Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat
Quebec Region | Science Advisory Report 2016/021

ASSESSMENT OF LUMPFISH (*CYCLOPTERUS LUMPUS*) IN THE GULF OF ST. LAWRENCE (3Pn, 4RS) IN 2015

Source: Claude Nozères

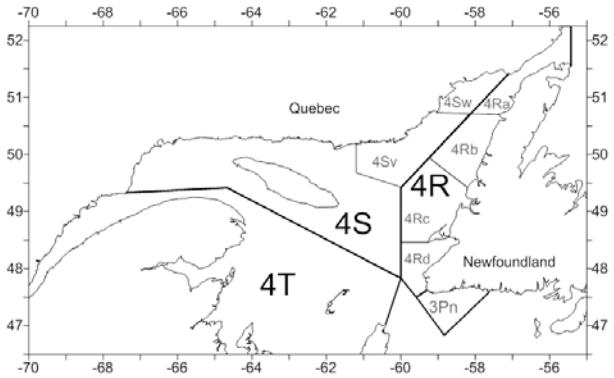

Figure 1. Gulf of St. Lawrence Map. The boundaries of NAFO Divisions 4R, 4S and 4T, and those of Subdivision 3Pn and unit areas are indicated.

Context:

*Fishing for lumpfish, also known as lumpsuckers (*Cyclopterus lumpus*), takes place in spring for a very short period of time. Females are exclusively fished, for the caviar market. Management is done by controlling the fishing effort (amount of gear, minimum mesh size and fishing season). Scientific knowledge on lumpfish in the Gulf of St. Lawrence is limited.*

As we do not know the structure of the population and are unable to identify lumpfish stocks, this report provides an assessment for the 4R and 4S Divisions, as well as the Subdivision 3Pn (Figure 1). This choice is based on the areas of interest where directed fishery is carried out for this species.

The lumpfish is currently a candidate for assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) because of concerns about its situation.

Lumpfish in 3Pn and 4RS are assessed every five years and the last peer review was done back in the winter of 2010. The main indicators used for this evaluation are pulled from fishing statistics data, sampling of commercial catches and bottom trawl survey data from DFO.

This scientific advisory report stems from the meeting of 18 February 2016 on the Assessment of Gulf of St. Lawrence NAFO Divisions 4RS and Subdivision 3Pn Lumpfish. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

SUMMARY

- Lumpfish roe landings in 3Pn and 4RS dropped significantly from an annual average of 349 t for the 1986-2009 period to 35 t for the 2010-2015 period.
- The number of active fishers fell from an annual average of 404 for the 1986-2009 period to 65 for the 2010-2015 period. Since 2013, all fishing activity has been concentrated in the 4Ra unit area,

whereas traditionally it took place in Subdivision 3Pn, along the west coast of Newfoundland, and along the Lower North Shore in unit area 4Sw.

- The decline in landings and fishing effort could be due in part to factors such as market conditions, a synchronization of fishing with the arrival of females in coastal waters, weather conditions and the possibility of more lucrative fisheries.
- The fishery performance index shows cyclical, synchronous variations in every Division. This index was low from 2009 to 2012. In 4Ra in 2015, the index was the same as the 1986-2014 average.
- According to DFO's annual survey in August, lumpfish are a rare catch and are not very abundant but are widely distributed in the northern Gulf of St. Lawrence. The highest concentrations are observed along the North Shore.
- The bulk of the lumpfish captured in DFO's survey were juveniles. Given the scarcity of mature individuals in the survey, we are unable to comment on the status of this resource.
- This fishery targets gravid females. Moreover, local over-exploitation is possible given that lumpfish seem to return to the same spawning sites every year.
- The sharp decline in landings and effort suggests a significant decline in resource abundance since 2006. The abundance of lumpfish seems to fluctuate on a cyclical basis and has been low since 2009. Despite uncertainty as to the causes of this low abundance, the vulnerability of this resource to reproductive potential overfishing argues for a very cautious approach.

INTRODUCTION

Species biology

The lumpfish (*Cyclopterus lumpus*) is widely distributed in temperate waters on both sides of the North Atlantic. This fish displays a semi-pelagic lifestyle.

In early spring, lumpfish migrate along the coast for spawning, which can continue until the summer. The males arrive first in shallow water and build nests. The females reach the spawning sites at different times, which could allow the males to spawn with several females. A sexual dimorphism is present in lumpfish and females grow to be larger than males. During courtship, there is also a state of dichromacy; females are grey-blue and males are orange-red on their underside and fins. The female lays her eggs on the surface of the nest where they are fertilized by the male. Females can lay 2-3 egg masses at intervals of 8 to 14 days. They then leave the coastal area and the males guard the nest, which can house 10,000 to 200,000 eggs. The males remain near the nest during the incubation period providing parental care for the eggs, aerating them and protecting them against certain predators. Incubation can last more than 60 days. It has been suggested that spawning off the east coast of Newfoundland is temperature-dependent and starts when the water reaches 4°C. At the point of hatching, the larvae are about 5 mm. The events following hatching are not well known. During the early stages of life, lumpfish can be found under floating algae or attached to rocks, in lobster traps or fixed to other solid objects via their adhesive pelvic muscles. They are found in coastal areas, eelgrass beds and also in the high seas.

Several tagging studies have shown that lumpfish have been able to travel long distances of more than 300 km over a period of three months in the northern Gulf of St. Lawrence (nGSL). In Iceland, the longest distance traveled in one day was 49 km and the longest distance ever reported was 587 km over 18 days. These studies also showed that a high proportion of individuals marked at their spawning sites were recaptured a year later near the site.

Preliminary studies on age determination using otoliths of lumpfish captured in the Newfoundland region indicate that age when sexual maturity is reached is 5.6 years (ranging from four to seven years) for the female. This estimate is comparable to the average of five years determined for female lumpfish in Iceland.

Lumpfish would not produce plasma proteins that are known to improve resistance to cold among fish. Therefore, lumpfish have a low probability of survival if exposed to temperatures <0°C, temperatures that may be present in the coastal area in winter. This could partly explain the fall migration to deeper and relatively warmer waters.

Stomach contents

The diet of lumpfish in the Gulf, as determined from samples taken in August 2015 during a DFO research survey, is comparable to its diet described elsewhere in the Atlantic Ocean. In general, the lumpfish diet consists of a variety of invertebrates, including crustaceans such as crab larvae, euphausiids, amphipods, gelatinous zooplankton (jellyfish and comb jellies) and polychaetes.

Predators

Few fish have been identified as predators of the lumpfish. In the northwest Atlantic, studies of the stomach contents of wolffish (*Anarhichas spp*) and Greenland Halibut (*Reinhardtius hippoglossoides*) have identified lumpfish as rare prey for this species. As for the nGSL, examination of a database on the stomach contents of several thousands of Atlantic Cod, Greenland Halibut and Atlantic Halibut sampled between 1994 and 2015 identified the presence of lumpfish in only seven samples, i.e. three cod and four Atlantic Halibut.

Marine mammals are known predators of the lumpfish. In the nGSL, several studies have identified the Grey Seal (*Halichoerus grypus*) as a predator of lumpfish. The proportion of lumpfish in the stomachs of Grey Seals is highly variable and the highest values were reported in stomachs sampled at Anticosti Island during the lumpfish breeding period. The Grey Seal population in the Gulf has increased substantially in recent decades.

Fishery

In Canada, the lumpfish fishery targets exclusively females for the caviar market. This fishery is relatively new and has been carried out in the Gulf of St. Lawrence since the mid-1970s. It is practised mainly on boats under 35 feet in coastal waters in the spring. Fishing takes place over several weeks and the majority of landings (> 95%) take place in May and June when the fish migrate to the coast to spawn. Management is done by controlling the fishing effort: 1) a season that only lasts a few weeks 2) a limit of 50 gillnets of 50 fathoms with a minimum mesh size of 10.5 inches.

In the Gulf of St. Lawrence, lumpfish fishing is managed by two separate management plans: one for Subdivision 3Pn and Division 4R and one for Division 4S. The main differences between these management plans lies in the observer coverage, dockside monitoring and the type of logbook to be filled out. In Quebec (4S), observer coverage is 10% with 100% dockside monitoring and the obligation to complete a logbook. This document must be completed and returned to DFO Quebec region, which ensures the availability of nearly 100% of the information (amount of gear, soak time, fishing position) in the official statistics. In Newfoundland (3Pn, 4R), observer coverage is 5%, dockside monitoring is only mandatory when there is bycatch of cod or Atlantic Halibut and the logbook to fill out is that of the less than 35 foot vessel sector. Very few fishermen complete this latter logbook for lumpfish fishing. In recent years, the activities reported in these logbooks totaled between 0% and 16% of annual landings. In addition, information on the fishing effort and the soak time contained in these logs is not included in official fishery statistics.

Lumpfish fishing is strongly influenced by market conditions, and annual landings vary according to demand and prices. The price for roe is negotiated annually before the start of fishing, and depends partly on the surplus from the previous year. After the fishing season, the price may be adjusted depending on the markets. If prices are low, some fishermen may focus on other fisheries until prices recover.

Landings and participation

In official landings statistics (ZIFF - Zonal Interchange File Format), lumpfish are registered under two codes. Code 176 stands for whole lumpfish landings and code 928 for roe landings. All landings from directed lumpfish fishery are recorded as roe weight. No conversion factor is applied to these roe weight to convert them into whole fish weight. Code 176 is used only in rare cases of bycatch in directed fisheries for other species.

Lumpfish roe landings in 3Pn and 4RS dropped significantly from an annual average of 349 t for the 1986-2009 period to 35 t for the 2010-2015 period (Table 1).

In Division 4R, lumpfish fishing began in 1970. Two episodes of higher landings were observed; one in the late 80s with a maximum of 470 t in 1987 and a second in the late 90s with a maximum of 673 t in 1999 (Figure 2). From 1970 to 2009, the annual landing average was 182 t compared to 35 t for the period of 2010-2015. In the history of this fishery, landings were recorded in all unit areas, i.e. 4Ra, 4Rb, 4Rc and 4Rd. However, since 2008, the fishery is very localized and over 95% of landings come from the unit area 4Ra (Figure 1). The number of participants in this fishery has varied significantly (Figure 3). From 1986 to 2015, the maximum number of fishers was 664 in 1987 and the average for the 1986-2009 period was 247 fishers compared to 56 for the recent period (2010-2015).

In Subdivision 3Pn, directed lumpfish fishing began in 1980. The most important landings were recorded in 1997 and 1999 with 478 t and 471 t respectively. Between 1980 and 2009, the annual landing average was 127 t. For the period 2010-2015, the average dropped to less than one tonne. There were no landings in 2009 and from 2012 to 2015. The maximum number of participants was 199 in 1997 with an average of 100 fishers between 1986 and 2008 (Figure 3).

In Division 4S, fishing began in 1986 and the highest landing was recorded at the beginning of this fishery in 1987 with 114 t. Fishing is concentrated in the 4Sw unit area with nearly 90% of landings; the other landings are from the unit area 4Sv (Figure 1). From 1986 to 2009, the annual landing average was 27 t compared to less than one tonne for the period of 2010-2015. There were no landings in this Division from 2013 to 2015.

Table 1. Annual average of roe landings (tonnes) per period of ten years and annual landings for the recent period.

Period	3Pn	4R	4S	Total
1970-1979	-	59	-	59
1980-1989	135	212	56	369
1990-1999	195	263	15	473
2000-2009	56	97	28	175
2010	1	44	4	48
2011	0.006	33	0.3	33
2012	0	62	2	63
2013	0	5	0	5
2014*	0	35	0	35
2015*	0	28	0	28

** Preliminary data as at February 15, 2016.*

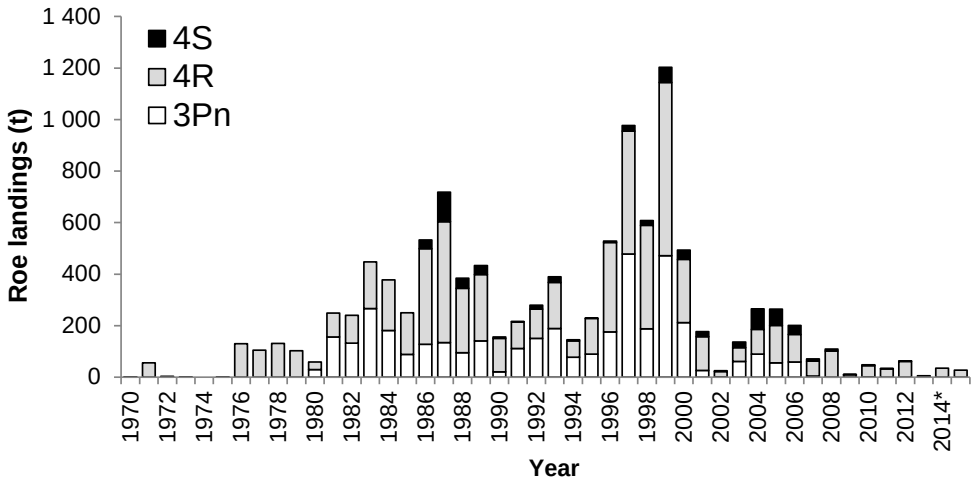

Figure 2. Annual roe landings for Subdivision 3Pn and Divisions 4R and 4S.

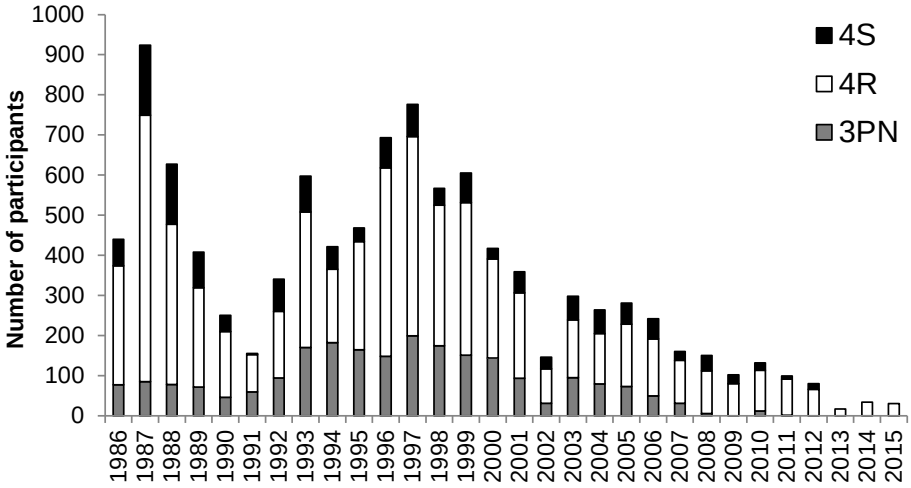

Figure 3. Number of fishers participating in lumpfish directed fishery from 1986 to 2015 for Subdivision 3Pn and Divisions 4R and 4S.

Bycatch

From 2010 to 2014, according to ZIFF data, landings of whole lumpfish or roe are only recorded in the lumpfish directed fishery. There were no lumpfish landings (whole or roe) from other directed fishery.

The information provided by the observer database indicates that from 2005 to 2014, there were unaccounted lumpfish discards in directed cod, redfish, turbot, American Plaice, Witch Flounder and shrimp fisheries. These discards represent less than 100 kg per fishery annually.

ASSESSMENT

Resource Status

Sources of data

Assessment of the state of the lumpfish in Subdivision 3Pn and Divisions 4R and 4S is done based on the data analysis

1) from commercial fishery,
2) from the DFO bottom trawl research survey and
3) from the sentinel fixed and mobile gear fishery program.

Fishery data are taken from official statistics compiled by the various DFO regions in the ZIFF files, the logbooks of the less than 35 foot vessel sector from Newfoundland, a sampling of the commercial catch made by DFO port sampler in Division 4S and the observer database.

Size structure

The size of lumpfish captured during the DFO research survey (Figure 4A) ranges from 3 to 48 cm. This distribution shows a mode at 4 cm representing one-year-old lumpfish and a second mode at 12 cm for two-year-old fish. Few fish are found in the range of 15-20 cm, which would represent the annual growth of fish from two to three years old. Only 7% of lumpfish captured during the survey were of commercial size (≥ 35 cm), which does not allow for proper monitoring of individuals targeted by the fishery (Figure 5).

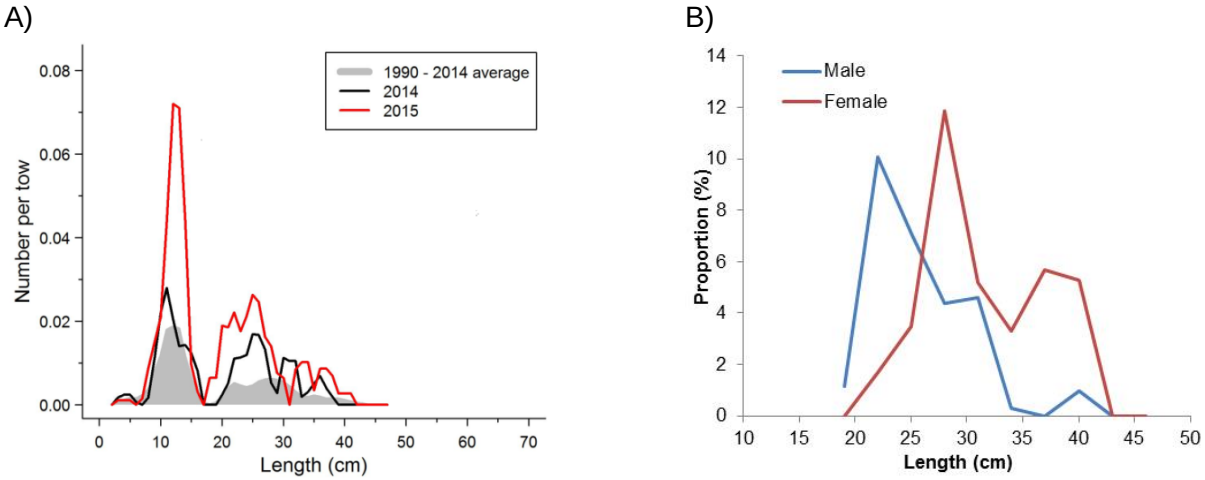

Figure 4. Lumpfish data from the DFO survey in the northern Gulf of St. Lawrence. A) Length frequency distributions (average number per 15-minute tow) B) Length frequency distributions (proportion) by sex for fish ≥ 19 cm.

Females reach a larger size than males, and represent the majority of fish 35 cm and longer (Figure 4B).

There is very little information on the size structure of lumpfish captured in commercial fishery in the Gulf since the roe is harvested at sea and the carcasses are discarded there. A monitoring program set up in 2006 in Division 4S helped collect a small amount of data (Figure 5). The size of lumpfish caught by 10.5-inch gillnets ranged from 30 to 52 cm, with the average size being around 40 to 42 cm. Based on information on growth and age of this species, several cohorts would be present in this fishery.

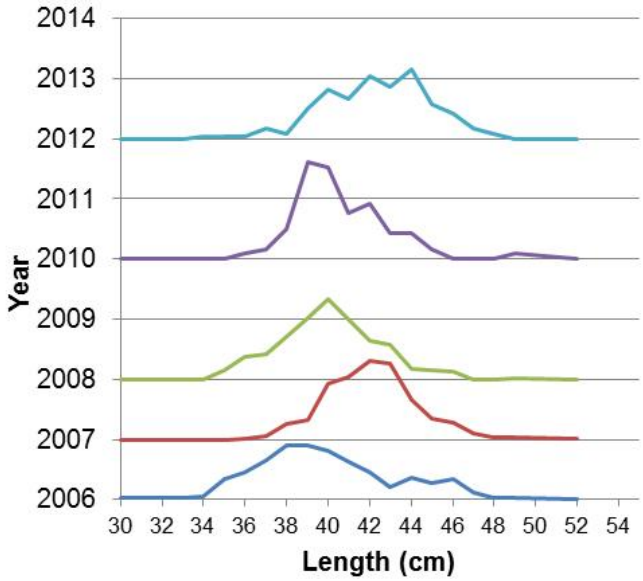

Figure 5. Size frequencies of lumpfish sampled during commercial fishery in Division 4S.

Abundance indices and catch rates

DFO research vessel surveys

The DFO survey has not proven to be an optimal tool for tracking the abundance of lumpfish, firstly, because it is a bottom trawl survey and the semi-pelagic nature of the lumpfish reduces its catchability, and secondly, because the survey was conducted in August when a number of the mature individuals were still in coastal waters (mainly the males taking care of the nests) and therefore outside of the sampling area.

Research surveys conducted in the Barents Sea have shown: 1) greater catchability of lumpfish in pelagic trawl compare to bottom trawl over the course of surveys performed simultaneously in August and 2) higher catchability of lumpfish in bottom trawl in winter than in summer.

Between 1990 and 1994, two bottom trawl surveys were underway in the nGSL, one in January (NM Gadus Atlantica with an Engel trawl) and the other in August (CCGS Alfred Needler with a Uri trawl). A comparison of distribution of lumpfish catches recorded during these surveys (Figure 6) shows a marked difference in catchability based on season, with lumpfish being captured in 46% of winter tows vs. 8% in summer. The fact that catches were higher in winter might indicate an aggregation of lumpfish at the bottom, making them more available to the trawl at this time of year. It is important to note that in addition to seasonality, which varied in both surveys, selectivity was also different du to the use of different ships and trawls.

Although the bottom trawl surveys carried out in August were not optimal for sampling lumpfish, the long time series (> 30 years) of the DFO survey gives an indication of the general distribution of the species (Figure 7). A recurring concentration is observed at the entrance to the Strait of Belle Isle where directed lumpfish fishery is still ongoing. We also observed a distribution along the North Shore with a continuous concentration northwest of Anticosti. Several samples of eelgrass in the region have also indicated the presence of juveniles and adults lumpfish.

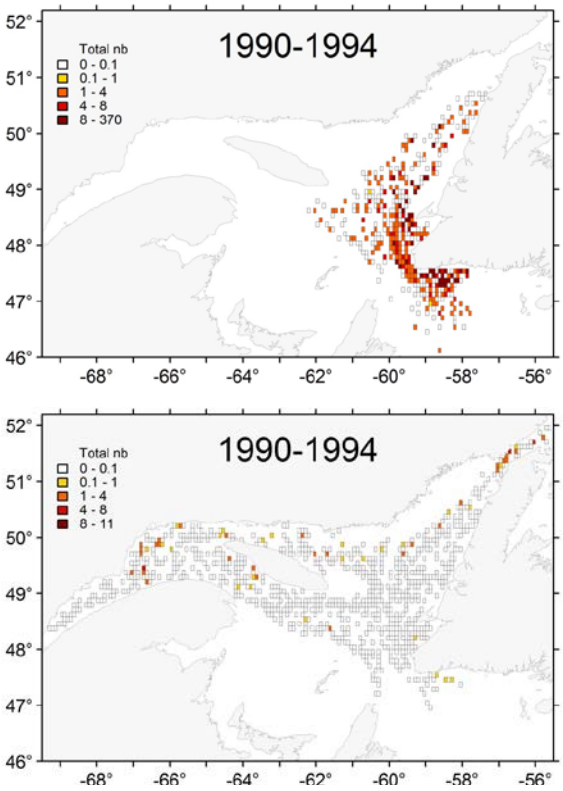

Figure 6. Distribution of lumpfish catches, total number per grid square, recorded during the January survey (top panel) and the August survey (bottom panel). The white grid squares indicate areas that were trawled but resulted in no lumpfish catches.

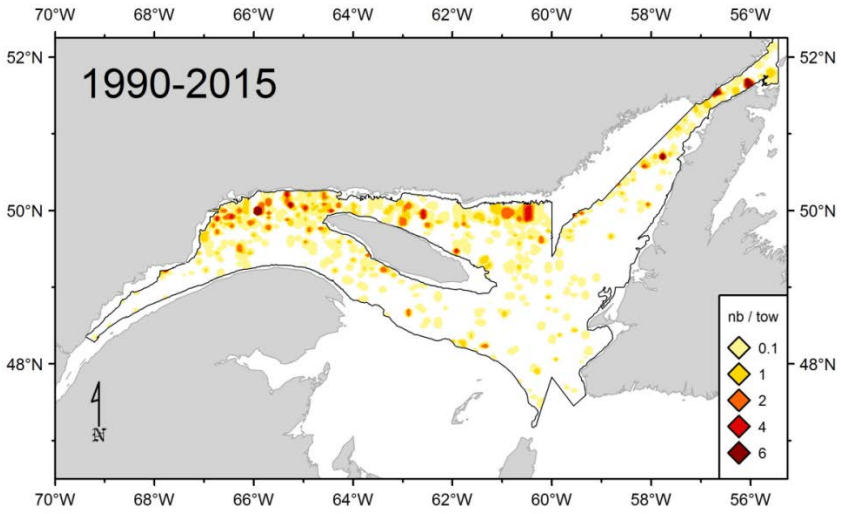

Figure 7. Distribution of lumpfish catch rates (number / 15-minute tow) recorded during the DFO bottom trawl survey in August. The black line represents the outline of the study area.

On average, thirty lumpfish are caught annually during the August DFO survey in the nGSL. In 2015, 75 were captured. The average number per 15-minute tow shows an increase between 2012 and 2015 (Figure 8). The 2015 value is comparable to that of 2006 and is above the 1990-2014 average. The

area of occupancy of lumpfish, based on survey data, is stable and represents nearly 16% of the sampled area.

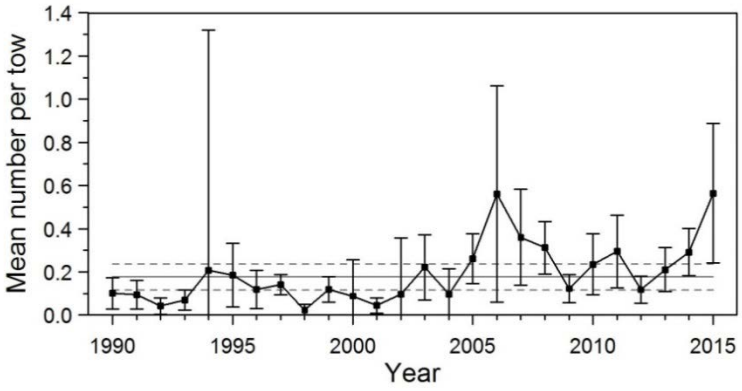

Figure 8. Average number of lumpfish per 15-minute tow observed during the northern Gulf of St. Lawrence survey. The vertical bars indicate a 95% confidence interval. The horizontal solid line represents the 1990-2014 average and the dotted lines represent plus or minus half the standard deviation around the average.

Sentinel Fishery Program

Lumpfish is a rare catch in the sentinel fishery fixed gear program. Catches are made during gillnet fishery and are mainly concentrated in the Strait of Belle Isle, in unit areas 4Ra and 4Sw (Figure 1). These sporadic catches do not help identify trends in the abundance of this resource.

The distribution of lumpfish observed during the mobile survey of the July sentinel program was similar to that observed in August during the DFO survey in Divisions 4R and 4S (Figure 9). In addition, the sentinel survey covers Subdivision 3Pn and it shows an absence of lumpfish in the offshore portion of this Subdivision (Figure 9). Lumpfish catchability during this survey is unknown but is likely low for the same reasons as in the DFO survey. Lumpfish was captured in only 5% of the tows performed in this survey. Between 1995 and 2002, a similar survey was conducted in October and the proportion of the tows where lumpfish were captured was 12%. This information also shows that the catchability of bottom trawl lumpfish varies seasonally. There is no information available on the size of lumpfish captured in the mobile sentinel surveys. Catch rates are low and fairly stable with an average of 0.07 lumpfish per 30-minute tow.

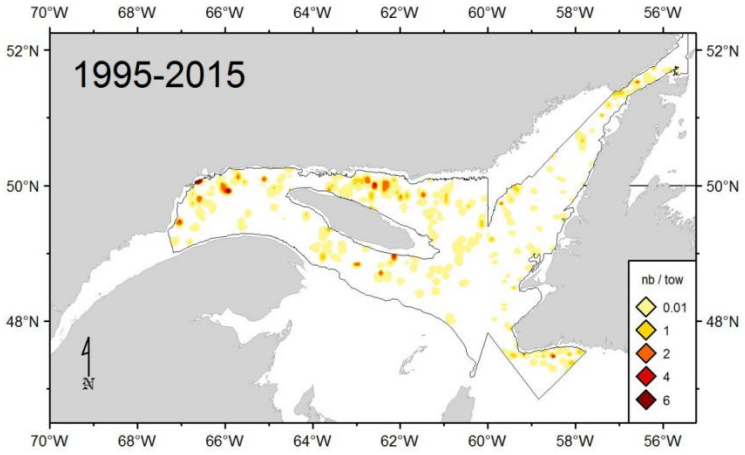

Figure 9. Distribution of lumpfish catch rates (number / 30-minute tow) recorded during the mobile survey of the sentinel program in July. The black line represents the outline of the study area.

Fishery performance index

Commercial data from the dockside monitoring program provide information that can help draw certain conclusions about the performance of directed lumpfish fishery between 1986 and 2015 for Subdivision 3Pn and Divisions 4R and 4S (Figure 10). Annual landings are usually correlated with the number of activities. The fishing performance index, calculated annually as the sum landings over the total number of fishing activities (CPUE), shows synchronous cyclical variations in each area. This index was low from 2009 to 2012. In 4Ra in 2015, the index was similar to the 1986-2014 average. The CPUE of commercial fishery should not be used as an indicator of lumpfish population abundance since CPUE is influenced by many factors including: market conditions, climatic conditions, synchronism between fishing and the arrival of females to coastal areas, the duration of the fishing season and the occurrence of more lucrative fisheries.

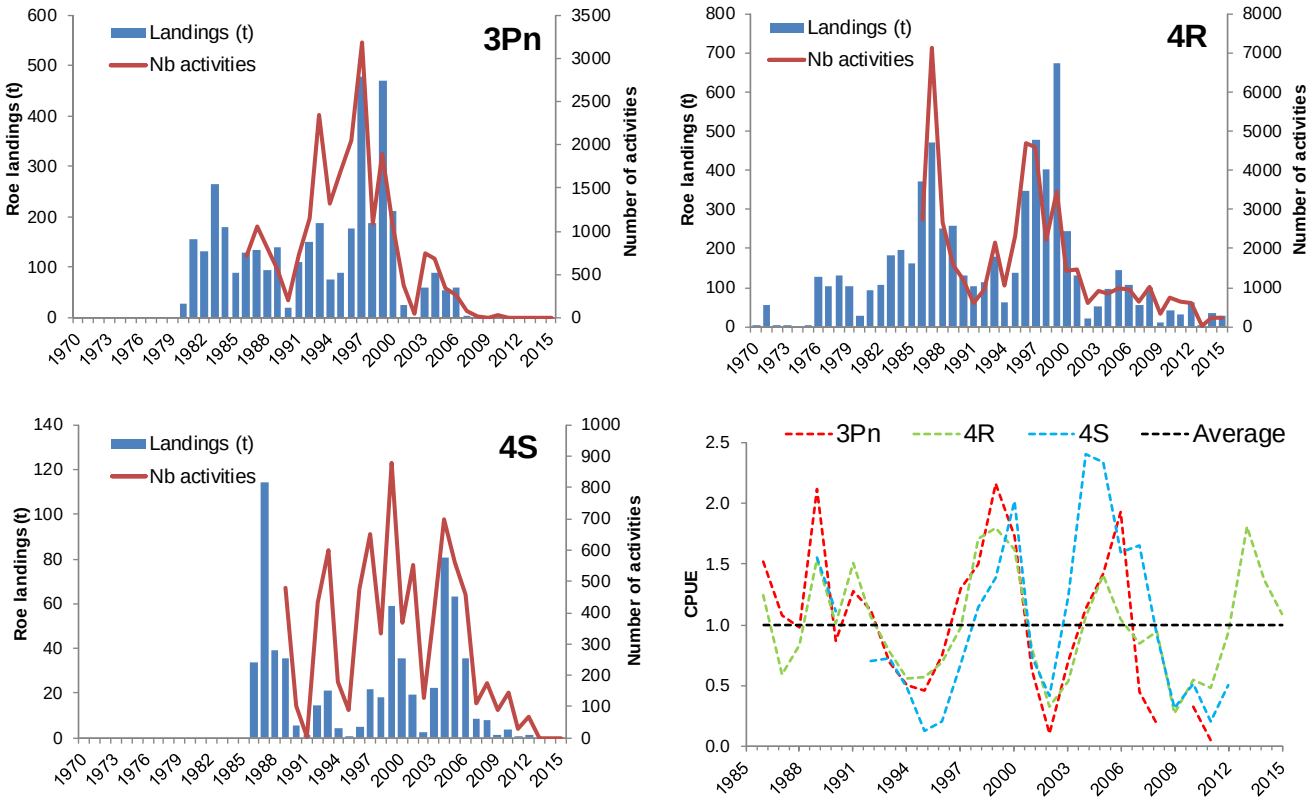

Figure 10. Roe landings (tonnes), number of fishing activities and normalized catch per unit effort (CPUE) (sum of landings / number of activities / series average) per year and fishing area.

Sources of uncertainty

Lumpfish catchability during the DFO bottom trawl survey is unknown and probably low, firstly, because of the semi-pelagic nature of lumpfish and secondly, because the survey was conducted in August when a portion of the mature individuals are still in coastal waters for reproduction and outside of the sampling area. During the survey, lumpfish was captured in 11% of tows and less than 7% of sampled fish were of commercial size. Thus, there is not a reliable indicator of abundance trends for lumpfish.

There is a regional disparity in the type of logbook filled out by fishers, leading to differences in the availability of information on fishing activities. Thus, for the Newfoundland and Labrador region, fishing position data, the amount of gear used and soak time are mostly absent. It is therefore not possible to

calculate catch per unit effort based on the amount of gear and the soak time. In addition, the proportion of data available at the time of the assessment varies from one region and year to the next because data entry is not yet completed.

A recent genetic study, based on a small number of individuals and sites, suggests that lumpfish in the waters of Greenland, Canada and Maine would represent the same population. To effectively manage this species, it is important to define stock and distribution.

Knowledge of lumpfish in the St. Lawrence Gulf is very limited; for example we do not know the size at sexual maturity, its location after spawning or its migration route.

CONCLUSION

Lumpfish fishery targets gravid females for the caviar market. Moreover, local over-exploitation is possible given that lumpfish seem to return to the same spawning sites every year. The sharp decline in landings and effort suggests a significant decline in resource abundance since 2006. The abundance of lumpfish seems to fluctuate on a cyclical basis and has been low since 2009. Despite uncertainty as to the causes of this low abundance, the vulnerability of this resource to reproductive potential overfishing argues for a very cautious approach.

SOURCES OF INFORMATION

This scientific advisory report stems from the meeting of 18 February 2016 on the Assessment of Gulf of St. Lawrence NAFO Divisions 4RS and Subdivision 3Pn Lumpfish. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

Bourdages, H., Brassard, C., Desgagnés, M., Galbraith, P., Gauthier, J., Légaré, B., Nozères, C., Parent, E. and Schwab P. 2016. Preliminary results from the groundfish and shrimp multidisciplinary survey in August 2015 in the Estuary and northern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/004. v + 88 p.

DFO. 2014. Stock Assessment of Canadian Grey Seals (*Halichoerus Grypus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/010.

Fréchet, A., Gauthier, J., Schwab, P., Collier, F., and Spingle, J. 2006. Tagging of Lumpfish (*Cyclopterus lumpus*) in the Northern Gulf of St. Lawrence from 2004-2006. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/084. v + 15 p.

Fréchet, A., Gauthier, J., Schwab, P., Beaudoin, M., Collier, F., and Way, M. 2011. Assessment of Lumpfish (*Cyclopterus Lumpus*) in the Gulf of St. Lawrence (3Pn, 4RST) in 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/119: vii + 33 p.

THIS REPORT IS AVAILABLE FROM THE:

Centre for Science Advice (CSA)
Quebec Region
Fisheries and Oceans Canada
Maurice Lamontagne Institute
850 route de la Mer, P.O. Box 1000
Mont-Joli, Quebec,
Canada G5H 3Z4

Telephone: (418) 775-0825
E-Mail: bras@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087

Correct citation for this publication:

DFO. 2016. Assessment of Lumpfish (*Cyclopterus Lumpus*) in the Gulf of St. Lawrence (3Pn, 4RS) in 2015. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/021.

Aussi disponible en français:

MPO. 2016. Évaluation de la lompe (Cyclopterus lumpus) du golfe du Saint-Laurent (3Pn, 4RS) en 2015. Secr. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/021.