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

Quebec Region

Canadian Science Advisory Secretariat
Science Advisory Report 2018/036

ASSESSMENT OF THE WEST COAST OF NEWFOUNDLAND (DIVISION 4R) HERRING STOCKS IN 2017

Atlantic herring (Clupea harengus) from Nozères and al. 2010. Can. Tech. Rep. Fish. Aquat. Sci. 2866.

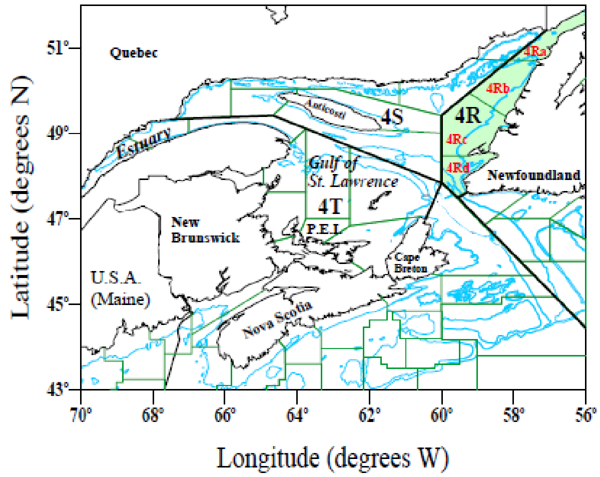

Figure 1. Map of unit areas of NAFO Division 4R (West coast of Newfoundland). Division 4R is identified by the coloured area.

Context:

Atlantic herring is a pelagic species that perform significant annual migrations associated with spawning, feeding and wintering. Atlantic herring are part of a commercial fishery and in Canadian waters, the main fishing areas are south-western Nova Scotia and the Bay of Fundy (complex of stock 4VWX), the southern Gulf of St. Lawrence (4TVn stocks), the northern Gulf of St. Lawrence (4S stock), the West coast of Newfoundland (4R stocks) and the east and south-east coasts (3KLPs stocks) of Newfoundland. On the West coast of Newfoundland (NAFO Division 4R, Figure 1), the average annual landings of herring have been about 16,000 metric tons (t) since 1975. The main fishing gear is the purse seine with average annual landings of near 13,000 t. In order of important gears, the purse seine is followed by the "tuck" seine (modified bar seine), gillnet, and traps.

The West coast of Newfoundland 4R herring fishery is managed by a Total Allowable Catch (TAC) associated with both spawning stocks. The current TAC of 20,000 t stems from advice produced during the last analytical assessments conducted in the early 2000s. The TAC is split between the various fleets as follows: 55% for large seiners (> 65 '), 22% for small seiners (<65') and 23% for fixed gear.

A first series of acoustic surveys was conducted between 1991 and 2002. A second series of surveys began in the fall of 2009 and continued until 2017. This newer series allows the computation of the acoustic abundance indices coupled with commercial fishing data as the inputs of the analytical assessment.

The last assessment of the two herring spawning stocks on the West coast of Newfoundland was done in 2016. The Fisheries and Aquaculture Management Branch has requested a new scientific advice on these stocks for the 2018 and 2019 fishing seasons. At a meeting held on May 2, 2018, the status of these stocks was reviewed. This paper presents the results and conclusions from that meeting.

SUMMARY

- Based on preliminary data, herring catches from the West coast of Newfoundland (NAFO Division 4R) totalled 19,938 t in 2016 and 15,194 t in 2017 with an annual total allowable catch of 20,000 t. The quotas allocated to large and small seiners, as well as fixed gears, were not reached in 2017.
- Fall-spawning West coast of Newfoundland herring aged 11+ dominate catches since 2014. The 2008 cohort has been contributing to the fishery, but is not as dominant as the 2000 year-class.
- Catches of the spring-spawning stock have increased slightly in 2017 and have been mostly made up of the 2012 and 2013 cohorts.
- Both of these stocks show a downward trend in mean length-at-age and weight-at-age since the beginning of the 1980s. Since 2011, the condition index of the two stocks is below the series' average.
- The mean fork length at which 50% of individuals are mature (L_{50}), calculated with data from 1982 to 2017, is respectively 24.1 cm and 25.0 cm for spring spawners and fall spawners. Even though the L_{50} values varied over the years, recent values are just over their respective averages.
- According to the fall 2017 acoustic survey, fall-spawning herring represent 90% of total abundance of herring.
- Biomass of fall-spawning herring, as estimated from the acoustic survey, has dropped by 63% since 2011, falling to 45,313 t in 2017. Such a low level has not been estimated for this stock since the 1990s.
- For spring-spawning herring, the acoustic index of total biomass is estimated at 5,050 t, which is one of the lowest values of the series.
- A Virtual Population Analysis (VPA) of spring and fall-spawning stocks contains uncertainties on the absolute level of biomass of spawners. The VPA follows the acoustic index, which also suggests that the spawning stock biomass of spring-spawning herring has been very low in recent years and under the limit reference point (LRP = 37,384 t). The spawning stock biomass of fall-spawning herring has been declining for many years and is getting close to the upper reference point (URP = 61,074 t) established in 2010.
- Since old fish from the fall spawning stock that supported the fishery in recent years have declined and recruitment is apparently very weak, maintaining the current level of catches could bring the stock below the upper reference point in the short term.
- Given that the spring-spawning stock is still in the critical zone, it would be advisable to maintain a low level of fishing mortality.

INTRODUCTION

Species Biology

Atlantic herring (*Clupea harengus*) is a pelagic fish that frequents cold Atlantic waters. Its distribution in Canada extends from the coasts of Nova Scotia to the coasts of Labrador. It travels in tight schools in order to feed, to spawn near the coast and to overwinter in deeper waters. Herring return to the same spawning, feeding and wintering areas year after year. This homing phenomenon is attributed to a learning behaviour with the recruitment of young year-classes in a population. At spawning, eggs attach themselves to the sea floor, forming a carpet of a few centimetres thick. The egg incubation time and larval growth are linked to ambient environmental characteristics such as water temperature. Most herring reach sexual maturity at four years of age, at a length of about 25 cm. Herring populations on the West coast of Newfoundland are characterized by two spawning stocks. Spring herring generally spawn in April-May, and fall herring in August and September.

Overview of the fishery

The herring fishery on the West coast of Newfoundland (Division 4R, Figure 1) is managed by a Total Allowable Catch (TAC) associated with two spawning stocks. The current TAC of 20,000 t was established following scientific advice from the last analytical assessments conducted in the early 2000s. The main fishing gear used on the West coast of Newfoundland are the purse seine, the “tuck” seine (modified bar seine), the gillnet, and the trap. The TAC is split between the various fleets as follows: 55% (11,000 t) for large seiners (>65'), 22% (4,400 t) for small seiners (<65'), and 23% (4,600 t) for fixed gear. Herring on the West coast of Newfoundland is also fishing bait used for snow crab, lobster, and groundfish fisheries.

ANALYSIS

Commercial fishery

Herring landings on the West coast of Newfoundland increased between 1999 and 2008 and have since remained close to 20,000 t (Figure 2) from 2008 to 2016. In 2016, they totaled 19,933 t while in 2017, 15,194 t of herring were caught, a level of landings that has not been observed since 2007. In 2017, a total of 9,652 t were caught in unit area 4Rb, compared to 2,609 t, 1,809 t and 1,123 t for unit areas 4Ra, 4Rc and 4Rd (Table 1). Since 2007, there has been a growing concentration of the landings in area 4Rb, at the expense of areas 4Rc and 4Rd.

On the West coast of Newfoundland, most herring landings are associated with the purse seine (Figure 3). In 2017, landings by large seiners (>65') totaled 9,517 t compared to 3,217 t by small seiners (<65'), 1,154 t by the "tuck" seine, 722 t by trap and 546 t by gillnet (Table 2). The "tuck" seine, which is a modified bar seine, has been used in the herring fishery since 2005. It is considered a fixed gear. In 2016, all fleets (large and small seiners, and fixed gears) have fished their respective annual allocation, but in 2017, no fleet took their maximum annual allowance (Figure 4).

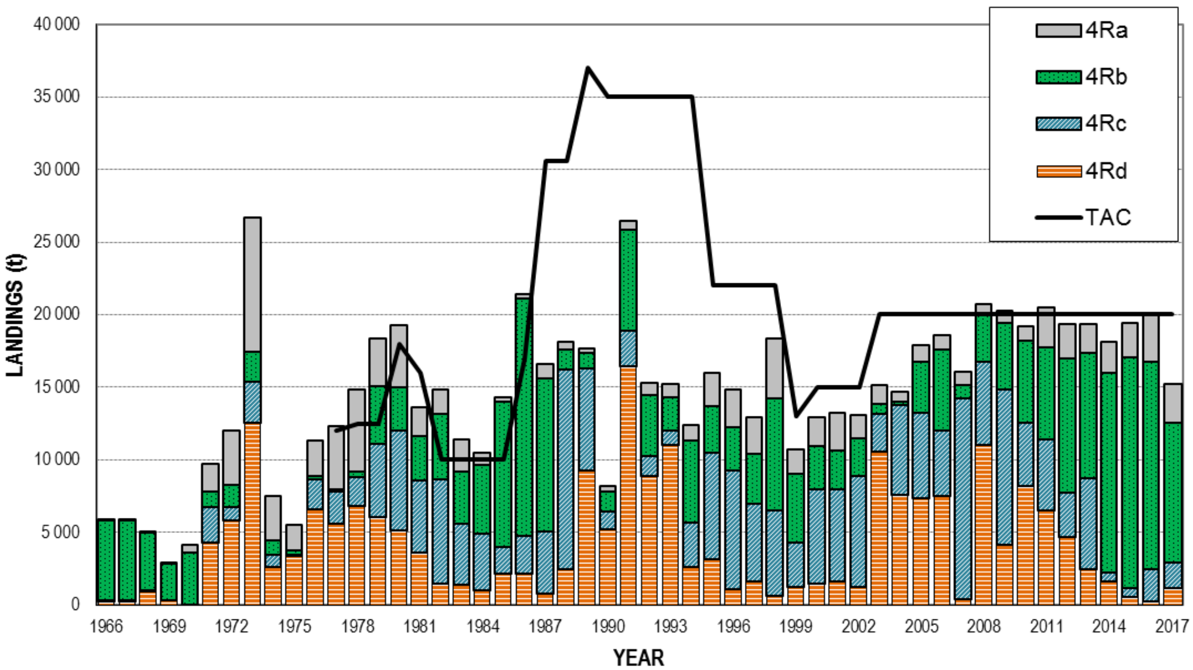

Figure 2. Herring cumulative commercial landings (t) and Total Allowable Catch (TAC) for unit areas of the West coast of Newfoundland (NAFO Division 4R), from 1966 to 2017.

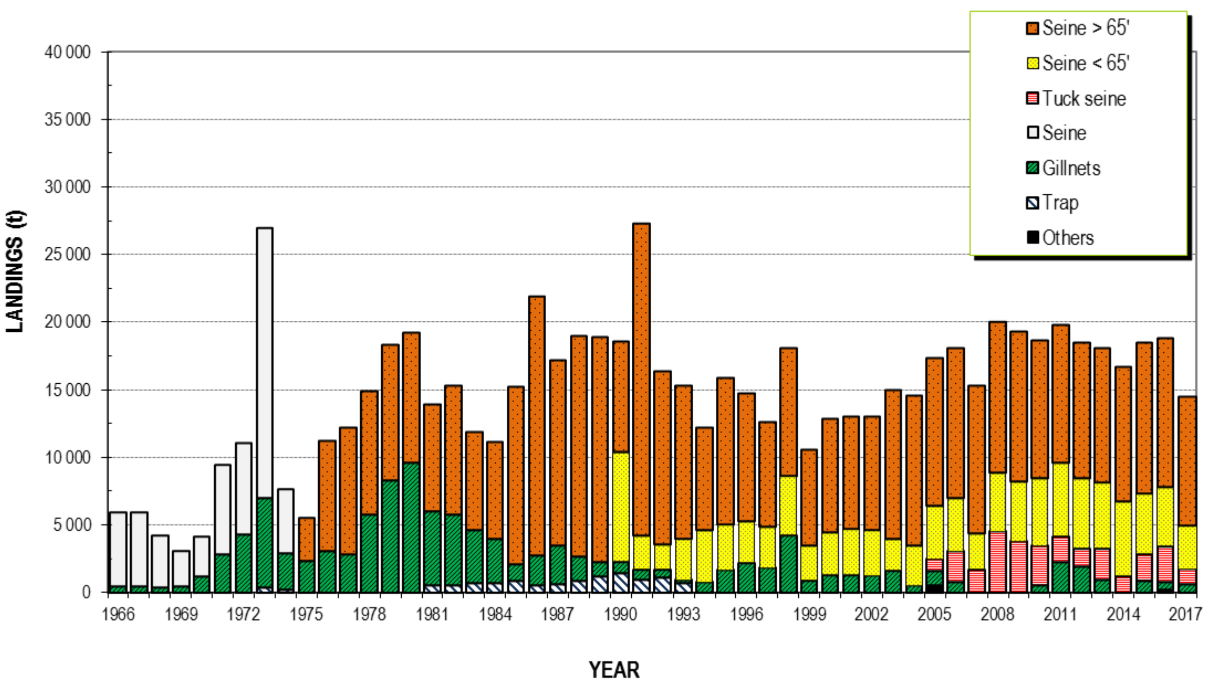

Figure 3. Herring cumulative commercial landings (t) per fishing gear for the West coast of Newfoundland (NAFO Division 4R), from 1966 to 2017.

Table 1. AnnualTotal Allowable Catch (TAC) and herring catches (t) in the unit areas of the West coast of Newfoundland (NAFO Division 4R).

UNIT AREA	AVERAGE (1985-1999)	YEAR																		AVERAGE (2000-2017)
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	2017*	
4Ra	**1,275**	1,981	2,613	1,604	1,290	712	1,137	957	884	731	821	984	2,694	2,396	1,977	2,129	2,322	3,195	2,609	**1,724**
4Rb	**4,239**	2,995	2,643	2,621	714	252	3,574	5,645	915	3,286	4,573	5,651	6,389	9,249	8,651	13,798	15,915	14,271	9,652	**6,155**
4Rc	**3,743**	6,469	6,379	7,660	2,593	6,162	5,889	4,457	13,831	5,668	10,707	4,342	4,899	2,994	6,322	640	637	2,193	1,809	**5,203**
4Rd	**3,729**	1,470	1,589	1,232	10,533	7,574	7,326	7,538	375	11,058	4,134	8,228	6,489	4,712	2,424	1,585	546	273	1,123	**4,345**
TAC		**15,000**	**15,000**	**15,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**-**
TOTAL	**12,986**	**12,916**	**13,224**	**13,117**	**15,131**	**14,700**	**17,927**	**18,597**	**16,005**	**20,742**	**20,235**	**19,205**	**20,470**	**19,351**	**19,374**	**18,152**	**19,419**	**19,933**	**15,194**	**17,427**

** Preliminary data*

Table 2. Annual herring catches (t) for the main fishing gear used on the West coast of Newfoundland (NAFO Division 4R).

FISHING GEARS	AVERAGE (1985-1999)	YEAR																		AVERAGE (2000-2017)
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	2017*	
Large seiner (>65')	**9,372**	8,427	8,344	8,392	11,090	11,099	11,006	11,102	10,954	11,184	11,170	10,217	10,259	10,047	9,986	9,994	11,167	10,999	9,517	**10,275**
Small seineur (<65')	**2,518**	3,153	3,418	3,383	2,307	2,973	3,918	3,942	2,660	4,357	4,415	4,950	5,428	5,171	4,905	5,504	4,470	4,397	3,217	**4,032**
"Tuck' seine'	**-**	0	0	0	0	0	909	2,300	1,545	4,498	3,778	2,953	1,883	1,342	2,337	1,075	2,029	2,593	1,154	**1,578**
Gillnet	**1,502**	1,277	1,215	1,256	1,629	499	1,031	703	132	3	0	525	2,107	1,790	915	96	680	623	546	**835**
Trap	**103**	59	150	73	104	127	528	498	706	700	872	560	626	862	1,230	1,440	928	1,133	722	**629**
Others	**2**	0	96	13	0	2	535	53	8	0	0	0	167	138	0	43	143	188	37	**84**
TOTAL	**12,986**	**12,916**	**13,224**	**13,117**	**15,131**	**14,700**	**17,927**	**18,597**	**16,005**	**20,742**	**20,235**	**19,205**	**20,470**	**19,351**	**19,374**	**18,152**	**19,419**	**19,933**	**15,194**	**17,427**

** Preliminary data*

Fishing effort activities declined sharply at the end of the 1990s following the implementation of management measures to protect the spring spawning stock. In the fall, the herring fishery follows that of the mackerel fishery. The pattern of cumulative landings of large seiners indicates that this fishery starts and runs later since 2014 and much later than the historical average.

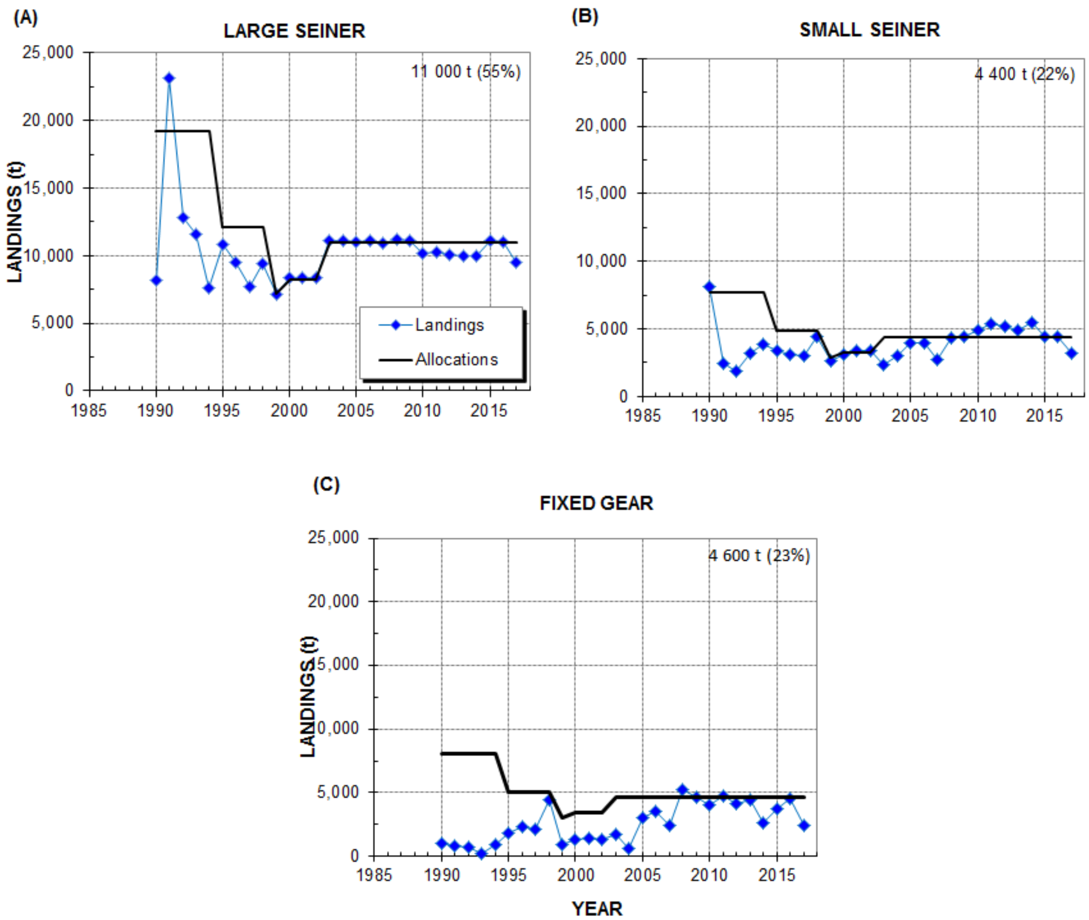

Figure 4. Herring landings (t) (represented by the diamonds) and annual allocations (t) (represented by a solid black line) per fishing fleet large seiner (A), small seiner (B) and fixed gear (C) since 1990 for NAFO Division 4R.

Biological Indicators

Length frequency analysis indicates that herring stocks on the West coast of Newfoundland are characterized by the periodic occurrence of dominant year-classes. For fall spawners, the dominant year-class since 2005 is the 2000 year-class, followed by the 2001 year-class (Figure 5B). The 2008 year-class accounts for approximately 20% of the landings (in number) since 2013 but its contribution to the fishery remains lower than those of the 2000-2001 year-classes. Indeed, between 2014 and 2017, fish aged over 10 years accounted for 44 to 50% of landings (in number).

In the spring spawning stock, the 2002 year class has dominated landings since 2008 (Figure 5A). Two new cohorts (4 and 5 years old) born in 2012 and 2013 have recently appeared in the commercial fishery. However, analysis of the biological data in the coming years will confirm the importance of these cohorts.

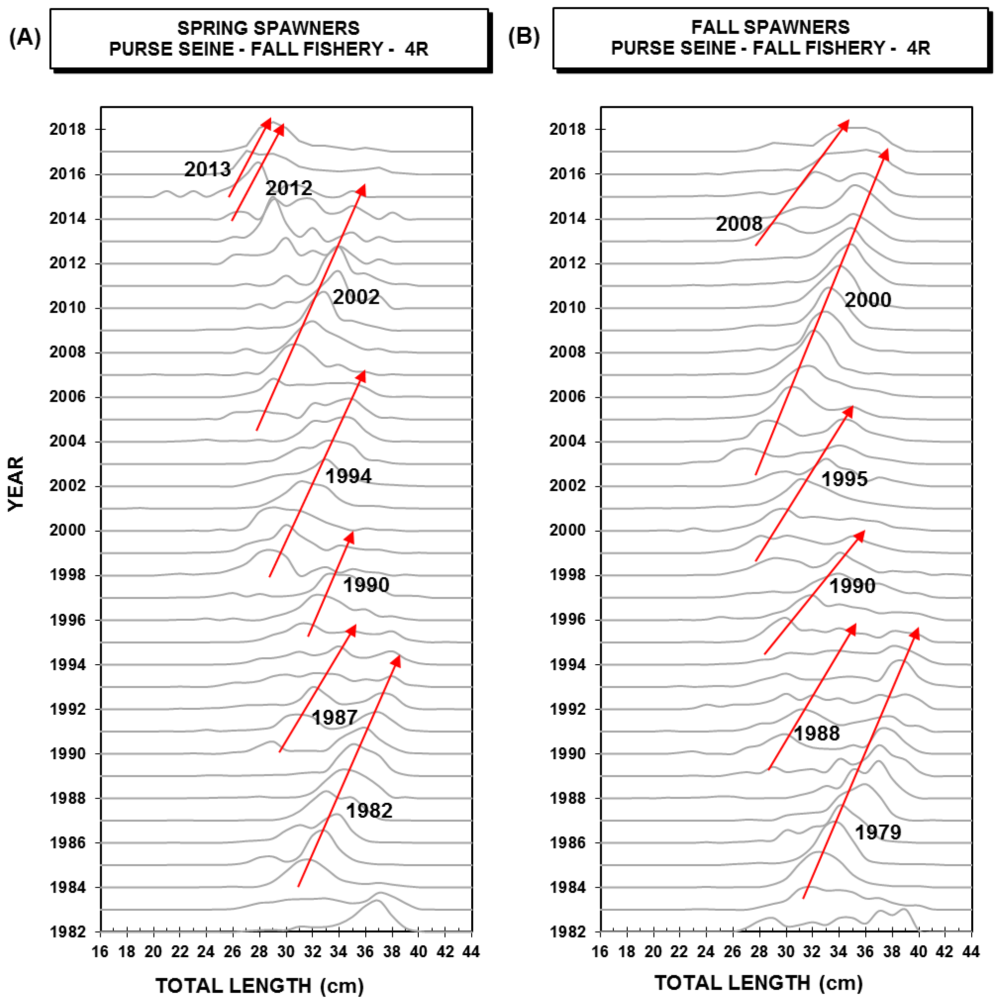

Figure 5. Annual length (cm) frequencies (%) of spring (A) and fall (B) spawning herring caught in the fall with the purse seine in Division 4R from 1982 to 2017. Some dominant year-classes are indicated.

The mean length at which 50% of the herring have reached maturity (L_{50}) in both stocks has varied in recent decades. The spring herring L_{50} mean fork for the different cohorts is 241 mm for the entire series (Figure 6A). For fall spawning stock, the L_{50} mean fork by cohort is of 250 mm during the entire period of the study (Figure 6B). The L_{50} for both stocks was generally above their respective mean during the years 1980 and from 2002 to 2012, and under the mean for 1993 to 2001 (Figure 6).

Both herring spawning stocks showed similar annual variations in their Fulton condition index (Figure 7). This index was relatively stable until 1992; however, significant annual variations were observed thereafter. The index for the both stocks showed a significant decrease from 2008 to 2011. It increased slightly from 2013 to 2015, but remains below the long-term mean, and shows values close to historical lows in 2016 and 2017.

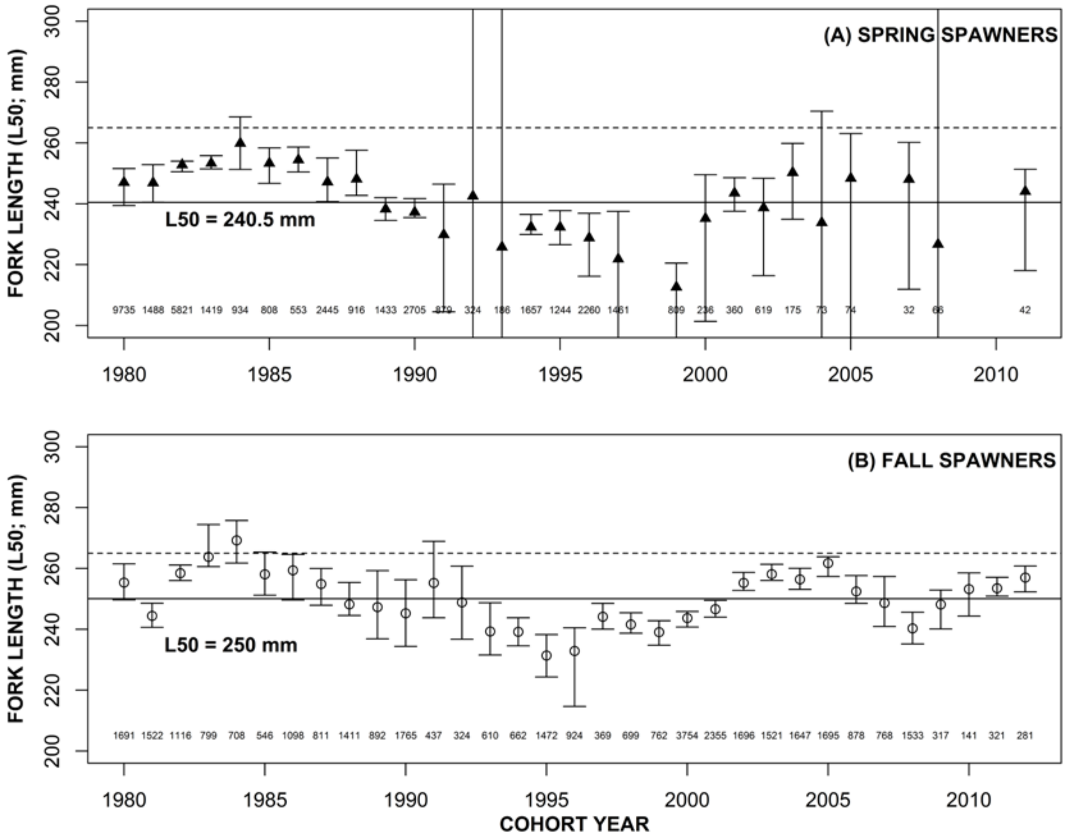

Figure 6. Mean fork length (mm) at which 50% of the herring have reached maturity (L_{50}) by cohort from 1982 to 2012 for the spring spawning stock (A, triangle full) and fall (B, empty circle) in NAFO Division 4R. The mean of the period for both stocks is represented by the solid line and the minimum commercial fork length by the horizontal dashed line. Numbers above the X-axis represent the number of herring measured.

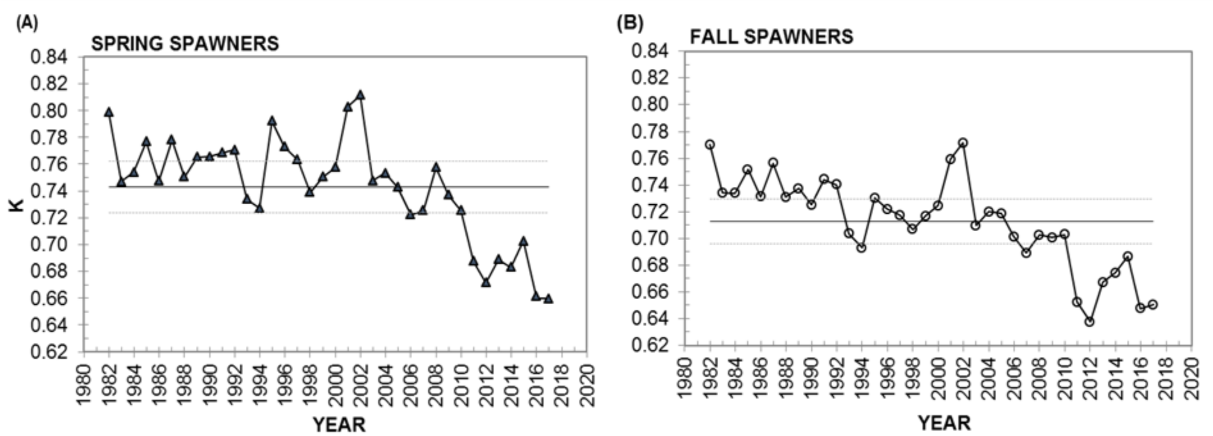

Figure 7. The average annual Fulton condition index (K) for spring (A) and fall (B) herring spawners on the West coast of Newfoundland (NAFO Division 4R). The horizontal lines show the 1970-2017 averages ± 0.5 standard deviation.

Resource Status

Acoustic Survey

A first series of acoustic surveys was conducted between 1991 and 2002. A second series of surveys began in the fall of 2009. The 2017 acoustic survey took place between October 20 and November 3. Despite difficult navigation conditions, spatial coverage has been improved compared to 2015. Indeed, the survey covered almost all the strata with the exception of the strata 1 and 4 which were, respectively, partially surveyed and abandoned due to a lack of time. In 2017, the most significant acoustic signals were measured in strata 2, 3, 9 and 10 (Figure 8). The patterns of the signals observed during the 2011 to 2017 surveys vary annually and show that the strong signals can be observed throughout Division 4R. With the assistance of industry, four biological samples were obtained at times and in regions corresponding to the acoustic survey.

Validation of the biomass calculations from the acoustic data collected from 2009 to 2015 was conducted. Corrections were made on some parameters used to estimate the biomasses by following the approach applied from 1991 to 2002 (McQuinn and Lefebvre, 1999). These modifications concern the length-weight relationships, the number of lines produced, and the area of the sampled strata, as well as in the gain adjustment during the calibration of the acoustic system. Following these corrections, for spring and fall spawning stock, a positive effect has been observed in 2010 and 2013, and a negative effect in 2009, 2011, and 2015. Finally, corrections were made to the estimates of the dead zone which allows the fish included in the acoustic cone to be taken into account despite the strong signal from the sea bottom (McQuinn *et al*., 2005). This correction increased the biomass index of both stocks for the years 2010 and 2013. However, the index values remained similar for the other years.

The total biomass index of spring-spawning herring fell considerably between 1991 and 1993 (Figure 9). After some stability, this index fell again, decreasing from 34,500 t in 2002 to 5,050 t in 2017, one of the lowest values of the series.

The index of the total biomass of fall herring spawning stock increased from 1999 to 2013 to reach 165,674 t. It has subsequently declined until 2017 to 48,486 t, a level that had not been observed since the mid-1990s. According to the last acoustic survey, fall herring spawning stock fish represent 90% of the total abundance of herring.

Analytical Assessment

A sequential population analysis (SPA) model using inputs from the commercial fishery such as the catch at age, weight at age, and age at maturity was matched with abundance indices of twelve acoustic surveys from 1991 to 2017.

As in 2015, the 2017 SPA for spring and fall stocks contains uncertainties on the absolute level of spawning stock biomass.

For the spring spawning stock, the SPA follows the acoustic index which also suggests that the spring herring spawning stock biomass is very low in recent years (Figure 10) and is below the limit reference point (LRP = 37,384 t), despite sustained conservation measures.

The SPA for the fall stock presents important retrospective patterns. However, it follows the acoustic indices to indicate a sharp increase in the spawning stock biomass between 2003 and the early 2010s, followed by a steady decline until 2017 (Figure 10).

The analysis shows that the absolute value of the current biomass, as well as the peak biomass years and the level reached during this peak, are heavily dependent on data from the commercial fishery. The fall herring spawning stock biomass has been declining for several years and is approaching the upper reference point (URP = 61,074 t) established in 2010.

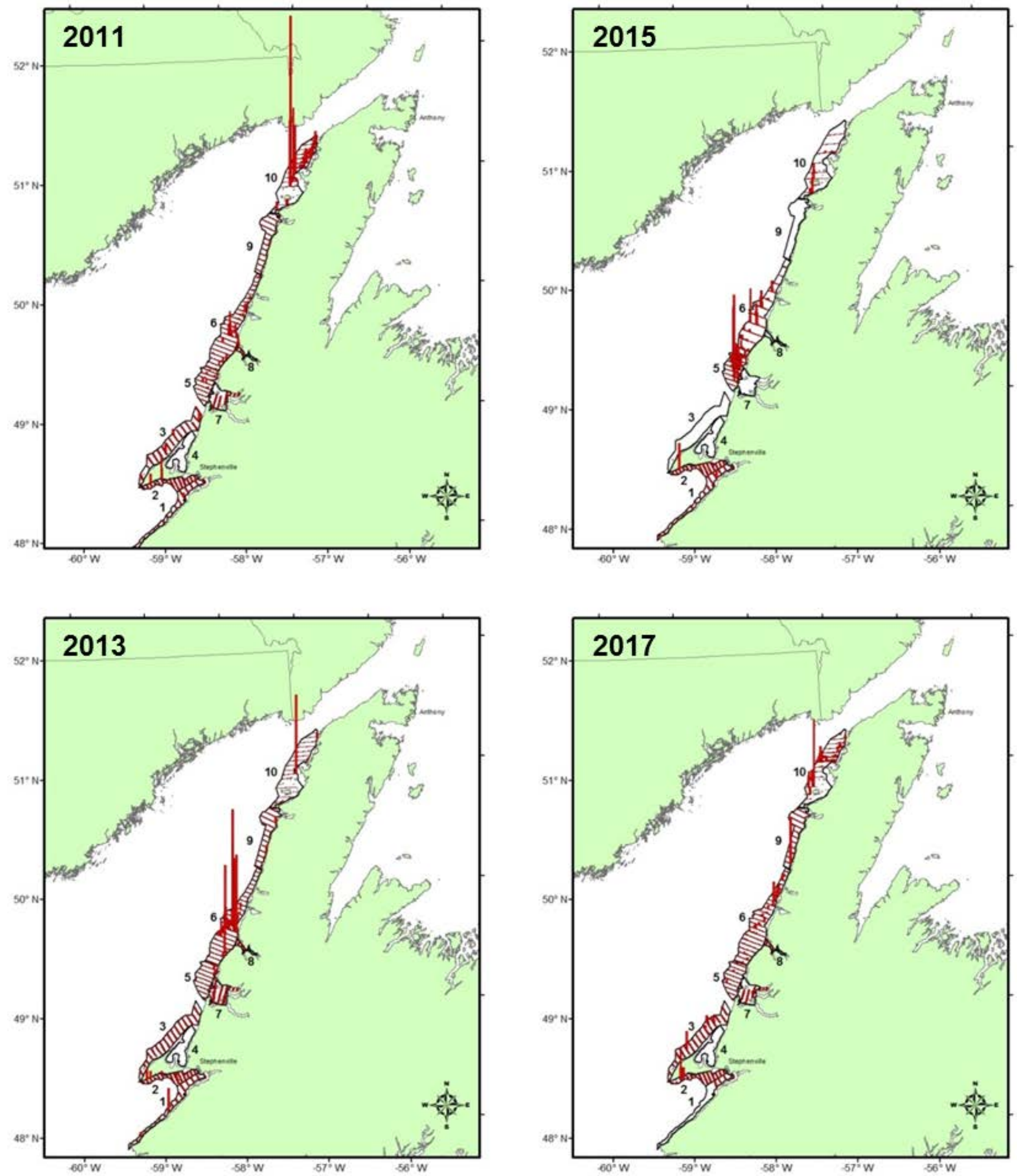

Figure 8. Herring density distribution (acoustic signal) along the West coast of Newfoundland in the fall of 2011, 2013, 2015 and 2017.

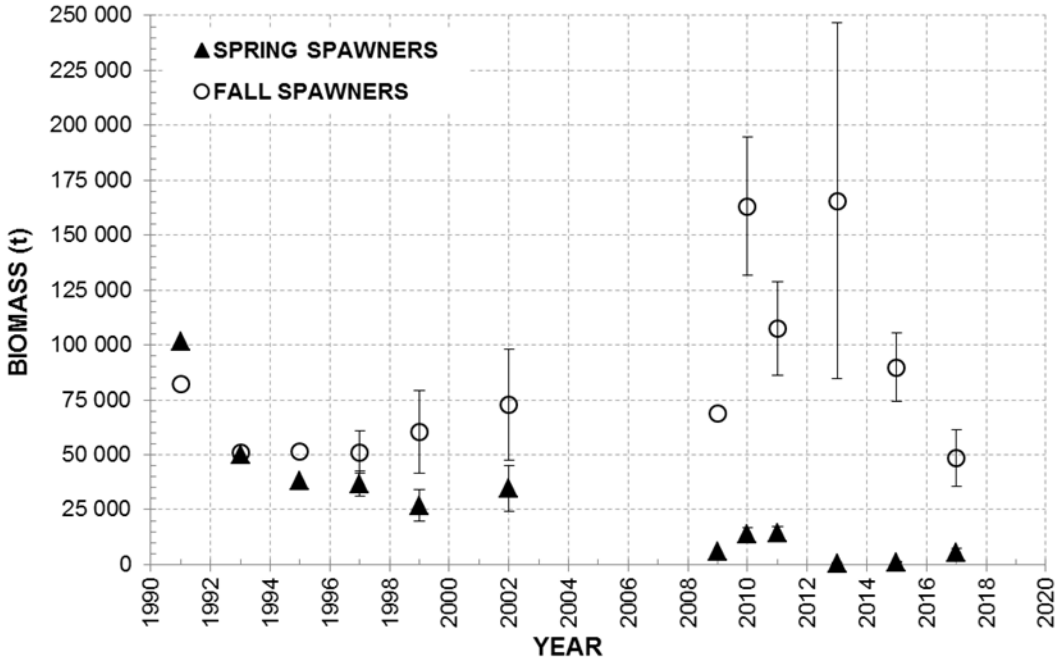

Figure 9. Total biomass index (with standard error) for the spring (triangles) and fall (circles) spawning herring stocks on the West coast of Newfoundland (NAFO Division 4R) estimated by the acoustic survey from 1991 to 2017.

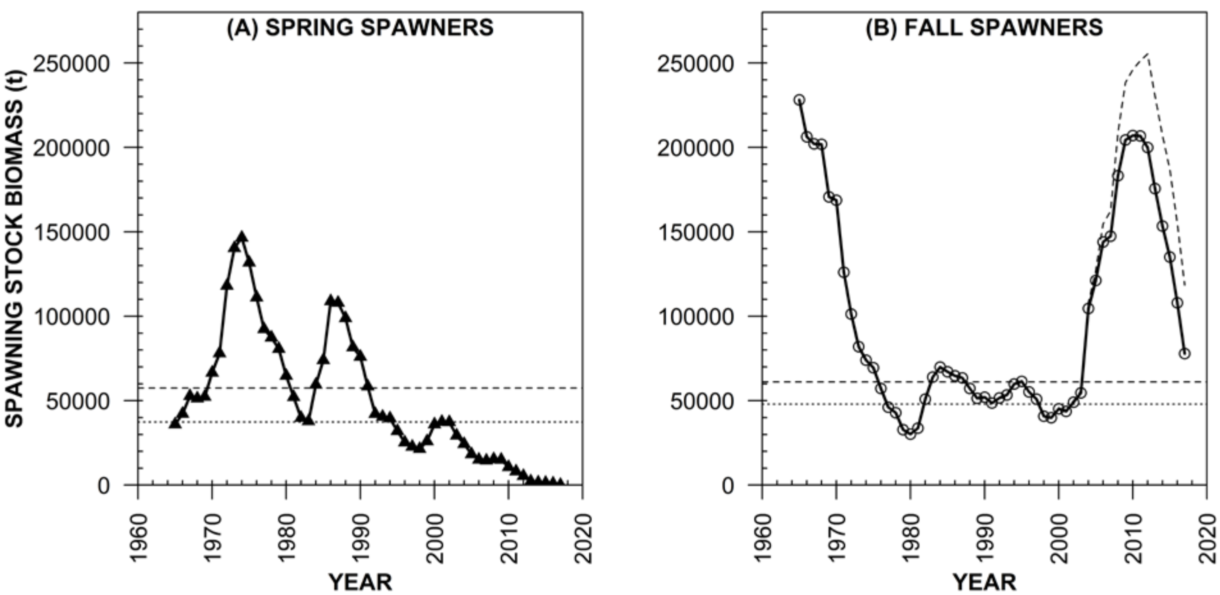

Figure 10. Spawning stock biomass estimated by the sequential population analysis for spring (A) and fall (B) spawners. The dashed line shows the retrospective pattern observed when excluding the 2017 acoustic survey. Horizontal dashed lines: upper reference points. Horizontal dotted lines: limit reference points.

Ecosystem and Environmental Considerations

Herring feed mainly on zooplankton throughout its life, from larvae to adults. The species composition, abundance, and phenology (plankton bloom events) of the zooplankton in the Gulf of St. Lawrence vary at different temporal scales in a coordinated manner with the variations in the physical environment, suggesting a strong link between the physical processes and the zooplankton dynamics.

Statistical models have been used to describe the potential effects of these environmental changes on the recruitment of 4R herring from 1990 to 2014. The results show that changes in the physical environmental conditions and zooplankton dynamics predict the observed trend in the recruitment in recent decades, accounting for 75% and 76% of the variability in recruitment of spring and fall spawning stock respectively (Brosset *et al.*, 2018). Strong recruitment of spring spawning stock is associated with cooler environmental conditions than the average while the strong recruitment of fall spawning stock occurs when the environmental conditions are slightly warmer than average (Brosset *et al.*, 2018).The analyses also suggest that between 1990 and 2014, the recruitment of spring and fall spawning stock was mainly influenced by environmental conditions, while changes in the spawning stock biomass of these stocks do not seem to have had a major influence (Brosset *et al.*, 2018).

These results provide the first empirical demonstration that recruitment of spring and fall spawning stock is favoured by different environmental conditions. This work also sheds light on the potential mechanisms that explain the relationship between herring recruitment and the key characteristics of the zooplankton community structure and its phenology.

After considering environmental variability in the stock assessment process, the next step will be to develop a framework for evaluating management strategies. By integrating new knowledge on the environmental indices that influence herring recruitment, different productivity regimes may be taken into account and scenarios with multiple recruitment paths and spawning stock biomass can be presented at the next stock assessment.

Sources of Uncertainty

The period during which acoustic surveys take place has been questioned for many years by the fishing industry. The last six surveys were conducted during similar periods between mid-October and early November. These surveys are designed to measure the abundance of herring schools near the coast and those offshore before they begin their migration to the coast. In recent years, there is a tendency for seine fishermen to start their season later in the fall and finish later in December. Weather conditions and the scarcity of commercially-sized fish during the fishery are the reasons the industry offers to explain these changes. Later in the fall, when the navigation conditions are difficult, the fishermen do not go offshore, and prefer to wait for the herring to migrate close to the shore to capture it in protected areas such as bays. The suggestion to delay the mission in December should be discussed with all concerned stakeholders.

The herring stock assessment in Division 4R depends primarily on fish samples that are annually caught in the commercial fishery. Since larger fish are in demand, few small fish or young cohorts are available. Also, as mentioned in the 2016 Scientific Advisory Report, commercial samples had to be used in 2018 in the conversion of the acoustic index into biomass. The almost-exclusive use of commercial samples compromises the statistical independence of acoustic samples from the fishery data, and increases uncertainty in the acoustic survey results and ultimately the analytical model. The first solution considered to overcome this problem is to obtain samples from a chartered seiner that will accompany the ship in charge of the acoustic survey. Among other possible solutions, it is suggested to optimize the use of herring landing data from the Groundfish and shrimp multidisciplinary survey in August and to take advantage of the time of observers at sea to collect samples that will improve the representativeness of under-legal size small herring.

It is possible that errors in the aging of herring based on otolith readings for older fish may create errors in the tracking of year-classes. This could lower the capacity of analytical models to fit the commercial catch-at-age data and be partly responsible for the observed retrospective patterns.

Following the recommendations of the 2016 Scientific Advisory Report, the role of the environment in the variations of the spring and fall spawning stock recruitment has been studied. The results of the work provide a partial understanding of the influence of the environment on herring recruitment (Brosset *et al.*, 2018). This new knowledge can be integrated in a new stock assessment model that takes account environmental changes.

CONCLUSION AND ADVICE

Results from the fall 2017 acoustic survey suggest that the spring spawners abundance index is at a lower value in the series despite sustained conservation measures over the last 20 years. It is likely that the trajectory of the spring component reflects primarily the effect of environmental changes. In the absence of evidence of stock enhancement, it would be wise for the fishery to maintain a low fishing mortality rate.

Survey results from 2017 also indicate a downward trend in the abundance of fall-spawning herring observed in 2015. This stock consists mainly of fish aged 10 years and more (accounting for 50% of all catches in numbers in 2017), as well as some fish from the 2008 year-class (22% of catches).

Catches of about 20,000 t in 2016 and 15,000 t in 2017 have been supported for the most part by older year-class of fall spawners, which has ensured stability in the herring fishery on the West coast of Newfoundland. Because of natural mortality, the old fish that have supported the fishery will continue to decline. Without strong recruitment, there is a risk that maintaining catches at their current level will bring the fall-spawning stock below the upper reference point (61,074 t). The 2008 year-class seems significant, but its contribution to the fishery at age 9 (in 2017) is less than that of dominant classes that have been previously observed in this stock. Catch-at-age should therefore be monitored closely until the next acoustic survey, which is scheduled for fall of 2019.

In the future, it would be advisable to improve biological sampling during the survey as well as to increase the representativeness of samples from the commercial fishery with the assistance of observers at sea. A flexible catch-at-age statistical model is currently in development and will allow for errors committed during the assignment of ages to biological samples. Also, the review of the effect of environmental changes on both spawners groups and the population dynamics, as well as the inclusion of the productivity regime (environment) in the model and the existing reference points are in progress. It is also important to revise the reference points for both spawning components over the next few years.

SOURCES OF INFORMATION

This Science Advisory Report is from the May 2, 2018 Assessment of the West Coast of Newfoundland (Division 4R) herring stocks in 2017. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Brosset, P., Doniol-Valcroze, T., Swain, D.P, Lehoux, C., Van Beveren, E., MBaye, B.C., Émond, K. and Plourde, S. 2018. Environmental variability controls recruitment but with different drivers among spawning components in Gulf of St. Lawrence herring stocks. Fish Oceanogr. 2018; 00:1-17.

DFO. 2016. Assessment of the West Coast of Newfoundland (Division 4R) herring stocks in 2015. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/024.

McQuinn, I. H., Simard, Y., Stroud, T. W. F., Beaulieu, J-L., and Walsh, S. J. 2005. An adaptive, integrated ‘‘acoustic-trawl’’ survey design for Atlantic cod (Gadus morhua) with estimation of the acoustic and trawl dead zones. ICES J. Mar. Sci., 62: 93-106.

McQuinn, I.H. and Lefebvre, L. 1999. An Evaluation of the Western Newfoundland Herring Acoustic Abundance Index from 1989-97. DFO. Canadian Stock Assessment Secretariat; Res. doc. 99/120: 20 p.

Nozères C., Archambault D., Chouinard P.-M., Gauthier J., Miller R., Parent E., Schwab P., Savard L., and Dutil J.-D. 2010. Identification guide for marine fishes of the estuary and northern Gulf of St. Lawrence and sampling protocols used during trawl surveys between 2004 and 2008. Can. Tech. Rep. Fish. Aquat. Sci. 2866: xi + 243 p.

THIS REPORT IS AVAILABLE FROM THE:

Center for Science Advice (CSA)
Quebec Region
Fisheries and Oceans Canada
Maurice Lamontagne Institute
850 Route de la mer
Mont-Joli, Québec
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. 2018. Assessment of the West Coast of Newfoundland (Division 4R) herring stocks in 2017. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/036.

Aussi disponible en français :

MPO. 2018. Évaluation des stocks de hareng de la côte ouest de Terre-Neuve (division 4R) en 2017. Secr. can. de consult. sci. du MPO, Avis sci. 2018/036.