Fisheries rebuilding success indicators: 2020

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Summary

Canada's marine fisheries are highly valuable: they are a major driver of our economy, shape our culture and sustain our coastal communities. Yet despite continued and improved progress made over recent years towards policy implementation aimed at rebuilding and maintaining healthy fisheries in Canada, change in the water is not in the direction desired, and much more work remains to be done (Oceana Canada 2019a, 2019b). In 2017, Oceana Canada published its first annual Fishery Audit, revealing the state of Canada's fisheries and providing an assessment of how the government is managing them (Oceana Canada 2017a, 2017b). The current document uses newly available information published over the last year to update the status of Canada's marine fish and invertebrate populations and examine changes in indicators demonstrating the extent of progress made by Fisheries and Oceans Canada (DFO) towards rebuilding healthy and abundant oceans.

In 2020, Canada's marine fish and invertebrate stocks remain in a state of concern, with just over one-quarter that can confidently be considered healthy. There are more stocks at increased risk of depletion as compared to last year, with fewer index stocks considered healthy (26.8 per cent in 2020 compared to 29.4 per cent in 2019) and more stocks in the cautious zone (19.1 per cent in 2020 compared to 15.5 per cent in 2019). While there is the same number of critically depleted stocks as compared to last year (33 stocks or 17.0 per cent in both years), overall there are seven more critically depleted stocks than in the first evaluation in 2017 (26 stocks or 13.4 per cent in 2017). Meanwhile, the composition of critically depleted stocks has also changed over the last four years, with an increasing number of invertebrate stocks in both the Atlantic and Pacific now in the critical zone. Additionally, one more forage fish stock in the Atlantic Ocean became critically depleted in 2020, bringing the total there to four. There are no longer any healthy forage fish stocks in the Pacific Ocean. Loss of forage fish biomass could have serious repercussions throughout the ecosystem.

In contrast to the concerning negative trends highlighted above, we are seeing some recent positive signs in other taxa, like rockfish and redfish (i.e., *Sebastes* spp.), where some stocks have had unprecedented recruitment events that facilitated rebuilding from depleted status. These unexpected increases have created management challenges that could be perceived as both negative (e.g., bycatch in other fisheries) and positive (e.g., providing an opportunity to intentionally plan for a re-emerging fishery). While the exact causes of these extreme recruitment events are not known, favourable environmental conditions likely facilitated their occurrence (Schroeder et al. 2019). Climate change is likely to have positive and negative impacts on individual populations, expected to result in "winners" and "losers" with respect to access to future fisheries (Talloni-Álvarez et al. 2019, Willson et al. 2020, Lam et al. 2016). DFO must also now determine what climate-ready fisheries management means in Canada and put in place the means to implement it.

There has been continued and improved efforts made towards rebuilding and maintaining healthy fisheries in Canada, but much more work remains to be done, and the pace of change is insufficient. In 2020, there was another small increase in the percentage of index stocks having upper stock reference points (USRs), as has been the case over the last four years. But over half of Canada's stocks still do not have this important benchmark identifying the boundary between a healthy state and one of concern (i.e., cautious zone), below which removals must be progressively reduced in order to avoid reaching the limit reference point (LRP) (DFO 2009). After continual increases in the percentage of stocks having LRPs, progress halted this year, and this indicator slightly decreased. More than a third of index stocks do not have this important benchmark identifying the point below which serious harm is occurring to the stock and where there may also be resultant impacts to the ecosystem and a long-term loss of fishing opportunities (DFO 2009). Similarly, after a large increase in the percentage of stocks

included in Integrated Fisheries Management Plans (IFMPs) last year (from 74.7 per cent in 2018 to 90.2 per cent in 2019), this indicator stalled, with only one more stock included in an IFMP.

Meanwhile, other indicators have appeared to stabilize after previously moving in the wrong direction. For instance, in 2020, after continual decline in the percentage of index stocks that have recent biomass estimates, this indicator stabilized and did not decrease further. Currently, over 40 per cent of stocks do not have recent biomass or abundance estimates, and over 30 per cent have not had any publicly available evaluation of trends in indices within the last five years to support fisheries management.[1] This year, after continual small increases, the percentage of index stocks of uncertain status shrank to levels last seen in 2018; scientists are not confident in the status of just under 40 per cent of stocks (37.1 per cent), either due to a lack of reference points or uncertain and/or highly variable data. The percentage of index stocks with fishing mortality estimates has remained about the same over the last four years, at about one in five index stocks, and very few of these estimates account for all sources of fishing mortality. But continual small increases in the percentage of stocks with total mortality and natural mortality estimates indicate some improvements to the estimation of how many fish die each year. Clearly, there is plenty of room for improvement in most indicators, and this indicates current progress by DFO has not sufficiently delivered on commitments to implement the Sustainable Fisheries Framework (SFF), now in place for over 10 years (DFO 2009).

Starting this year, DFO has released a Sustainable Fisheries Framework Work Plan (SFF Work Plan) to help implement the SSF. It will be developed and reported on annually on a dedicated website (DFO 2020b). This work plan is a continuation of the work plans released in response to the Commissioner of the Environment and Sustainable Development's (CESD) October 2016 audit (CESD 2016). The work plans outline DFO priorities for the development of LRPs, harvest control rules, IFMPs, rebuilding plans and, more recently, USRs (DFO 2017, 2018a, 2019e, 2020c). The public release of these work plans, combined with the continued annual public release of the Sustainability Survey for Fisheries (DFO 2019d), is encouraging progress towards increasing transparency in fisheries management in Canada. DFO must ensure enough resources are allocated to deliver on commitments. As deliverables in the plans are met, important increases in the indicators evaluated here are expected. If all deliverables outlined in the work plans were completed, the percentage of index stocks with LRPs and USRs would each rise by more than 10 percentage points, and the percentage included in IFMPs would increase to over 93 per cent[2] (see Oceana Canada 2020a for further details).

Success will also require improvements to data related to catch and effort, along with continued and sustained investment in the science capacity to use it. Catch monitoring is key to collecting robust data, which in turn can be used to improve stock assessments and other science to inform fisheries management decision making. According to the 2020 results, most of Canada's marine fish and invertebrate stocks have some catch monitoring tools in place, but it remains difficult to know if the tools are monitoring the entire catch (targeted species and bycatch, both retained and discarded), what monitoring levels are being achieved and whether these are adequate to achieve catch monitoring objectives, if they exist. Until last year, DFO did not have a national policy on catch reporting and fishery monitoring. They acknowledge that this has led to: inconsistent monitoring and reporting requirements and no explanation for the differences; concerns about the adequacy and quality of data from fishery monitoring programs, which is needed to manage fisheries sustainably; and an absence of national goals with

[1] 114 stocks have recent biomass or abundance estimates, and 21 of the stocks without them have at least had recent biomass or abundance index evaluations.

[2] It should be noted that, starting with the 2019/20 work plan, the wording of deliverables has been updated to clarify that most deliverables are not expected to be completed in the fiscal year the plan covers. Instead, DFO aims to make progress towards their completion. At this time next year, according to wording in the 2020/21 work plan, Oceana Canada expects these indicators to rise at a slower rate. The percentage of marine fish and invertebrate stocks included in Oceana Canada's Fishery Audit index dataset with LRPs should increase to at least 67.0 per cent, the percentage of stocks with USRs should increase slightly to 49.0 per cent, and the percentage of stocks included in IFMPs should rise to 93.3 per cent. Ten more rebuilding plans are expected for index stocks, which will increase the percentage of critical zone stocks with rebuilding plans at this time next year to 48.5 per cent. See Oceana Canada (2020) for further details.

which to assess performance (DFO 2018b). Furthermore, a lack of a national policy precluded the consideration of cumulative impacts across fisheries on species or the ecosystem (Archibald and Rangeley 2019). Thus, it was appropriate that in November 2019, DFO finalized and released a national Fishery Monitoring Policy (DFO 2019b). If implemented in a timely and rigorous way, the policy will provide the impetus for acquiring the right scientific information required for rebuilding under Canada's new *Fisheries Act*. But without a timely and dedicated investment in the implementation phase of the policy, the ability to achieve the goals of the new regulations will be compromised. Rebuilding plans and regulations will only be as strong as the data used to inform their measures and estimate fishing mortality, which must include all sources. With improved catch monitoring, fisheries managers will have the data required to effectively manage Canada's fisheries.

According to the precautionary approach (PA) framework, all stocks within the critical zone must have rebuilding plans (DFO 2009). In 2020, there was no increase in the percentage of critically depleted marine fish and invertebrate index stocks included in a rebuilding plan (18.2 per cent or 6 stocks). Two were expected; one (Atlantic mackerel) is completed but not yet publicly available,[3] while the second (northern cod) is again delayed. In the next year, it is expected that both plans will be published. Of the 15 remaining stocks identified for rebuilding plan development in DFO's fiscal year work plans, three do not have expected completion dates, while the other 12 are expected to be completed by the end of March 2021. This is now less than one year away, and it takes time to develop rebuilding plans, especially those that meet international best practices (Oceana Canada 2019d). The lack of progress on several of the remaining rebuilding plans is concerning (see Oceana Canada 2020a for further details). Furthermore, the impacts of the COVID-19 pandemic are more likely to be seen in next year's analysis, with DFO indicating in the 2020/21 fiscal year work plan that it was developed prior to the pandemic and that the timing of certain deliverables will need to be adjusted. While good rebuilding plan development does take time, there is a trade-off between taking the time required to develop an effective plan and promptly responding to stock decline. If DFO is serious about investing in rebuilding abundance in Canadian fisheries, then getting rebuilding plan development on track must be a government priority. If all stocks currently indicated for inclusion in rebuilding plans were completed on time, the percentage of index stocks in the critical zone with rebuilding plans would rise to nearly 50 per cent by the end of 2021 (see Oceana Canada 2020a for further details). With DFO's commitment to accomplishing this (CESD 2016; DFO 2017, 2018a, 2019e, 2020c), combined with the new requirement for rebuilding plans for critically depleted stocks under the amended *Fisheries Act* and the urgency with which the plans are needed, the situation is expected to improve in coming years.

Introduction

Canada's marine fisheries are highly valuable: they are a major driver of our economy, shape our culture and sustain our coastal communities. Yet many of Canada's stocks are depleted; it is estimated that 52 per cent of the biomass of Canadian fish has disappeared since 1970 (Hutchings et al. 2012). Canada has a good policy framework in place to manage fisheries, but many policy instruments have not been fully implemented. The consistent application of these policy tools will be essential to ensure the stability of healthy fisheries and the best chance of rebuilding depleted stocks for the benefit of marine ecosystems, coastal communities and the fishing industry.

Successful fisheries management will also require meaningful shifts towards fully embracing an ecosystem-based management (EBM) approach. This means considering the role of the target species in the ecosystem — both as predator and as prey. It means considering the impacts of fisheries on other species and habitats and ensuring spatial and temporal protections are in place to protect key spawning, nursery, migration and foraging areas. It means considering the impacts of climate change and the cumulative effects of multiple stressors on species across populations. And last, but certainly not least, it means considering our role in the ecosystem and ensuring coastal communities are able to access and sustainably harvest and consume nutritious seafood and ensure that healthy oceans can continue to play an important role in their culture. Canada's policy framework, the Sustainable Fisheries

[3] As of the annual data inclusion cut-off date (July 1st of each year) used in this analysis

Framework, is intended to provide the foundation for an ecosystem-based approach (DFO 2009), and the good news is that EBM may be feasible now using existing science tools, policy instruments and management structures (Levin et al. 2018).

In 2017, Oceana Canada published its first annual Fishery Audit, revealing the state of Canada's fisheries and providing an assessment of how the government is managing them (Oceana Canada 2017a, 2017b). Last year's update showed that there has been continued and improved progress made over the last three years towards policy implementation aimed at rebuilding and maintaining healthy fisheries in Canada, but much more work remains to be done, and change in the water is not in the direction desired (Oceana Canada 2019a, 2019b). Last year's update revealed Canada's marine fish and invertebrate stocks continue to remain in a state of concern, with less than one-third that could confidently be considered healthy. There were more stocks at increased risk of depletion as compared to previous years, with fewer stocks considered healthy (29.4 per cent of index stocks in 2019 compared to 34.5 per cent in 2017) and more considered critically depleted (17.0 per cent in 2019 compared to 13.4 per cent in 2017).

The composition of critically depleted stocks also changed, with an increasing number of invertebrate and forage fish stocks in both the Atlantic and Pacific now in the critical zone. Loss of forage fish biomass could have serious repercussions throughout the ecosystem. Additionally, there are concerns in all of our oceans about shifting species distributions and changing communities driven by climate change, which combined with other human activities like fishing, coastal development and resource exploitation makes the future health of our oceans highly uncertain (DFO 2019a, 2020a; Talloni-Álvarez et al. 2019). It has never been more urgent that Canada accelerates the implementation of long-standing and critical policies designed to provide the best opportunity of maintaining and restoring the health of Canada's oceans and fisheries.

The Fishery Audit built upon a 2016 report commissioned by Oceana Canada (Baum and Fuller 2016) to develop indicators that measure progress toward maintaining or rebuilding fisheries to healthy levels in Canada and track how well DFO is implementing its commitments from year to year (Oceana Canada 2017a, 2017b, 2018a, 2018b, 2019a, 2019b). These indicators represent the basic and essential information required for sustainable management of our marine fish and invertebrate stocks. As a result, they are largely focused on the current predominance of a single-species management approach but are not meant to preclude further development of EBM, which will require each stock to be effectively managed as well. The current document uses newly available information published over the last year to examine changes in nine essential indicators, updating the status of Canada's marine fish and invertebrate populations and demonstrating the extent of DFO's progress towards rebuilding healthy and abundant oceans.

Indicators to measure progress towards healthy fisheries in Canada

The indicators are summarized as follows:

1. **Status:** The number and percentage of stocks in the healthy, cautious, critical and uncertain health status zones (DFO 2009). This information is essential to determine and prioritize management actions, including determining where rebuilding plans are most needed. This indicator provides a snapshot of the overall health of Canada's marine fish and invertebrate stocks.

2. **Stocks whose health status has shifted from uncertain to certain (or vice versa):** The number of stocks whose health status was previously unknown or uncertain that can now be confidently assigned a status. This indicates how much of the reported changes are due to having better information available. As DFO continues to develop reference points and improve stock assessments, the number of stocks with an uncertain status should decline. However, sometimes assessment methods change, or new information

comes to light, creating situations where the reverse occurs, so this report also includes the number of stocks where the health status has become uncertain.

3. **Change in status:** The number and percentage of stocks whose health status improved, worsened or stayed the same. This indicates how things have changed since the previous year. Over time, with the success of fisheries rebuilding efforts, more stocks should move out of the critical and cautious zones and into the healthy zone.

4. **Biomass/abundance known:** The number and percentage of stocks with biomass/abundance estimates that are no older than five years. This indicator shows how many stocks have recent estimates of abundance and how this number changes from year to year. Given the recent investment in science capacity and the hiring of more scientists (Hutchings 2016), this number should increase over time and is one measure of the quality of the stock assessment. Most full peer-reviewed stock assessments are now conducted on a multi-year cycle (e.g., 2–5 years), but monitoring continues for many stocks on an annual basis. To meet the need for advice in interim years between complete assessments, scientists often provide interim-year updates on the status of the stock based on pre-identified indicators (DFO 2016). During interim updates, indicators are evaluated against predetermined thresholds. If the indicators cross those thresholds, pre-defined management actions may be implemented or a full assessment may be required earlier than scheduled (DFO 2016). For stocks not assessed recently, the number and percentage of stocks with a recent interim update is also reported, indicating whether trends in proxies for biomass/abundance are being evaluated.

5. **Sources of mortality known:** The number and percentage of stocks that have an estimate of fishing mortality, natural mortality and total mortality, as estimated by models. Fish are removed from a population due to natural causes and fishing. In terms of fisheries management, it is most important to know the fishing mortality rate (F). Ideally, estimates will include information from all potential sources of fishing mortality: directed commercial fisheries, recreational fisheries, bait fisheries, food-social-ceremonial fisheries and bycatch. One or more of these sources are often missing from fishing mortality estimates, and they may end up being included with an estimate of natural mortality. Natural mortality (M) is the removal rate of fish from the population from causes not directly attributable to fishing. It can include disease, competition, cannibalism, old age and predation but may also include catch that is unreported or unaccounted for. Most common stock assessment models assume natural mortality is constant and input it into the model using an informed guess. However, several approaches have been developed to estimate natural mortality within models that allow it to vary. The sum of fishing and natural mortality is termed total mortality (Z). In some mortality estimation approaches, only total mortality can be estimated. For some stocks, the data available or the most appropriate modelling approach simply does not allow for an estimation of all sources of mortality. For this reason, the number and percentage of stocks with exploitation rate index estimates are reported. An exploitation rate index is the proportion of the population removed by fishing. It can be expressed as number of fish or as biomass. It provides an indication of fishing pressure. Its calculation requires an estimate of biomass in the population. If this is unavailable, then managers should at least know how many fish are removed from the population due to fishing. To assess this, the number and percentage of stocks with landed volume are reported. Combined, these indicators show what information managers are using to make decisions about fishing pressure on Canada's stocks. An increase in the number and percentage of stocks that have an estimate of fishing mortality, natural mortality and total mortality from year to year will indicate that scientists have increased ability to estimate all sources of mortality for more stocks, thanks to more data and the ability to use the models required. As a result, managers will have more certainty in the outcomes of management decisions.

6. **Reference points:** The number and percentage of stocks that have health status benchmarks, such as limit reference points (LRPs) and upper stock reference points (USRs). Reference points define the stock health

status zones, allowing an assessment of whether a stock is in healthy, cautious or critical condition and providing the basis for rebuilding plan goals (DFO 2009). Reference points enable objective assessments of stock health and the success of management measures. With DFO's commitment to developing reference points for all major stocks (CESD 2016), more stocks are expected to have reference points from year to year.

7. **Management plans in place:** The number and percentage of stocks included in an Integrated Fisheries Management Plan (IFMP), which is Canada's planning framework for the conservation and sustainable use of our fisheries. These plans outline in a single document the process by which a fishery will be managed over a given period. IFMPs are also an important tool for implementing departmental policies and the primary tool for managing stocks in the healthy and cautious zones and rebuilding stocks from the cautious to the healthy zone. A transparent, fully accessible and detailed IFMP makes it easy to determine how a stock is managed, making it less vulnerable to bad decision making. With DFO's commitment to develop and release IFMPs for all major stocks (CESD 2016), more stocks are expected to be included in them from year to year.

8. **Catch monitoring:** The number and percentage of stocks with at-sea observers/electronic video monitoring, dockside monitoring of landings, logbooks that record the entire catch and electronic vessel monitoring systems (VMS) that monitor the location and time of fishing activity. When fisheries have accurate estimates of how much of each species is caught, how much is discarded and where and when fishing is occurring, they can make informed fisheries management decisions. These indicators assess how well the fisheries on our stocks are monitored. There are many ways to monitor the catch, but at-sea observers/electronic video monitoring, dockside monitoring and logbooks are among the most common tools. Each has some trade-offs. Dockside monitoring is a land-based program that monitors the weight and type of fish landed from a commercial fishing vessel when it returns to port. Although this is a good way to assess retained catches, it often does not record species discarded at sea. At-sea observers and electronic video monitoring record the entire catch, both retained and discarded. However, 100 per cent coverage can be expensive and not necessary for all fisheries. The entire catch can also be recorded in logbooks, in which fishers record information about their catch and activities. However, it is not always a requirement to record all bycatch species, and catches identified using species guides may not be reported accurately. Electronic vessel monitoring systems allow scientists and managers to assess fishing effort in time and space using satellite technology, but this may not be feasible or required in all fisheries. By using a combination of catch monitoring tools, ideally recording the entire catch, fisheries managers will have the data required to effectively manage our fisheries. With the release of a national Fishery Monitoring Policy in November 2019 (DFO 2019b), more attention is expected from DFO to determine and ensure the appropriate type and frequency of catch monitoring in all our fisheries. One of the implementation steps is ensuring there are specific and measurable catch monitoring objectives in all IFMPs with monitoring requirements required to achieve them outlined. To evaluate the implementation of the national Fishery Monitoring Policy, the number and percentage of stocks with *specific and measurable* catch monitoring objectives appearing in their IFMPs is reported. These indicators should increase from year to year as the fisheries on these stocks evaluate and improve their catch monitoring.

9. **Critical stocks with rebuilding plans:** The number and percentage of critical-status stocks that have rebuilding plans. DFO follows a fisheries decision-making framework that incorporates the precautionary approach (PA). The precautionary approach means being cautious when scientific knowledge is uncertain and not using the absence of adequate information as a reason not to take action. According to the PA framework, all stocks within the critical zone must have rebuilding plans (DFO 2009). Similar to an IFMP, a rebuilding plan provides a framework for the management of a fishery, with additional requirements included to rebuild the stock out of the critical zone (DFO 2009, 2013), preferably to a healthy state. Ideally, all stocks in the critical

zone should have rebuilding plans, and with DFO's commitment to accomplishing this (CESD 2016), this indicator is expected to increase from year to year.

Methods

The initial Fishery Audit stock list (n = 194 stocks) was created for the 2017 Fishery Audit (see Oceana Canada 2017b for details on stock list creation). At the time, it was the most complete list of stocks available for Canada. It is based on marine fish and invertebrate stocks[4] included in Oceana Canada's 2016 report (Baum and Fuller 2016), combined with those included in the first detailed release of the results of the DFO Sustainability Survey for Fisheries (SSF) (2015 results, released in October 2016; DFO 2019c), with the addition of any stocks with newly available information from departmental reports that year. Oceana Canada's Fishery Audit stock list is closer to representing all marine fish and invertebrate stocks that are managed within Canada and are subject to targeted or incidental commercial fishing pressure than the SSF, which only includes major commercial stocks (DFO 2019d),[5] but several minor stocks are still missing. There is no comprehensive list of all commercial fish stocks subject to federal management in Canada. In Oceana Canada's subsequent Fishery Audits, efforts were made to continue to strive towards a comprehensive stock list by adding to the dataset any further stocks found in newly available information from departmental science reports, departmental work plans (i.e., DFO 2017, 2018a, 2019e, 2020c) or new additions to the SSF (DFO 2019c). However, to make comparisons from year to year, this report focuses only on stocks included in the 2017 stock list, which is now called the index stock dataset.

To update the information pertaining to the indicators, Oceana Canada reviewed DFO websites for published IFMPs and rebuilding plans and reviewed all Canadian Science Advisory Secretariat (CSAS) Science Advisory Reports, Research Documents and Science Responses published since the last Fishery Audit (i.e., between July 2, 2019 and July 1, 2020). For stocks assessed by regional fisheries management organizations (RFMOs) and joint U.S./Canada-assessed stocks, relevant websites were reviewed for newly available information. If newly available information did not result in an update to an indicator, values from 2019 were carried forward. A few minor errors (e.g., assessment year based on publication date rather than last year of data used) found in previous records were corrected when found during the 2020 update process. These minor errors did not change indicator values significantly, and annual comparisons are made using the corrected indicator dataset.

This year's report continues to use the same indicators used in past years, and during the update process, information was interpreted in the same manner. See the previous reports for further details on how indicators are evaluated for each stock (Oceana Canada 2017b, 2018b, 2019b). Briefly, the health status of each stock was updated. In some cases, Oceana Canada was able to find this information in the documents searched, using the biomass estimates in relation to reference points. In other cases, health status was assigned based on an interpretation of data included in the documents. In determining if a stock had a recent biomass/abundance estimate (less than or equal to five years old), the last year of data included in the assessment was used to determine how recent the estimate was. This reduced the confusion from the long time lapse (i.e., years) that sometimes occurs between when assessments are conducted and when the results are published (see Oceana Canada 2018c, 2019c). Additionally, only complete assessments with a new biomass (or proxy) estimate were accepted as an assessment; interim updates of indicators were not because they are most often based on trends in survey and catch data and usually do not include biomass estimates expressed in relation to reference points (DFO 2016). However, the year of the most recent interim update process was recorded for each stock. This information is used to calculate the number and percentage of stocks with an interim update since the last complete

[4] It does not include marine mammals, diadromous fish and freshwater fish

[5] The number of stocks included in the SSF has varied over time since the first stock-by-stock results release for 2015 (n = 159 stocks in 2015; n = 170 stocks in 2016; n = 179 stocks in 2017; n = 177 stocks in 2018). The most recent results (2018) of the SSF includes 177 stocks, of which 132 are marine fish and invertebrates and 43 stocks are marine mammals, diadromous fish or freshwater fish. These stocks represent most of the landings from fisheries managed by DFO but are just part of all the stocks managed by DFO. Stocks are selected for inclusion in the survey based on their economic, cultural or environmental importance (DFO 2019d).

assessment, indicating whether trends in proxies for biomass/abundance are being evaluated in the absence of recent complete assessments.

In 2017, the only source of mortality included in Oceana Canada's Fishery Audit was fishing mortality. Natural and total mortality rates were added in 2018, and values were informed by the most recent stock assessment documents available for all stocks. Estimates of fishing mortality should ideally include information from all potential sources (e.g., directed commercial fisheries, recreational fisheries, bait fisheries, food-social-ceremonial fisheries and bycatch) (DFO 2009). Therefore, in 2019 Oceana Canada began recording when stock assessment reports clearly indicated all sources were incorporated in the fishing mortality estimation. However, there are stocks where a lack of data or the modelling approach used by scientists simply does not allow for an estimation of fishing mortality, natural mortality or total mortality. In such cases, Oceana Canada simply recorded whether exploitation rates, exploitation rate indices or relative fishing mortality rates (i.e., catch/survey biomass) were estimated. Similarly, because the calculation of exploitation rate requires an estimate of biomass in the population, which is not always available, it was also noted whether the volume of landings was available in assessment reports.

The language describing reference points can be ambiguous in CSAS documents. Terms such as "calculated" or "proposed" are often used with little indication as to whether the reference points have been accepted and implemented. For the purposes of this Fishery Audit, Oceana Canada concluded that stocks had reference points if there was any indication of them having been developed but not if there was a clear indication in the reports that they were not accepted by managers. In the case of stocks assessed by RFMOs, if reference points exist, they often have different criteria and definitions of health status zones and reference points than DFO's PA framework. If information on these stocks included the biomass relative to a biomass limit reference point (B_{LIM}) or the biomass at maximum sustainable yield (B_{MSY}), this information was used to assign a status zone analogous to DFO's PA framework (e.g., if the currently assessed biomass was less than B_{LIM} or less than 40 per cent of B_{MSY}, the stock was assigned to the critical zone). Similarly, if there was a B_{LIM} indicated, it was considered an LRP. Additionally, for some stocks no longer subject to a directed commercial fishery, DFO appears to be developing biomass recovery targets instead of reference points. Although recovery targets should be developed to rebuild healthy populations (i.e., above an equivalent USR), DFO often, confusingly, uses definitions like those used for LRPs (i.e., 40 per cent B_{MSY}) (e.g., Swain et al. 2016). Thus, in these cases, biomass recovery targets developed by DFO were considered analogous to LRPs.

It is not unusual for more than one fishery to catch a given stock. This makes assessments of catch monitoring challenging, since different fisheries may have different targeted levels of at-sea observer coverage that varies by gear type and/or vessel size. Therefore, Oceana Canada established indicator values broad enough (e.g., complete coverage, varying levels of coverage, uncertain if tool is used) to allow for an amalgamation of values, but available details on targeted levels of tool use were recorded in brackets within the indicator value for each stock. If there was no indication of the use of the monitoring tool in the documents and websites searched, "uncertain" was assigned as the indicator value. "No" was only assigned when it was clearly indicated the tool was not used. In 2019, the requirement to use electronic VMS or an automated identification system (AIS) was added to the existing three commonly used catch monitoring tools evaluated in previous reports (see Oceana Canada 2017b, 2018b). Further, in anticipation of the finalization and implementation of the national Fishery Monitoring Policy, the number and percentage of stocks with specific and measurable catch monitoring objectives appearing in their IFMPs was recorded starting in 2019. To meet this requirement, objectives had to be clearly stated as monitoring objectives, with the purpose stated, and details such as the tools, targeted coverage levels and acceptable level of dependability to meet the objective included.

In 2020, the indicators of stock status and whether a stock was recently assessed or not were explored in relation to proxies for recent landed volume and value. This was done to characterize stock status in relation to these two

proxies of economic importance and to determine if their economic importance influences stock assessment priorities. Volume of reported landings for each stock was obtained from their most recent stock assessment reports. Stock assessment reports are the only location where publicly available landings data are reported by stock consistently across species and regions. Because it is intended to represent an indicator of economic importance, any estimates of unreported landings or discard mortality were excluded. Sometimes the volume of reported landings obtained represented a recent annual average if the most recent year was not reported by itself, and sometimes the volume found was dated if the most recent report itself was dated. Therefore, it should be considered a proxy for recent harvest volume. Value is also not reported publicly by stock across all regions in a consistent manner. However, DFO does report annual aggregate national value data by taxa group and province on its Seafisheries Landings website (DFO 2020d). A proxy for recent landed value for each stock was estimated by multiplying the volume of reported of landings (metric tonnes) obtained from reports by the most recent value per metric tonne of the taxa group and region to which the stock belongs in the DFO Seafisheries Landings website dataset. The value per metric tonne was calculated by dividing the value per taxa group and region (Atlantic or Pacific) in the most recent year reported (2018) by the quantities per taxa group and region in the same year. Given the taxa level reported on the Seafisheries Landings website differ in resolution, and that actual ex-vessel prices differ by quality, region and time of year, this value should only be considered as a proxy for recent value of reported landings.

Results/Discussion

The 2020 index stock dataset for this Fishery Audit includes 194 marine fish and invertebrate stocks[6] that are managed within Canada and subject to targeted or incidental commercial fishing pressure (Table 1). The complete dataset of stocks and stock-specific indicator values is available online (see oceana.ca/FisheryAudit2020).[7] For a visualization of most indicators by DFO administrative region, see Appendix 1 of this document.

1. **Status:** In 2020, only 26.8 per cent (52 stocks) of Oceana Canada's marine fish and invertebrate index stocks can be confidently considered healthy. Further, 19.1 per cent (37 stocks) are in the cautious zone, 17.0 per cent (33 stocks) are in the critical zone, and the status of 37.1 per cent (72 stocks) are uncertain. Uncertain stocks are likely a mix of states, some of which are likely critical (e.g., Pacific sardine, yellowtail flounder on Georges Bank), while others are likely healthy (e.g., American lobster around Anticosti Island). These results indicate a recent change in the overall status of the fisheries over the last four years (Figure 1, Table 1), with fewer healthy stocks and a startling increase in the number of cautious and critically depleted stocks.

[6] It does not include marine mammals, diadromous fish and freshwater fish
[7] In 2020, Oceana Canada continued its efforts to build a comprehensive stock list by adding to the dataset any additional stocks found during the update using newly available information from DFO reports, work plans or new additions to the SSF. This resulted in a dataset that grew from 223 stocks in 2019 to 227 stocks. Results calculated using all stocks did not differ greatly from those using index stocks and are available in Table 2.

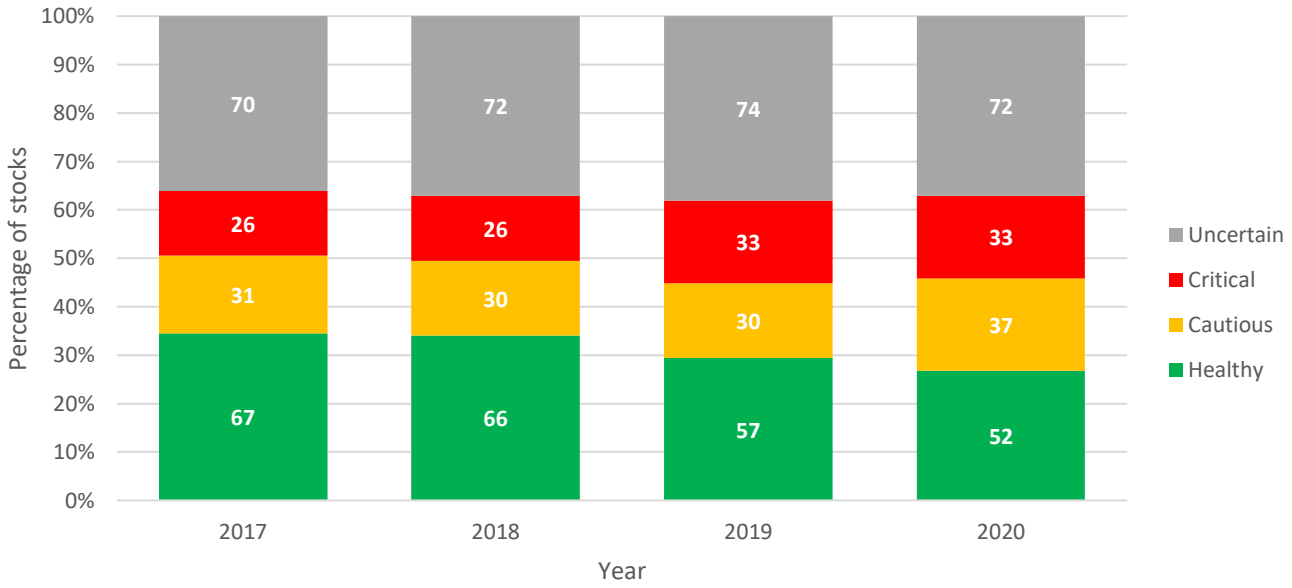

Figure 1. The percentage of Oceana Canada index stocks (n = 194 stocks) in each of the health status zones described in DFO's precautionary approach (PA) framework (DFO 2009) in 2017, 2018, 2019 and 2020. The number of stocks in each status zone is indicated in white font within the bars.

Most of the critically depleted stocks are groundfish (11 stocks) and flatfish (six stocks) located in the Atlantic Ocean (Figures 2, 3, 4), many of which have not recovered since the groundfish collapse in the mid-1990s. However, within the last four years, a notable number of invertebrate stocks have become critically depleted in the Atlantic Ocean (two stocks in 2020) and in the Pacific Ocean (six stocks in 2020), increasing the overall number of critically depleted invertebrate stocks in Canada's oceans from just one in 2017 to eight in 2020. Over the same period, invertebrate stocks in these two oceans saw the largest decreases in the number that were healthy: from 20 to 17 stocks in the Atlantic Ocean and 17 to 8 stocks in the Pacific Ocean. In addition, one more forage fish stock in the Atlantic Ocean became critically depleted in 2020, bringing the total there to four; there are no longer any healthy forage fish stocks in the Pacific Ocean. Loss of forage fish biomass could have serious repercussions throughout the ecosystem. The status of the few stocks in the Arctic Ocean included in the index dataset have remained relatively unchanged, but in 2020 one stock did change from the healthy to the cautious zone (Figure 4).[8]

Still, there have been improvements in stock health with some taxa. Rockfish in the Pacific Ocean have increased from five healthy stocks (in 2017) to seven in 2020, one of which was previously in the critical zone.[9] Redfish stocks in the Atlantic Ocean continue to show positive signs without any now classified as critically depleted.[10] Several *Sebastes* species are characterized by episodic or spasmodic recruitment, a pattern of long periods of weak recruitment with irregular and infrequent episodes of strong recruitment. After nearly 30 years without good recruitment, deepwater redfish (*Sebastes mentella*) in the Gulf of St. Lawrence had large recruitment events from 2011 to 2013 that produced the most juveniles ever seen from surveys. This pulse of juveniles, as they grew, quickly increased the stock biomass from the critical zone to the healthy zone (DFO

[8] Striped shrimp in the Eastern Assessment Zone
[9] Yelloweye rockfish – outside population
[10] Although the status of two of these stocks changed from critical to uncertain due to the rejection of previously used LRPs with no replacement, these stocks are showing signs of improvement in research vessel survey datasets.

2020f). On the Pacific coast, Bocaccio rockfish (*Sebastes paucispinis*) had a recruitment event in 2016 that was 44 times larger than ever seen before and is expected to quickly grow the stock biomass into the healthy zone (DFO 2020g). Both stocks are part of populations that had previously been assessed as endangered (COSEWIC 2010, 2013). These seemingly unpredictable events, while positive for the individual populations, can add uncertainty to the management of other species. Sudden increases in abundance of depleted populations caught as bycatch in other fisheries can present challenges for existing harvest rules, while resultant ecosystem changes (e.g., through predator-prey or competitive dynamics) could potentially impact the population dynamics of other targeted species. While the exact causes of these extreme recruitment events are not known, favourable environmental conditions likely facilitated their occurrence (Schroeder et al. 2019). For example, it is possible that the Bocaccio recruitment event is linked with the marine heat wave in the northeast Pacific Ocean in 2014 and 2015, called the "The Blob" (DFO 2020g). Climate change is likely to have positive and negative impacts on individual populations, expected to result in "winners and losers" with respect to access to future fisheries (Talloni-Álvarez et al. 2019, Willson et al. 2020, Lam et al. 2016). DFO must also now determine what climate-ready fisheries management means in Canada and put in place the means to implement it.

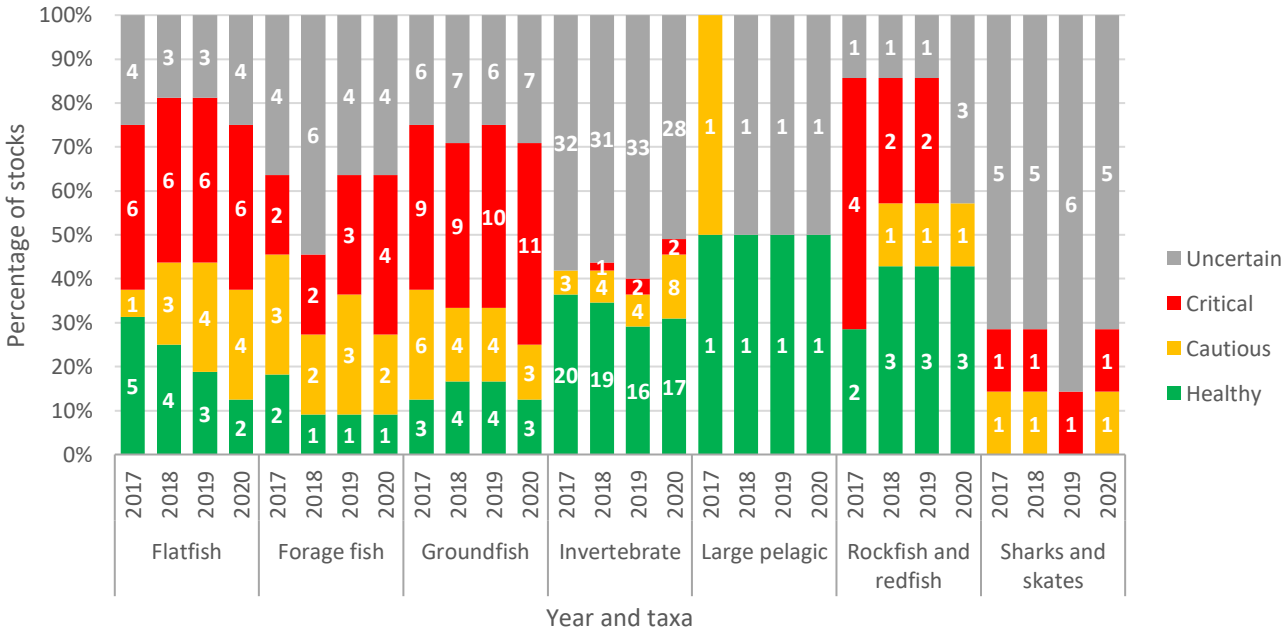

Figure 2. The percentage of Oceana Canada index stocks (n = 194) in each of the health status zones described in DFO's precautionary approach framework (DFO 2009), by taxa groups, in the Atlantic Ocean in 2017, 2018, 2019 and 2020. The number of stocks in each year-taxa-status combination are reported in white font within the bars.

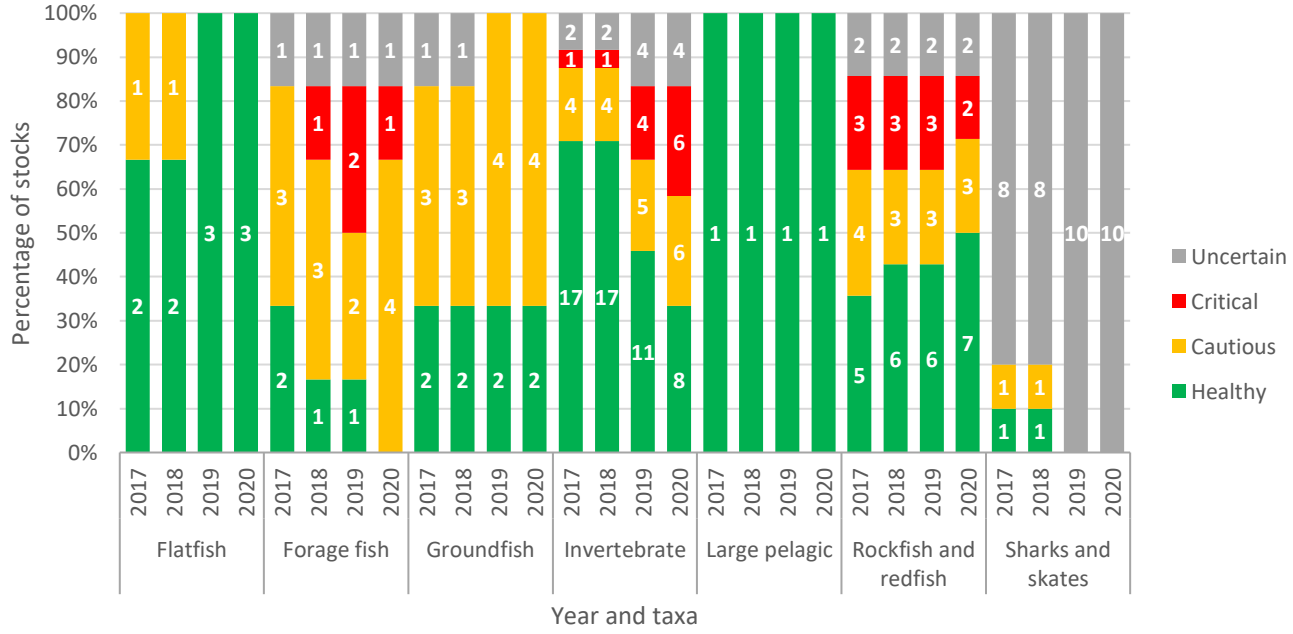

Figure 3. The percentage of Oceana Canada index (n = 194) stocks in each of the health status zones described in DFO's precautionary approach framework (DFO 2009), by taxa groups, in the Pacific Ocean in 2017, 2018, 2019 and 2020. The number of stocks in each year-taxa-status combination are reported in white font within the bars.

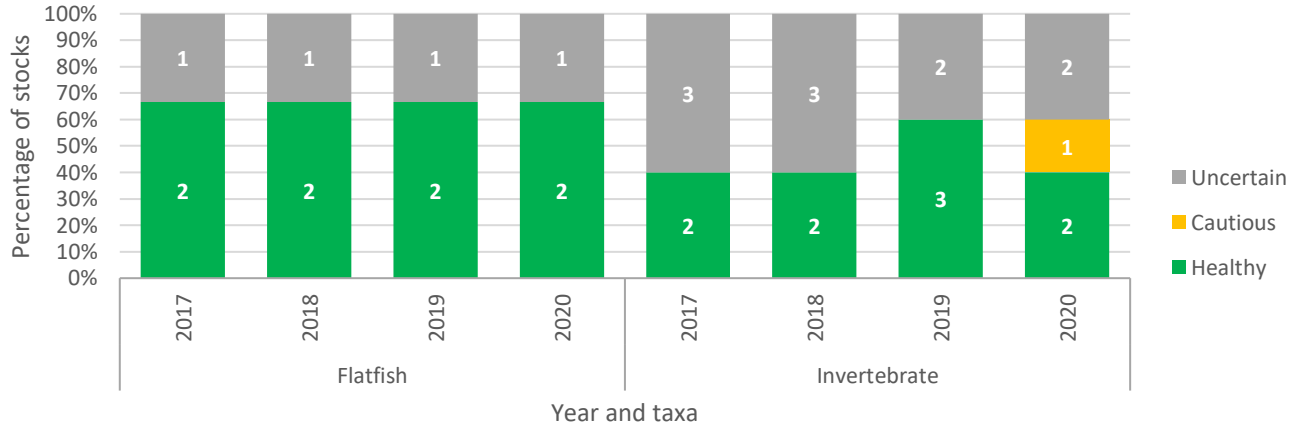

Figure 4. The percentage of Oceana Canada index stocks (n = 194) in each of the health status zones described in DFO's precautionary approach framework (DFO 2009), by taxa groups, in the Arctic Ocean in 2017, 2018, 2019 and 2020. The number of stocks in each year-taxa-status combination are reported in white font within the bars.

The 2020 status results reported here differ from the most recent (2018) results of the DFO SSF, where 10.7 per cent (19 stocks) were critically depleted, 15.3 per cent (27 stocks) were in the cautious zone, 32.8 per cent (58 stocks) were in the healthy zone, and the status of 41.2 per cent (73 stocks) were uncertain (DFO 2019c). These differences are likely due in part to the inclusion of additional taxa in the SSF (e.g., freshwater fish) not included in the Oceana Canada index stock dataset, which focuses on marine fish and invertebrates that live

their entire life cycle in the ocean.[11] The differences are also likely due in part to the delay in the SSF; given it takes nearly a year to conduct and analyze the survey, results are reporting on the previous year's data (DFO 2019f) and released nearly a year after the survey year (i.e., 2018 results are released in late 2019). The 2020 statuses reported here are based on information available up to and including July 1, 2020 and are therefore informed by more recent information that was not available when the 2018 SSF was completed. Additional differences likely arise from differences in stock definitions and inclusion. Oceana Canada's index stock dataset was created from a merger of stocks included in the Baum and Fuller (2016) report and the 2015 SSF, with stock definition discrepancies decided by the unit used in the most recent CSAS report (see Oceana Canada 2017b for details). Oceana Canada's index stock dataset is closer to representing all marine fish and invertebrate stocks that are managed within Canada and are subject to targeted or incidental commercial fishing pressure than the SSF, which only includes major commercial stocks (DFO 2019d).[12] Therefore, although the index dataset used here includes all stocks from the SSF at the time it was first published,[13] it also includes several stocks (46 stocks) not included in the 2018 SSF in any form.[14] Of these stocks not overlapping with the 2018 SSF stock list, nine are in the critical zone (19.6 per cent), seven are in the cautious zone (15.2 per cent), five are in the healthy zone (10.9 per cent) and 25 are uncertain (54.3 per cent). This indicates the health of stocks that DFO considers "minor" may be worse than those it considers "major," contributing to the differences in health status reporting.[15] Regardless of these differences, the SSF dataset is also showing a large decline in healthy stocks (20 fewer healthy stocks in 2018 as compared to 2015; DFO 2019g), and when using the SSF to report on sustainable development indicators, the government is also reporting concerns about the health status of key forage fish and invertebrate stocks (ECCC 2020).

One of the several reasons a stock would be included in the SSF is if annual landed volume of catch exceeds 2,000 metric tonnes (t) (i.e., high volume) or landed value exceeds $1 million (i.e., high value) (DFO 2019f). When health status is broken down within Oceana Canada index stocks by those with reported annual landings exceeding 2,000 t,[16] most stocks with high-volume harvests are healthy (54.5 per cent or 30 stocks; Figure 5A). Similarly, most stocks with high-value harvests are healthy (39.0 per cent or 39 stocks; Figure 5B). Still, several critical zone stocks (18.2 per cent or six of 33 critical zone stocks) have annual harvests greater than 2,000 t,[17] and even more critical zone stocks (33.3 per cent or 11 of 33 critical zone stocks) have annual

[11] The Oceana Canada stock list excludes freshwater fish, diadromous fish and marine mammals, all of which are included in the SSF.
[12] The number of stocks included in the SSF has varied over time since the first stock-by-stock results release for 2015 (n = 159 stocks in 2015; n = 170 stocks in 2016; n = 179 stocks in 2017; n = 177 stocks in 2018). The most recent results (2018) of the SSF includes 177 stocks, of which 132 are marine fish and invertebrates and 43 stocks are marine mammals, diadromous fish or freshwater fish. These stocks represent most of the landings from fisheries managed by DFO but are just part of all the stocks managed by DFO. Stocks are selected for inclusion in the survey based on their economic, cultural or environmental importance (DFO 2019d).
[13] Here efforts are made to maintain the same number of stocks and definitions across years in Oceana Canada's index stock dataset to enable annual comparisons, but each year stocks are added to a larger dataset, building towards a comprehensive stock list of all marine fish and invertebrate stocks managed in Canada. Each year, stocks are added to the larger dataset that appear in newly available stock assessment reports, departmental work plans (i.e., DFO 2017, 2018a, 2019e, 2020b) or new additions to the SSF (DFO 2019c). The larger stock dataset includes all stocks appearing in the 2018 SSF, and results calculated using it are available in Table 2.
[14] When the 2020 index dataset is filtered to just stocks that do overlap with the SSF, results break down as follows: 16.2 per cent in the critical zone (24 stocks), 20.9 per cent in the cautious zone (31 stocks), 31.1 per cent in the healthy zone (46 stocks) and 31.8 per cent (47 stocks) with an uncertain status.
[15] Additionally, in Oceana Canada's larger dataset, there are 36 critical zone stocks and only 24.8 per cent of stocks (56 of 226 stocks) are healthy. This dataset includes some additional "major" stocks listed in the SSF but mostly stocks that are not listed in the SSF.
[16] More specifically, annual landed volume by Canadian harvesters as reported in the most recent stock assessment report. This may represent a recent annual average if the most recent year was not reported by itself, or it could be dated if the most recent report itself is dated. Additionally, any estimated unreported landings or discard mortality volumes were excluded. See the Methods section for further details.
[17] Critically depleted stocks with an annual landed volume proxy greater than 2,000 t are: Atlantic herring on the Scotian Shelf/Bay of Fundy (NAFO 4VWX), Atlantic mackerel in NAFO subareas 3 and 4, Atlantic cod in NAFO 3Ps, Atlantic cod in NAFO 2J3KL (i.e., northern cod), northern shrimp in Shrimp Fishing Area 6 and snow crab in NAFO 3L – inshore.

landed value greater than $1 million dollars.[18] Furthermore, given that some former economically valuable stocks are depleted, current landed volume or value does not account for their potential economic value (Teh and Sumaila 2020). When stocks are in the critical zone, DFO policy indicates removals by all human sources must be kept to the lowest possible level and biological considerations should prevail over socio-economic considerations to facilitate rebuilding (DFO 2009). "Lowest possible levels" has never been defined, but the provisional harvest rule within DFO policy for the critical zone includes a provisional removal reference or fishing mortality equal to zero, while the harvest strategy example included indicates that when a stock is in the critical zone, the harvest rate is to be reduced to zero as a result of directed fishing and other removals (e.g., bycatch) reduced at a level consistent with growth (DFO 2009).

[18] Critically depleted stocks with an annual landed value proxy greater than $1 million are: American plaice in NAFO 3LN0, Atlantic herring on the Scotian Shelf/Bay of Fundy (NAFO 4VWX), Atlantic mackerel in NAFO subareas 3 and 4, Atlantic cod in NAFO 3Ps, Atlantic cod in NAFO 2J3KL (i.e., northern cod), Atlantic cod on the Scotian Shelf/Bay of Fundy (NAFO 4X5Y), pink shrimp in the Fraser River Shrimp Management Area (SMA), pink shrimp in SMA 14, northern shrimp in Shrimp Fishing Area 6 and snow crab in NAFO 3L – inshore.

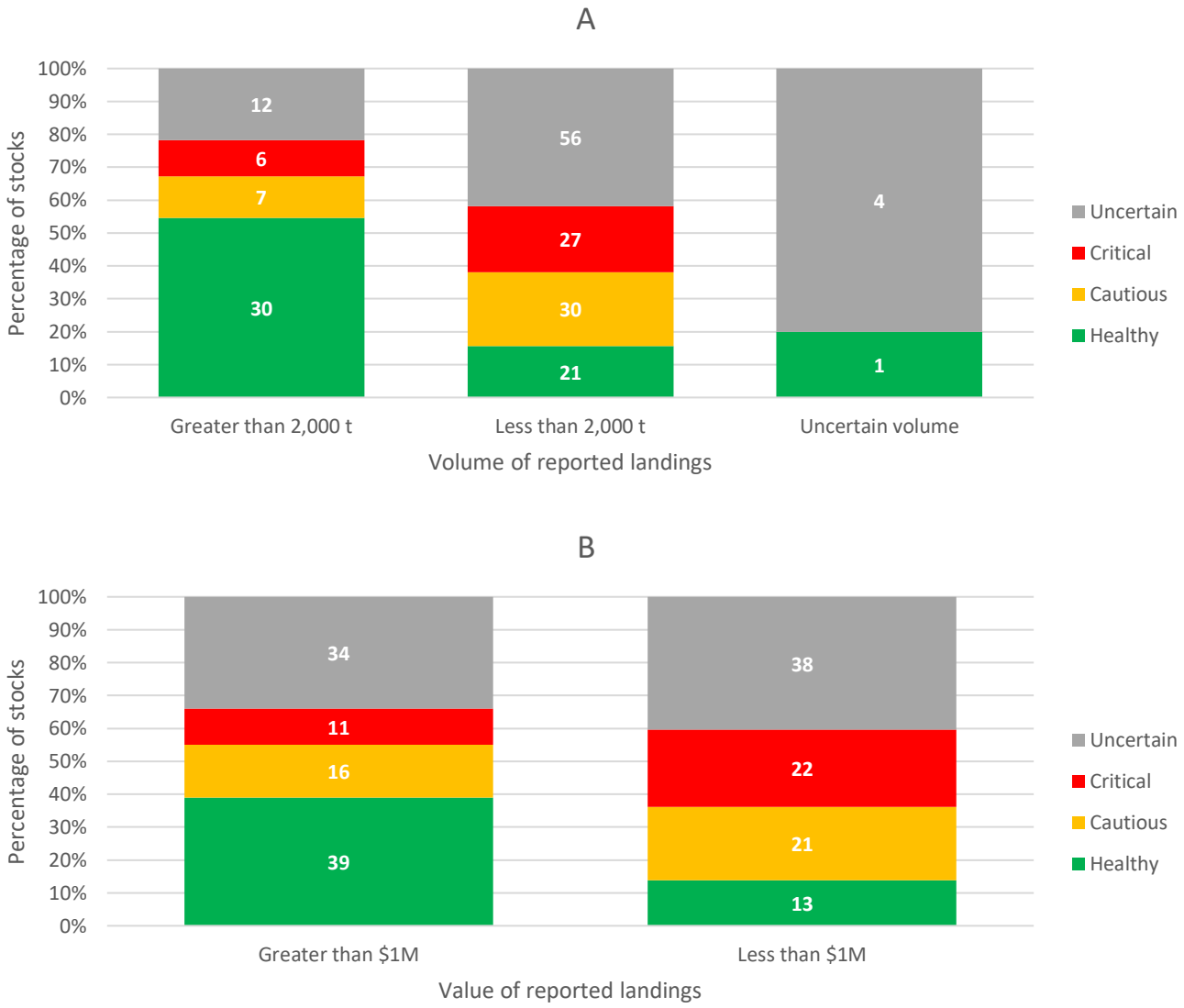

Figure 5. The percentage of Oceana Canada index stocks (n = 194) in each of the health status zones described in DFO's precautionary approach framework (DFO 2009) in 2020 by volume (A) and value (B) of annual reported landings. Annual reported landings represent the most recently reported annual volume of reported landings by Canadian harvesters in the most recent stock assessment report. This may represent a recent annual average if the most recent year was not reported by itself, or it could be dated if the most recent report itself is dated. Additionally, any estimated unreported landings or discard mortality volumes are not included. Landed value was estimated by multiplying landed volume by the corresponding taxa value per tonne according to the DFO Seafisheries Landings website (DFO 2020d). See the Methods section for further details. The number of stocks in each volume-category-status combination is reported in white font within the bars.

When all stocks within a taxa group are aggregated, it is evident that most forage fish landings (54.9 per cent) come from critically depleted stocks, with groundfish subject to the second-highest proportion of landings from critical stocks (11.5 per cent) (Figure 6A). Similarly, these two taxa groups have the highest proportion of landed value coming from critically depleted stocks (Figure 6B).

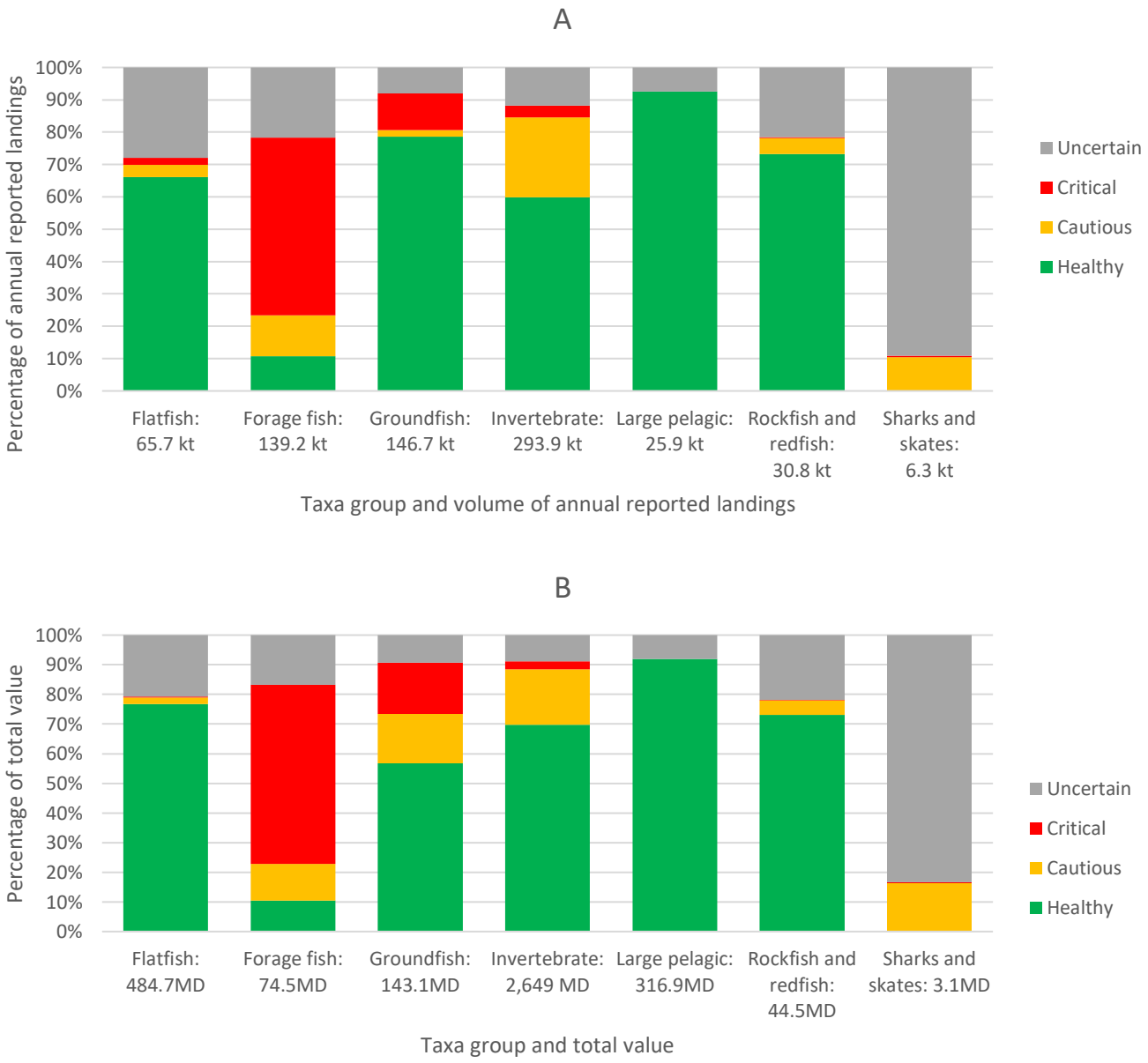

Figure 6. The percentage of annual reported landings volume (A) and value (B) in each taxa group originating from stocks assigned to each health status zone among Oceana Canada index stocks (n = 194 stocks). The sum of the annual reported landings (thousand metric tonnes; kt) or value (millions of dollars; MD) within each taxa group is indicated in the x-axis labels after the taxa group name. Annual reported landings represent the most recently reported annual volume of reported landings by Canadian harvesters in the most recent stock assessment report. This may represent a recent annual average if the most recent year was not reported by itself, or it could be dated if the most recent report itself is dated. Additionally, any estimated unreported landings or discard mortality volumes are not included. Landed value was estimated by multiplying landed volume by the corresponding taxa value per tonne according to the DFO Seafisheries Landings website (DFO 2020d). See the Methods section for further details.

2. **Stocks whose health status has shifted from uncertain to certain (or vice versa):** In 2020, six index stocks went from having an unknown/uncertain status in 2019 to having one assigned due to new information (Table 1). The health status of five were assigned as cautious[19] and one as critical.[20] Four stocks underwent the reverse change, with Oceana Canada unable to determine their status with certainty (two from healthy to uncertain[21] and two from critical to uncertain[22]), which resulted in an overall decrease in the total number stocks with uncertain status from to 74 in 2019 to 72 in 2020 (Table 1, Figure 1). This is the first net decrease in the number of stocks of uncertain status, reversing the previous trend of an increasing number of uncertain status assignments (Table 1, Figure 1). While the number of uncertain status stocks in the index dataset has remained relatively stable (between a minimum of 70 stocks in 2017 and a maximum of 74 in 2019), the number of uncertain stocks in the SSF has increased greatly, from 34 stocks in 2015 to 73 in 2018. DFO indicates this is for several reasons, such as a lack of reference points, insufficient data or fluctuations in population level that makes assigning a health status difficult (DFO 2019g). This lack of sufficient information to reliably assess the health status of some stocks, combined with the increase in the number of stocks included in the SSF, has contributed to the high number of stocks with an uncertain status (ECCC 2020). Given the continued development of reference points and improved science capacity for stock assessments within the department in the last four years, the SSF data displays a change in the opposite direction than expected, while the Oceana Canada index dataset shows little net change in the ability to assign a health status for over a third of our marine fish and invertebrate stocks.

3. **Change in status:** In 2020, 12.4 per cent of index stocks (24 of 194 stocks) had a different health status as compared to 2019 (Table 1). As outlined above, many of these changes (10 stocks) were stocks that moved from uncertain to certain or the reverse. In addition, nine stocks were identified as more at risk, with four stocks declining from healthy levels to the cautious zone,[23] one stock declining from healthy levels to the critical zone[24] and four stocks declining from the cautious zone to the critical zone.[25] Stocks declining to the critical zone included three shrimp stocks located in the Pacific Ocean, an Atlantic cod stock and an Atlantic herring stock. Only five stocks were identified as less at risk, with three moving from the critical zone to the cautious zone,[26] one moving from the critical zone to healthy zone[27] and one moving from the cautious zone to healthy zone.[28] With more stocks declining in health status than improving, the net change in status of these index stocks over the last four years indicate an overall decrease in the health of Canada's marine fish and invertebrate stocks.

4. **Biomass/abundance known:** In 2020, 58.8 per cent of index stocks (114 of 194 stocks) had a biomass or abundance estimate within the last five years. After previous drops in this indicator, it remained the same in 2020 from 2019 (Figure 7, Table 1). As in previous years, although many stocks (56) had more recent biomass estimates this year than they did last year, most of the previous estimates were still less than five years old.

[19] Uncertain to cautious: Atlantic Canada dogfish in NAFO 4VWNX+5, snow crab in NAFO 2HJ, snow crab in NAFO 3K, snow crab in NAFO 3LNO – offshore and snow crab in St. Pierre Bank (NAFO 3Ps)
[20] Uncertain to critical: snow crab in NAFO 3L – inshore
[21] Healthy to uncertain: Atlantic halibut in the Gulf of St. Lawrence (4RST) and haddock on the Scotian Shelf/Bay of Fundy (NAFO 4X5Y)
[22] Critical to uncertain: Acadian redfish in NAFO 2+3K and deepwater redfish in NAFO 2+3K
[23] Healthy to cautious: intertidal clams on the North Coast (i.e., Haida Gwaii razor clams), Pacific herring in the Strait of Georgia, sidestripe shrimp in the Fraser River Shrimp Management Area (SMA) and striped shrimp in the Eastern Assessment Zone
[24] Healthy to critical: sidestripe shrimp SMA 16
[25] Cautious to critical: Atlantic herring on the Scotian Shelf/Bay of Fundy (NAFO 4VWX), Atlantic cod in NAFO 3Ps, northern/pink shrimp in the Prince Rupert District SMA and northern/pink shrimp in SMA 14
[26] Critical to cautious: Pacific herring in the Prince Rupert District, sidestripe shrimp in SMA 14,and snow crab on the Scotian Shelf (NAFO 4X)
[27] Critical to healthy: The yelloweye rockfish outside population (of Vancouver Island) underwent a science advisory process evaluating potential rebuilding strategies for this stock that indicated that all operating model scenarios implied that the stock is currently above 0.4 B_{MSY} (i.e., LRP) coast-wide, even though the spawning stock biomass declined rapidly by 49–71 per cent in the north, and by 57–79 per cent in the south over the past two generations.
[28] Cautious to healthy: northern shrimp on the Scotian Shelf (SFA 13–15)

Meanwhile, several stocks assessed in 2014 (i.e., six years ago) have not been reassessed since and are now considered outdated in this year's analysis. As a result, there was no net change in this indicator in 2020.

To examine possible assessment priorities, results were explored using the same reported landings volume and value categories as above (see Figure 5) and health status. Of the 56 stocks that had new biomass estimates within the last year, most (57.1 per cent or 32 stocks) had annual reported landings of less than 2,000 t, indicating several of these frequently assessed stocks have lower-volume harvests. However, most of these stocks with new assessments (71.4 per cent or 40 stocks) had high landed value (greater than $1 million dollars), indicating that high value may contribute to being frequently assessed. Similarly, stocks with lower annual reported landings (less than 2,000 t) also make up the majority (62.3 per cent or 71 stocks) of index stocks with recent estimates (i.e., assessments within the last five years; 114 stocks), while the majority with recent assessments (61.4 per cent or 70 stocks) are also high value (greater than $1 million dollars).

The majority of stocks in each of the annual landings volume categories (excluding uncertain) have had a biomass or abundance estimate in the last five years (76.4 per cent of stocks with annual landings greater than 2,000 t; 53.0 per cent of stocks with annual landings less than 2,000 t). While most higher-value stocks (70.0 per cent or 70 stocks) have had recent assessments, most of the lower-value stocks (53.2 per cent or 50 stocks) have not been recently assessed. Stocks with lower-volume landings constitute the large majority (78.8 per cent or 63 stocks) of stocks *without* recent biomass estimates (80 stocks). Within this category, most are also lower value (62.5 per cent or 50 stocks). These results indicate that assessment priority is not determined by landed volume but may be influenced by landed value instead, at least based on the stock definitions used here (i.e., fisheries that target several stocks of the same species that combined have high volumes or value could all be prioritized together).

In terms of health status, the majority of stocks in the cautious, critical and uncertain zones have recent biomass estimates (63.6 per cent of stocks in the critical zone, 62.2 per cent of stocks in the cautious zone and 61.1 per cent of stocks of uncertain status), while half (50.0 per cent) of stocks considered healthy do. This indicates the department may be prioritizing stocks that are uncertain or suspected to be depleted. Considered another way, it also means half of the healthy status assignments are at least in part based on outdated biomass estimates. Considering that, overall, more than 40 per cent of stocks lack recent biomass or abundance estimates, DFO should ensure several stocks that do not have assessments or have assessments that are more than five years old are included in upcoming stock assessment planning, in addition to stocks that are economically important.

Of the 41.2 per cent of index stocks (80 stocks) without complete assessments in the last five years, 26.3 per cent (21 stocks) have had an interim update reporting on trends in proxies for biomass/abundance within the last five years. This means that 69.6 per cent of index stocks have had at least some sort of evaluation of trends in abundance or biomass indices within the last five years to support fisheries management.[29] However, of the interim updates, only one stock had indicators evaluated against predetermined thresholds used to trigger pre-defined management actions or a full assessment earlier than scheduled (DFO 2016).[30] This could be related to the newness of this policy (2016) pertaining to interim updates requiring indicator evaluations. However, the majority (81.0 per cent or 17) of these interim updates were conducted in 2017 or later, suggesting the policy is not being consistently implemented.[31]

[29] 114 stocks with recent biomass or abundance estimates and 21 stocks with recent biomass or abundance index evaluations
[30] Western component pollock (NAFO 4X5)
[31] Three additional stocks *with* complete assessments within the last five years have also had more recent interim updates with indicators evaluated (American plaice in NAFO 4T, Greenland halibut in NAFO 4RST and yellowtail flounder in NAFO 4T), but there are also many stocks (31) with interim updates after 2016 that have not had indicators to evaluate.

5. **Sources of mortality known:** In 2020, 20.6 per cent of index stocks (40 of 194 stocks) had an estimate of fishing mortality. This represents a slight increase over the previous two years, returning the number to 2017 levels (Figure 7, Table 1). This means roughly one in five stocks have sufficiently robust data or a modelling approach that allows for the estimation of fishing mortality, which is valuable in assessing whether overfishing is occurring (NOAA 2013). Ideally, fishing mortality estimates should include all sources of fishing mortality (DFO 2009; Gilman et al. 2013): commercially directed, recreational, bait, food-social-ceremonial and bycatch. Only two stocks have recent stock assessment reports that clearly indicate all suspected sources were accounted for,[32] while 11 additional stock assessment reports clearly indicate they at least partially account for sources other than reported commercial landings.[33] Several approaches have been developed to estimate natural mortality within models and/or to allow it to vary. In 2020, 19.1 per cent of index stocks (37 of 194 stocks) have an estimate of natural mortality, representing another year-over-year increase (13.9 per cent in 2018; 15.5 per cent in 2019), likely representing increased use of the new modelling approaches. In some mortality estimation approaches, only total mortality can be estimated. In 2020, 11.3 per cent of index stocks (22 of 194 stocks) have an estimate of total mortality, again representing another year-over-year increase (6.7 per cent in 2018; 8.8 per cent in 2019).

   There have been notable improvements in the number of stocks with natural and total mortality estimates, which hopefully signals improvements in the ability to estimate all sources of mortality. Still, the number of stocks with fishing mortality estimates has remained relatively stable, and few of these stocks have all sources of fishing mortality incorporated in their estimation. These results indicate a lot more work is needed to ensure there is the data and ability to use the models required to estimate all sources of mortality, so there can be more confidence in management decisions. In the absence of that data and ability, it important to at least have an estimate of the exploitation rate. Exploitation rate indices are the proportion of the population removed by fishing (expressed in numbers or biomass) and provide an indication of fishing pressure. In 2020, less than half (42.8 per cent; 83 of 194 stocks) of index stocks have exploitation rates or indices reported, a slight improvement over last year (39.2 per cent). At a minimum, it is important to know the volume of fish landed. In 2020, most index stocks (97.4 per cent; 189 of 194 stocks) have estimates of reported landings included in their most recent stock assessments,[34] relatively unchanged over last year (97.9 per cent).

6. **Reference points:** In 2020, 63.9 per cent of index stocks (124 of 194 stocks) have LRPs and 48.5 per cent (94 stocks) have USRs. After previously increasing year over year, the percentage of index stocks with LRPs declined in 2020 as two stocks that previously had LRPs had them removed and proposed approaches to develop new ones were not acceptable to scientists during peer review (Figure 7, Table 1).[35] USR development has continued to increase year over year, albeit at a slower rate than LRPs were previously (Figure 7, Table 1). Without reference points, it is difficult to apply the PA framework, assess stock health and identify targets for rebuilding depleted stocks to healthy levels. DFO has committed to developing reference points for all major commercial fish stocks (CESD 2016), and the results here indicate they are making some progress. But with more than a third of the marine fish and invertebrate index stocks lacking LRPs and more than half lacking USRs, managers continue to operate without these benchmarks, and the status of many stocks remains uncertain. All index stocks in the critical and cautious zones have LRPs or their equivalent. However, almost one-third of these stocks are missing USRs (in the critical zone, 30.3 per cent or 10 stocks are missing USRs; in

[32] Pacific halibut and winter skate in the Gulf of St. Lawrence (NAFO 4T)
[33] American plaice in the Southern Gulf of St. Lawrence (NAFO 4T), bluefin tuna in the western Atlantic, Atlantic herring SW New Brunswick (NAFO 5YZ), Atlantic mackerel in NAFO subareas 3 and 4, Atlantic cod in NAFO 3Ps, Atlantic cod in NAFO 2J3KL (i.e., northern cod), Atlantic cod on eastern Georges Bank (NAFO 5Zjm), Pacific cod in the Hecate Strait (5CD), Pacific cod in the Queen Charlotte Sound (5AB), the yelloweye rockfish inside population and the yelloweye rockfish outside population
[34] Note that CSAS reports are the only source of *stock level* landings data. DFO reports annual landed volume aggregated by province and broad taxa group, but these figures are not always species specific and do not provide stock-level details.
[35] Acadian redfish in NAFO 2+3K and deepwater redfish in NAFO 2+3K

the cautious zone, 27.0 per cent or 10 stocks are missing USRs). If stocks that are not doing well lack a USR, there is no target for rebuilding them to a healthy state.

7. **Management plans in place:** In 2020, 90.7 per cent of index stocks (176 of 194 stocks) were included in an IFMP. There has been a continual increase in this indicator since 2017 but only a slight increase over last year (Figure 7, Table 1). In 2019, several new multi-stock IFMPs were published that resulted in a large increase in this indicator. However, in 2020, only one more stock was included in an IFMP. In 2020, 173 of the index stocks are included in IFMPs that are available online in 43 unique IFMPs. Only three index stocks are included in IFMPs that are not available online.[36] Each stock should be included in an IFMP, and entire IFMPs (not just summaries) should be publicly available. If fish stocks are not included in a management plan, fisheries managers lack the framework required for conservation and sustainable use, and if those plans are not easily accessible, it is difficult for stakeholders and the public to assess how a fishery is being managed. DFO has committed to having all major commercial fish stocks included in IFMPs and to make these available to the public on its website (CESD 2016), which has resulted in the large increases in this indicator. But there is still more work to do (see Oceana Canada 2020a), so it is expected that this indicator will continue to rise.

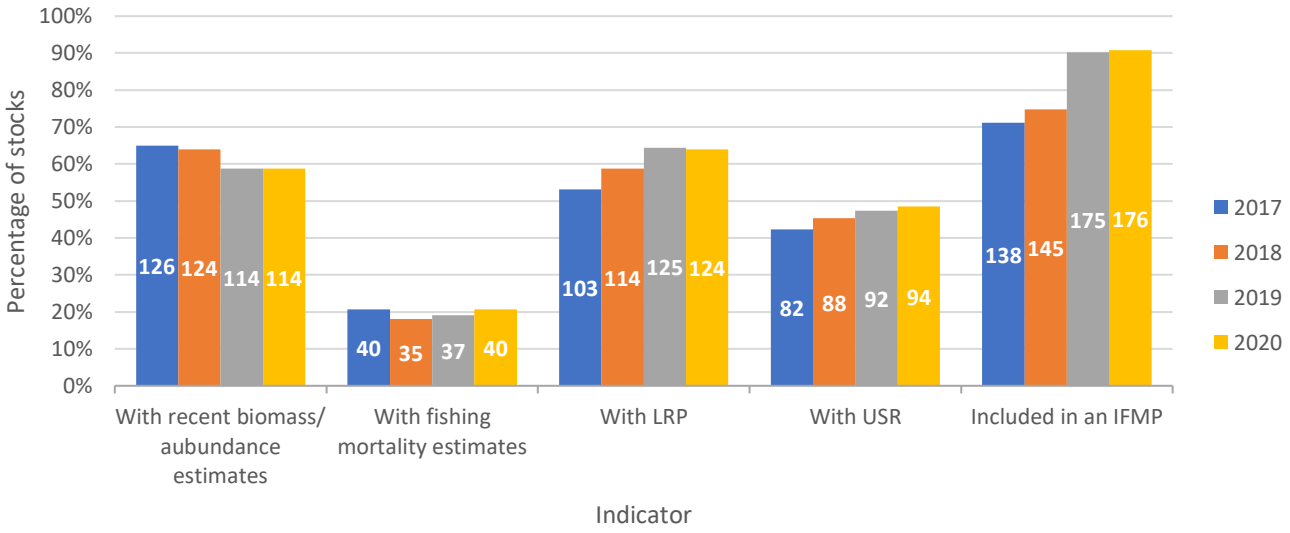

Figure 7. An assessment of how stocks perform on five indicators, based on Oceana Canada's index stock dataset (n = 194 stocks) in 2017, 2018, 2019 and 2020. The indicators included the percentage of stocks: 1) with a biomass/abundance estimate within the last five years; 2) with fishing mortality estimates; 3) with a limit reference point (LRP); 4) with an upper stock reference point (USR); and 5) included in an Integrated Fisheries Management Plan (IFMP). The number of stocks for each indicator is in white font within the bars. See the Introduction and Methods sections for further details on indicator definitions and calculations.

8. **Catch monitoring:** In 2020, 83.5 per cent of index stocks (162 of 194 stocks) have fisheries with at-sea observer or electronic (i.e., video) monitoring (Figure 8, Table 1). Of these 162 stocks, 42 have fisheries with 100 per cent monitoring, while 120 have fisheries with varying target monitoring levels. The presence of at-sea or electronic monitoring was uncertain in 16.5 per cent of stocks (32 stocks). These results are identical to last year (Figure 8, Table 1): last year the uncertainty decreased from 2018 due to an increase in the number of stocks in, and availability of, IFMPs. Furthermore, in 2019, a recent review of catch monitoring tools in major Canadian fisheries was published that provided increased clarity on targeted at-sea coverage levels

[36] Atlantic herring in NAFO 4S, spring spawning Atlantic herring in NAFO 4T and fall spawning herring in NAFO 4T

(Beauchamp et al. 2019). This year, there was only one stock included in a new IFMP, likely contributing to this indicator remaining the same.

In 2020, the vast majority of index stocks require the use of logbooks (96.4 per cent; 187 of 194 stocks). However, the entire catch (targeted species and bycatch) is clearly indicated as being recorded for only 28.4 per cent of index stocks (55 of 194 stocks); 68.0 per cent (132 stocks) have fisheries where logbooks are used, but it was not clear from the materials searched whether the entire catch is recorded. There is uncertainty about the use of logbooks for 3.6 per cent of stocks (seven stocks). Again, these values changed little from last year, but overall, there is more certainty about general logbook use and details recorded since 2017 (Figure 8, Table 1). Again, this is likely due in large part to increasing transparency from the increasing availability of IFMPs.

In 2020, 87.6 per cent of index stocks (170 of 194 stocks) have fisheries that require some level of dockside monitoring of landings. Of these 170 stocks requiring dockside monitoring, 70.0 per cent (119 stocks) have fisheries that are required to have 100 per cent of landings verified by a certified independent dockside monitor. A further 30.0 per cent (51 stocks) have dockside monitoring requirements, but the level of monitoring is varied or unknown. The use of dockside monitoring in the fisheries of 12.4 per cent of stocks (24 stocks) is uncertain. Again, there has been little change since last year, but overall since 2017, there has been increased certainty in the general use of dockside monitoring, to whom it applies and the levels targeted (Figure 8, Table 1). Again, this is likely due in large part to increasing transparency from the increasing availability of IFMPs and the recent review of catch monitoring tools in major Canadian fisheries (Beauchamp et al. 2019).

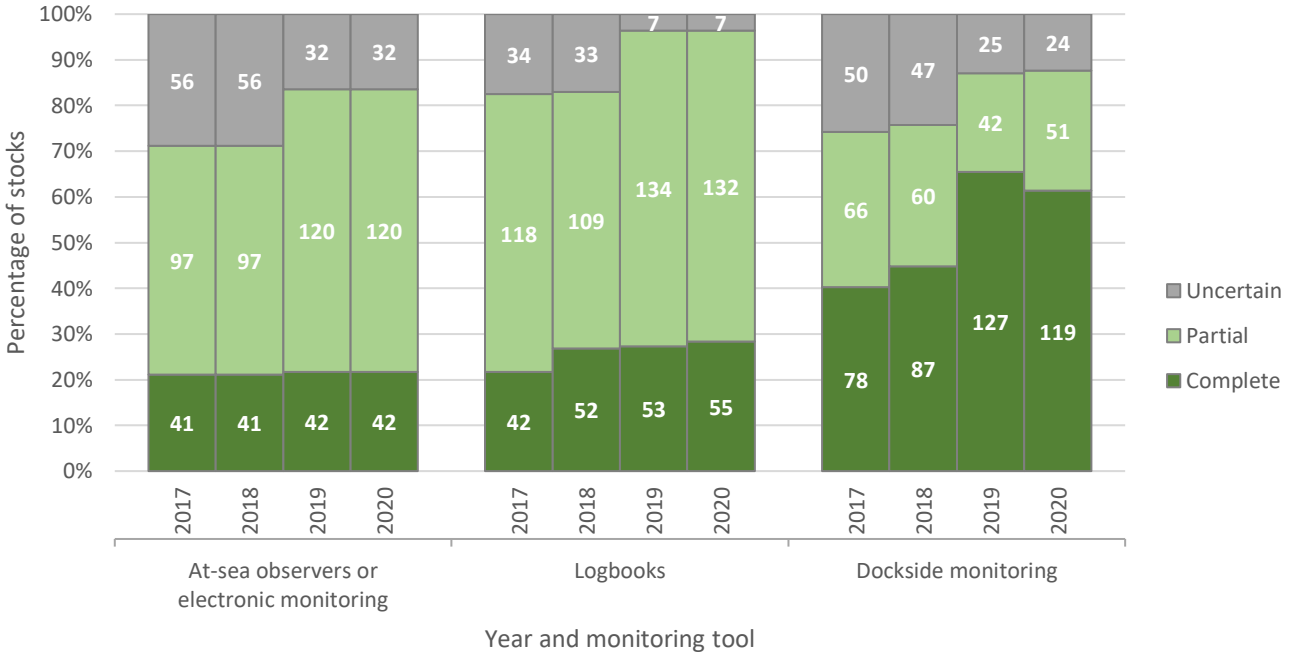

Figure 8. The percentage of stocks in Oceana Canada's index stock dataset (n = 194 stocks) in 2017, 2018, 2019 and 2020 that have the following catch monitoring tools in place: 1) at-sea observer or electronic (i.e., video) monitoring; 2) logbooks recording the entire catch (i.e., targeted species and bycatch); or 3) independent dockside monitoring. The number of stocks with each level of monitoring is indicated in white font within the bars. "Uncertain" level was assigned when there was no indication of the use of the monitoring tool in the documents and websites searched. "Partial" level was assigned when it was clearly indicated the monitoring tool was used but levels of tool use vary or are uncertain or, for logbooks, when it was unclear if

bycatch is recorded. "Complete" level was assigned when it was clearly indicated the monitoring tool is used on 100 per cent of fishing trips or, for logbooks, when both targeted and bycatch are recorded. It should be noted, 100 per cent coverage for at-sea observers or electronic monitoring is not necessary for all fisheries.

In 2020, 60.8 per cent of index stocks (118 of 194 stocks) have fisheries with at least some vessels requiring electronic location monitoring, all via a VMS (no fisheries are *required* to use AIS at this time). About one-quarter (23.7 per cent or 46 of 194 stocks) do not require any vessels to be electronically monitored, while the use of this tool is uncertain for 15.5 per cent of index stocks (30 of 194 stocks). Of the 118 stocks with some use of VMS, 72 stocks have fisheries where 100 per cent of vessels require electronic location monitoring at all times; 37 stocks have fisheries that use the tool for some but not all vessels; and nine stocks have fisheries that use the tool, but it is uncertain if it is used by all vessels or at all times. Although there was the same level of overall uncertainty about use of this monitoring tool as last year, there was some increased clarity in its intended coverage within fisheries where it was required (Table 1).

These results are based on publicly available information from scattered sources with varying levels of detail and, as such, likely do not reflect the full extent of catch monitoring in Canada. This is reflected in the high number of stocks in the partial-use categories. Often, more than one fishery catches a given stock, making assessments of catch monitoring on that stock challenging (i.e., due to different levels of at-sea observer coverage, varying by gear type and/or vessel size). DFO scientists recently reviewed catch monitoring tools used in major Canadian fisheries, which contributed to the large increase in clarity on tool use and targeted levels for most stocks and fishery sub-units in 2019 (Beauchamp et al. 2019). However, targeted coverage levels are often not achieved, and even when they are, levels can be inadequate to assess impacts to non-target species and sensitive habitats (Benoît et al. 2009, Gavaris et al. 2010, Clarke et al. 2015, CESD 2016). Furthermore, the CESD audit found that DFO did not provide a clear rationale for determining targeted levels of at-sea coverage and lacked systematic controls to ensure targets are met (CESD 2016).

DFO recently reviewed the catch monitoring programs of fisheries in Canada, acknowledging the current shortcomings, and in November 2019 finalized and released a national Fishery Monitoring Policy (originally intended to be released in 2017; CESD 2016) (DFO 2019b). As indicated by the department's own consultation materials, not having a national policy on catch reporting and fishery monitoring until now has led to: inconsistent monitoring and reporting requirements and no explanation for the differences; concerns about the adequacy and quality of data from fishery monitoring programs, which is needed to manage fisheries sustainably; and an absence of national goals with which to assess performance (DFO 2018b). Furthermore, a lack of a national policy precluded the consideration of cumulative impacts across fisheries on species or the ecosystem (Archibald and Rangeley 2019).

The new policy includes guidance on assessing risk of fisheries to sensitive habitats and species caught as bycatch, the risk of non-compliance with the rules, and assessing data quality and dependability. Together, these tools can be used to determine the fishery monitoring program dependability and inform a gap analysis for improvements that may be required. One requirement of the policy is for specific, measurable catch monitoring objectives to be included in IFMPs, with monitoring requirements required to achieve them outlined. This will be an improvement over the current situation, where it was found in 2020 that no stocks in the index dataset had specific and measurable catch monitoring objectives in their IFMP. It is expected this new indicator will increase in future years as the policy is implemented and DFO determines and ensures the appropriate type and frequency of catch monitoring in all our fisheries.

If implemented in a timely and rigorous way, the Fishery Monitoring Policy will provide the impetus for acquiring the right scientific information required for rebuilding under Canada's new *Fisheries Act*. But without a timely and dedicated investment to the implementation phase of the policy, the ability to achieve the goals

of the new regulations will be compromised. Rebuilding plans and regulations will only be as strong as the data used to inform their measures and estimate fishing mortality, which must include all sources. But DFO appears to have not yet developed work plans, allocated resources dedicated to implementing the policy or developed timelines for its implementation. This level of inaction raises serious questions about priorities and seems to indicate that the hard work developing policy and risk and data evaluation tools has been abandoned. The purpose of the Fishery Monitoring Policy is to create a standard within Canadian commercial fisheries where monitoring data is dependable, timely and accessible to better inform fisheries management, which will ultimately create less uncertainty in the fishery and for those who depend on it. With improved catch monitoring, fisheries managers will have the data required to effectively manage Canada's fisheries.

9. **Critical stocks with rebuilding plans:** In 2020, rebuilding plans are in place for 18.2 per cent of index stocks in the critical zone (six of 33 stocks).[37,38] There was no change in this indicator over the last year, although the stock composition within this zone has changed. Atlantic herring in NAFO 4XVW is now classified as critically depleted. While a rebuilding plan was developed in 2013 to rebuild the largest spawning component of this stock (southwest Nova Scotia/Bay of Fundy) from the cautious zone to the healthy zone, it likely requires updating given the stock has declined into the critical zone under this plan. It is expected that an ongoing Management Strategy Evaluation (DFO 2020e) will inform the development of an updated rebuilding plan for this stock.

   Meanwhile, the yelloweye rockfish outside population (of Vancouver Island) remains included in a rebuilding plan but is now classified as healthy in this audit analysis. In a recent DFO science advisory process evaluating potential rebuilding strategies for this stock, all operating model scenarios implied that the stock is currently above 0.4 B_{MSY} (i.e., LRP) coast-wide. This is despite the rapid decline of the spawning stock biomass by 49–71 per cent in the north, and by 57–79 per cent in the south over the past two generations (DFO 2020h). The science advisory report concluded that several potential management procedures (MPs) were identified that could increase or stabilize the stock biomass in both the north and south areas. However, it was not possible at the time to recommend a specific MP for each area without further guidance on fishery objectives and timelines from managers, First Nations rights-holders and fishery stakeholders. However, the report indicated an interim MP could be selected from the proposed MPs and implemented in the short term while that work is done. The rebuilding plan for the outside yelloweye rockfish was updated in 2020, indicating an increase in the mortality cap for the stock based on the updated science information, from 100 to 194 t in 2020/21. The rebuilding plan indicates further discussions with stakeholders and rights-holders are required to determine a target biomass, given that the current conservation objectives of growing the stock above the LRP have already been satisfied (DFO 2020i). But rebuilding is about more than just biomass and yield: it should also be about restoring a fully functioning stock (Oceana Canada 2019d). Without a complete recovery of population traits (e.g., age structure, sub-populations, age at maturity, geographical range), rebuilding might be incomplete and short-lived (Garcia et al. 2018). It is important that biomass targets be in the healthy zone and other non-biomass-related stock-specific objectives be developed and included in rebuilding plans. It is expected that the

[37] Two critical zone stocks do not have DFO PA-compliant rebuilding plan but do have an interim NAFO rebuilding strategy (Atlantic cod in NAFO 3NO, developed in 2011, and American plaice in NAFO 3LNO, developed in 2010). However, given these strategies are dated and that DFO has a policy requiring rebuilding plans for critically depleted stocks and has recently developed PA-complaint rebuilding plans for other transboundary stocks (e.g., Atlantic cod in NAFO 5Zjm and yellowtail flounder in NAFO 5Z), these are not counted as rebuilding plans here. There are also NAFO rebuilding strategies for one uncertain stock (Greenland halibut in NAFO 2-3KLMNO, developed in 2003) and one healthy stock (redfish species in NAFO 3LN, developed in 2013), and there is a rebuilding strategy developed by the International Commission for the Conservation of Atlantic Tunas for one uncertain stock (bluefin tuna in the western Atlantic, developed in 1998).

[38] One uncertain stock, yellowtail flounder on Georges Bank (NAFO 5Zjm), is also included in a rebuilding plan. This stock is indicated as being in the critical zone within the rebuilding plan, and the plan has the objective of rebuilding above the LRP. But there are no reference points in place for this stock (LRP or USR), leading to its classification as uncertain in this analysis, although it is acknowledged the stock is severely depleted.

yelloweye rockfish outside population rebuilding plan will be revised and include broader objectives in the future.

According to the PA framework, all stocks within the critical zone must have rebuilding plans, and DFO has committed to developing rebuilding plans for all major stocks in the critical zone (CESD 2016, DFO 2009). Annual fiscal year work plans indicated that two more stocks were supposed to be included in a rebuilding plan in the last year (DFO 2017, 2018a, 2019e): the delayed and urgently needed rebuilding plan for northern cod (Atlantic cod off the northeastern coast of Newfoundland and Labrador in NAFO 2J3KL) and the rebuilding plan for Atlantic mackerel on the Atlantic coast (NAFO sub-areas 2 and 3). The 2020/21 fiscal year work plan indicates the rebuilding plan for Atlantic mackerel was completed in the 2019/20 fiscal year (DFO 2020c), but it was not published on the DFO website by Oceana Canada's annual cut-off date (July 1st of each year) for data included in this analysis. This year's fiscal year work plan again shifted the expected completion date of the delayed rebuilding plan for the iconic northern cod stock from the end of fiscal 2018/19 to the end of fiscal 2020/21, noting that activities were not carried out as described but that rebuilding plan completion is expected this fiscal year (see Oceana Canada 2020a for further details).

The 2020/21 fiscal year work plan outlines progress towards the development of rebuilding plans for 24 stocks:[39] four of which are in the critical zone and are noted above as having completed and publicly available rebuilding plans;[40] two stocks for which the department indicates a rebuilding plan is no longer required;[41] and one stock of uncertain status that had a plan developed.[42] In the next year, one might expect that the delayed rebuilding plan for northern cod will finally be completed and published and the completed rebuilding plan for Atlantic mackerel on the Atlantic coast (NAFO areas 2 and 3) will be published. Of the 15 remaining stocks, three do not have expected completion dates, while the other 12 are expected to be completed by the end of March 2021. This is now less than one year away, and it takes time to develop rebuilding plans, especially those that meet international best practices (Oceana Canada 2019d).

Rebuilding plan development is not an insignificant task, and to meet international best practices, these plans must be developed in close consultation with the rights-holders and stakeholders. The draft rebuilding regulations indicate DFO intends to develop and implement rebuilding plans within 24 months after the Minister determines that a listed stock has declined to or below its LRP (DFO 2018b). This may be extended to 36 months if additional time is required to collect further scientific information, seek feedback from Indigenous peoples or discuss management measures for a shared stock with other jurisdictions. Thus, it is not surprising that most of the expected dates of completion for rebuilding plans for the original 19 stocks included in the first fiscal year work plan (2017/18) were later rather than earlier. But it has now been four years since the

[39] Including some stocks in the cautious zone and some with uncertain status, as well as marine mammal stocks and diadromous fish stocks
[40] Atlantic cod in NAFO 4X5Y, Atlantic cod in NAFO 5Zjm, northern shrimp in SFA 6 and the yelloweye rockfish outside population. Note that the DFO fiscal year work plan lumps both yelloweye rockfish populations together. However, here these are considered as two stocks. The yelloweye rockfish outside population was already included in a rebuilding plan at the time the first fiscal year work plan was released in 2017, while the inside population was added to the Pacific multispecies groundfish rebuilding plan on schedule and as indicated by the work plan in 2018 (and is now classified as healthy here). The other two critical zone stocks included in rebuilding plans were already included in plans prior to the fiscal year work plans (Bocaccio rockfish and Atlantic herring in NAFO 4VWZ). Therefore, although six critical zone stocks are included in rebuilding plans, only three were technically part of this commitment.
[41] At the meeting of the recently formed Redfish Advisory Group in early May 2018, DFO announced it will no longer be pursuing a rebuilding plan for redfish in units 1 and 2. Based on reference points and stock status developed in the recent Management Strategy Evaluation process, both species are now out of the critical zone in units 1 and 2 combined, so a plan is not required by policy. However, this growth is largely due to a few recent large cohorts (2011–2013), and Acadian redfish remain in the cautious zone. DFO and industry recognize they need to figure out the best means to determine the species split in the catches; identify ways to mitigate impacts on small redfish, bycatch and habitat; and include a harvest control rule to guide catch-level decisions. How this will be done is not clear, as currently there is no single fisheries management plan (rebuilding plan or IFMP) that covers both species in the entire stock area. Oceana Canada is advocating for a single management plan (rebuilding plan or IFMP) to be developed for this rebuilding fishery.
[42] The status of yellowtail flounder on Georges Bank (NAFO 5Z) is uncertain because reference points have not been defined, although it is acknowledged it is likely severely depleted.

initial work plan was created, and the lack of progress on several of the remaining rebuilding plans is concerning (see Oceana Canada 2020a for further details). Furthermore, the impacts of the COVID-19 pandemic are likely to be seen in next year's analysis.[43] When DFO published its 2020/21 fiscal year work plan, it indicated that the plan was developed prior to the pandemic and that the timing of certain deliverables will need to be adjusted. While good rebuilding plan development does take time, there is a trade-off between investing time to develop an effective plan and promptly responding to stock decline.

Recent investments to support stock assessments and the implementation of rebuilding provisions in a renewed *Fisheries Act*, which were slated to start in fiscal 2019/20,[44] should help (POFO 2019). Meeting rebuilding plan commitments as soon as possible and getting rebuilding plan development on track must be a government priority if it is serious about investing in rebuilding abundance in Canadian fisheries. But inclusion in a plan is not enough. It is important that the plans developed when meeting these commitments are consistent with internationally recognized best practices and include elements that ensure depleted populations are given the best chance to recover to a healthy level of abundance (see Oceana Canada 2019d for an assessment of the quality of existing rebuilding plans and recommendations for the future). Environmental conditions will pose challenges to the recovery of some stocks. To promote the best chances of recovery, rebuilding plans will need to be developed, and these plans must consider climate change and the cumulative impact of all human activities on marine ecosystems.

Conclusions and recommendations

The state of Canada's marine fish and invertebrate stocks remains concerning. These results reveal that things have not changed for the better over the last four years, with fewer healthy stocks and a startling increase in the number of cautious and critically depleted stocks. Most of the critically depleted stocks are groundfish and flatfish located in the Atlantic Ocean. Many of these stocks have not recovered since the groundfish collapse in the mid-1990s, due in part to formerly high harvest levels combined with unfavourable environmental conditions (ECCC 2020). But the composition of critically depleted stocks has changed over the last four years, with an increasing number of invertebrate stocks now in the critical zone. There are also now more critically depleted forage fish stocks in the Atlantic Ocean than ever before, and there are no longer any healthy forage fish stocks in the Pacific Ocean. Still, there have been some improvements with other taxa, like rockfish and redfish, where favourable environmental conditions have likely facilitated large recruitment events in some stocks.

Climate change is expected to result in "winners" and "losers" with respect to access to future fisheries, and there are concerns in all of our oceans about shifting species distributions and changing communities driven by climate change (DFO 2019a, 2020a; Lam et al. 2016; Talloni-Álvarez et al. 2019; Willson et al. 2020). Combined with other human activities like fishing, coastal development and resource exploitation, the impacts of climate change make the future health of our oceans highly uncertain. Together with the declining trends of stock status noted above, the uncertainty associated with climate change means it has never been more urgent for Canada to accelerate the implementation of long-standing and critical policies designed to provide the best opportunity of maintaining and restoring the health of Canada's fisheries and oceans. Although there has been continued progress made with some policy implementation over the last four years covered by the Fishery Audit, progress is insufficient to address the changes required in a reasonable timeframe. At the current rate of progress,[45] it will take 10 more years until all index stocks have an LRP, 25 more years until all have a USR and 37 more years until all critically depleted index stocks are included in a rebuilding plan.

[43] Although the pandemic may have impacted the indicators in this assessment, with the information cut-off of July 1st, it is difficult to attribute the decline in progress towards completion of deliverables in the 2019/20 fiscal year work plan (see Oceana Canada 2020a) to the pandemic given its impact began to be felt strongly in Canada in mid-March, two weeks before the end of the fiscal year (CBC 2020).
[44] In the 2018 fall economic statement, the Government of Canada announced an investment of $107.4 million over five years starting in 2019/20 and $17.6 million per year ongoing to support the implementation of stock assessment and rebuilding provisions in a renewed *Fisheries Act*.
[45] Based on the average annual increase in the percentage of index stocks with each indicator over the last four years

To enable acceleration of the implementation of these important tools, DFO needs to continue to invest resources in fisheries science. Scientists provide the evidence and advice required to implement most of the policy framework. However, the percentage of stocks with recent stock assessments is not increasing as expected, the percentage of stocks with fishing mortality estimates is stagnant at a low level, and the track record on keeping the public informed on the scientific basis of decisions is poor (Oceana Canada 2018c, 2019c, 2020b). Furthermore, the percentage of stocks with uncertain status is not decreasing as expected.

Improvements to these indicators will also require better data collection. Good data provides the foundation for good management. When armed with accurate estimates of how much of each species is caught and discarded, fisheries scientists can provide fishing mortality estimates that include all sources of fishing mortality and managers will have the key information required for rigorous fisheries management and decision making. That is why Oceana Canada is calling for the timely implementation of the national Fishery Monitoring Policy, while emphasizing that the precautionary approach means caution should be taken when scientific knowledge is uncertain and that the absence of rigorous information is not a reason to delay taking conservative measures. DFO needs to implement the Fishery Monitoring Policy and provide enough funds to ensure it happens in all fisheries as quickly as possible. Without improved quality of data, the intentions of the new *Fisheries Act* and rebuilding regulations are compromised.

The new *Fisheries Act* is now law, and the government has committed $100 million to assess and rebuild fish stocks. This provides a rare opportunity for ambitious progress to create change on the water, to reverse declines and increase the number of stocks in the healthy zone and to build resilience to climate change. In the year ahead, Oceana Canada recommends DFO's top priorities should be:

- Complete regulations to bring into force the new provisions in the *Fisheries Act*, including identifying major stocks and requiring targets and timelines for completed rebuilding plans;
- Address inconsistencies in catch monitoring by implementing the national Fishery Monitoring Policy introduced in November 2019; and
- Develop and implement high-quality rebuilding plans that include targets and timelines for stocks identified in the 2020/21 work plans.

In the interim, at minimum it is expected that DFO will continue to add to, update and publicly release the fiscal year work plans — now the SFF Work Plan — developed in response to the Commissioner of the Environment and Sustainable Development's (CESD) audit (DFO 2017, 2018a, 2019e, 2020c), using the best available science to inform completion of deliverables. To accelerate the implementation of DFO's policy framework, Oceana Canada recommends and expects the following to be completed by DFO within the next year:

Science

- Invest resources in timely stock assessments that include estimates of mortality from all sources, prioritizing stocks that do not have assessments or that have assessments more than five years old.
- Continue to address the causes of delays in publishing science information and improve publication timeliness.
- Continue to prioritize establishing reference points to define health status zones and develop harvest control rules (HCRs) for each zone. Specifically, fulfill ongoing commitments ongoing or those that have been delayed from previous work plans, as well as those scheduled to be completed this fiscal year:

- Develop LRPs for eight more stock groups,[46] ensuring at least nine more index stocks[47] have new or updated LRPs next year, increasing the percentage of index stocks with LRPs to 67.0 per cent.
- Develop USRs for three more stock groups,[48] ensuring at least six more index stocks[49] have a new or updated USR next year, increasing the percentage of index stocks with USRs to 49.0 per cent.
- Develop HCRs for two more stock groups,[50] ensuring at least two more index stocks[51] have new or updated HCRs next year.

Monitoring

- Begin implementation of the Fishery Monitoring Policy to ensure all commercial fisheries have sufficient monitoring to provide accurate estimates of all retained and discarded catches.
  - Include a published work plan with timelines to guide implementation of the policy.

Management

- Continue to prioritize completing and publishing management plans. Specifically, fulfill ongoing commitments or those that have been delayed from previous work plans, as well as those scheduled to be completed this fiscal year:
  - Develop and publish IFMPs for 19 stock groups,[52] ensuring at least 23 more index stocks[53] are included in a publicly available IFMP next year, increasing the percentage of index stocks with new or updated IFMPs to 93.3 per cent.
  - Develop and *publish* rebuilding plans for 14 more stocks:
    1. Atlantic mackerel – Atlantic coast (NAFO subareas 3 and 4)
    2. Atlantic cod – northern cod (NAFO 2J3KL)
    3. Atlantic cod – southern Gulf of St. Lawrence (NAFO 4TVn)
    4. Atlantic herring – southern Gulf of St. Lawrence spring spawners (NAFO 4T)
    5. American plaice – southern Gulf of St. Lawrence (NAFO 4T)
    6. White hake – southern Gulf of St. Lawrence (NAFO 4T)
    7. Winter flounder – southern Gulf of St. Lawrence (NAFO 4T)
    8. Iceland scallop – in Scallop Fishing Area (SFA) 16ef and 18a
    9. Beluga whale - Nunavik
    10. Chinook salmon – west coast Vancouver Island
    11. Pacific herring - Haida Gwaii
    12. Atlantic cod – NAFO 3Ps
    13. Witch flounder – NAFO 2J+3KL
    14. Atlantic cod – northern Gulf of St. Lawrence (NAFO 4RS3PN)
- Set priorities and timelines for completing rebuilding plans for *all* stocks in the critical zone and those in the cautious zone that are declining towards, or have declined, to half of their USR.

[46] Stock groups noted in the 2020/21 work plan for completion (i.e., "will complete") of LRP development, updating or revision by the end of the fiscal year, plus any outstanding LRP commitments from previous work plans. Note this tally is based off Table 2 in Oceana Canada (2020a) and may include diadromous fish, freshwater fish and marine mammals.
[47] Marine fish and invertebrate stocks included in Ocean Canada's Fishery Audit index dataset
[48] Stock groups noted in the 2020/21 work plan for completion (i.e., "will complete") of USR development, updating or revision by the end of the fiscal year, plus any outstanding USR commitments from previous work plans. Note this tally is based off Table 3 in Oceana Canada (2020a) and may include diadromous fish, freshwater fish and marine mammals.
[49] Marine fish and invertebrate stocks included in Oceana Canada's Fishery Audit index dataset
[50] Stock groups noted in the 2020/21 work plan for completion (i.e., "will complete") of HCR development, updating or revision by the end of the fiscal year, plus any outstanding HCR commitments from previous work plans. Note this tally is based off Table 4 in Oceana Canada (2020a) and may include diadromous fish, freshwater fish and marine mammals.
[51] Marine fish and invertebrate stocks included in Oceana Canada's Fishery Audit index dataset
[52] Stock groups noted in the 2020/21 work plan for completion (i.e., "will complete") of IFMP development, updating or revision *and* posting (i.e., "will post") by the end of the fiscal year, plus any outstanding IFMP commitments from previous work plans. Note this tally is based off Table 6 in Oceana Canada (2020b) and may include diadromous fish, freshwater fish and marine mammals.
[53] Marine fish and invertebrate stocks included in Oceana Canada's Fishery Audit index dataset

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Tables

Table 1. The percentage and number of marine fish and invertebrate[54] stocks for each indicator in the 2017, 2018, 2019 and 2020 index stock datasets (n = 194 stocks; the same stocks in each year).

Indicator	Details	2017	2018	2019	2020
	Number of stocks	194	194	194	194
1. Status	%/# of "healthy" stocks	34.5% / 67	34.0% / 66	29.4% / 57	26.8% / 52
	%/# of "cautious" stocks	16.0% / 31	15.5% / 30	15.5% / 30	19.1% / 37
	%/# of "critical" stocks	13.4% / 26	13.4% / 26	17.0% / 33	17.0% / 33
	%/# of "uncertain" stocks	36.1% / 70	37.1% / 72	38.1% / 74	37.1% / 72
2. Stocks going from uncertain to certain status (or vice versa) in the past year	# of stocks that went from uncertain status to known status	Baseline year	4	6	6
	# of stocks that went from known status to uncertain status	Baseline year	6	8	4
3. Change in status from previous year	%/# of stocks that have changed status	Baseline year	10.8% / 21†	13.4% / 26†	12.4% / 24†
	# of stocks whose status improved	Baseline year	5	2	5
	# of stocks whose status worsened	Baseline year	6	10	9
	%/# of stocks whose status remained the same	Baseline year	89.2% / 173	86.6% / 168	87.6% / 170
4. Biomass/abundance known	%/# of stocks with recent (≤ 5 years) biomass/abundance estimates	64.9% / 126	63.9% / 124	58.8% / 114	58.8% / 114
	%/# of stocks without recent assessments that have had interim updates of indicators since last complete assessment	Not available — new indicator	Not available — new indicator	18.8% / 15	26.3% / 21

[54] Excluding marine mammals, diadromous fish and freshwater fish

Indicator	Details	2017	2018	2019	2020
5. Sources of mortality known*	%/# of stocks with fishing mortality (F) known	20.6% / 40	18.0% / 35	19.1% / 37	20.6% / 40
	# of stocks that clearly incorporate all sources of F in its estimation	Not available — new indicator	Not available — new indicator	2	2
	%/# of stocks with natural mortality (M) known	Not available — new indicator	13.9% / 27	15.5% / 30	19.1% / 37
	%/# of stocks with total mortality (Z) known	Not available — new indicator	6.7% / 13	8.8% / 17	11.3% / 22
	%/# of stocks with exploitation rate known	Not available — new indicator	Not available — new indicator	39.2% / 76	42.8% / 83
	%/# of stocks with landings known	Not available — new indicator	Not available — new indicator	97.9% / 190	97.4% / 189
6. Reference points	%/# of stocks with limit reference points	53.1% / 103	58.8% / 114	64.4% / 125	63.9% / 124
	%/# of stocks with upper stock reference points	42.3% / 82	45.4% / 88	47.4% / 92	48.5% / 94
7. Management plans in place	%/# of stocks in an Integrated Fisheries Management Plan	71.1% / 138	74.7% / 145	90.2% / 175	90.7% / 176
8. Catch monitoring	%/# of stocks with at-sea/electronic monitoring	Yes — 100% 21.1% / 41	Yes — 100% 21.1% / 41	Yes — 100% 21.6% / 42	Yes — 100% 21.6% / 42
		Yes — coverage varies or level is uncertain 50.0% / 97	Yes — coverage varies or level is uncertain 50.0% / 97	Yes — coverage varies or level is uncertain 61.9% / 120	Yes — coverage varies or level is uncertain 61.9% / 120
		Uncertain 28.9% / 56	Uncertain 28.9% / 56	Uncertain 16.5% / 32	Uncertain 16.5% / 32
	%/# of stocks with logbooks	Yes — and records bycatch species 21.6% / 42	Yes — and records bycatch species 26.8% / 52	Yes — and records bycatch species 27.3% / 53	Yes — and records bycatch species 28.4% / 55

Indicator	Details	2017	2018	2019	2020
		Yes — but unclear if records bycatch species 60.8% / 118	Yes — but unclear if records bycatch species 56.2% / 109	Yes — but unclear if records bycatch species 69.1% / 134	Yes — but unclear if records bycatch species 68.0% / 132
		Uncertain 17.5% / 34	Uncertain 17.0% / 33	Uncertain 3.6% / 7	Uncertain 3.6% / 7
	%/# of stocks with dockside monitoring	Yes — 100% 40.2% / 78	Yes — 100% 44.8% / 87	Yes — 100% 65.5% / 127	Yes — 100% 61.3% / 119
		Yes — coverage varies or level is uncertain 34.0% / 66	Yes — coverage varies or level is uncertain 30.9% / 60	Yes — coverage varies or level is uncertain 21.6% / 42	Yes — coverage varies or level is uncertain 26.3% / 51
		Uncertain 25.8% / 50	Uncertain 24.2% / 47	Uncertain 12.9% / 25	Uncertain 12.4% / 24
	%/# of stocks with electronic vessel monitoring systems (VMS)/automated identification systems (AIS)	Not available — new indicator	Not available — new indicator	Yes — 100% of vessels always 36.1% / 70	Yes — 100% of vessels always 37.1% / 72
		Not available — new indicator	Not available — new indicator	Yes — some vessels but not all vessels 15.5% / 30	Yes — some vessels but not all vessels 19.1% / 37
		Not available — new indicator	Not available — new indicator	Yes — but uncertain if all vessels or all times 7.7% / 15	Yes — but uncertain if all vessels or all times 4.6% / 9
		Not available — new indicator	Not available — new indicator	Uncertain 16.5% / 31	Uncertain 15.5% / 30
		Not available — new indicator	Not available — new indicator	No 24.2% / 47	No 23.7% / 46
	%/# of stocks with specific catch monitoring objectives in their IFMP	Not available — new indicator	Not available — new indicator	0.0% / 0	0.0% / 0

Indicator	Details	2017	2018	2019	2020
9. Critical stocks with rebuilding plans	%/# of critical zone stocks with rebuilding plans	11.5% / 3	11.5% / 3	18.2% / 6	18.2% / 6

† This value includes those that changed status to or from uncertain.
** Sometimes it is not possible to estimate mortality with available data or models.*

Table 2. The percentage and number of marine fish and invertebrate stocks[55] for each indicator in 2018 (n = 215 stocks), 2019 (n = 223 stocks) and 2020 (n = 227 stocks) using all stocks in the dataset, including those added during the updates in addition to the index stock dataset (i.e., 2017 dataset stock list; indicator values found above in Table 1).

Indicator	Details	2018	2019	2020
	Number of stocks	215	223	227
1. Status	%/# of "healthy" stocks	31.6% / 68	27.4% / 61	25.1% / 57
	%/# of "cautious" stocks	14.4% / 31	14.3% / 32	17.2% / 39
	%/# of "critical" stocks	13.0% / 28	16.1% / 36	15.9% / 36
	%/# of "uncertain" stocks	40.9 % / 88	42.2 % / 94	41.9% / 95
2. Stocks going from uncertain to certain status (or vice versa) in the past year	# of stocks that went from uncertain status to known status†	4	7	6
	# of stocks that went from known status to uncertain status†	6	8	4
3. Change in status from previous year	%/# of stocks that have changed status†	10.8% / 21††	13.9% / 27††	12.4% / 24††
	# of stocks whose status improved †	5	2	5
	# of stocks whose status worsened †	6	10	9
	%/# of stocks whose status remained the same†	89.2% / 173	86.6% / 168	87.6% / 170
4. Biomass/abundance known	%/# of stocks with recent (≤ 5 years) biomass/abundance estimates	64.2% / 138	60.1% / 134	59.9% / 136
	%/# of stocks without recent assessments that have had interim updates of indicators since last complete assessment	Not available — new indicator	16.9% / 15	23.1% / 21

[55] Excluding marine mammals, diadromous fish and freshwater fish

Indicator	Details	2018	2019	2020
5. Sources of mortality known*	%/# of stocks with fishing mortality (F) known	16.7 % / 36	17.9 % / 40	18.9% / 43
	# of stocks that clearly incorporate all sources of F in its estimation	Not available — new indicator	2	2
	%/# of stocks with natural mortality (M) known	13.5% / 29	16.1% / 36	18.9% / 43
	%/# of stocks with total mortality (Z) known	6.0% / 13	8.1% / 18	10.6% / 24
	%/# of stocks with exploitation rate known	Not available — new indicator	39.5% / 88	42.7% / 97
	%/# of stocks with landings known	Not available — new indicator	96.4% / 215	96.9% / 220
6. Reference points	%/# of stocks with limit reference points	56.3% / 121	61.0% / 136	59.9% / 136
	%/# of stocks with upper stock reference points	42.3% / 91	43.9% / 98	44.5% / 101
7. Management plans in place	%/# of stocks in an Integrated Fisheries Management Plan	71.6% / 154	88.3% / 197	88.5% / 201
8. Catch monitoring	%/# of stocks with at-sea/electronic monitoring	Yes — 100% 20.9% / 45	Yes — 100% 22.0% / 49	Yes — 100% 22.0% / 50
		Yes — coverage varies or level is uncertain 48.8% / 105	Yes — coverage varies or level is uncertain 59.6% / 133	Yes — coverage varies or level is uncertain 59.5% / 135
		Uncertain 30.2% / 65	Uncertain 18.4% / 41	Uncertain 18.5% / 42
	%/# of stocks with logbooks	Yes — and records bycatch species 26.0% / 56	Yes — and records bycatch species 27.8% / 62	Yes — and records bycatch species 29.5% / 67

Indicator	Details	2018	2019	2020
		Yes — but unclear if records bycatch species 56.3% / 121	Yes — but unclear if records bycatch species 68.2% / 152	Yes — but unclear if records bycatch species 66.5% / 151
		Uncertain 17.7% / 38	Uncertain 4.0% / 9	Uncertain 4.0% / 9
	%/# of stocks with dockside monitoring	Yes — 100% 44.7% / 96	Yes — 100% 62.8% / 140	Yes — 100% 59.0% / 134
		Yes — coverage varies or level is uncertain 28.4% / 61	Yes — coverage varies or level is uncertain 22.9% / 51	Yes — coverage varies or level is uncertain 26.9% / 61
		Uncertain 27.0% / 58	Uncertain 14.3% / 32	Uncertain 14.1% / 32
	%/# of stocks with electronic vessel monitoring systems (VMS)/automated identification systems (AIS)	Not available — new indicator	Yes — 100% of vessels always 33.6% / 75	Yes — 100% of vessels always 34.8% / 79
		Not available — new indicator	Yes — some vessels but not all vessels 17.5% / 39	Yes — some vessels but not all vessels 20.3% / 46
		Not available — new indicator	Yes — but uncertain if all vessels or all times 8.1% / 18	Yes — but uncertain if all vessels or all times 5.7% / 13
		Not available — new indicator	Uncertain 18.8% / 42	Uncertain 18.1% / 41
		Not available — new indicator	No 22.0% / 49	No 21.1% / 48
	%/# of stocks with specific catch monitoring objectives in their IFMP	Not available — new indicator	0.0% / 0	0.0% / 0

Indicator	Details	2018	2019	2020
9. Critical stocks with rebuilding plans	%/# of critical zone stocks with rebuilding plans	10.7% / 3	16.7 % / 6	16.7% / 6

† Some stocks included in the 2018, 2019 and 2020 "all stocks" dataset were added during the update process and thus were not part of the original 2017 dataset. In order to calculate change from the previous year, Oceana Canada compared only the "index stocks" — those that formed the original 2017 dataset.
†† This value includes those that changed status to or from uncertain.
** Sometimes it is not possible to estimate mortality with available data or models.*

Appendix 1: Figures of select indicators by Fisheries and Oceans Canada (DFO) administrative regions

In addition to the National Capital Region based in Ottawa, DFO currently has six administrative regions across the country,[56,57] each responsible for the management of fisheries and oceans within their jurisdiction (Figure 1):

1. Newfoundland and Labrador
2. Maritimes – Scotia-Fundy (hereafter Maritimes)
3. Gulf
4. Quebec
5. Central and Arctic
6. Pacific

[56] Source: DFO (2020). Regions. Fisheries and Oceans Canada. http://www.dfo-mpo.gc.ca/regions/index-eng.htm
[57] Note that in 2018 DFO announced the creation of a stand-alone Arctic Region inclusive of the four regions of Inuit Nunangat for the Department of Fisheries and Oceans (DFO) and the Canadian Coast Guard., but the new stand-alone region is not yet found in any materials used to update this dataset. Source: DFO (2018). Fisheries and Oceans Canada, the Canadian Coast Guard and Inuit Tapiriit Kanatami announce new Arctic Region. https://www.canada.ca/en/fisheries-oceans/news/2018/10/fisheries-and-oceans-canada-the-canadian-coast-guard-and-inuit-tapiriit-kanatami-announce-new-arctic-region.html

Figure 1. Map of DFO administrative regions. Modified from: http://www.dfo-mpo.gc.ca/regions/index-eng.htm

The following pages provide visualizations of the Fishery Audit index dataset (n = 194 stocks) by taxa group within each DFO region (Figure 2) and select indicator values summarized by region in each year available (Figures 3 to 16).

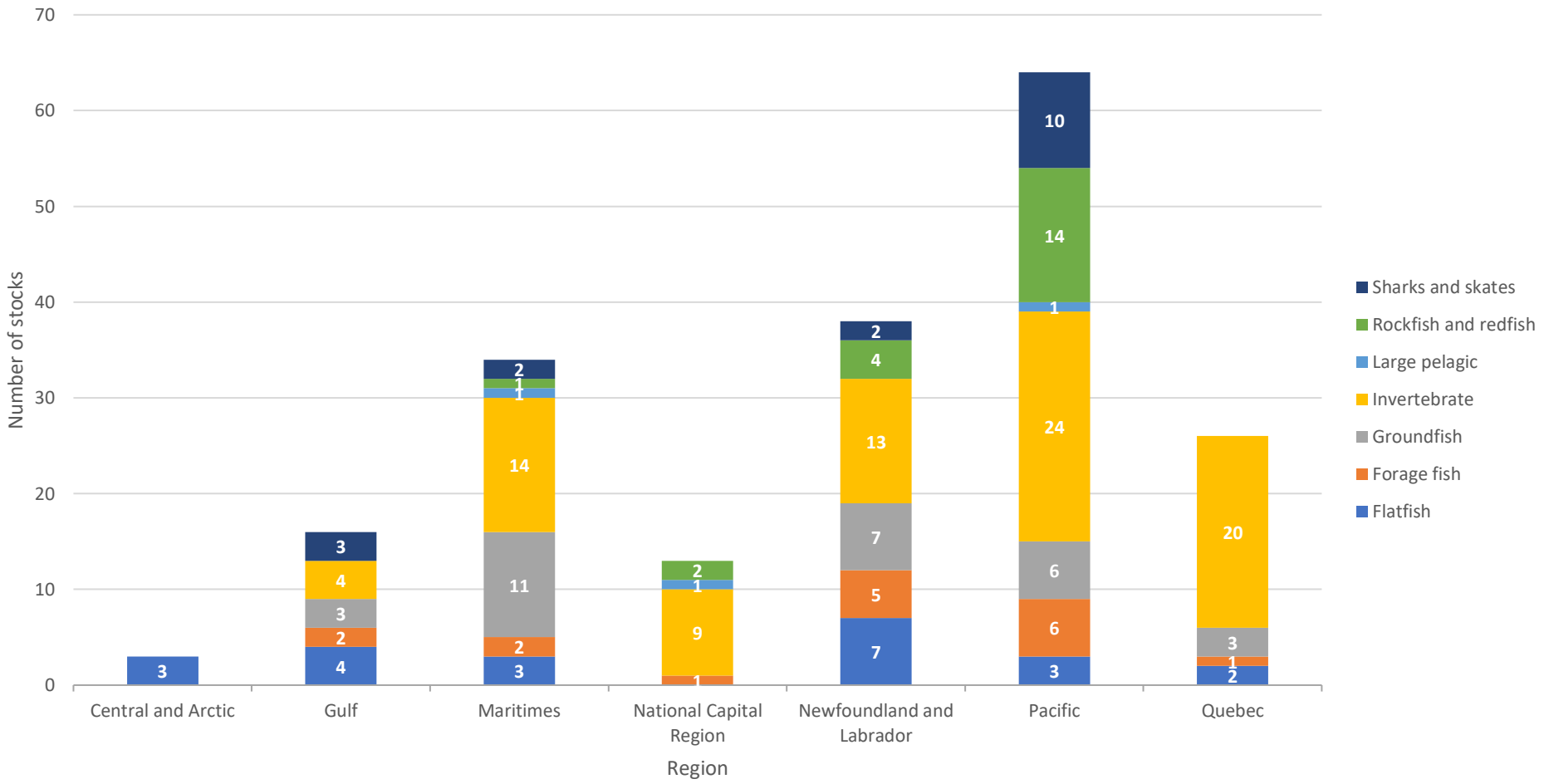

Figure 2. The number of Oceana Canada index stocks (n = 194 stocks) within each DFO administrative region and taxa group. The number of stocks in each region-taxa combination is reported in white font within the bars.

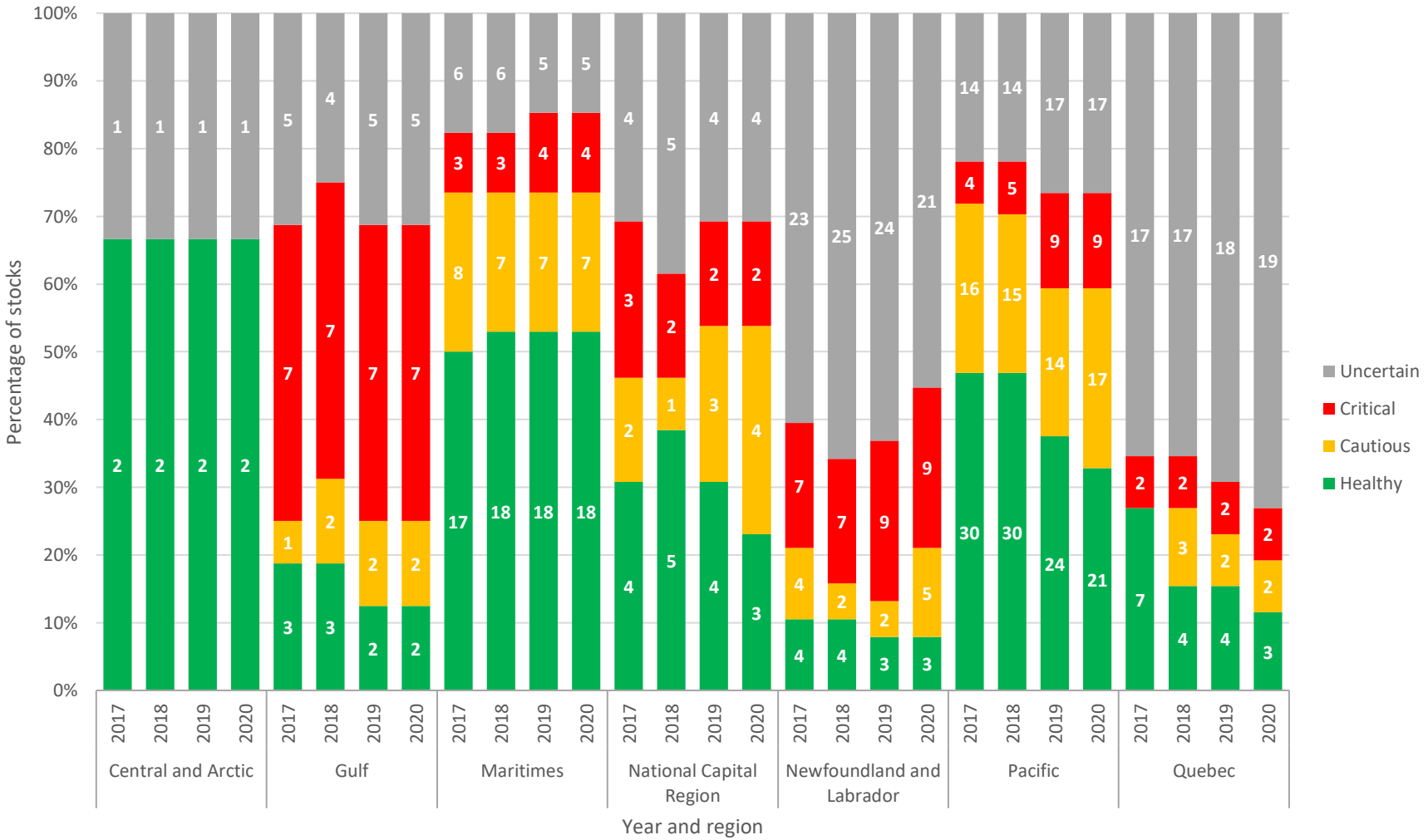

Figure 3. The percentage of Oceana Canada index stocks (n = 194 stocks) in each of DFO's precautionary approach (PA) framework health status zones in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-status combination is reported in white font within the bars.

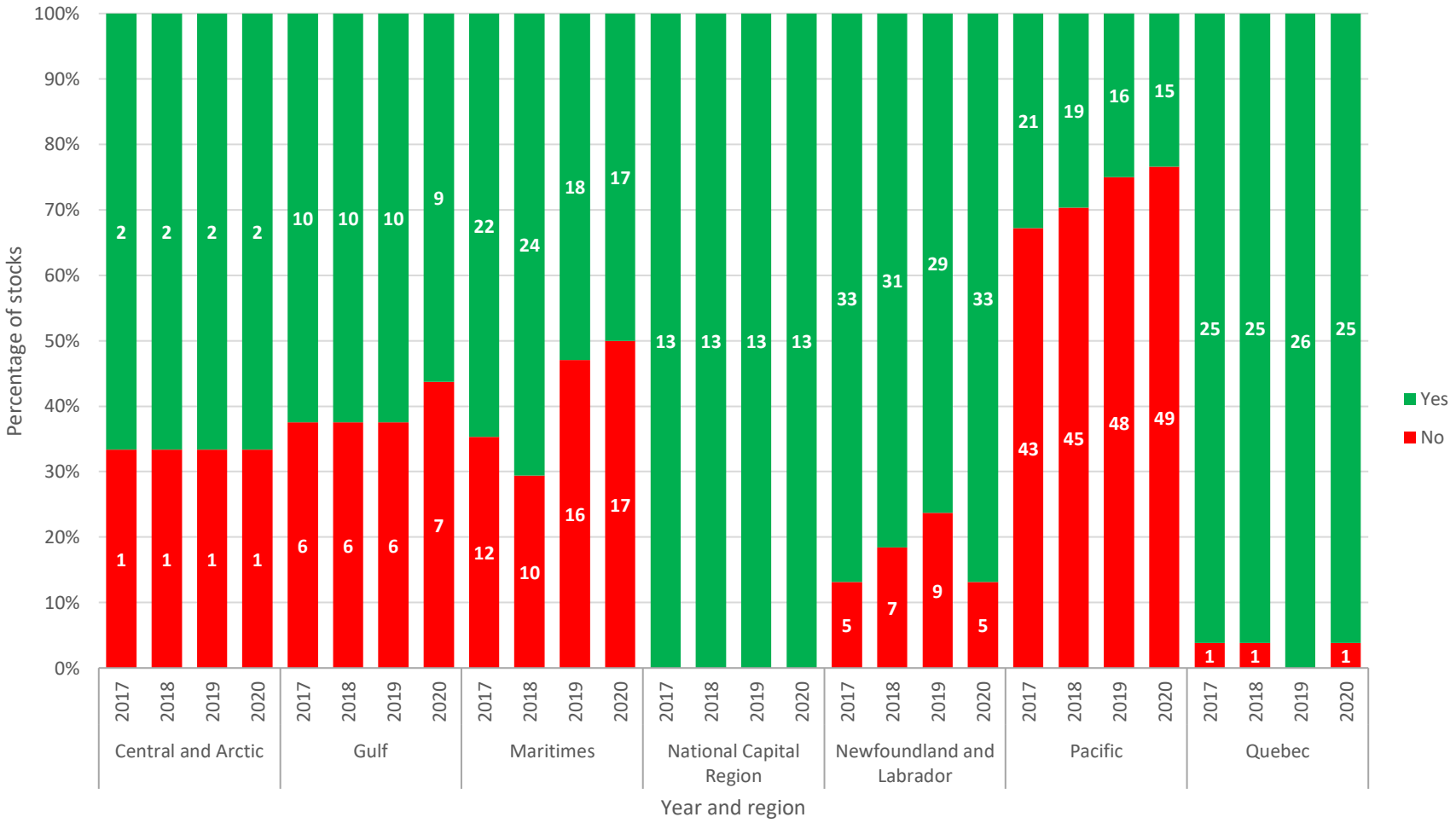

Figure 4. The percentage of Oceana Canada index stocks (n = 194 stocks) with recent (≤ 5 years old) biomass or abundance estimates in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.

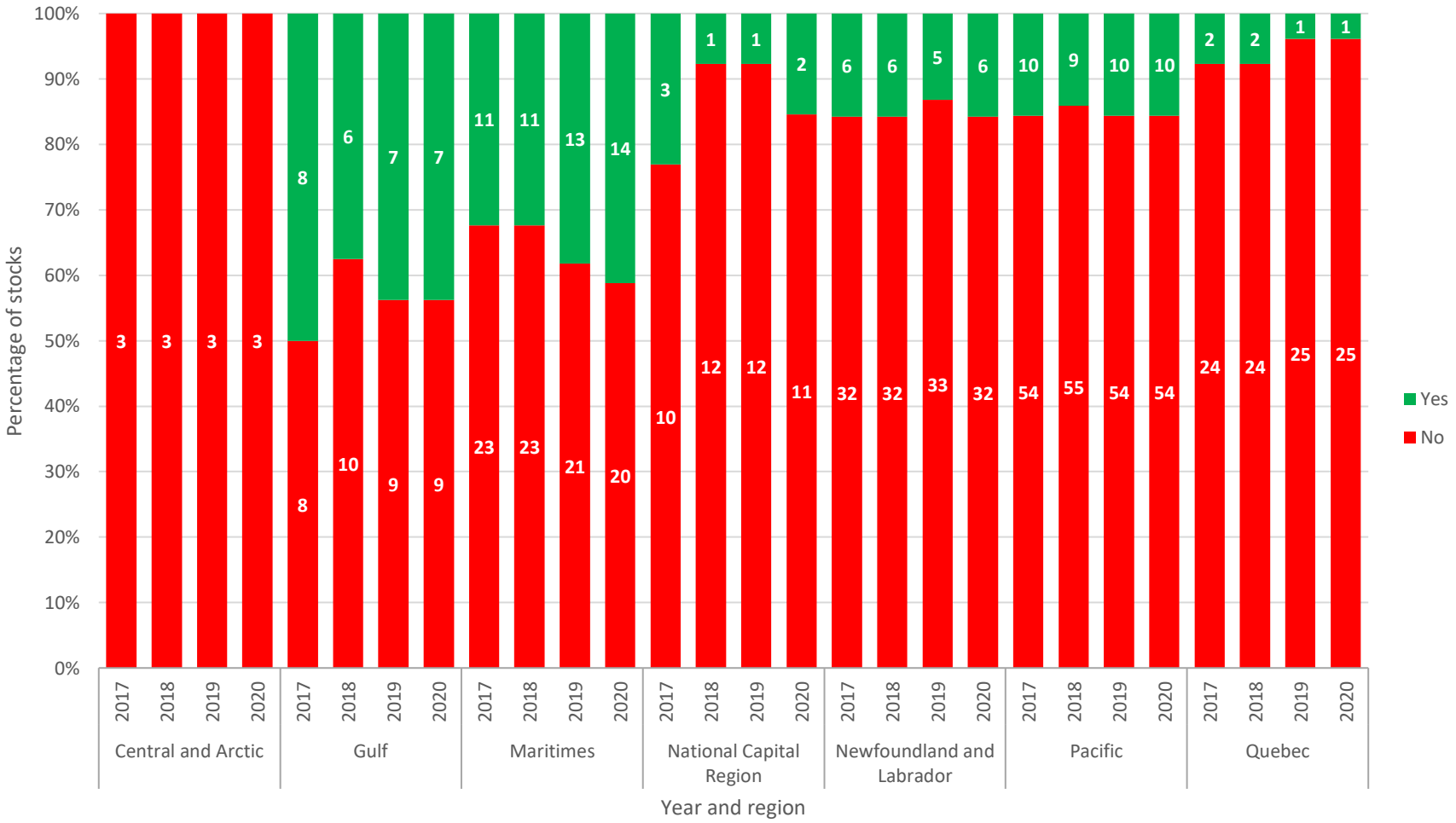

Figure 5. The percentage of Oceana Canada index stocks (n = 194 stocks) with fishing mortality (F) estimates in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.

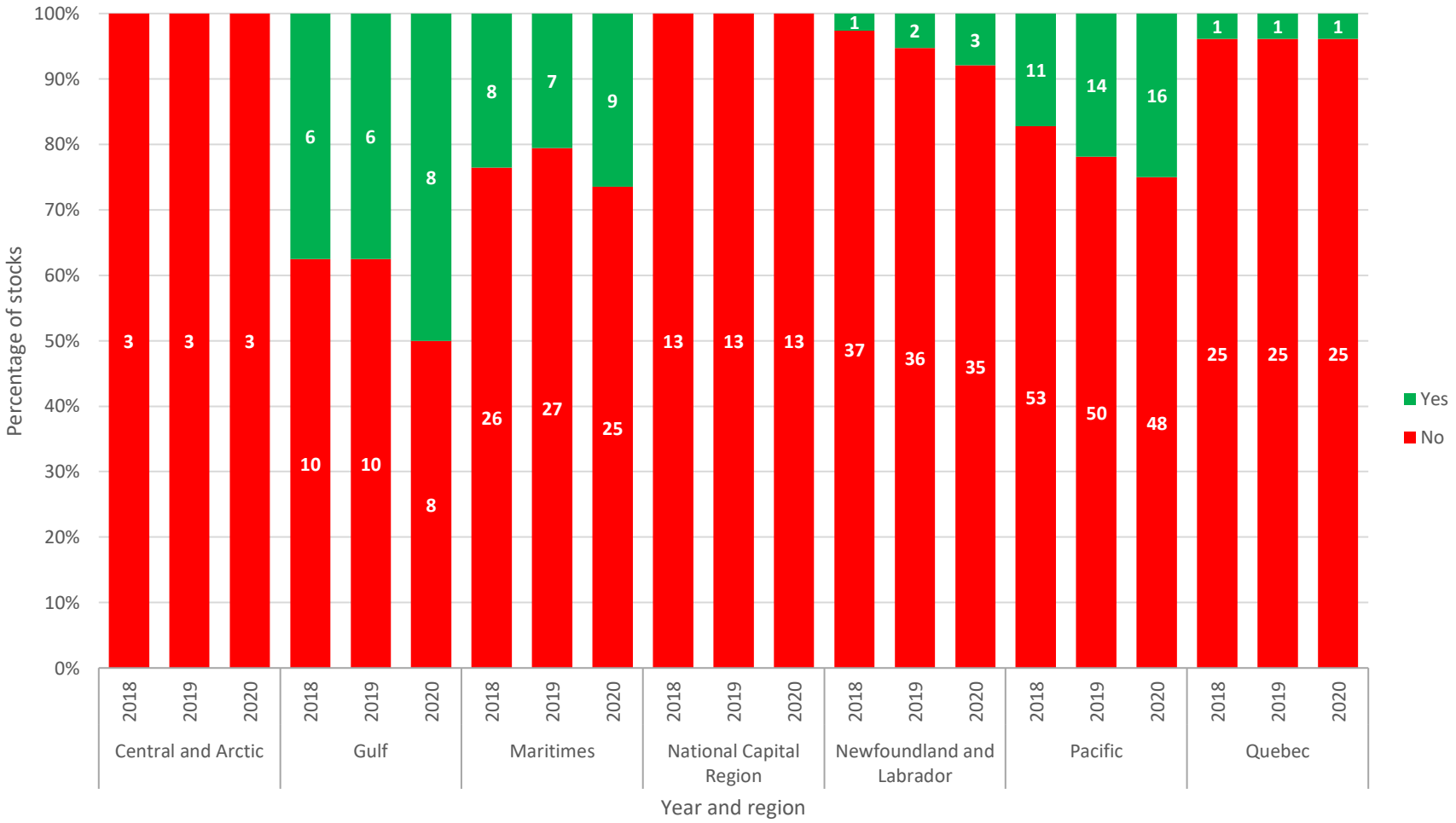

Figure 6. The percentage of Oceana Canada index stocks (n = 194 stocks) with natural mortality (M) estimates in each DFO administrative region in 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.

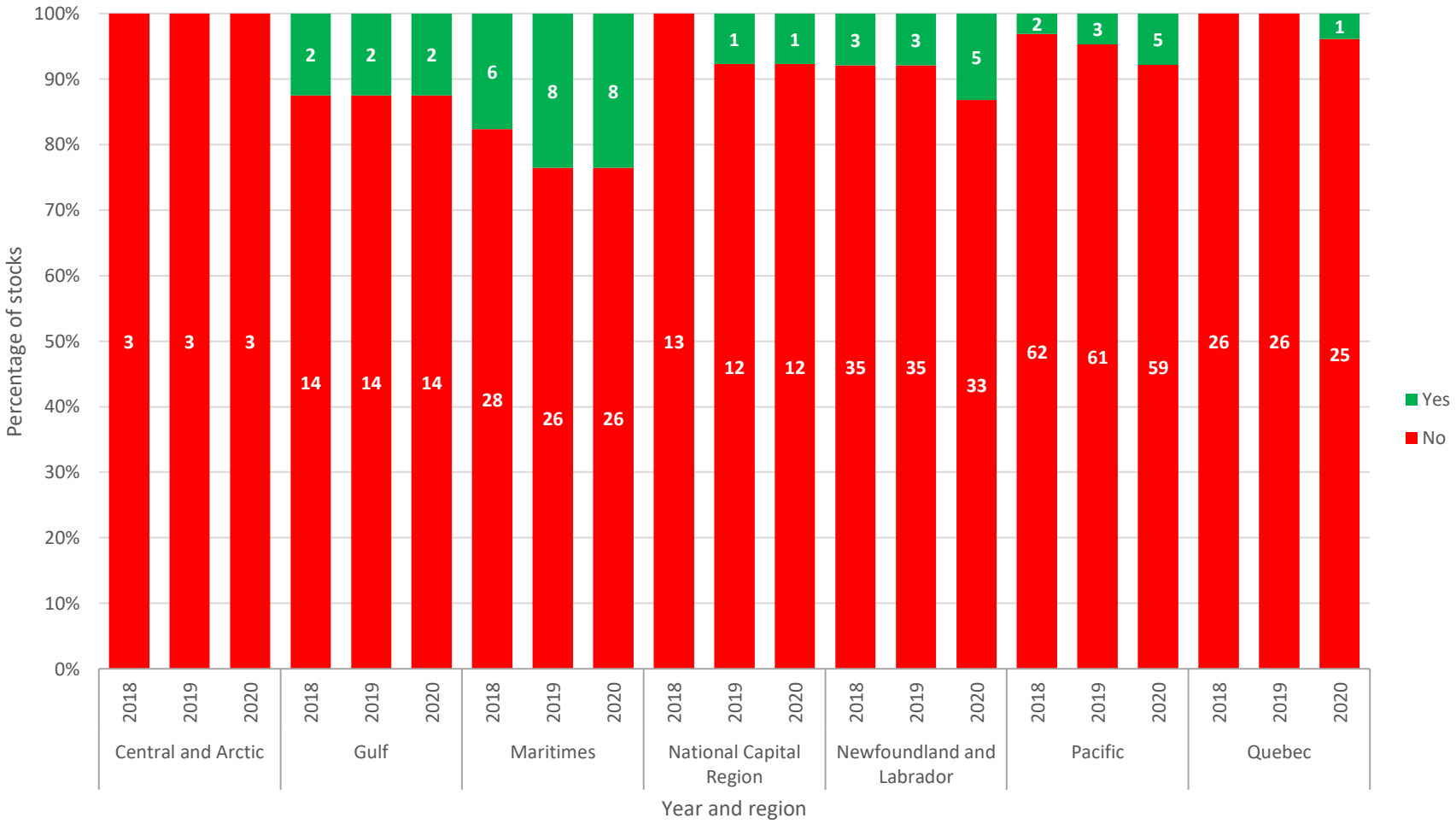

Figure 7. The percentage of Oceana Canada index stocks (n = 194 stocks) with total mortality (Z) estimates in each DFO administrative region in 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.

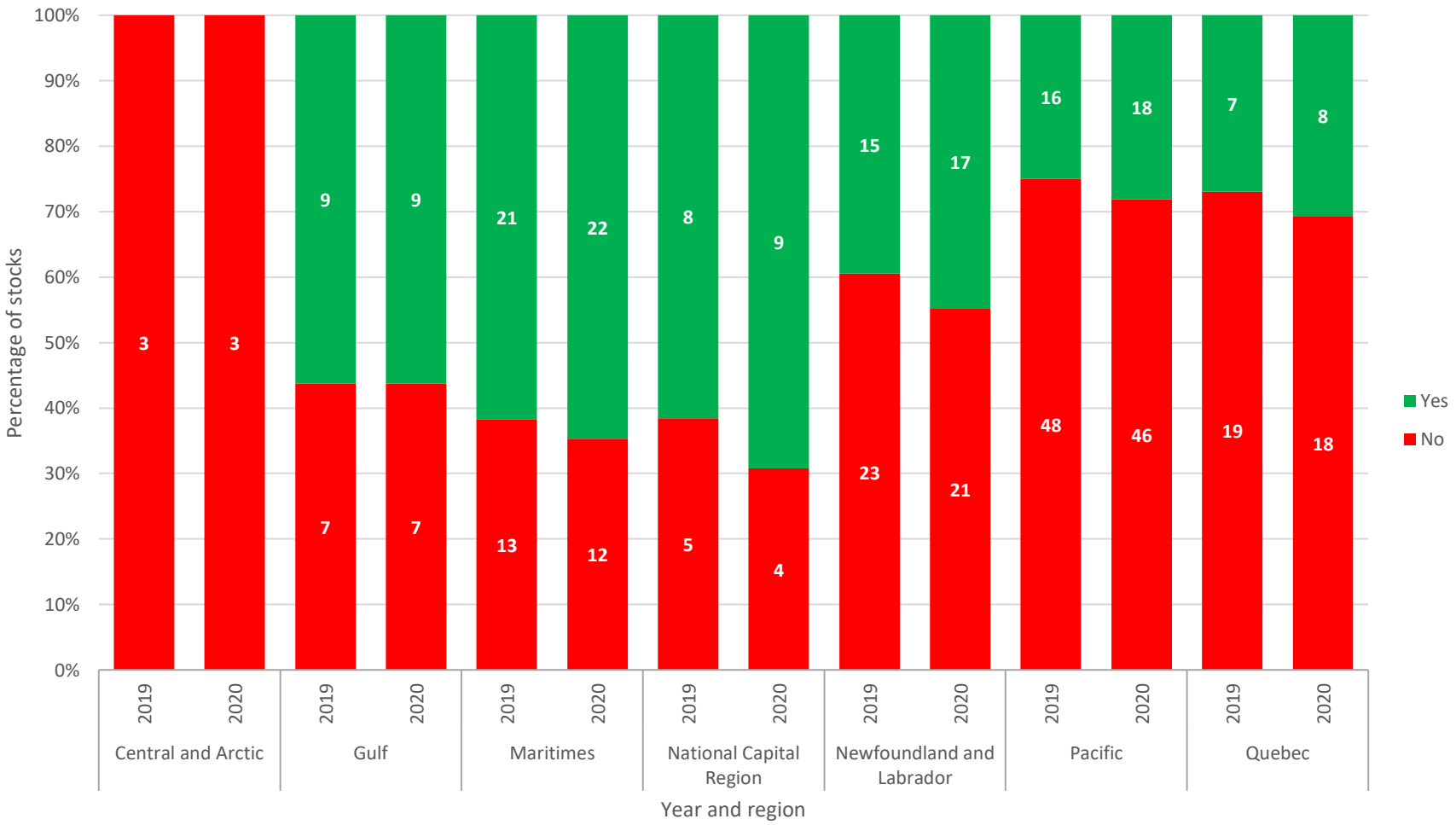

Figure 8. The percentage of Oceana Canada index stocks (n = 194 stocks) with exploitation rate estimates in each DFO administrative region in 2019 and 2020. The number of stocks in each region-category combination is reported in white font within the bars. Please note this indicator was added in 2019.

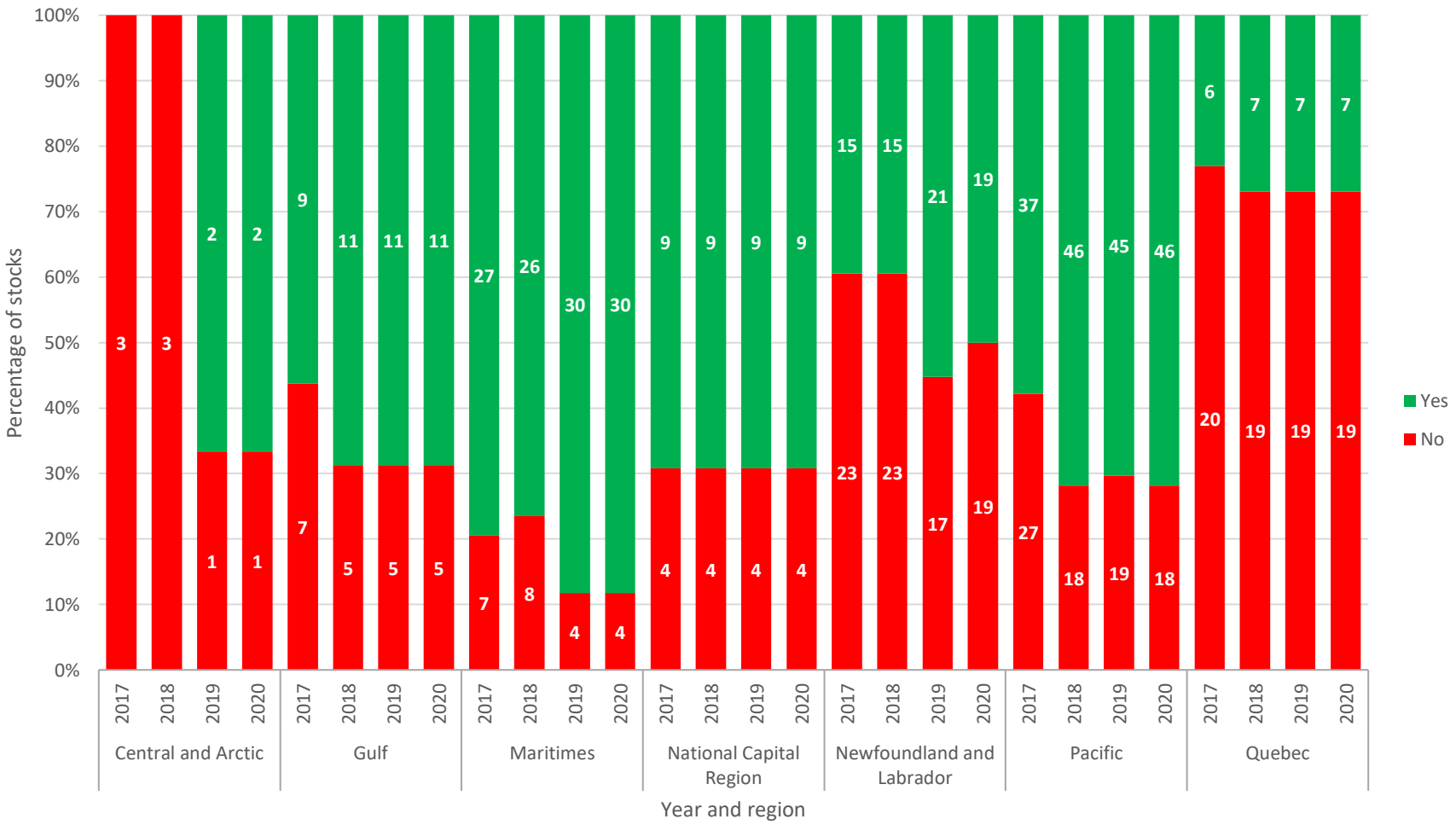

Figure 9. The percentage of Oceana Canada index stocks (n = 194 stocks) with limit reference points (LRPs) in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.

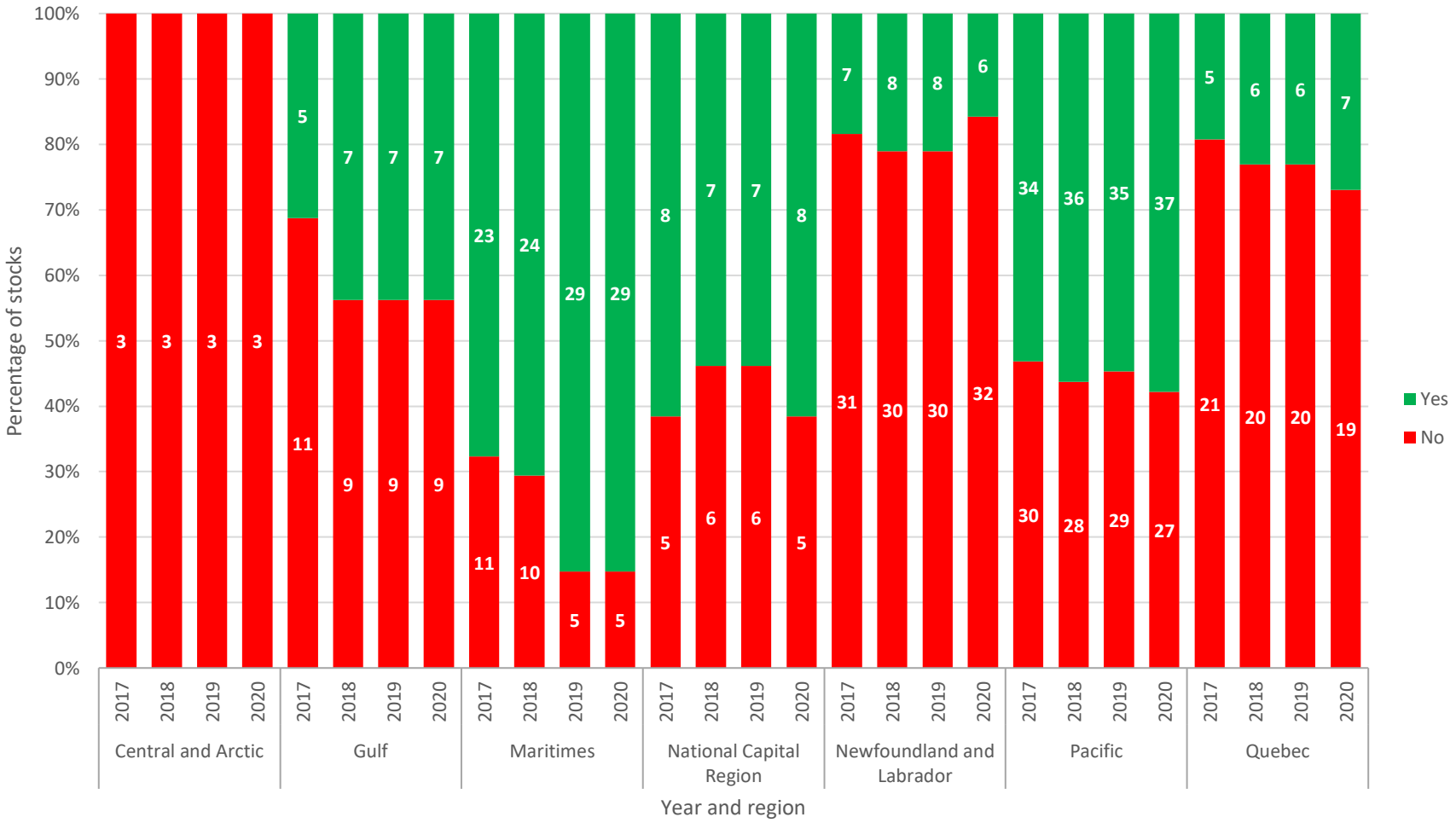

Figure 10. The percentage of Oceana Canada index stocks (n = 194 stocks) with upper stock reference points (USRs) in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.

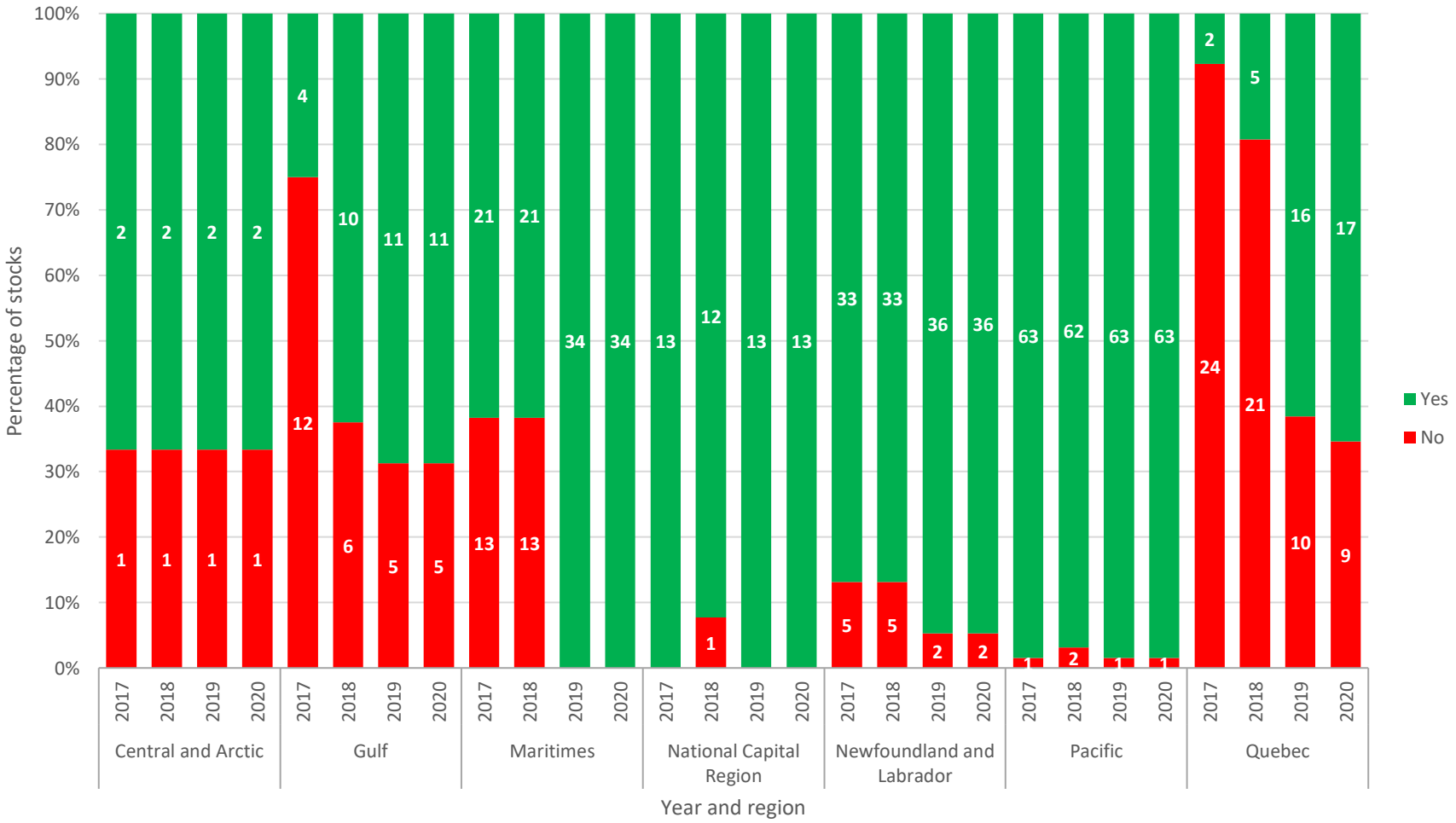

Figure 11. The percentage of Oceana Canada index stocks (n = 194 stocks) included in Integrated Fisheries Management Plans (IFMPs) in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.

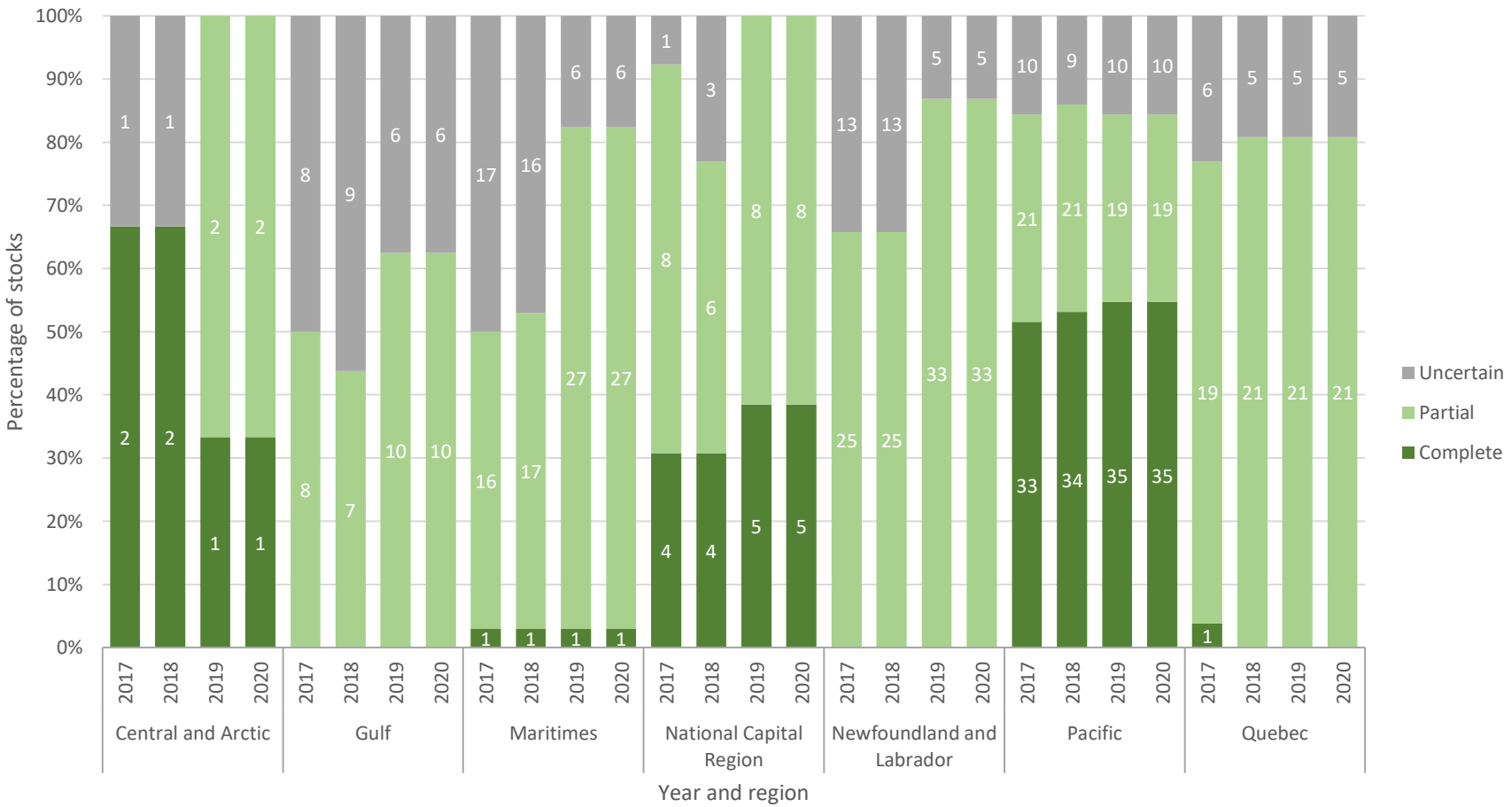

Figure 12. The percentage of Oceana Canada index stocks (n = 194 stocks) that have at-sea observer or electronic (i.e., video) monitoring in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars. "Uncertain" was assigned when there was no indication of the use of the monitoring tool in the documents and websites searched. "Partial" was assigned when it was clearly indicated the monitoring tool was used but levels of tool use varied or were uncertain. "Complete" was assigned when it was clearly indicated the monitoring tool is used on 100 per cent of fishing trips. It should be noted, 100 per cent coverage for at-sea observers or electronic monitoring is not necessary for all fisheries.

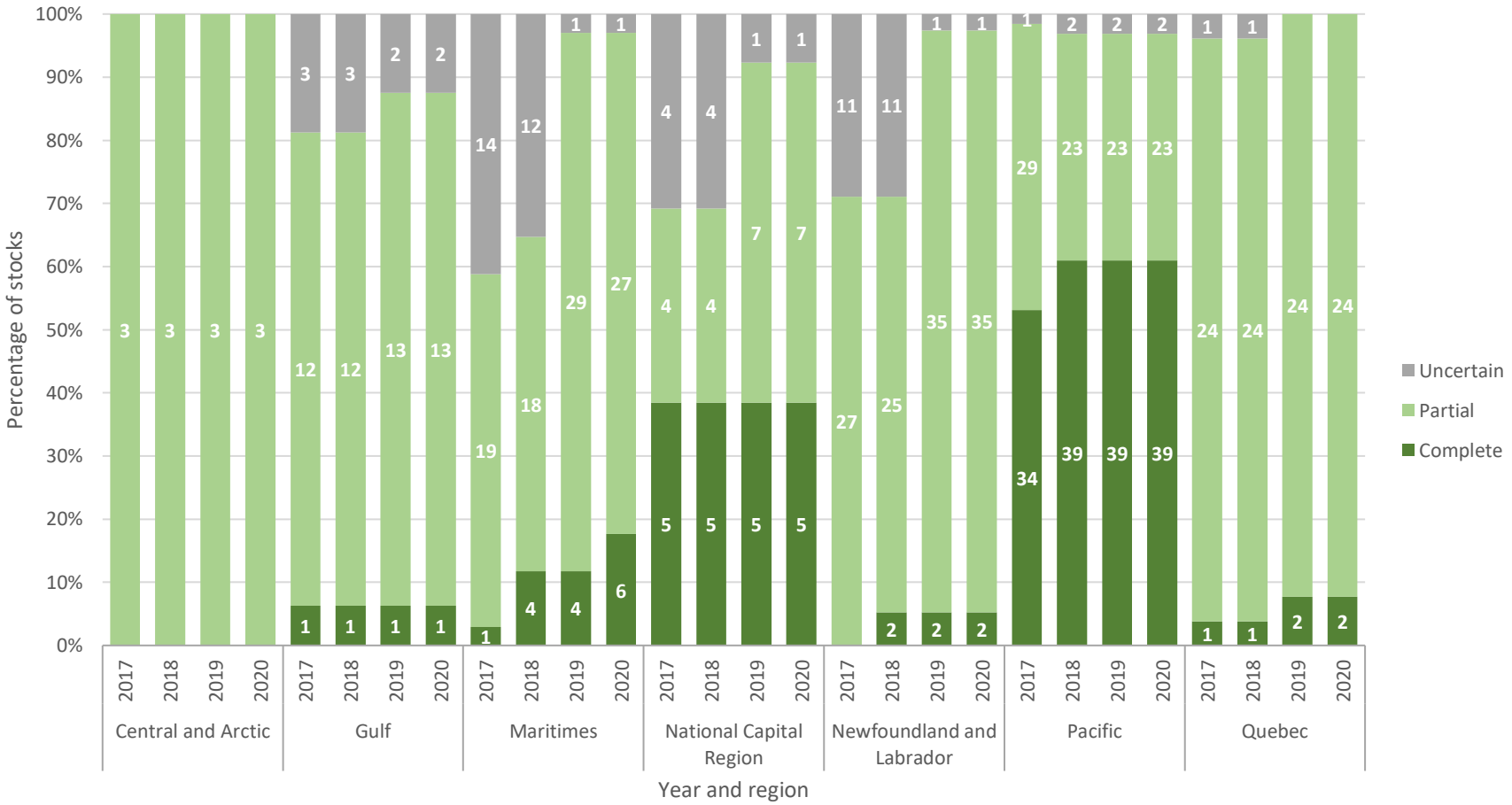

Figure 13. The percentage of Oceana Canada index stocks (n = 194 stocks) that require logbooks recording the entire catch (i.e., targeted species and bycatch) in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars. "Uncertain" was assigned when there was no indication of the use of the monitoring tool in the documents and websites searched. "Partial" was assigned when it was clearly indicated the monitoring tool was used but it was unclear if bycatch is recorded. "Complete" was assigned when it was clearly indicated both targeted and bycatch are recorded.

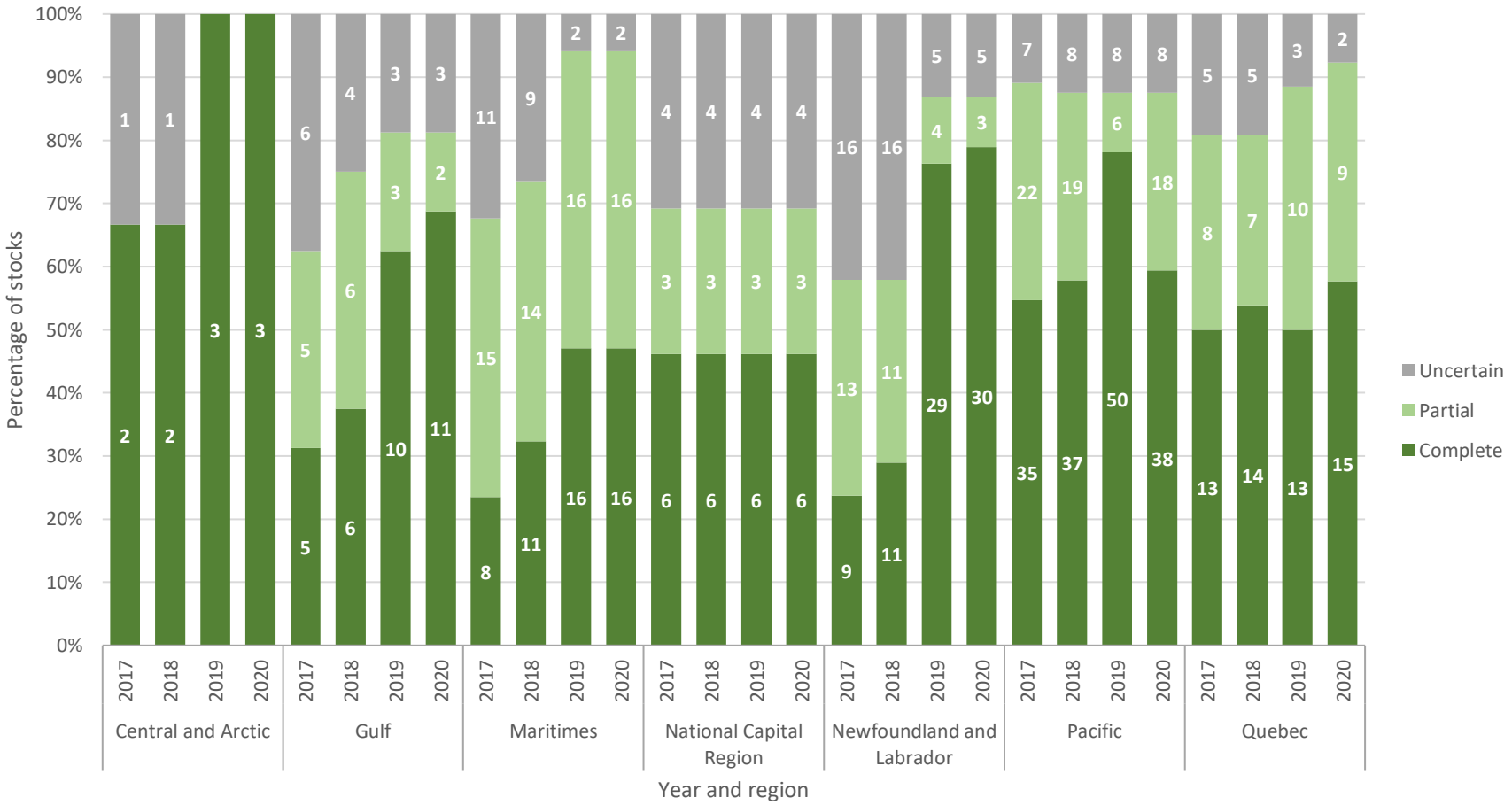

Figure 14. The percentage of Oceana Canada index stocks (n = 194 stocks) that have independent dockside monitoring in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars. "Uncertain" was assigned when there was no indication of the use of the monitoring tool in the documents and websites searched. "Partial" was assigned when it was clearly indicated the monitoring tool was used but levels of tool use varied or were uncertain. "Complete" was assigned when it was clearly indicated the monitoring tool is used on 100 per cent of fishing trips.

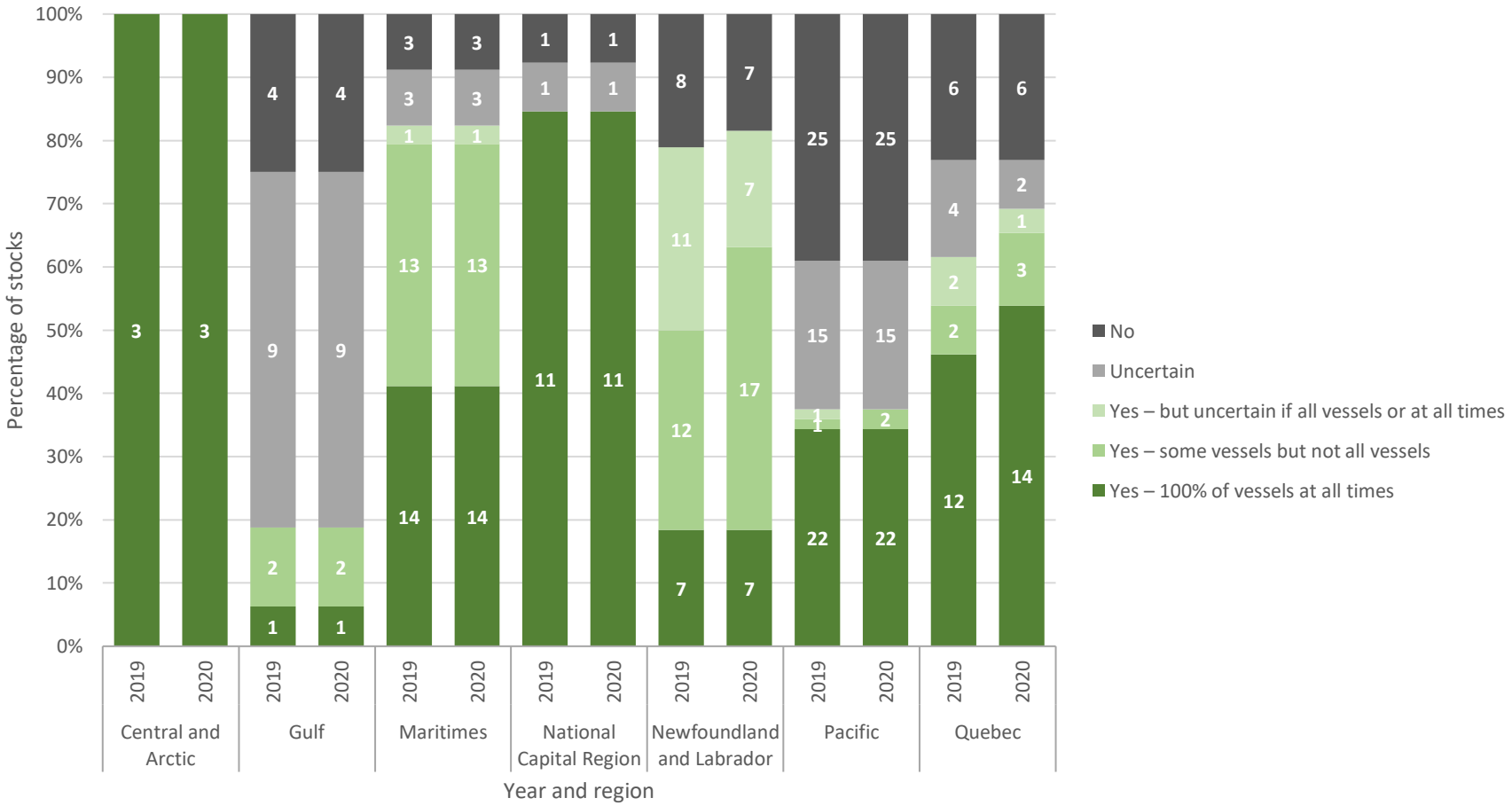

Figure 15. The percentage of Oceana Canada index stocks (n = 194 stocks) that have vessels requiring electronic location monitoring, either via vessel monitoring systems (VMS) or automated identification systems (AIS), in each DFO administrative region in 2019 and 2020. The number of stocks in each region-category combination is reported in white font within the bars. "Uncertain" was assigned when there was no indication of the use of the monitoring tool in the documents and websites searched. "No" was assigned when it was clear VMS or AIS was not required as indicated in the recent review of catch monitoring tool use in Canadian fisheries (Beauchamp et al. 2019). Please note this indicator was added in 2019.

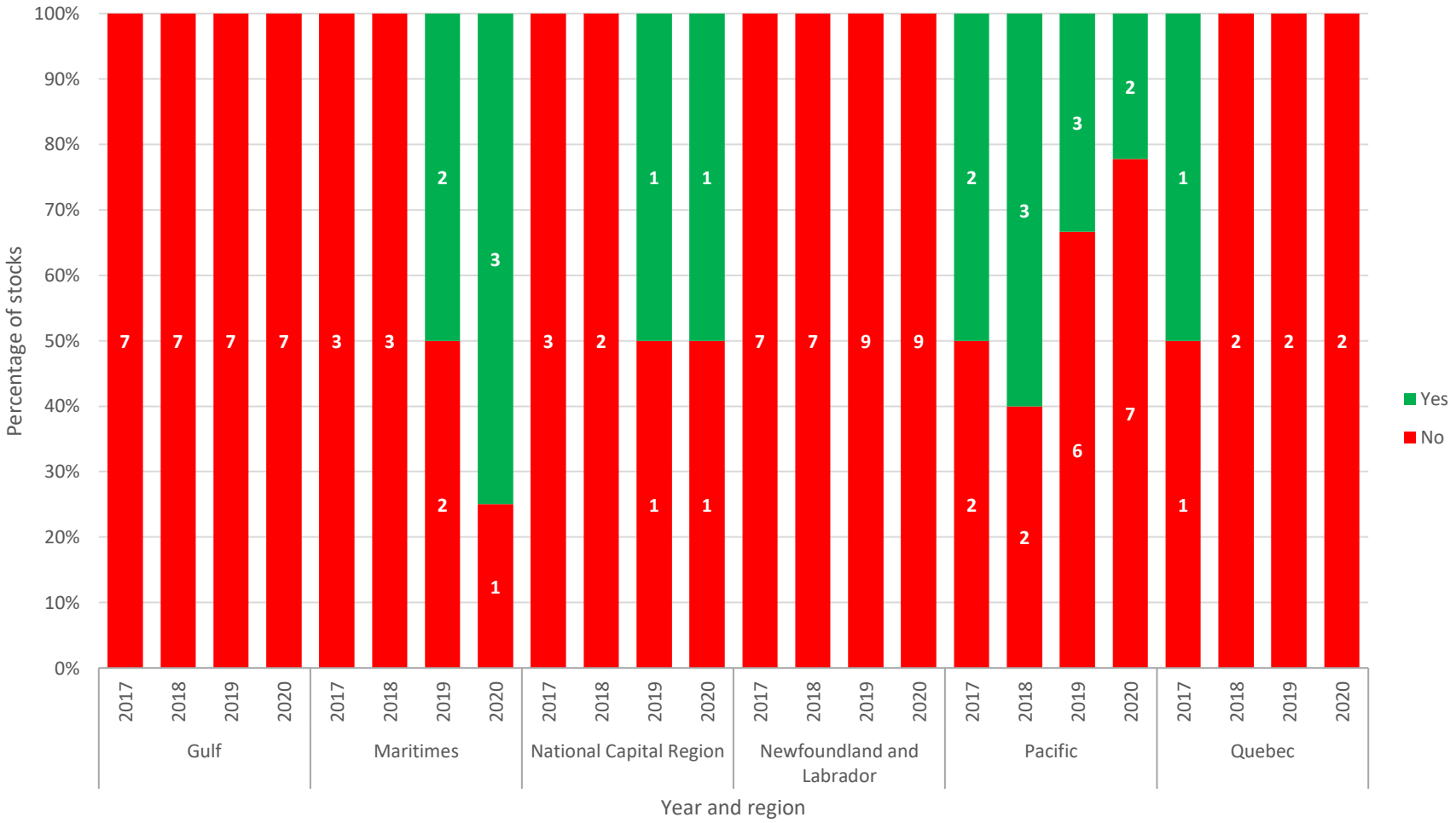

Figure 16. The percentage of Oceana Canada index stocks (n = 194 stocks) in the critical zone and included in rebuilding plans in each DFO administrative region in 2017, 2018, 2019 and 2020. The number of stocks in each year-region-category combination is reported in white font within the bars.