the lower end of the graph presented for Divs. 4VWX juvenile and adult lengths from 1970-2015. It was unknown which specific RV survey caught the YOY. One participant wondered whether the surveys were demersal since YOY are supposed to be in upper waters. However, it was mentioned that it could be plausible that the YOY could be from a pelagic survey. In order to know, the data would have to be formatted. It was suggested that conclusions could possibly be drawn by age at maturation.

Participants discussed the 34 cm cutoff to define maturity. The cutoff was determined by DFO staff and based on available literature. It was stated that COSEWIC also uses “knife-edge” cutoffs for maturity designation. Participants were happy that there is a “knife-edge” cut-off, but suggested that the 34 cm should be revisited.

A participant highlighted that the sources of the data have to be stated clearly in the CSAS Research Document (i.e., whether the Quebec Region collected the data).

A participant questioned whether data regarding lumpfish maturity are easy to assess. The Quebec Region currently does not have ability to assess lumpfish maturity data. It was recommended that researchers try and access that data. It was also recommended that future research should look at what is meant by maturity during the winter Divs. 4VsW & 5Z surveys and summer Divs. 4Vn, 4VsW and 4X surveys. It was noted that a cod key is often used by technicians. A key may or may not be appropriate for lumpfish as more information on morphology is required.

It was noted that the NL spring survey was incomplete in 2006. For an incomplete survey, there should be a break in the line for the Divs. 3LNO spring abundance and biomass graphs presented. It was concluded that there are no trends in abundance and biomass for Divs. 3LNO.

Participants noted that although gear is questionable, most lumpfish are caught in Subdivs. 3Ps and 3Pn. Within the NL Region, Subdivs. 3Ps and 3Pn have the most lumpfish biomass. The Yankee and Engel surveys, had more lumpfish per tow in Subdivs. 3Ps and 3Pn while the Campelen survey showed more within Divs. 3LNO.

The fall Divs. 2J3KLNO surveys, demonstrated a decline in lumpfish starting in the mid-2000s. The "pulse" trend was questioned. Participants wondered whether the trend was being driven by recruits.

Participants noted that there are dimorphic issues with the data. The NL Region has sex and length data, the Québec Region has sex and length data since 2004, however the Maritimes, Gulf, Québec and Central and Arctic Regions do not have this information. As such, averages should not be used. There was agreement among participants that information on sexed data could be useful and provided to COSEWIC; however, the data were not available during the meeting. Participants questioned whether it is appropriate to use the 34 cm average, or whether it is appropriate to use female size. A participant also asked whether it is difficult to determine immature lumpfish by sex. DFO Science made its raw data available for participants. The data did not have the list of core strata. That information was promised to be provided at a later date to meeting participants.

For Divs. 4X and 5Z and Subdivs. 4Vs, 4Vn,and 4VsW, only biomass was provided for participants. Abundance numbers were also not provided. Data pertaining to the numbers per tow need to be obtained.

It was highlighted that there are no trends and very few fish within Div. 4T and Subarea 0.

Participants discussed the catchability of lumpfish. It was stated that the gear change and also a gear season change are affecting lumpfish catchability. A participant questioned whether YOY move offshore and therefore become available to the trawl. The majority of trawls are currently located inshore. The Engel survey has never caught YOY. It was asked whether there is something that causes high mortality of YOY in the north but not in the south of the island of Newfoundland. A participant claimed that there could be the possibility of an ecosystem change in Subdiv. 3Ps that could affect lumpfish, such as increased temperature or predation by or White Hake. The discussion ended with a comment about how lumpfish in the Barents Sea have increased with an increase in sea temperature.

WEIGHT-LENGTH RELATIONSHIPS OF LUMPFISH (*CYCLOPTERUS LUMPUS*) IN THE NORTHWEST ATLANTIC

Presented by: B. Atkinson and D. Kulka

Abstract

For the most part, only linear weight – length relationships have been described for Lumpfish in Canadian waters of the northwest Atlantic and these have focused on mature females with the length range of samples being generally small (~ 35-55 cm). Total weight and length data were available from DFO research surveys conducted by all four Atlantic regions of DFO. The data were analyzed (sexes combined) and total weight – length relationships derived. Data were also available for Lumpfish in West Greenland. A total weight – length relationship was also derived from these data. All of the relationships from the various data sources are reasonably close even though statistically different. The total weight of lumpfish at length in West Greenland

waters is very close to those from Atlantic Canadian waters. Somatic weight data were also available from the northern Gulf of St. Lawrence and West Greenland. Analyses showed that somatic weight at length is also very similar between the two areas.[1]

Discussion

It was concluded by participants that the length/weight data were quite mixed. A participant found it interesting that females from the fall surveys were heavier at length than females from the spring survey (i.e. which would be pre-spawning).

It was discussed that for species at risk there is an issue with replacement. For example, replacement of lumpfish from Greenland to Canadian waters can occur. However, data from presenters showed that this replacement would be unlikely. It was stated that fish are more plump and robust in Canadian waters than Greenland waters. Although there was a gap in the data that was published in Fisheries Research, the lines were still noted to be valid. A participant stated that the Greenland data were questionable and it was suggested that data be added from the Central and Arctic Region, Iceland and Europe. Participants highlighted that Greenland has a very different ecosystem from Canada, and that there are a number of reasons why one would expect differences in lumpfish from Canada and Greenland (e.g., currents).

It was questioned whether the genetic studies from Iceland indicate there are genetic differences among DUs. A participant mentioned that hagfish are known to have the same morphological differences that are shown between Greenland and Canadian lumpfish.

When looking at the average size of eggs, the gonadosomatic index (GSI) for the study was noted to be the same as the GSI for other participants' studies. A participant asked whether lumpfish only spawn once and whether there was a large mortality of lumpfish after spawning. It was noted that the usage of nickel tags was not ideal and that no conclusions could be drawn regarding these questions based on the data currently available. It was clarified for participants that young lumpfish are known to leave nests. The discussion finished with the comment that weight/length discussions may have to be dismissed when analyzing the DU.

ESTIMATION OF GENERATION TIME (G) AND NATURAL MORTALITY (M) FOR LUMPFISH (*CYCLOPTERUS LUMPUS* (LINNAEUS, 1758)): A DISCUSSION PAPER

Presented by: B. Atkinson and D. Kulka

Abstract

Natural mortality (M) and generation time (G) are linked and important parameters to understand for marine fish when contemplating status based on COSEWIC criteria. There are a

[1] Soon after the meeting had concluded, weight – length information from West Greenland became available. The data were provided by R. Hedeholm and S.L. Post of the Greenland Institute of Natural Resources to A. Fréchet (DFO, Quebec Region (retired)) who then provided them to J. Gauthier (DFO, Quebec Region). Additionally, it was discovered that the weight – length information provided in Hedeholm et al. (2014) was of somatic rather than total weight such that the discussion surrounding, and the conclusions reached during the meeting regarding differences between Lumpfish in Canadian and Greenland waters were invalid.

An analysis of the West Greenland data provided indicated that:

a) The West Greenland total weight – length relationship is very similar to the relationships in Canadian waters, and

b) The West Greenland somatic weight – length relationship is very similar to the relationship derived from sampling by Quebec Region for the northern Gulf of St. Lawrence (nGSL).

number of approaches that can be used to estimate both M and G. The von Bertalanffy growth parameters can be input into the on-line Fishbase and estimates of G and M represent some of the outputs. Various other methodologies are also available, and von Bertalanffy parameters have been developed by a number of researchers for Lumpfish in the NE Atlantic. However, only two of the studies included detailed age determination information. For the NW Atlantic, there is only one known study of age determinations. All of these data were examined using the various tools available and overall estimates on M = 0.3 and G = 7 years resulted.

Discussion

The presenters clarified that t_0 is different for both the von Bertalanffy and the Fishbase estimates.

It was stated that a generation time of 7 seemed reasonable. However, there wasn't enough data for an estimate of generation time for DUs. If there is more than one DU, then there will be information for one DU but a lack of data for other possible DUs.

An article (Casselman et al.1987) was distributed to meeting participants. It was stated that lumpfish otoliths are quite small. Casselman et al. stated that lumpfish could be older than the literature suggests and also made a recommendation for an otolith age-validation study. It was stated that the mean age at first maturation would be a better gauge than length at first maturity. The fish in this study were sampled in Trinity Bight and a participant mentioned that the data were the only age-length data available from the NL Region. When a participant asked why the data were not used for the NL Region, it was stated that the data stops at approximately 47 cm.

The method of analysis was questioned by a participant. The participant stated that picking a method due to its consistent results was a poor rationale. Both Atkinson and Fishbase used temperature as an add-on in their calculations.

During these types of analyses, DFO Science generally uses M=0.2. DFO Science welcomed suggestions for M=0.3 and G=7. There was support from meeting participants for potential changes.

Participants discussed an Icelandic stock assessment which concluded that that lumpfish do not live beyond their first spawn. Papers in Fisheries Biology & Fisheries Research stated that lumpfish may be semelparous. It was concluded by meeting participants that while that has been found in other regions, there are not enough data to make the same assumptions for Canadian lumpfish.

DISCUSSIONS

LANDINGS AND COMMERCIAL CATCHES

It was speculated that in the past, landings for whole common lumpfish were due to harvesters using lumpfish for bait.

It was clarified that the target observer coverage level from the conservation harvesting plan is 5%.

A participant stated that there are round weight equivalent landings which date back to 1961 for lumpfish, and that there were minimal landings in the 1960s.

Participants agreed that the greatest decline in the NL lumpfish fishery occurred in Div. 3P.

OVERALL TRENDS, THREATS AND DESIGNATABLE UNITS

It was noted that only 19 fishers were active in 2014 and that they were all located within Div. 4R. In 2014, only 40 t was landed and almost all the landings occurred within Div. 4R.

Harvesters have been forced to abandon the lumpfish fishery (e.g., in 1996, the southern shore action committee abandoned fishing from Cape St. Francis to Cape Race). There was an assumption that the decline in participants is indicative of a resource decline. Regardless of market conditions in recent periods, the number of harvesters and the number of trips, the catches and the surveys indicate a similar trend: there is a general downward trend in the stock. Harvesters are tracking the same trends in their catches as the surveys.

Participants questioned the causation of blips in the data. Lumpfish has been called a boom and bust fishery. Ecological events that increased availability or increased YOY were pondered as a cause of the blips. However, participants agreed that ecological events were not a likely cause as lumpfish are a low fecundity species and as such the stock will not see a “boom” year class. It appeared to participants that changes in availability due to movement was a more likely scenario.

There was a discussion over the usage of standardized indices. In the future, participants hoped for a licence stipulation that allows for the release of data. In the Quebec Region, approval was obtained from fishers and buyers for the release of lumpfish data. The NL Region has not yet obtained such approvals. The release of information may impact the work of organizations such as COSEWIC. There was no consensus on whether the inability to release the information has impacted work of DFO’s Science Branch. It was assumed that the issue pertaining to the release of lumpfish data was due to the releasing of proprietary information for buyers and fishers.

It was stated that there is one Conservation Harvesting Plan for the NL Region and it restricts the fishery to the depths of 25 fathoms.

The list of potential threats to lumpfish was discussed amongst participants. It was clarified that seismic activities has been added to the list of threats as the YOY could be affected by seismic work. It was suggested that emerging fisheries located within the inshore such as whelks and periwinkles could also be added to the list.

Participants questioned why mature lumpfish are not observed in the middle section of the Scotian shelf. It was stated that there could be an opportunity for the mixing of mature and juvenile groups of lumpfish. There could also be potential for larval dispersal as post larval juveniles are located in the water column. The surveys could not be collecting adult lumpfish due to their timing (i.e. lumpfish are inshore spawning at that time).

Participants discussed DUs and concluded that there is no justification for more than one DU. There was some discussion on natal homing (i.e. do lumpfish have a seasonal residence that may vary from year to year?) Currently this is still unknown although there is no indication of spawning site fidelity for lumpfish. Available data suggests that lumpfish have been tagged and captured again near the same site. However, it is unknown whether lumpfish spawn at that same site. It was questioned whether spawning site fidelity is required to have a deemed residence? It has been observed that male lumpfish do return to the same nests but it is unknown whether those returning male lumpfish are the same fish. It was unknown whether SARA requires the exact same lumpfish to return to the exact same nest during its decision on spawning site fidelity. A participant suggested that there is the potential for lumpfish to have a residence as they do nest. While female lumpfish have been tagged and are known to wander, it is unknown whether female lumpfish return to the same nests to spawn. It is also unknown whether males return to the same nest. A participant has observed multiple female lumpfish

depositing eggs in nests, and one male lumpfish maintaining up to three nests of eggs deposited by different females. It was stated that this was observed in the mid-1980s, and that the nests were not present when divers returned to the area in 2014.

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APPENDIX I: TERMS OF REFERENCE

Pre-COSEWIC Assessment for Lumpfish

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

November 17-19, 2015
St. John's, NL

Chairperson: Peter Shelton

Context

The implementation of the federal *Species at Risk Act* (SARA), proclaimed in June 2003, begins with an assessment of a species' risk of extinction by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC is a non-government scientific advisory body that has been established under Section 14(1) of SARA to perform species assessments, which provide the scientific foundation for listing species under SARA. Therefore, an assessment initiates the regulatory process whereby the competent Minister must decide whether to accept COSEWIC's assessment and add a species to Schedule 1 of SARA, which would result in legal protection for the species under the Act. If the species is already on Schedule 1 of SARA, the Minister may decide to keep the species on the list, reclassify it as per the COSEWIC assessment, or to remove it from the list (Section 27 of SARA).

Fisheries and Oceans Canada (DFO), as a generator and archivist of information on marine species and some freshwater species, is to provide COSEWIC with the best information available to ensure that an accurate assessment of the status of a species can be undertaken.

The Lumpfish (*Cyclopterus lumpus*) was listed on COSEWIC's Fall 2014 Call for Bids to produce a status report.

Objectives

The overall objective of this meeting is to peer-review existing DFO information relevant to the COSEWIC status assessment for Lumpfish in Canadian waters, considering data related to the status and trends of, and threats to this species inside and outside of Canadian waters, and the strengths and limitations of the information. This information will be available to COSEWIC, the authors of the species status report, and the co-chairs of the applicable COSEWIC Species Specialist Subcommittee. Publications from the peer-review meeting (see below) will be posted on the CSAS website.

Specifically, DFO information relevant to the following will be reviewed to the extent possible:

1. Life history characteristics

- Growth parameters: age and/or length at maturity, maximum age and/or length
- Total and natural mortality rates and recruitment rates (if data are available)
- Fecundity
- Generation time
- Early life history patterns
- Specialized niche or habitat requirements

2. Review of designatable units

Available information on population differentiation, which could support a COSEWIC decision of which populations below the species' level would be suitable for assessment and designation,

will be reviewed. Information on morphology, meristics, genetics and distribution will be considered and discussed.

See COSEWIC 2013 Guidelines for recognizing Designatable Units below the Species Level

3. Review the COSEWIC criteria for the species in Canada as a whole, and for each designatable units identified (if any).

COSEWIC Criterion – Declining Total Population

1. Summarize overall trends in population size (both number of mature individuals and total numbers in the population) over as long a period as possible and in particular for the past three generations (taken as mean age of parents). Additionally, present data on a scale appropriate to the data to clarify the rate of decline.
2. Identify threats to abundance— where declines have occurred over the past three generations, summarize the degree to which the causes of the declines are understood, and the evidence that the declines are a result of natural variability, habitat loss, fishing, or other human activity.
3. Where declines have occurred over the past three generations, summarize the evidence that the declines have ceased, are reversible, and the likely time scales for reversibility.

COSEWIC Criterion – Small Distribution and Decline or Fluctuation: for the species in Canada as a whole, and for designatable units identified, using information in the most recent assessments:

1. Summarize the current extent of occurrence (in km^2) in Canadian waters
2. Summarize the current area of occupancy (in km^2) in Canadian waters
3. Summarize changes in extent of occurrence and area of occupancy over as long a time as possible, and in particular, over the past three generations.
4. Summarize any evidence that there have been changes in the degree of fragmentation of the overall population, or a reduction in the number of meta-population units.
5. Summarize the proportion of the population that resides in Canadian waters, migration patterns (if any), and known breeding areas.

COSEWIC Criterion – Small Total Population Size and Decline and Very Small and Restricted: for the species in Canada as a whole, and for designatable units identified, using information in the most recent assessments:

1. Tabulate the best scientific estimates of the number of mature individuals;
2. If there are likely to be fewer than 10,000 mature individuals, summarize trends in numbers of mature individuals over the past 10 years or three generations, and, to the extent possible, causes for the trends.

Summarise the options for combining indicators to provide an assessment of status, and the caveats and uncertainties associated with each option.

For transboundary stocks, summarise the status of the population(s) outside of Canadian waters. State whether rescue from outside populations is likely.

4. Describe the characteristics or elements of the species habitat to the extent possible, and threats to that habitat

Habitat is defined as “in respect of aquatic species, spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or

indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced".

The phrasing of the following guidelines would be adapted to each specific species and some could be dropped on a case-by-case basis if considered *biologically* irrelevant. However, these questions should be posed even in cases when relatively little information is expected to be available, to ensure that every effort is made to consolidate whatever knowledge and information does exist on an aquatic species' habitat requirements, and made available to COSEWIC.

1. Describe the functional properties that a species' aquatic habitat must have to allow successful completion of all life history stages.

   In the best cases, the functional properties will include both features of the habitat occupied by the species and the mechanisms by which those habitat features play a role in the survivorship or fecundity of the species. However, in many cases the functional properties cannot be described beyond reporting patterns of distribution observed (or expected) in data sources, and general types of habitat feature known to be present in the area(s) of occurrence and suspected to have functional properties. Information will rarely be equally available for all life history stages of an aquatic species, and even distributional information may be missing for some stages. Science advice needs to be carefully worded in this regard to clearly communicate uncertainties and knowledge gaps.

2. Provide information on the spatial extent of the areas that are likely to have functional properties.

   Where geo-referenced data on habitat features are readily available, these data could be used to map and roughly quantify the locations and extent of the species' habitat. Generally however, it should be sufficient to provide narrative information on what is known of the extent of occurrence of the types of habitats identified. Many information sources, including Aboriginal Traditional Knowledge (ATK) and experiential knowledge, may contribute to these efforts.

3. Identify the activities most likely to threaten the functional properties, and provide information on the extent and consequences of those activities.

   COSEWIC's operational guidelines require consideration of both the imminence of each identified threat, and the strength of evidence that the threat actually does cause harm to the species or its habitat. The information and advice from the Pre-COSEWIC review should provide whatever information is available on both of those points. In addition, the information and advice should include at least a narrative discussion of the magnitude of impact caused by each identified threat when it does occur.

4. Recommend research or analysis activities that are necessary.

   Usually the work on the other Guidelines will identify many knowledge gaps.

   Recommendations made and enacted at this stage in the overall process could result in much more information being available should a Recovery Potential Assessment be required for the species.

5. Describe to the extent possible whether the species has a residence as defined by SARA

SARA's 2(1) defines Residence as “a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating.”

6. Threats

A threat is any activity or process (both natural and anthropogenic) that has caused, is causing, or may cause harm, death, or behavioural changes to a species at risk or the destruction, degradation, and/or impairment of its habitat to the extent that population-level effects occur. Guidance is provided in: Environment Canada, 2007. Draft Guidelines on Identifying and Mitigating Threats to Species at Risk. *Species at Risk Act* Implementation Guidance.

List and describe threats to the species considering:

- Threats need to pose serious or irreversible damage to the species. It is important to determine the magnitude (severity), extent (spatial), frequency (temporal) and causal certainty of each threat.
- Naturally limiting factors, such as aging, disease and/or predation that limit the distribution and/or abundance of a species are not normally considered threats unless they are altered by human activity or may pose a threat to a critically small or isolated population.
- Distinction should be made between general threats (e.g. agriculture) and specific threats (e.g. siltation from tile drains), which are caused by general activities.
- The causal certainty of each threat must be assessed and explicitly stated as threats identified may be based on hypothesis testing (lab or field), observation, expert opinion or speculation.

7. Other

Finally, as time allows, review status and trends in other indicators that would be relevant to evaluating the risk of extinction of the species. This includes the likelihood of imminent or continuing decline in the abundance or distribution of the species, or that would otherwise be of value in preparation of COSEWIC Status Reports.

Working Paper

A working paper related to the status of the Lumpfish may be submitted for review 2 weeks prior to the meeting

Expected Publications

- Proceedings
- Research Document

Participation

- DFO Science
- DFO Species at Risk Management
- DFO Resource Management
- DFO Policy and Economics
- Provincial governments
- Fishing Industry
- Non-governmental organizations
- Aboriginal groups
- COSEWIC status report author and members

APPENDIX II: AGENDA

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

November 17-18, 2015

St. John's, NL

Chairperson: Peter Shelton

November 17, 2015

Time	Activity	Presenter
9:00-9:30	Introduction/ Review Terms of Reference	Chair
9:30-10:30	Biology and Life history	Collins/Gauthier
10:30-10:45	Break	N/A
10:45-12:00	L-W, M and G	Kulka/Atkinson
12:00-1:00	Lunch (not provided)	N/A
1:00-1:45	Distribution/Area Occupied	Gauthier/Collins
1:45-2:30	Survey Abundance/Size/Maturity	Miri/Gauthier
2:30-2:45	Break	N/A
2:45-3:30	Fishery	Gauthier/Simpson
3:30-4:00	Threats and Decline	All
4:00-4:30	Review of the Designatable Unit(s) and COSEWIC Criteria	All
4:30-5:00	Discussion	All

November 18, 2015

Discussion Continued.

APPENDIX III: LIST OF PARTICIPANTS

Name	Affiliation
Peter Shelton (Chair)	DFO Science-NL
Jim Meade	DFO Science-NL(CSA Office)
Erika Parrill	DFO Science-NL(CSA Office)
Patricia Williams	DFO RMAF-NL
Sue Forsey	DFO Species at Risk-NL
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Johanne Gauthier	DFO Science-Quebec Region
Erin Carruthers	FFAW
Kevin Hedges (teleconference)	DFO Science-C&A